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Design and Development of a Prototype Assistive Mobility Solution for the Visually Impaired

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Abstract— **The World Health Organization (WHO) reported that there are 285 million visually-impaired people worldwide. Among these individuals, there are 39 million who are totally blind. There have been several systems designed to support visually-impaired people and to improve the quality of their lives. Unfortunately, most of these systems are limited in their capabilities. In this paper, we present a comparative survey of the wearable and portable assistive devices for visually-impaired people in order to show the progress in assistive technology for this group of people. Thus, the contribution of this literature survey is to discuss in detail the most significant devices that are presented in the literature to assist this population and highlight the improvements, advantages, disadvantages, and accuracy. Our aim is to address and present most of the issues of these systems to pave the way for other researchers to design devices that ensure safety and independent mobility to visually-impaired people.**

Keywords: *assistive devices; visually-impaired people; obstacles detection; navigation and orientation systems; obstacles avoidance*

I INTRODUCTION

According to a global survey report on visual impairment around the world by WHO in 2010, there were estimated over 285 million visually impaired people in the world. Of the 285 million, 13.7% are blind and 86.3% ie. 246 million people have low vision. And on a further note, 21.9% of the worlds visually impaired are from India, whereas 26.5% are from China.[1] Given a look at the numbers, it is clear there is a populace that can be served to ful_l a need. Most of the impaired are found to be in developing nations, over a wide range of ages. These individuals are hindered from a normal life and wages. A innovative step towards accessibility and portability would make life easier and, furthermore, a lot more interesting. There have been many aids developed with this goal in mind, like the smart stick[2] with transducers and lasers fitted on a white cane to identify hindrances and obstacles, and there will furthermore be many more developments in the days to come. But here is our take on the problem. This is a solution for improving the mobility of visually impaired persons. Albeit the consequent goal is to improve the lives of the blind, for practical purposes, this system will gratify low vision individuals more than it would for the total blind. This is a system where the visually impaired user can achieve better mobility despite his/her impairment with little to no help from another person. Mobility is described by Emerson Foulke as The ability to travel safely, comfortably, gracefully, and independently, referred to hereafter by the single term mobility, is a factor of importance in the life of a blind individual. [3] The term blindness is qualitative, and it describes the clinical condition where the individual has total vision loss: that is no light perception. It could also describe certain individuals who have very low to negligible vision. Moreover, the term visual impairment is also a qualitative term used to describe loss of vision that is a consequence to various diseases that affect parts of the eye at an organ level. Low vision is a description of lesser degree of vision.

II REVIEW OF LITERATURE

Our main motivation throughout this project was the desire to build something that helped the visually impaired population of this country by incorporating modern technology into their lives. We also wanted to implement such a solution as cheaply as possible in order to make it affordable for the general public. The idea of a smart shoe sparked in our minds after we saw the recent rise in the popularity of wearable computing devices. That in conjunction with the increasing availability of Internet and cheap smart phones, convinced us that we could in fact, combine smart phones, Internet and wearable computing devices to build a system that can help visually impaired people navigate in a reliable, affordable and elective way without obstructing their current lifestyle. At the same time we wanted this system to have features that would enable the visually impaired persons dear ones to monitor him/her remotely.

Our paramount objective throughout this venture was the drive to fabricate something that helped the outwardly weakened populace of this developing nation, considering the large numbers thereof [1], by consolidating ubiquitous technological innovations into their lives. We needed to actualize an answer to this need keeping in mind the end goal to make it moderate and efficient for the overall visually impaired

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population. The possibility of a simple shoe becoming smart ignited in our brains after we saw the recent ascent in ubiquitous wearable devices. That in conjuncture with the expanding accessibility and reach of the Internet and commodity smart phones, persuaded us that we could actually, join handhelds, wearable and the Internet to fabricate a framework that can at the very least improve the lives of individuals to explore the world around them in a viable route without hindering their present way of life. Furthermore, we needed this framework to have features that would allow the visually impaired individual's beloved ones to monitor him/her remotely. We started out with the following intentions for our goal:

- Use information given by sensors in the wearable to caution the individual about any obstacles on current heading.
- Connect the wearable to an Android device wirelessly using Bluetooth, so that the said Android device may process the information collected by sensors.
- Design an arrangement which wouldn't hinder the individual from his regular life.
- Make the arrangement economical.
- Build-on and overcome any shortcomings of previous works.

III SYSTEM OBJECTIVE

1. Use data provided by sensors in wearable to warn the visually impaired person about obstacles.
2. Connect multiple wearable to an android phone via Bluetooth so that the phone can read vital data regarding the visually impaired person.
3. Implement solution in such a way that it does not disrupt the visually impaired person's normal life.

IV PROPOSED SYSTEM

The proposed system has Hardware, Android, GPS and web based system capable of assisting the blind and visually impaired without the help of sighted person. To achieve the final objectives the following sub objectives have been accomplished using design principles of mobility aid.

The shoes are mounted with ultrasonic sensors. Sensors are place on the medial, central, and lateral aspects of the front of the shoe. Sensors are also placed at the temple by mounting it on spectacles. These sensors can detect obstacles situated at different levels. The sensors are connected to an Arduino board which also includes a Bluetooth module connected to it. The Bluetooth module is used to interface and send messages to the android phone wherein the app, to guide the user, is installed The board is mounted with ultrasonic sensors to And obstacles in the path of the visually impaired individual.

To recognize the position and vicinity of the visually impaired individual, and for navigation, we depend on Global Positioning System (GPS). The application proposed in this paper utilizes TTS and Google Maps API so as to furnish routing with voice guidance. This recommended framework utilizes a smart phone which is ubiquitous, and is genuinely modest and gives a simpler versatility. The hardware to be used is to be designed to be ergonomic and minimal. It is desired to have something lightweight and sturdy. We need it to be portable.

V SYSTEM ARCHITECTURE

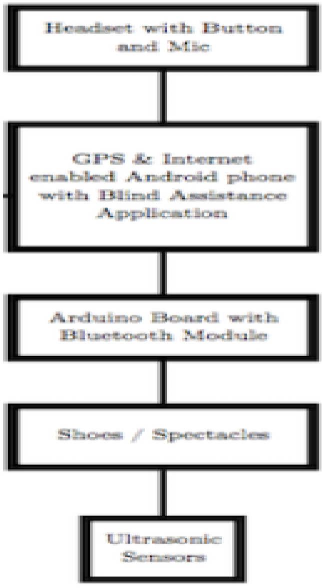


Figure 1 System Architecture

VI ADVANTAGES

- Tracking the movement of pedestrians in real time using the appropriate location sensors in order to optimally estimate the current position of the user.
- Ability to track in three-dimensional space with the accuracy sufficient to determine the floor a user on
- Achieving the uninterrupted monitoring of the position during the transition from outdoor and indoor areas. The integration of sensors in a mod Module for determining the current location and orientation of the user
- A computer system that contains a Geographic Information System (GIS) with the information about the space through which the user will move
- The user interface, usually tactile and audio

VII APPLICATIONS

- Android Application:

  Android is an open-source operating system used for smart phones and tablet computers among others. It is developed by Google and later the OHA, and is based on the linux kernel. Applications are developed for Android in Android Studio.

- Location Tracking:
  Location tracking refers to keeping a record of the timeline of a person's travel, including their current location.
- Navigation:
  It is the process of accurately ascertaining ones position and planning and following a route.
- Ultrasonic Sensors:
  An ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It does so by recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object. It uses high frequency pulses of sound with frequencies beyond the human audible range, often roughly at 40 kHz.

VIII ALGORITHM

Obstacle detection algorithm Step:

1. Start
2. Read users destination input.
3. Pass the input to Google Maps api.
4. Start the navigation.
5. If ping returns true then
6. Calculate the distance of obstacle
7. if Threshold matches return Alert Message
8. Return the obstacle detection on front with distance as voice
9. If Ultrasonic sensor returns true

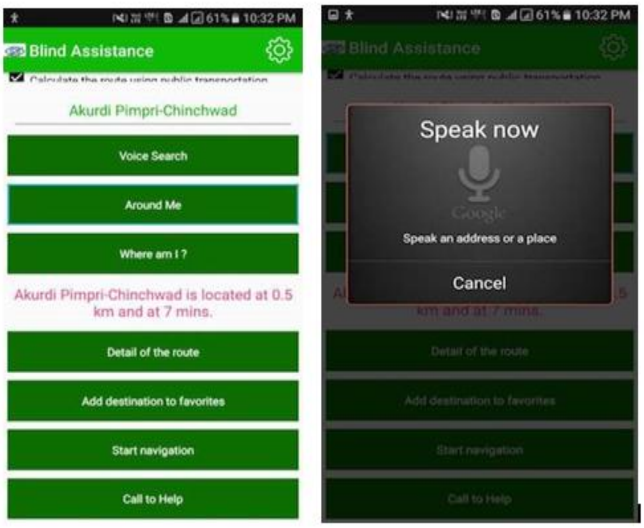
10 Return obstacle detection on left/right as voice

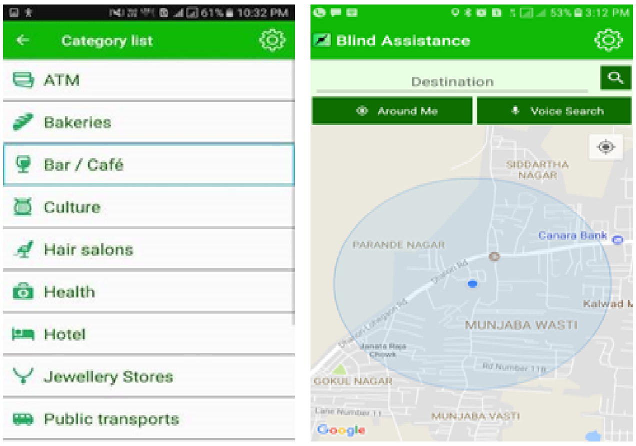
11. Repeat 5-6 till app is running

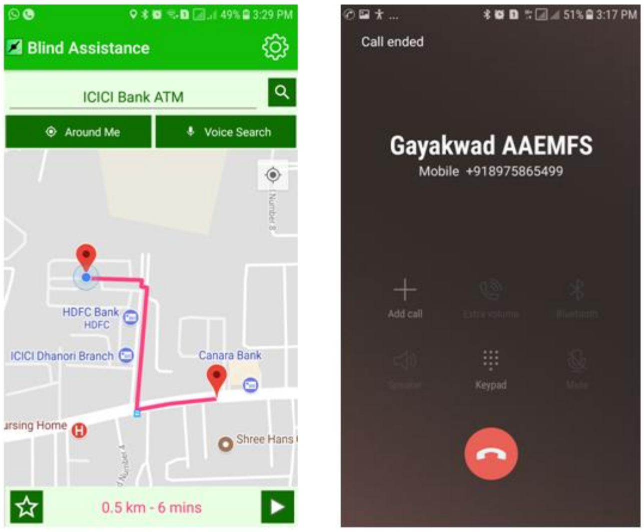
12 Stop

IX EXPERIMENTAL RESULT

1. **Blind Assistant Application**







X CONCLUSION

We began with the goal to create a aid which would enable visually impaired persons to move more conveniently and navigate to places they desired. The final product of our work is a device capable of guiding the visually impaired along a route and also features a design integrating the setup with the Internet. This enables guardians to monitor the impaired individual online. The framework has been tried through a few experiments. This assistive gadget powered by an android device is significantly valuable to a visually impaired individual to move without the assistance of others and can look for help in a crisis through an emergency phone call. The application also keeps a record of location history on an online server which is accessible to the guardian.

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