Blind Assistance Toolkit for Android using RFID based Navigation

Siddharth Hawa[1] Vikrant Shinde[2] Sanchit Reshi[3]
[1,2,3]Department of Information Technology
[1,2,3]Smt. Kashibai Navale College of Engineering, Savitribai Phule University of Pune, India

Abstract— Radio Frequency Identification Tags or RFID tags is a relatively mature technology and its application has been ubiquitous due to planned implementation. RFID tags can be active or passive depending on their data processing and transmission capability. They interact with an RFID reader which relays the information to and from the processing device usually a computer. This technology can come to the aid of the visually disabled by aiding their navigation. The visually disabled face a stigma when it comes to using technology as the user interface lacks the ease of use and interaction features it should ideally possess. The existing applications aiding the visually disabled heavily rely on text to speech features which aren't always effective in every scenario. RFID based navigation can be achieved by tagging objects using passive RFID tags and a reader fixed on the cane of the user. Other vital features like calling and messaging can be enhanced using gesture recognition. In case of an emergency the location of the user can be tracked using GPS. The advantages of using the toolkit involve lower cost, effective navigation and enhanced user experience.

Key word: RFID, GPS, Enhanced User Experience

I. INTRODUCTION

The goal of this Blind assistant toolkit project is to develop navigation assistance technology for the blind or visually impaired. Specifically, we seek to develop a portable navigation device for visually impaired users, along with the accompanying radio frequency identification (RFID) localization infrastructure. In the research through literature, as well as interviews with various researchers the main problem identified was that the visually impaired experience trouble with indoor navigation in unfamiliar buildings. There has been little done in regards to indoor navigation in current assistive technologies, known as Electronic Orientation Aids (EOA) [1], possibly due to high cost for instrumentation and limited capabilities. The goal is to breakdown these barriers by introducing an EOA system which is relatively inexpensive for both the blind and the businesses that equip their buildings. The proposal issuing RFID tags to setup allocation tagging infrastructure within buildings such that the blind can use an RFID equipped device(such as a cell phone) to determine their location[2][3]. The basic concept of this system is to aid navigation with the help of RFID tags. Objects will be tagged with the help of RFID tags and their predefined distances will be measured and coded. Through RFID reader the objects will be sensed and the user will be alerted of the object in range, the IR sensors will help measure the accurate distance at which the objects lie. Apart from this the users location will be tracked via GPS and his/her emergency contacts can be alerted in times of an emergency.

II. LITERATURE SURVEY

The primary purpose of conducting a literature survey is to thoroughly study the problem domain and the technology being used in order to understand and develop a solution to it. The current project involved a significant analysis of related literature in terms of journals, papers, books and open source content videos regarding the problem domain. Literature survey provided an insight into the already developed systems, their features and their shortcomings. Relevant technologies like RFID tags, android based development and location tracking through IR sensors were surveyed and analyzed.

A. Related Work

The problem of navigation assistance has been present from a really long period of time and a solution has been looked after from the human interaction point of view, in terms of usability and in terms of cost and establishment from the communication point of view. Many GPS based outdoor navigation modules exist which work on a mobile phone or a PDA like co-pilot live. Infrared based sensing and navigation has been tested and tried in crossing junctions and proved a success to a great extent [6]. Some IR sensor based modules have also been developed for external navigation in which IR sensors track the location and a voice command is issued to the user using a FM band. There also exist light based indoor navigation systems in which strategic positioning of the LED lights help guide the user [7]. In the previously mentioned system LED lights are strategically placed in the indoor premises, as the user moves, the emitted light from a particular source is captured by the handheld device and the data is processed to calculate location via triangulation[3], and the navigation is issued via sound based commands.

Apart from these previously tried systems a technology currently very prevalent was analyzed, RFID[8][11]. Due to the above mentioned problems of lack of cost effectiveness, RFID comes in handy as it as an effective and cost saving technology. RFID consists of two types of tags namely, active and passive tags. An active tag has the capacity to emit data as it has its own power source. Active RFID are read/write in nature and data can be written or read from them. Passive RFID tags lack any power source and are power by the frequencies emitted by the reader and are read only in nature. An RFID reader is a device which constantly emits frequencies at a range. When an RFID tag comes in this range the data exchange is initiated based on the card and the computing function. In the current system being developed only passive RFID cards and a reader is required which are both low in cost and easy to use. Another very crucial part of the literature survey was to understand the physique and nature of the visually challenged and it was a great input in order to achieve a user friendly design and deliver a higher level of user experience.

B. Existing Methodology:

There is an absence of a free navigation application on the android application store. The current applications which do exist are extremely lacking on usability and are very difficult to use[10]. Even though techniques like text to speech and speech to text are implemented the end user experience and net effectiveness of the system is extremely poor. They also lack behind in cost parameter as they use expensive transmitters and the cost of acquisition as well as maintenance is extremely high. The existing systems are based on very limited set of user studies and lack in depth analysis of the target users. They solely rely on IR sensors which is an insufficient technology to cater the needs of usability and cost effectiveness.

III. GAP ANALYSIS

After surveying the below mentioned metrics it can be easily inferred that the current systems lack in usability effectiveness, cost effectiveness and the use of relevant technology. The gap can be bridged to a great extent by the current system by using efficient technology like RFID which sets ups a robust infrastructure for working as well as provides plenty of functionality at a minimal operational cost. In depth user analysis also provides a very a suitable approach in providing optimum user experience.

Literature Survey	**Metric Analyzed**
Kirti Chawla, "RFID based object localization framework and system"	Object localization framework
Abdel Illah, Nour Alshbatat, "Automated mobility and orientation system for blind or partially sighted people".	Ultrosonic sensor range
George Agollah, "Blind audio guidance system"	Voice effectiveness in navigation
Alechy Kashevnik, Maxim Schetkov "Comparative Analysis of Indoor Positioning Systems Based on Communications Supported by Smartphones".	Triangulation
Sandra Mau, Nik A Metchior, Maxim Makatchov, Aaron Steinfield, "Blind aid – an electronic travel aid for the blind.	Button based navigation
Mohammad Nouman, Sohail khan, "Design and Implementation of a Fine-grained Resource Usage Model for the Android Platform".	Ease of application Development
Dhruv Jain, "Path-Guided Indoor Navigation for the Visually Impaired Using Minimal Building Retrofitting".	Amount of added infrastructure
Massleung, "Passive RFID Application Using MSP430F2274 and PaLFI".	Power management in RFID
Hussam Elbehiery, M. S. Abdel-Wahab, "Smart Touch Phones Blind Assistant System"	Use of RFID
Akbar S. Shaik, G. Hossain, M. Yeasin, "Design, Development and Performance Evaluation of Reconfigured Mobile Android Phone for People Who are Blind or Visually Impaired".	Usablity performance parameters

IV. PROPOSED METHODOLOGY

The Authors propose that the toolkit will include a cane, on which the IR sensors and micro-controller will be mounted and an android phone. Inclusion of the cane was done on account of the familiarity of use possessed by the user when it comes to a cane. The application will always be running in the background on the operating system, hence the user needn't put in efforts to open it. Passive RFID tags need to be used to identify objects in the immediate surroundings or the space intended to be covered by the visually disabled.
The passive RFID tags will help identify the object. The IR sensors on the cane will calculate the distance of the nearest object. The readings from the IR sensor will be fed to the micro-controller, the micro-controller will trigger a vibrating alarm indication in the phone if the object is too near and the user will be notified about the object using text to speech feature available on the android platform. The object will be identified using the passive RFID tag on it. The safety range of every object can be pre-programmed and till the safety range is not breached the application will provide navigation assistance by informing the user the distance of an object from it with the help of the text to speech feature.

To improve the usability of the application, the authors propose to simplify the user experience using gesture recognition. The authors propose that the user should be able to access every feature of the application with the help of customized gestures. The user should be able to access the call feature using a single tap on the screen and messaging using a double tap. A standard gesture like a back swipe could be used to cancel or go back to previous option. The authors feel the use of gesture recognition could be further extended to typing text messages. Hand gesture made on the screen could be mapped to an alphabet and to ensure that the alphabet interpreted is correct, the application will confirm it using text to speech. Customized hand gestures can be used for emergency features as well.

The hand gestures and emergency contact numbers will have to be pre-programmed with the help of human assistance.

V. CONCLUSION AND FUTURE WORK

There is a visible void between the visually disabled and efficient use of technology, the authors propose an application which aims at bridging that gap and aid the visually disabled with utmost efficiency. The authors have made use of existing technology to propose this application and it can be further enhanced using active RFID tags and development of an operating system dedicated specifically for the visually disabled.

VI. ACKNOWLEDGMENT

The authors acknowledge the support and encouragement provided by the faculty and staff at Smt. Kashibai Navale College of Engineering, Wadgaon, Pune.

REFERENCES

[1] Sandra Mau,Nik A Melchoir, Maxim Makatchov , Aaron Steinfield Blind Aid: An Electronic Travel Aid for the Blind, Robotics Institute, Carnegie Mellon University, May 2008.
[2] Kirti Chawla, "RFID based object localisation and framework", Dissertion presented to University of Virginia, May 2014

[3] Alechy Kashevnik, "comparative analysis of indoor positioning system based on communications supported by smartphones,12th conference of FRUCT association."
[4] Massleung, "Passive RFID application using MSP40F2274 and PaLf1",texas instruments application report, May 2011
[5] Dhruvjain, "path guided indoor navigation for the visually impaired using minimumbuilding retro fitting infrastruture,IITdelhi,june 2014.
[6] George Agollah, BreyDanels, Blind Audio Guidance System, University of Houston, 2013.
[7] MadokaNakajima ,shinichiomarijama, new indoor navigation system for visually impared people using visible light communication, EURASIP journal or wireless communication and networking,2013.
[8] ChristophJetlischket, survey paper on RFID trends,cse 5704-56,may 2014.
[9] http://www.pghvis.org
[10] FatihNayeli, Jean-Marc Deshavrais, alainarban, State of the art of mobile application usability evaluation,Ecolie de technologiesupierior.
[11] SL Ting, S.K.Kwok,Albert H.C. Tsanga,Warge T.S. Ho, The study on using passive RFID tags for indoor positioning, hongkong polytechnic,april 2013.

