Combination of the Navigation System TANIA with RFID-Based Initialization and Object Recognition

Focus: Independent Precise Indoor and Outdoor Navigation
Topic: Orientation and Mobility

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Summary

In order to initialize the user's location more accurately, the TANIA indoor and outdoor blind navigation system has been extended with an RFID reader. The system can also be used for the recognition of tagged objects.

Introduction

The TANIA system (Tactile-Acoustical Navigation and Information Assistant) was originally developed to provide visually impaired people with a navigation device which can be used independently indoors and outdoors, without any pre-installed infrastructure.

Usability tests have shown that the system can be very helpful to blind users, but depends strongly on the accuracy of the position estimation. The tracking of the user's position by compass and movement sensor is quite accurate but the position needs to be initialized and corrected from time to time, as small errors accumulate to larger amounts over time. This can be achieved by user input, by synchronization with the map (e.g. people cannot walk through walls), or by GPS, which is only available outdoors and has accuracy varying with environmental conditions. Unfortunately, all of these methods have varying degrees of availability and accuracy. Therefore the system has been extended with an RFID reader, in order to enhance its accuracy.

Related Work

Research in the area of navigation assistance systems for the blind has been done for more than 20 years and has resulted in several prototype systems such as Drishti [5] or Personal Guidance System [4] as well as commercial systems such as Trekker [3] relying mainly on GPS.

RFID tags have also been used for navigation systems. The system by Willis and Helal [6] uses a dense grid of tags installed on the ground and read by an RFID reader integrated into the long cane or the shoe. Amemiya et al. [1] use a dense grid of active RFID tags and calculate the position by the change of the reception of several tags over time.

System Description

The TANIA system consists of a lightweight, portable tablet PC suspended from a strap worn around the neck. Fixed at the strap are a GPS sensor and a combined movement sensor and compass, which allows the user's current position to be tracked [2]. The system uses detailed maps of the environment in order to give feedback about the current position to the user and to allow preliminary exploration of a certain area. The maps are augmented by guiding grids to insure safe navigation even in large open spaces without

physical cues, and by text information specific to each environment. Navigation and environmental information is presented acoustically or in Braille.

As the combination of compass and movement sensor can only track the user's position relative to a previous position, the absolute position needs to be initialized at the beginning and corrected from time to time. This can still be done by the GPS signal or by user input e.g. when GPS signals are weak or absent. However, the extended version of TANIA includes an RFID reader, which can detect tags. Fixed at important landmarks, such as doors or stairways, each tag contains an identification number. Those numbers can be linked to positional information stored within the map, thereby allowing accurately detecting the user's position. Tags can also be linked to corresponding text information stored within the TANIA system's map, e.g. the bus schedule at the bus stop.

The combination of RFID positioning with the previous operation mode of TANIA has the advantage that the system still works without any previously installed infrastructure (i.e. RFID tags), but that accuracy can now be enhanced by the system's operator; more tags resulting in greater accuracy.

Conclusion
First experiments have shown that this enhancement to TANIA represents another step toward our goal of independent navigation for blind and deafblind people. However, realization of this goal requires extensive mapping and tagging and is therefore dependent on public awareness and commitment.

Acknowledgments

References
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