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Visual Impaired Person Navigation Assistance Using Motion Sensor

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Abstract

According to the website of World Health Organization (WHO), there are about 285 million people are visually impaired worldwide. This can be separated into 39 million are blind and 246 have low vision. As the vision system has degraded, the person will have difficulty to navigate. In general, the visually impaired person will use a white cane or a seeing-eye dog. However, these systems are considered to be cumbersome due to the difficulties of the usage. For example, in some places, the seeing-eye dog cannot be brought inside, such as a restaurant. Another example is the white cane will have the possibility to be left somewhere.

In order to solve the problems, a new technology is needed. In this research, a low cost motion sensor, Kinect sensor, will be used as a tool for assisting a visual impaired person to navigate in a complex environment, such as an indoor environment.

The Kinect motion sensor, Figure 1 is completed with (from left to right) an IR projector, an RGB camera and an infrared camera. This device also has a four-microphone array in addition to a RGB camera. Therefore, it can provide depth signals, RGB images, and audio signals simultaneously.The configuration of the sensor on the Kinect sensor and the data captured from a Kinect sensor is shown in Figure 1.

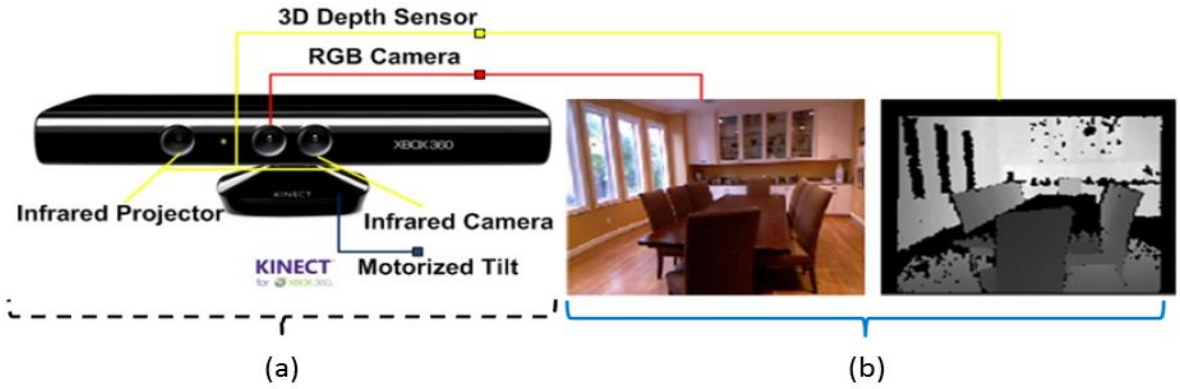

Figure 1 : The Microsoft Kinect Sensor [1] (a) Sensors and (b) Raw Data

Figure 1 (b) which is the depth image is obtained by using the IR projector and the IR camera on the sensor. The depth map is containing the information about the distance of objects from the Kinect sensor. The value of the distance to the object is represented in a grey scale image. The darker the pixel value, the nearer the distance is from the Kinect sensor. However, as we observe from the image, the image of tree which is far away from the sensor has the dark value which means the object is near to the sensor. The depth image is not match with the real condition. Therefore, the challenge is to provide accurate objects position information on the depth map.

This depth map is used in many researches to conduct autonomous navigation [2], mapping a building [3], [4] and obstacle avoidance [5]. Inspired by the usage of Kinect sensor for the mobile robot navigation, we propose a navigation system using a Kinect motion sensor to assist a visual impaired

person to navigate in a complex environment, such as indoor environment. Indoor environment is a difficult area for a visual impaired person to navigate. It contains many objects around that can be harmful for the blind person. Accurate and low cost navigation assistance for a visual impaired person in an indoor environment becomes crucial and important task to be completed.

The schematic diagram of the system is shown in Figure 2. The raw data from the IR image and position comes from IR projector will be fused and processed using an Artificial Neural Network (ANN) to obtain a precise depth image. In the next step, the raw RGB image from Kinect will be fused with the processed depth image in order to get the information about the type of the object, the distance to the object and lastly the navigation suggestion to the blind person which will be in the audio format.

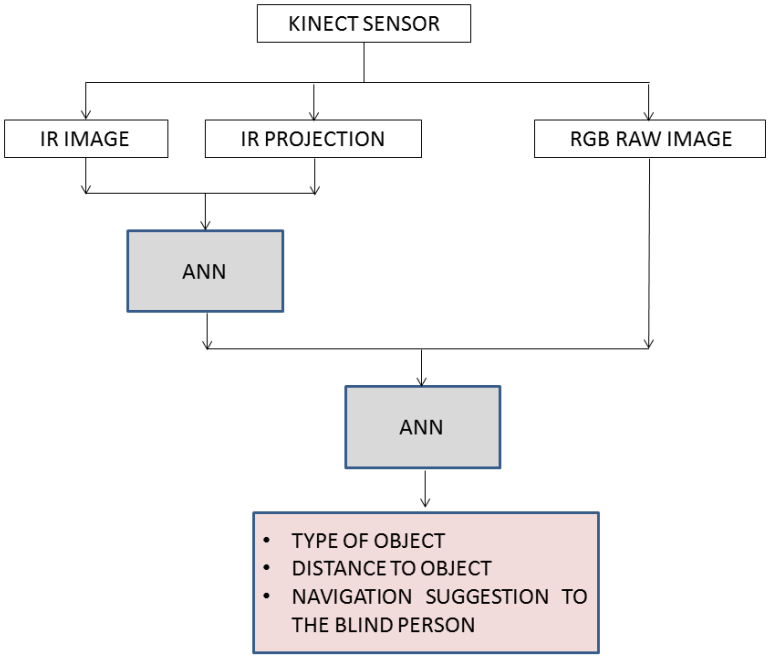

Figure 2 : Schematic Diagram of Navigation Assistance System

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