BLIND GUIDE-AN OUTDOOR NAVIGATION APPLICATION FOR VISUALLY IMPAIRED PEOPLE

[1]ALMA S, [2]NITHYASHREE S, [3]PODILI ALEKHYA, [4]RAMYA S N, [5]LOVEE JAIN

[1,2,3,4,5]Department of Computer Science and Engineering
[1,2,3,4,5]NIE Institute of Technology, Mysore, India
E-mail: [1]almasudheer72@gmail.com, [2]nithyashreeshivaprakash@gmail.com, [3]alekhyapodili@gmail.com, [4]ramyasnag@gmail.com, [5]itsmelovee@gmail.com

Abstract— Blind Guide is a breakthrough technology in navigational and rehabilitative aids for the blind and visually impaired. It is designed to communicate physical location and object location using voice-based guide for users in order to have easy mobilization. Ordinary route navigational systems in the outdoor environment are expensive and its manufacturing is time consuming. Blind people are at extensive drawbacks as they regularly do not have the data which is required, while passing obstacles and dangers. They generally have little information about data such as landmarks and self velocity information. This blind Guide work goes for giving the route to blind persons, by designing a cost-effective and more flexible navigation system. This allows them to move independently without any manual help or guidance. There are a few advanced technologies which are now accessible in the market to cater the needs yet they have their own particular drawbacks, thus one of the efficient solutions is to use embedded system. Blind Guide will be a powerful tool and it is very helpful for visually impaired, in achieving fully independent navigation for those with vision loss and blindness to move freely, safely, and independently.

Keywords— Physical Location, Object Location, Navigation, Voice-Based Guide, Cost-Effective.

I. INTRODUCTION

A. Background

We should first understand what blindness means to a person. Blindness can mean different for different blind people because few people are blind from birth and few loose their vision due to some diseases gradually at a later stage. A person who is blind from birth can see nothing not even black because they do not know what black is. All they see is abyss because they have not seen anything ever to have a knowledge of what anything is. Approximately there are about 38 millions of people around the world in developing countries who are blind and visually impaired, among them over 15 million are from India. Blind people feel they are an outcast from the rest of the society, Because of this inferior feeling blind people are taken back from societal activities and their participation in sports academics is also very limited. As a result the percentage of blind people who are unemployed is around two thirds of working-age visually impaired folks according to 2006 statistics. A March 2008 article in Forbes magazine cited discrimination as one of the biggest obstacles to employment for blind. This in a way can affect the country's economic growth as well. Problems faced by visually impaired people are many, among them many have trouble maintaining a proper circadian rhythm due to lack of visual input to their brains, critical in reading, writing, navigation and identifying objects. Reading and writing can be accomplished to a great extent through development of Braille language. People with complete blindness or low vision often have a difficult time self-navigating outside well-known environments. In fact, physical movement is one of the biggest challenges for blind people, travelling or simply walking down a crowed street may pose great difficulty. Hence blind people need an assistive device that will allow blind user to navigate freely and this requirement has become crucial. Based on this real context or condition we focused the work on developing assistive technologies that may help blind individuals in becoming independent and contributing actively towards the development of the country.

B. Problem statement

Outdoor navigation is becoming a harder task for blind and visually impaired people in the increasingly complex urban world. Technology available for navigation of the blind is not
sufficiently accessible some devices rely heavily on infrastructural requirements. We develop an android application which can be activated and deactivated through a button provided on the white cane. The application guides the user through voice commands from his respective source to his particular destination. The ultrasonic sensor embedded in white cane is used to detect the obstacles along the path and passes the same information to the android application through USB. The application alerts the user and guides him/her to a safer path. We also develop a website that contains all the information about the user whereabouts, the respective parent/guardian can have access to this information by logging into the website through his respective account.

II. LITERATURE SURVEY

The basic requisite for any system to be developed is to understand the available and existing systems in the respective fields. There is a need to understand

the gap between what the user expects and what the system provides. Therefore a detailed study of various available systems has been done in this section.

A. Traditional Systems

Traditionally the assistive systems available for visually impaired were long cane, white cane, short cane, kiddie cane, guide cane, identification cane and support cane. None of these provided information about the obstacle until the user encountered them physically.

B. Assistive Technology Systems

- 3D Ultrasonic Stick for Blind[1]
  This paper goes for developing a stick embedded with three ultrasonic sensors to detect obstacles in three different directions. Disadvantage of this system is that delay to detect the obstacles is more it is between 2- 4 seconds also, delay for GPS is about 30 seconds-1 minute.
- Using Ultrasonic Sensor for Blind and Deaf persons Combines Voice Alert and Vibration Properties[2]
  This system is designed to help both visually impaired and deaf people to navigate. It involves a vibrator to generate vibrations for deaf and voice based guidance for visually impaired. Disadvantage of this is it consumes more battery power for vibrations.
- Use of ultrasonic sensors, GPS and GSM technology to implement alert and tracking system for Blind Man[3]
  This intended work was successful in providing a low cost equipment for navigation but it involves too many modules to be integrated.
- A Multidimensional Walking Aid for Visually Impaired Using Ultrasonic Sensors Network with Voice Guidance[4]
  This paper goes for developing a stick embedded with many ultrasonic sensors combined to form a network of sensors to detect obstacles in different directions. Disadvantage of this system is that delay to detect the obstacles is more. It cannot determine the distance of the obstacle to the multidimensional.
- Voice Based Guidance and Location Indication System for the Blind Using GSM, GPS and Optical Device Indicator[5]
  This method involves finding location of the user and obstacles in user's path. The main disadvantage is they developed a new model that was too heavy to hold and inconvenient to carry around
- Electronic Guide Cane with Ultrasonic eyes for Visually Impaired[6]
  This technology goes for developing a system that can detect obstacles through sensors embedded in cane along with a camera fixed to take images of the path in front of the user each and every second. Disadvantage is more memory space and complexity in processing the images.
- An Outdoor Navigation With Voice Recognition Security Application For Visually Impaired[7]
  This application detects obstacles and guides the user through voice but the main disadvantage is that the application is initiated by comparing the user's voice with the sample user's voice collected at the beginning. The voice sample could not be matched against different tones of the user.
- Voice Operated Outdoor Navigation System for Visually Impaired Persons[8]
  This equipment involves detecting obstacles and providing guidance through voice but the disadvantage is use of complex NMEA protocol
- Ultrasonic Stick for Blind[9]
  It involves detecting obstacles using sensors as well as camera and it uses vibrator to give the feedback of obstacles so the disadvantage is consumption of more battery power and memory space.
- Voice Based Navigation System for Blind People Using Ultrasonic Sensor[10]
  This model involves detecting obstacles and providing guidance through voice but the disadvantage is use of complex text to speech and speech to text conversion through Espeak, GoogleAPI, Pocket sphinx, Raspberry pi.

III. PROPOSED SYSTEM

Here we design a system that overcomes the drawbacks of all the aforementioned systems. Precisely our system is designed to do the following action sequences, which includes creating the shortest path by taking destination from the user, guiding the user to specified destination, detect the obstacles along his/her way. A Blind guide should be installed on android mobile, which support GPS. To activate the application, user should just press a button on the stick. The destination spoken by the blind is recorded by mobile and sent to the centralized server along with the source where the blind is at present. GPS in android, locate your current position that is taken as source for blind navigation. After getting the source and destination information GPS forms the path, and application starts speaking out to the blind. Guidance for directions to be taken is given through voice output. The server directs the blind until he reaches the destination. When the blind requests for any instruction, each time a new shortest path is created from current location to the destination so that the blind can reach the destination even if he diverts from the instructed path. An ultra sonic sensor is used to find the obstacles anywhere in the path. If any

obstacle is found, then the sensor will report to the server, and then the server will report to the blind immediately and changes his/her path. Application is always in contact with the server and blind's path. Concerned person(s) of the visually impaired can login to centralized server to track his/her path.

The main features that act as strong points for our system are:

1. Easy to use.
2. Input or output voice communication for the conveni-ence of the user.
3. Warns them if any obstacles found in the path and re-directs them to a safer path (alternate path).
4. Cost effective.

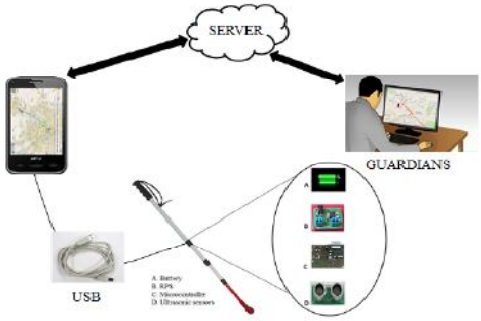

Fig. 1 Overview of Proposed System

IV. SYSTEM DESIGN

System design consists of both hardware and software requirements.

A. Software Requirements

We use android as a platform and java language for coding. Here we develop two applications, one is to guide the user about his path and another one is for his guardians to track his path.

1) Android Mobile Application: An Android Mobile Application blind guide should be installed on android mobile which support GPS, when blind takes his android mobile near mouth, the application starts recording his destination which he speaks out. To activate the application, we use proximity sensor of the mobile. The destination spoken by the blind is recorded through mobile and sent to the centralized server along with the source where the blind is at present.

GPS in android locate your current position that is taken as source for blind navigation, using source and destination position centralized server forms the path through a customer care executive. After getting the source and destination information from the server, the application starts speaking out to the blind. Guide is given as voice output. Blind's current direction will be found out using mobile's orientation sensor and spoken out to the blind. Through voice output, the server tells direction to blind until he reaches the destination. Blind is provided an option to repeat the given instruction as well as to get the next instruction. When the blind requests for the next instruction, each time a new shortest path is created from current location to the destination so that the blind can reach the destination even if he diverts from the instructed path. If any obstacles found in path, then the application warns blind and changes path.

2) Server Module: The Server Module is executed on a desktop PC running Windows. The blind is completely tracked by the server and later their concerned people can see his tracks. An ultrasonic sensor will report to the server, and then the sensor will report to blind as soon. Server checks each time for the ultra sonic sensor reports. So those blind will be safe. Application is always in contact with the server and blinds path and given instructions are tracked everywhere. Concerned persons of blind can login to centralized server to watch blind activities and they can track the blinds.

B. Hardware Requirements

User is provided by a stick which consist the following components.

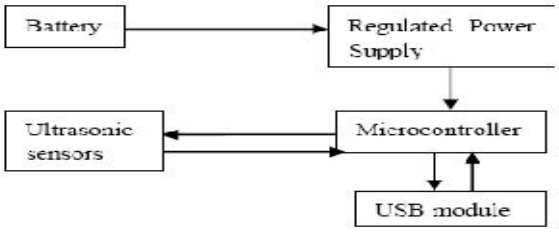

Fig. 2 Block diagram of hardware unit

1) Battery: Battery is used for power supply. Here we use a 9V battery which is sufficient to supply enough power to control the stick operation. The battery used here is a chargeable which is advantageous when compared to other non-chargeable batteries.

2) Regulated Power Supply (RPS): RPS is an embedded circuit. Its function is to supply a stable voltage to a device that must be operated within certain power supply limits. The type of stabilization used may be restricted to ensuring that the output remains within certain limit under various load conditions, or it may also include compensation for variations in its own supply source. Here it converts the varying input voltage and produces a constant output voltage of 5V.

3) Ultrasonic distance sensor: Ultrasonic sensors are proximity sensors that are able to measure distance of the objects within the specific range and without any physical contact. They generates high frequency sound wave and transmit it. Once the wave hits any obstacles, echoes are reflected back and receive by the detector.

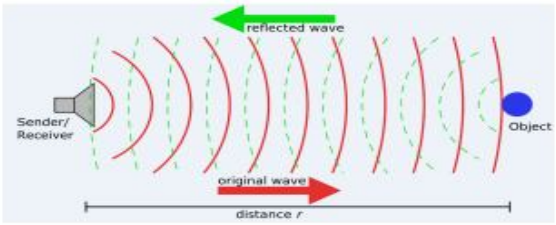

Fig. 3 Working of Ultrasonic sensors

The sensor calculates the time interval between sending the waves and receiving the echoes. This time interval is used to determine the distance between the object and the sensor. The timing information will be sent to the microcontroller.

4) Microcontroller: The main function of the microcontroller is to control all other component which are integrated with it. The microcontroller we use is PIC16F877A. It has 40 pins and is a capable microcontroller that can do many tasks because it has a large enough programming memory, that is 8K and 368Bytes of RAM. The timing information sent from the ultrasonic sensors are converted to distance between the object and the stick. This distance information sent to android application through USB module.

5) USB Module: USB is used to connect the stick and the android application to send distance information from stick to mobile. After sending those distance information, the application will alert user about the obstacles. Hence collision with obstacles can be avoided.

V. IMPLEMENTATION

The software is implemented using java language on android platform. The stick with ultrasonic sensor which is controlled by microcontroller, detects the obstacles. The working process of the above system is shown in flow chart.

A. Flow chart:

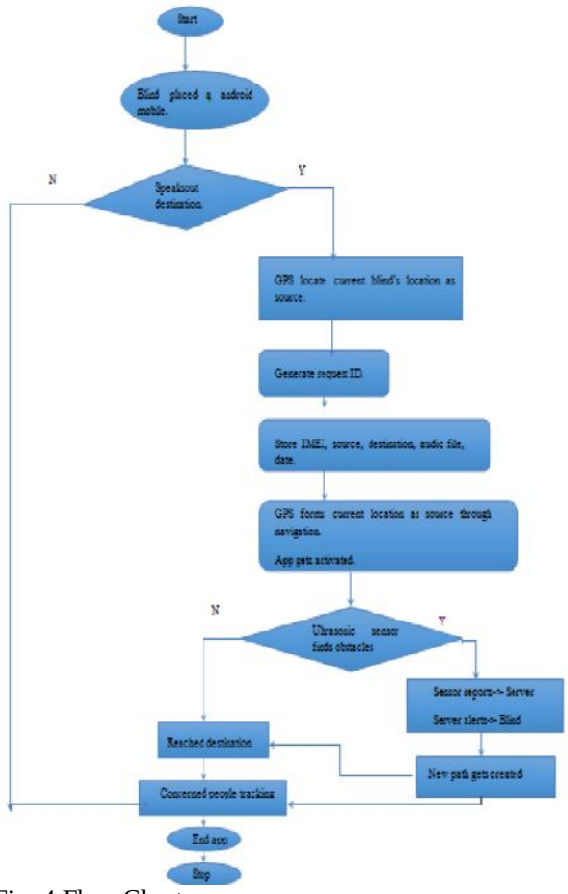

Fig. 4 Flow Chart

B. Use case Diagram:

The actors here are administrator, blind, concerned people(s).

Blind provides the destination through voice, administrator receives the destination, controls the application and guides

the blind along his way, and the concerned people can track the user by logging in to the server.

Fig. 5 Use case Diagram

CONCLUSION & FUTURE ENHANCEMENT

The proposed system helps the visually impaired to move independently and safely. It can be used in any public places. As it is a voice based system, the user can provide the destination easily. This system is designed in less time with low cost and low power consumption. The application requires less space and it is dynamic. Compared to other existing system, this system is more efficient. The future scope for this project is to improve another device that can be either necklace or goggles embedded with ultrasonic sensors that can detect obstacles above the abdomen level so that user can navigate more effectively.

REFERENCES

[1] Osama Bader AL, JeenVinouth "3D Ultrasonic Stick for Blind",International Journal of Latest Trends in Engineering and Technology (IJLTET)

[2] Mahdi Safaa A., Mushin Asaad H. and Al-MosawiAli Technical Institute, "Using Ultrasonic Sensor for Blind and Deaf persons Combines Voice Alert and Vibration Properties", Research Journal of Recent Sciences

[3] K.C. Nalavade, FatemaBharmal, TruptiDeore, Ajay Patil, "Use of ultrasonic sensors, GPS and GSM technology to implement alert and tracking system for Blind Man" , International Conference of Advance Research and Innovation.

[4] Olakanmi O. Oladayo, "A Multidimensional Walking Aid for Visually Impaired Using Ultrasonic Sensors Network with Voice Guidance", I.J. Intelligent Systems and Applications, 2014, 08, 53-59 Published Online July 2014 in MECS

[5] M. Naveen Kumar, K. Usha, "Voice Based Guidance and Location Indication System for the Blind Using GSM, GPS and Optical Device Indicator", International Journal of Engineering Trends and Technology July 2013

[6] B.MohanSitaramaiah, M.Naganaik, " Electronic Guide Cane with Ultrasonic eyes for Visually Impaired" , International Journal of Advanced Technology in Engineering and Science January 2015

[7] Nandish M S, Mr. ChetanBalaji, Prof. Shantala C P, Mr. ChetanBalaji, "An Outdoor Navigation With Voice Recognition Security Application For Visually Impaired", International Journal of Engineering Trends and Technology Apr 2014

[8] Somnathkoley, Ravi Mishra, "Voice Operated Outdoor Navigation System for Visually Impaired Persons", International Journal of Engineering Trends and Technology 2012

[9] Ankit Agarwal, Deepak Kumar, Abhishek Bhardwaj, "Ultrasonic Stick for Blind", International Journal Of Engineering And Computer Science,April 2015

[10] Anushree, Chitra.M, "Voice Based Navigation System for Blind People Using Ultrasonic Sensor", International Journal on Recent and Innovation Trends in Computing and Communication.

[11] A. Nurulnadwan, M.R. Nur-Hazwani, and A.M. Ariffin, "Assistive Courseware for Visually Impaired," (2009). In Proc. IVIC 2009, LNCS 5857, 2009, pp. 905-915.
[12] J.Borenstein and I.Ulrich,"TheGuideCane - Applying Mobile Robot Technologies to Assist the Visually Impaired," IEEE Transactions on Systems, Man, and Cybernetics, Part A: Systems and Humans, Vol. 31, No. 2, 2001, pp. 131-136.
[13] Faria J Lopes St, FernandesH, Martins P, Barroso J. "Electronic white cane for blind people navigation Assistance", World Automation Congress © 2010 TSI Press.
[14] J.Almeida,H.Fernandes,V.Filipe and J.Barroso,"Web platform architecture to support the Geographic Information System of the University of Tnis-os-Montes and Alto Douro Campus", Proceedings of the 2009 International Conference on New Trends in Information and Service Science, Beijing, 2009, pp.1112-1117.
[15] J. Carvalho, P. Martins, H. Paredes, A. Costa, A. Vasconcelos, A. Reis, J. Barroso and J.Bulas-Cruz, "WI-FI User Location Systems", European University Information Systems, Grenoble, 2007, pp. 26-29.
[16] http://www.harmonyindia.org/hportal/VirtualPageView.jsp ? Page_id=15 184
[17] Kuei-Chun Liu, Ching-Hung Wu, Shau-Yin Tseng, Yin-Te Tsai, "Voice Helper: A Mobile Assistive System for Visually Impaired Persons", 2015 IEEE International Conference on Computer and Information Technology
[18] Gunta Chomchalerm, Jitsupha Rattanakajornsak, Unchalee Samsrisook Damras W ongsawang, W orapan Kusakunniran, "Braille Dict-Dictionary Application for the Blind on Android Smartphone", 2014 Third ICT International Student Project Conference
[19] Anna Pitera, Dariusz Bober, and Jacek Kesik, "Image Edges Locator Dedicated to Visually Impaired People – an Experimental Application for Mobile Devices", the 8th IEEE International Conference on Intelligent Data Acquisition and Advanced Computing Systems
[20] N.H, Ismail, Zarina Tukiran,N.N. Shamsuddin, E.I.S Saadon, "Android-based Home Door Locks Application via Bluetooth for Disabled People", 2014 IEEE International Conference on Control System
[21] Dianne T.V. Pawluk, Member, IEEE, Richard J. Adams, Senior Member, IEEE, and Ryo Kitada, "Designing Haptic Assistive Technology for Individuals Who Are Blind or Visually Impaired" 2015 IEEE transactions on haptics, vol. 8
[22] Kabalan Chaccour, Student Member, IEEE, Jean Eid, "Multisensor guided walker for visually impaired elderly people", 2015 International Conference on Advances in Biomedical Engineering
[23] G. Cerri1, A. De Leo, V. Di Mattia, G. Manfredi, V. Mariani Primiani, V. Petrini, M. Pieralisi, P. Russo, L. Scalise, "The Electromagnetic Technology for Safe Mobility of Visually Impaired People", 2014 22nd Mediterranean Conference on Control and Automation University of Palermo. June 16-19, 2014. Palermo, Italy
[24] Namita Agarwal, Anosh Iyer, Sonalakshi Naidu, Snedden Rodrigues, "Electronic Guidance System For The Visually Impaired -A Framework", 2015 International Conference on Technologies for Sustainable Development
[25] B. Mustapha, A. Zayegh1, R.K. Begg, "Reliable Wireless Obstacle Detection System for Elderly and Visually Impaired People with Multiple Alarm Units", 2014 IEEE 2014 International Conference on Computer, Communication, and Control Technology
[26] Rabia Jafri, Syed Abid Ali, "Exploring the Potential of Eyewear-Based Wearable Display Devices for Use by the Visually Impaired", 2014 3rd International Conference on User Science and Engineering
[27] Yusuke Kuramochi, Hotaka Takizawa, Mayumi Aoyagi, Nobuo Ezaki and Mizuno Shinji, "Recognition of Elevators with the Kinect Cane System for the Visually Impaired", 2014 IEEE International Symposium on System Integration

★★★