Casualty Detection for Mobile Rescue Robots via Ground-Projected Point Clouds

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Abstract. In order to operate autonomously, mobile rescue robots need to be able to detect human casualties in disaster situations. In this paper, we propose a novel method for autonomous detection of casualties lying down on the ground based on point-cloud data. This data can be obtained from different sensors, such as an RGB-D camera or a 3D LIDAR sensor. The method is based on a ground-projected point-cloud (GPPC) image to achieve human body shape detection. A preliminary experiment has been conducted using the RANSAC method for floor detection and, the HOG feature and the SVM classifier to detect human body shape. The results show that the proposed method succeeds to identify a casualty from point-cloud data in a wide range of viewing angles.

1 Introduction

Searching and detecting injured humans, i.e. casualties, in a disaster scene is one of the key challenges for autonomous mobile rescue robots in search and rescue (SAR) missions. Even though a number of successful studies have been conducted for human-presence detection methods *based on 2D images*, such as pedestrian detection [1], it remains challenging to use these methods for casualty detection by mobile robots in SAR scenarios. There are many reasons why this is difficult: (i) the fact that the casualty is lying down on the ground creates many more diverse orientations compared to a standing person with respect to the camera; (ii) the floor is right under the body which makes depth segregation more challenging; (iii) the camera viewing angle and the robot orientation in 3D keep changing depending on the terrain. Using 3D shape information such as point-cloud data could be one of the alternatives for dealing with this casualty detection challenge. Therefore, in this work, we aim to develop a novel approach utilising point-cloud data for casualty-detection applications.

2 Proposed Methodology

Figure 1 illustrates the flowchart of the proposed method for detecting a casualty based on point cloud data. A ground-projected point-cloud (GPPC) image is used in this process to achieve the casualty detection process. This GPPC image is generated by projecting the point-cloud data onto the detected ground plane (i.e. floor). In order to detect the floor, the RANSAC algorithm (Random sample consensus) is used to estimate and fit a plane model to the point-cloud data [2]. Once the ground plane is detected, all the points associated to this plane, i.e.

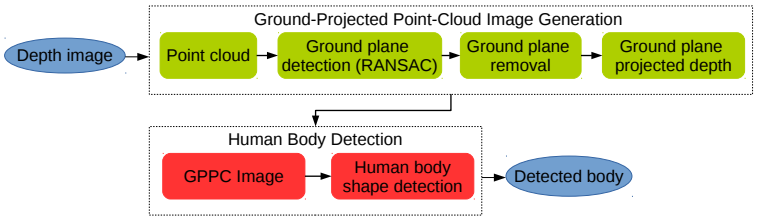
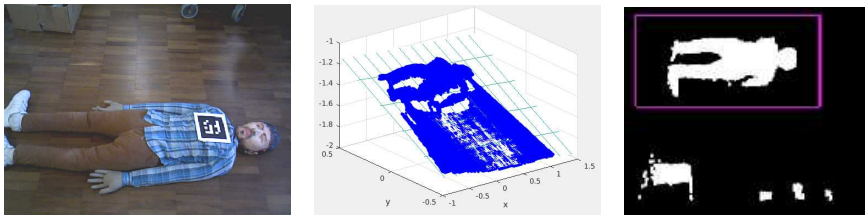


Fig. 1: The proposed methodology for casualty detection via ground-projected point-cloud image.



(a) RGB image (b) Point-cloud data and detected plane (c) GPPC image and detected human body

Fig. 2: Preliminary experimental results from casualty detection using the proposed method.

inliers, are removed. Then, the remaining points are projected orthogonally onto the plane to produce the GPPC image. Afterwards, this image is used as an input for executing the human body shape detection algorithm to detect the casualty in the image. In this preliminary work, we used a person-detection algorithm based on HOG features and SVM classifier [1].

3 Preliminary Experimental Results and Conclusion

Preliminary experiments have been conducted to evaluate the proposed method. In this experiment an ASUS Xtion RGB-D camera was used to obtain point-cloud data. For each conducted test, the camera was tilted at a random angle towards the ground to test the plane detection. Figure 2 demonstrates the casualty detection process and results using the proposed method. The preliminary test results prove that this method can successfully detect the casualty from point-cloud data and potential to become an essential part of autonomous mobile rescue robots. In the future work, we are planning to integrate this casualty detection module into mobile rescue robot—called ResQbot—that we have developed [3].

References

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