WiP Abstract: Low-Complexity Partially Occluded Pedestrian Detection Scheme using LIDAR-RADAR Sensor Fusion

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***Abstract*—In the past decade, object detection has been researched to use a camera, a LIDAR and a RADAR. However, camera-based techniques have heavy image processing and are sensitive for light intensity. LIDAR can measure precise distance from objects, but it is difficult to classify objects. In addition, previous researches were unable to detect partially occluded pedestrian because the data to determine the pedestrian were insufficient. To solve the problem, we use LIDAR and RADAR sensor. We propose LIDAR-RADAR sensor fusion scheme for detecting partially occluded pedestrian with low-complexity.**

Keywords- LIDAR-RADAR sensor fusion; pedestrian detection; occluded detection; low-complexity

I. INTRODUCTION

In recent years, intelligent vehicles are one of interests of many people. Above all, safety of the pedestrians and drivers has been attracting attention from researchers. A camera, a LIDAR and a RADAR have been used for object detection in intelligent vehicle area. However, a camera has unreliable results as light intensity change with heavy image processing. LIDARs are able to obtain precise location and shape of object in visible region. However, LIDARs are hard to classify object in comparison with a camera. RADARs can present range and velocity of objects using Doppler Effect [1]. Meanwhile, the classification of the objects complicates since it is difficult to obtain the characteristic of objects such as shape, color and size extracted from RADARs. Camera-LIDAR fusion method aims low image processing cost and high confidence level [2]. On the other hand, this method cannot apply at night since classification is performed in the image processing. To address this problem, we propose LIDAR-RADAR sensor fusion scheme.

II. LIDAR-RADAR FUSION SCHEME

In our work, we propose LIDAR-RADAR sensor fusion scheme for pedestrian detection. The proposed scheme is consisted of several steps: calibration, object detection and occluded volume generation.

In the calibration step, errors which are induced with distance between mounted positions of sensors are corrected. After that, the object detection is executed from each sensor. RADAR can detect the objects by using Doppler Effect and generate the ROI of objects. In LIDAR process, objects are identified by ROIs extracted from RADAR. In next step, the occluded volume is generated with LIDAR data and occluded objects are determined considering RADAR ROIs in volume. The occluded volume means a shaded area behind objects, and some objects can exist in this area. Figure 1 shows an example of an occluded pedestrian and an occluded volume. LIDAR data is represented by green dots. Red and yellow circles are pedestrians. One pedestrian in the yellow circle is occluded by other pedestrian in the red circle.

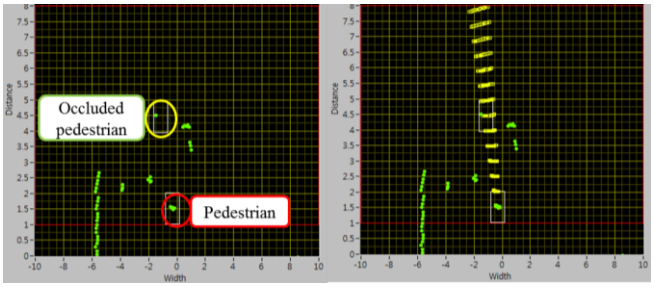

Fig. 1. An example of partially occluded pedestrian detected by LIDAR: (Left) not include occluded volume, (Right) include occluded volume

III. CONCLUSION AND FUTURE WORK

In this paper, we propose the partially occluded pedestrian detection scheme. The scheme can be utilized to object detection mechanism of autonomous vehicle system at daytime and night. In addition, the complexity is reduced by using the ROIs generated from RADAR. In future work, we intend to find an efficient classifier and will construct classification step.

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