

Addition of RFID-Based Initialization and Object Recognition to the Navigation System TANIA

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Summary

The TANIA indoor and outdoor blind navigation system has been augmented with RFID technology, providing automatic initialization and recognition of tagged objects.

Introduction

During the 2008 CSUN Conference a prototype of a navigation aid called TANIA (Tactile-Acoustical Navigation and Information Assistant) was presented [2].

The system was originally developed to provide visually impaired people with a navigation device which could be used independently indoors and outdoors, without any pre-installed infrastructure. TANIA utilizes a movement sensor, a GPS sensor, and detailed maps of the current environment. Its maps are augmented by guiding grids to insure safe navigation even in large open areas without physical cues, and by text information specific to each environment. Navigation and environmental information is presented acoustically or in Braille [5].

In the case of the CSUN conference, architectural details of the conference hotels were added, as well as presentation schedules, names of booths, information about exhibitor companies, etc. TANIA was tested by visually impaired, blind, and deafblind conference participants indoors within the exhibition environment, and outdoors between the two conference hotels.

Usability tests at the 2008 Conference and at other pilot locations revealed potential for system improvement in two areas. The first involved initialization of the TANIA system inside buildings, where GPS signals are unavailable. In order to establish their position within the system map, users had to explore TANIA's touch screen with a finger, or input information on the keyboard. This proved difficult for some people, especially those unaccustomed to spatial tasks. The second area involved providing greater specificity in object recognition and access to stored text information. Information about architectural features and areas of interest could not be pinpointed on the map to areas smaller than approximately ten square feet.

To address these two operational challenges, RFID (Radio Frequency Identification) technology was integrated into the TANIA system [1]. Although the system can still be operated without any infrastructure anywhere in the world where adequate mapping has been done [4], RFID enhances its value to blind navigators.

Related Work

Currently there are several methods of enhancing navigation systems and/or supporting object recognition. These include the use of DGPS (Differential GPS, which incorporates correction data), WiFi signals, and bar codes or visual patterns. Signals provided in these ways are detected by the use of laser scanners, cameras, or corresponding receiver technology.

When compared to such methods, however, RFID technology offers several advantages. RFID tags are unaffected by poor lighting conditions, dust or dirt – all of which impede the performance of other systems. In addition, RFID tags and readers are increasingly available and affordable. Tags vary by range and by type, depending upon whether or not they include a battery, and cost between a few cents and several dollars each.

System Description

The TANIA system consists of a lightweight, portable tablet PC suspended from a strap worn around the neck. An inertial sensor is fixed at the center of the strap and connected by cable to the tablet PC. The extended version of the TANIA system includes a connected RFID reader. As was previously the case, initial position is determined using GPS signals, or can be entered by the user when GPS signals are weak or absent. Now, however, initial position can also be determined by means of RFID tags. Fixed at important landmarks, such as doors, stairways, and other points of interest, each tag contains an identification number which can be detected by the RFID reader. The user's location and movement can be determined based on inertial measurements and optionally synchronized map, GPS and/or RFID signal data. In addition, tag numbers can be linked to corresponding text information stored within the TANIA system map. Users can receive a menu at a restaurant RFID tag, the bus schedule at the bus stop RFID tag, etc. All of this information can be presented acoustically over loudspeaker or headset, or in Braille. The newest prototype includes a portable Active Tactile Control (ATC) Braille display, based on technology developed by Handy Tech [3]. This allows for automatically scrolling at the end of the last letter of the Braille display. Passive RFID tags (those without batteries) can be read from a range between millimeters and a few meters. Active readers have extended ranges up to several hundred meters, but require a battery.

Conclusion

The TANIA navigation system for the blind and deafblind has been enhanced with the addition of RFID technology. Pilot studies at the University of Stuttgart suggest that system initialization is facilitated, and more specific environmental object recognition achieved. Such enhancement to TANIA represents another step toward our goal of safe, independent navigation for blind and deafblind people. Realization of this goal, however, will require global mapping, extensive tagging, and the public awareness and financial commitment necessary to their support.

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