KINECT FOR INDOOR NAVIGATION

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INTRODUCTION

Autonomous mobility is arguably the toughest challenge facing blind and visually impaired individuals. To successfully navigate an environment without use of a human or animal guide, the blind person must first familiarize herself with the particular spatial surroundings, usually with the aid of the traditional white cane. This process is arduous, mentally taxing, and can take quite a bit of time: the subject must memorize the location of potential obstacles, doors, exits, and any other location of interest. Furthermore, for this to be effective, he or she must depend on the hope that this familiar environment remains static, or changes as little as possible. Any introduction of new obstacles, or changes in the environment's configuration, and the familiarization process must be repeated again to update the memory.

In this paper, we propose an alternative navigation system based on the Kinect RGB-D sensor to reliably replace or augment traditional navigation tools used by the blind, such as the white cane and the guide dog. This system is lightweight, affordable and more capable, with features such as obstacle detection and avoidance with auditory warnings, real-time indoor mapping, and people tracking.

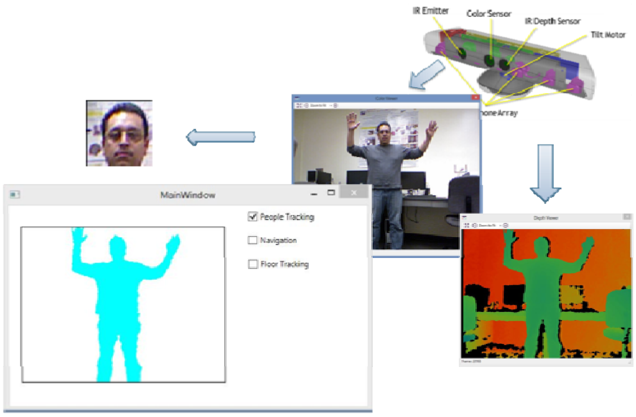

Figure 1: Kinect navigation and human/face tracking

SYSTEM ARCHITECTURE AND FEATURES

The centerpiece of our system is the Kinect sensor. Kinect is a collection of various sensors in a single lightweight package: RGB, depth, microphone array and accelerometer. Data from the sensor is accessed via the Kinect SDK and processed by means of a commodity PC carried in a backpack. The sensor itself can be mounted either on the subject's waist using a belt, or on the head atop a hard hat. Our implementations include both navigation and people detection modules (Figure 1).

Navigation: Using the onboard depth sensor, we develop an accurate obstacle detection system. Kinect can measure 3D depth data up to a distance of 8 meters (although accuracy starts decreasing after 4 meters). This allows us enough time to vocally alert the blind user of detected obstacles and plot an avoidance or navigation course. The navigation algorithm works by making a real-time 2D map of the Kinect's field of view, i.e.: projecting all depth points onto the floor plane (Figure 2). This gives us a 2D obstacle map that's easier and faster to process, while allowing the user to navigate safely around any obstacles.

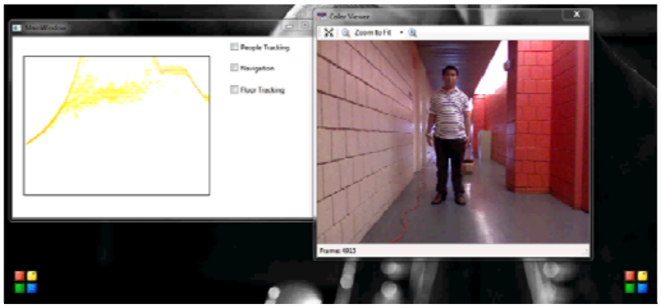

Figure 2: Kinect corridor navigation

People Detection and Tracking: A hallmark feature of the Kinect is its human detection and skeletal tracking ability. We use this functionality to better inform the user about his/her surroundings. The system can enumerate the number of people around the user, track a specific user, help avoid running into oncoming people or bystanders, etc.

CONCLUSION

Recent statistics from the World Health Organization estimate that there are 39 million blind people on the planet. We've presented an alternative navigation system that improves on traditional navigational aids for the bind by offering features such as human detection and tracking, auditory feedback, range extension, etc., allowing blind people to safely navigate both familiar and unfamiliar indoor environments.

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