A BLIND NAVIGATION SYSTEM USING RFID FOR INDOOR & OUTDOOR ENVIRONMENTS

U. SATHWASTA GOLLA, S. PRASANTH KUMAR, DR. K. MANIKANDAN
Dept of ECE, VIT University, Vellore, Tamil Nadu, India

ABSTRACT

In recent years, several approaches have been made to create systems that allow seamless tracking and navigation both in indoor and outdoor environments. This paper proposes a prototype which uses RFID technology to provide location-based services and navigation to the blind, or visually impaired. An overview of previous work made in the context of systems developed to assist the mobility of blind users. The reader reads the tag's ID by RFID communication. It then sends this information through a Bluetooth channel to the PDA device. The ID string and data is processed and then an output is sent through another Bluetooth channel to the headsets which finally produce the audio output that is used by the visually impaired person.

Keywords: ARM7, RFID Tags, RFID Reader, Bluetooth, Android phone.

INTRODUCTION

The goal of Blind-Aid project is to develop navigational assistance technology for the blind or visually impaired. Specifically, we seek to develop a portable Electronic Travel Aid (ETA) for visually impaired users, along with the accompanying radio frequency identification (RFID) localization infrastructure used to equip buildings [1]. The problem of navigation assistance has been addressed in academia, primarily from the angle of human-computer interactions, and in the industry, by proposing some commercially viable systems that utilize recent advances in mobile device and Bluetooth technology.

REALTED WORK

In this paper, we proposed an RFID based navigation system for in-building navigation for blind people. Our proposed system helps blind people to find a shortest path from his current location to a destination. It also helps to them when they get lost by automatically detecting the lost and recalculate a new route to the same destination. Our proposed system embeds RFID tags into a footpath that can be read by an RFID reader with a cane antenna. Our proposed work can also be used as a tourist guide system for a museum or a navigation system for a rescue in hazardous environments where it is difficult to find an emergency exit.

LITERATURE SURVEY

Nowadays, navigation systems are widely used to find the correct path, or the quickest, between two places. These systems use the *Global Positioning System* (GPS) and only work well in outdoor environment since GPS signals cannot easily penetrate and/or are greatly degraded inside of buildings. Several technologies have been proposed to make navigation inside of buildings possible. One such technology is Radio-Frequency Identification (RFID). In the case of outside environments, some hybrid systems have been proposed that use GPS as main information source and RFID for corrections and location error minimization. In this article we propose a navigation system that uses RFID as the main technology to guide people with visual impairment in unfamiliar environments, both indoor and outdoor, complementing the traditional white cane and providing information about the user's geographical context. For visually impaired people, outdoor pedestrian mobility is very difficult and often dangerous. The visually impaired commonly rely on a cane and/or a guide dog to assist them in efficiently reaching a desired destination without harm. However, this approach is successful only if the majority of the path to the destination is already known to the affected person (or to the guide dog). In a world in which perception extends to the tip of the blind's cane, orientation is very difficult, especially in environments which were not designed for blind people. To better understand the problem we should point out that orientation is essentially based on the recognition.

METHODOLOGY

The proposed blind navigation system is composed of three subsystems, the track infrastructure, the navigation device, and the navigation voice. The track infrastructure is composed of RFID tags. Each tag can be embedded into a stone block and put it on a footpath. The RFID stone block is also used by blind people for navigation. The type of RFID tags is selected upon the usage. The tags can be installed along the footpath or at least at the junction of the footpath. The tag stores the tag ID, and the tag location. To reduce the massive amount of location information for users, the location can be hierarchically divided; for example, each tag location is identified by a location area, a path. In this paper, the distance is approx 7-10 centimeters. The frequency range of RFID (radio frequency identification) is of low frequency range (30 KHz to 500 KHz). Keil software is used in this project, which is burn in the ARM7 – LPC2148 microcontroller which is highly efficient device with RFID TAGS is used.

- RFID reader is mounted on dry printed circuit board.
- Some mechanical applications like stick, plate (in which PCB is mounted), wheel etc.
- 3.5 mm jack ear phone is used to hear the output response.
- 12 v supplies are provided to the circuitry to operate.

Fig1. The guidance system for a blind person

Secondly, the navigation device is an embedded system that is equipped with a microprocessor unit (MCU), an RFID reader, a communication module, a user interface module, a memory module. The MCU is ARM7TDMI-S based high-performance 32-bit RISC Microcontroller with Thumb extensions 512KB on-chip Flash ROM with In-System Programming (ISP) and In-Application Programming (IAP), 32KB RAM, Two UARTs, one with full modem interface. The communication module communicates with the navigation data to send a request and to receive a planned route from the server for navigation. We use the Bluetooth module to convey information via wireless networks.

RESULTS WITH DISCUSSION

We have built a system prototype including a simulated with 10 tags to form a grid paths. Each tag contains Tag ID and its location. The actual size of the prototype is about 12 x 18 x 6 cm in dimension and about 0.5 kg by weight, not including the tag reader. The tag reader is about 22 x 12 x 5 cm in dimension and about 0.4 kg by weight. The device is portable equipped with a headphone for blind navigation where only voice is used to guide the users to navigate. The device is operated by a rechargeable 12V battery that can last about 6 hours. The device is attached for blind people.

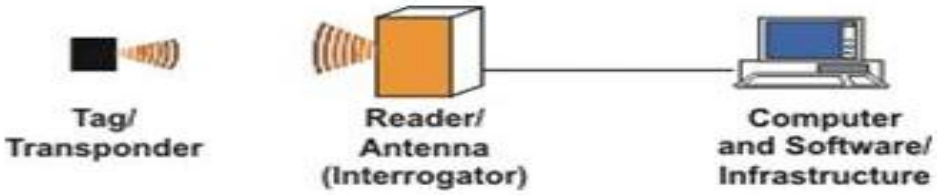
We have tested our system by a simulation of the navigation. The system prototype has shown the promising result although its size is still large. We also found some communication delay in the device to connect for the first time. There is also some delay in the voice playback where the voice file is read from MMC module. In our future work, we will reduce the cycle delay by using

a pre-start cycle. Additionally, we will improve the voice playback module by storing some frequently-used words in the ROM and pre-load some words in the RAM module for faster speech transfer or using a speech synthesizer to generate voice.

DETAILS OF HARDWARE AND SOFTWARE

RFID Reader:

In a typical RFID system tags are attached to objects. Each tag has a certain amount of internal memory (EEPROM) in which it stores information about the object, such as its unique ID (serial) number, or in some cases more details including manufacture date and product composition. When these tags pass through a field generated by a reader, they transmit this information back to the reader, thereby identifying the object. Any corresponding tag in the vicinity of the reader will detect the signal and use the energy from it to wake up and supply operating power to its internal circuits. The tags must use the power they receive to operate their integrated circuits and return a signal with their ID to the reader. Once the Tag has decoded the signal as valid, it replies to the reader, and indicates its presence by modulating (affecting) the reader field.



Bluetooth technology:

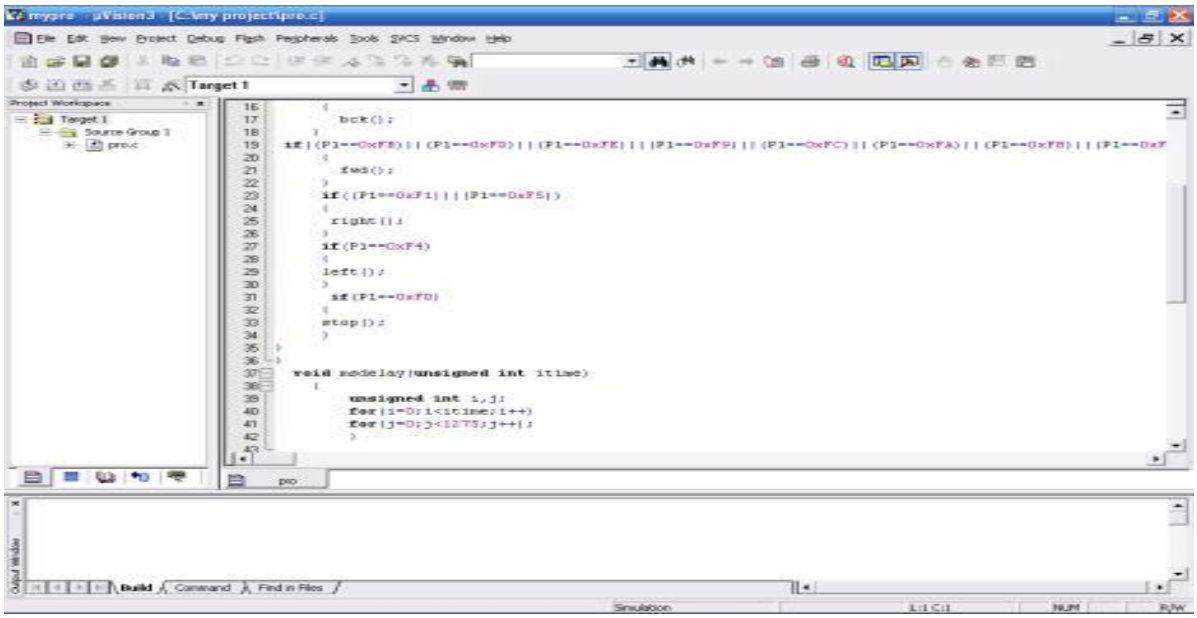
The Bluetooth technology supports asynchronous data channel, or 3 simultaneous synchronous voice channels, or a channel which supports asynchronous data and synchronous voice. Bluetooth was selected as our way of communicating PDA/Mobile with a central system. The reason Bluetooth was selected over Bluetooth for various reasons. First of all, Bluetooth security is less complex and more stable than that of Wi-Fi. Bluetooth manages a security measure of only permitting certain selected devices to interact with them; Wi-Fi in the other hand establishes a WEP key that has been known to be cracked. Another reason that Bluetooth was selected over Wi-Fi is that Bluetooth has a shorter range of signal emission than Wi-Fi. This is a pro because the shorter the range the less the amount intruders that will try to infiltrate your home system

Bluetooth Features:

- ✓ *Standard 3V3 operation*
- ✓ *Bluetooth standard Ver. 2.0 + EDR compliant*

- ✓ *Low current consumption*
- ✓ *Hold, Sniff, Park, Deep sleep modes*
- ✓ *Support for up to seven slaves*
- ✓ *Supports UART,USB,PCM,I2C interface to host system interface*
- ✓ *SPP(Serial Port Protocol) firmware*

PROGRAMING DONE ON KEIL SOFTWARE



REFERENCE

[1] P. Bahl and V. N. Padmanabhan, "RADAR: An In-Building RF-based User Location and Tracking System," in Proc. IEEE INFOCOM, 2000, pp. 775–784.

[2] P. Krishnan, A. S. Krishnakumar , WenHua Ju , Colin Mallows , Sachin GanuA System for LEASE: Location Estimation Assisted by Stationary Emitters for Indoor RF Wireless Networks, IEEE INFOCOM 2004, March 7-11, 2004, Hong Kong.

[3] Leonard E. Miller, "Indoor Navigation for First Responders: A Feasibility Study," Technical Report, National Institute of Standards and Technology, February 2006.

[4] Hirohiko Ohkubo, Seiji Kitakaze, Yo Fujishima, Naoto Watanabe, Minoru Kamata, "Integrated Way Finding/Guidance system using GPS/IR/RFID with mobile device, Technology & Persons with Disabilities Conference, March 14-19, 2005, Los Angeles, CA

[5] S. Willis, S. Helal, "RFID information grid for blind navigation and way finding," in Proceedings of the Ninth IEEE International Symposium on Wearable Computers, 2005 18-21 Oct. 2005.

[6] Jongwhoa Na, The Blind Interactive Guide System Using RFID-Based Indoor Positioning System, in Computers Helping People with Special Needs, LNCS Volume 4061, ISBN 978-3-540-36020-9, 2006.

[7] Sergio Polito and et.al., Performance Evaluation of Active RFID Location Systems based on RF Power Measures, in the proceedings of the IEEE 18th International Symposium on Personal, Indoor and Mobile Radio Communications (PIMRC 2007), September 2007.

[8] World Health Organization," WHO — Visual Impairment and Blindness. "Fact Sheet No. 282, 2014

[9] S. Shoval, I. Ulrich, and J. Borenstein," NavBelt and the Guide-Cane [obstacle-avoidance systems for the blind and visually impaired]"IEEE Robotics and Automation Magazine, vol. 10, no. 1, pp. 9– 20, 2013

[10] A.M Kassim, Jamaluddin, M.H., Yaacob, M.R., Anwar, N.S.N., Sani, Z.M., Noordin, A., " Design and development of MY 2nd EYE for visually impaired people "2011 IEEE Symposium on Industrial Electronics and Applications (ISIEA), pp. 700–703, 2011

[11] A.M Kassim, M.S Jamri, M.S.M Aras, M.Z.A Rashid, MR Yaacob, "Design and development of obstacle detection and warning device for above abdomen level "2012 12th International Conference on Control, Automation and Systems (ICCAS), pp. 410–413, 2012

[12] So-In Chakchai, S. Arch-int, C. Phaudphut, K. Rujirakul, N. Weeramongkonlert, "A new mobile phone system architecture for the navigational travelling blind", *Computer Science and Software Engineering (JCSSE) 2012 International Joint Conference on*, pp. 54-59, 2012.

[13] A.M Kassim, A.Z Shukor, C.X Zhi, T Yasuno, " Performance Study of Developed SMART EYE for Visually Impaired people "Australian Journal of Basic and Applied Sciences, 7 (14) pp. 633–639, 2013.