Assistive Technology for Visually Impaired People

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***Abstract*— Visual information is the basis for most navigational task, so the visually impaired people need necessary information about the surrounding environment. The objective of the project is to design a product useful for visually impaired people. The proposed system has smart stick which is integrated with sensor and also have smart phone. The system allows the visually impaired people to walk confidentially in an unfamiliar environment by detecting obstacles. The sensor detects the obstacles and passes the data to the device. The mobile application finally processes the data and delivers the information to the visually impaired people according to the size of the object through voice communication. The aim of this project is to present a navigation system of visually impaired people providing various technologies with their usefulness, challenges and requirements of visually impaired people.**

Keywords—Sensor, Navigation system, Mobile Application

I. INTRODUCTION

Eyes play a vital role in our life. But the visually impaired people encounter many problems in leading an independent life due to their reduced perception of the environment. The visually impaired people to be navigate efficiently by detecting obstacles and providing required information. Smart obstacle detector helps visually impaired people in moving and to perform the work easily and comfortably. In proposed system the objects are detected by Ultrasonic sensors and the size of the objects are detected by sensor which is placed at the different level. The commands are delivered to the user according to the size of an object using mobile application. The objective of the paper is to explain the further development work of a cane that could communicate with the users through mobile application, which involves coding and physical installation. Moreover, the system presents a text-to-speech conversion to ease the usage of smart phones for the visually impaired user. Using the various functionality of any basic mobile phone like calling, messaging, knowing the date, time and location, battery level etc. are made easy for the visually challenged user. This assistive technology helps the people by providing any basic functionality to them.

The common way for navigating visually impaired person is using a blind stick or walking cane. In [2] the walking cane is used, which is a simple and purely mechanical device dedicated to detect static obstacles on the ground, uneven surfaces, holes and steps via simple tactile-force feedback. Detecting obstacles using image processing techniques have been used in several industrial applications. In [3] it is necessary to use object detection for visually impaired people and give them audio/ vocal information about it. It is detecting an object using the mobile camera and giving voice instructions about the direction of an object. It will be an issue if a picture quality is not good. The system [7] allow visually impaired people to safely catch buses by using vibrating device, a tactile interface and alarm through a wireless system. The visually impaired people have the opportunity to get information about the arrival and departure time of the bus and also provide the presence of a user on the road. But this system is not applicable for all the navigation systems.

With the advancement of modern technology, both in hardware and software front have brought enough potential to provide efficient navigation systems. There has been a lot of Electronic Travel Aids (ETA) designed to help the visually impaired navigate independently and safely [5]. The aim of the overall system is to provide a low cost and efficient navigation aid for visually impaired which gives a sense of artificial vision by providing appropriate information about the objects around

them. The system helps in reducing many barriers for the visually impaired people and so it is referred to as Assistive Technology (AT) for visually impaired people.

II. Related Works

RFID based map-reading system provides solution for the visually impaired people to pass through public locations effectively using RFID cane Reader, Bluetooth interface, RFID tag grid and personal digital assistance. But its development cost is quite high and occurrence of interference in heavy traffic [1]. The Smart Vision system [2], give the ability for the visually impaired users to move around in both indoor and outdoor environment, through a user friendly interface. The sensors will detect the obstacles and process the data, then deliver the commands through speakers. The paper is focused mainly in the development of the computer vision module of the Smart Vision system. The system is based on ultrasonic sensor that detects obstacles and commands by the two-wheeled steering axle. The visually impaired feels the steering commands through the handler and follows the instructions. But the other system uses the ultrasonic sensor to identify the distance between the object and sensor by means of vibration.

The author in [4] proposed an intelligent guide stick that consists of an ultrasound displacement sensor, two DC motors, and a microcontroller. Until recently, most touch screens provided few or no accessibility features, but they are unusable by visually impaired people. However, both the visually impaired people community and technology manufacturers has made progress on these issue in recent years. In [6] A voice operated navigation system developed using ultrasonic sensor and GPS. The system alert user's current location and provide voice communication for navigating to a remote destination. But it fails to give an obstacle detection and warning alert.

The inimitable application for visually impaired using android [8] is a mobile application for visually impaired to use the touch screen efficiently like a sighted person. The application enables the user to interact in a friendly manner. It is developed to obtain messages and calls and to set the date, time, sound and alarm of the mobile phone through voice. The system mainly involves the text to speech conversion and vice versa. The Guide Cane [9] is designed to help the visually impaired users to navigate safely among obstacles. The people hold the Guide Cane in front of the user while walking. The system is heavier than the white cane, because it uses a servo motor. The author in [10] proposed RFID based system to aid the visually impaired people in the task of grocery shopping. The system relies on the RFID tags that are placed at various locations in the store and provides the aids just inside the store.

III. Proposed System

The proposed system specially designed for visually impaired people. It contains both Assisted Navigation System and smart phone for visually impaired People. The white cane comprises of ultrasonic sensor which is used to detect obstacles and its size. The smart phone has a special mobile application to interact effectively by the visually impaired people.

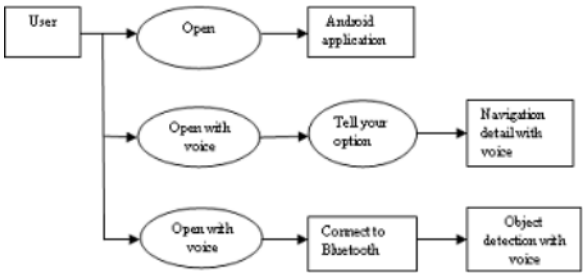

Fig 1: Overall Flow Diagram

The purpose of the system is to develop a mobile application that would enable the visually impaired people to use some basic features of mobile phones to make their work simpler. The system involves both hardware and software implementation.

A. Hardware Implementation:

1) System Architecture:

The proposed system consists of ultrasonic sensor, battery, Arduino UNO and Bluetooth connectivity.

i. Ultrasonic Sensor

Ultrasonic sensors works on a principle to evaluate the distance of a object by interpreting the echoes from sound waves respectively. Ultrasonic sensors generate high frequency sound waves and the echo which is received back by the sensor. The sensors will calculate the distance of an object by transmission and reception the sound waves.

ii. Battery

The 9v battery is to provide power supply to the Arduino UNO interface.

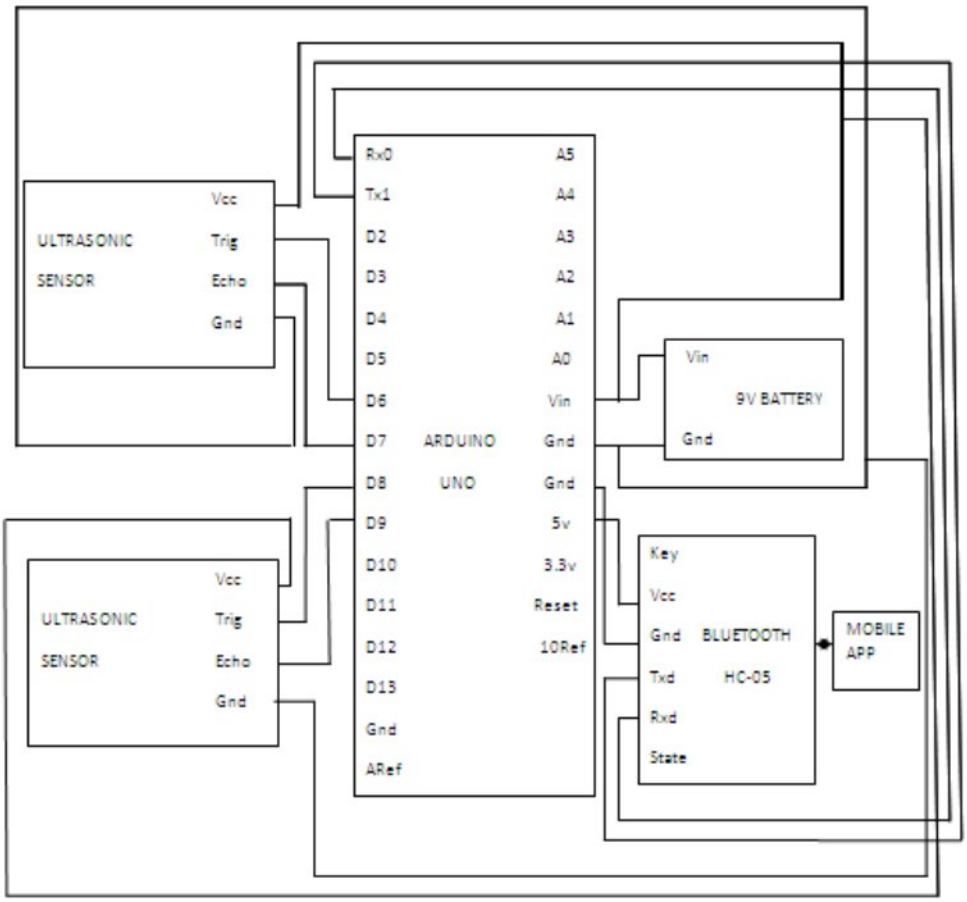

Fig2: Block Diagram of Proposed System

iii. Arduino UNO

Arduino is open source software that created microcontroller based kits for interactive objects and building digital devices that can sense and control physical devices. The boards feature serial communication interfaces for loading programs from personal computers using USB. For programming the microcontrollers Arduino provides an integrated development environment (IDE) based on programming languages such as C, C++ and Java.

iv. Operation:

The ultrasonic sensors s1 and s2 are attached to the white cane. The sensors s1 at the bottom and s2 at the top. If obstacle is detected by s1 then the object is at the lower level otherwise at the higher level. So the commands are delivered according to the height of the sensor. The 9v battery is used to provide power supply. The received data is send to the mobile application through Bluetooth connectivity. The mobile application processes the data and finally delivers commands to the user.

B. Software Implementation:

The mobile application is provided for efficient communication system. Most of the applications used for navigating visually impaired people but the developed Android application is to navigate the user as well as easy for usage of mobile phones. The application has several modules which include command delivering, voice calling and messaging, location tracking, emergency calling and battery alert. The data received by the sensor are analyzed and the right commands are delivered to the user through voice communication. The commands delivered from the mobile phone are determined by the height of the sensors placed on the white cane. The visually impaired people unable to read the contacts to make calls and messages. So the System uses Google voice for voice calling and messaging. The sending and receiving of messages depends on speech to text conversion and vice versa.

The location of the user is tracked by using GPS (Global Positioning System). The GPS spontaneously locate the user moving from one place to another. The automatic call generated for the given numbers at an occurrence of any

emergency to the user. The battery level is notified through voice when the battery is drained down. The incoming calls and messages is also notified through Google voice. The current date and time is intimated to the user whenever user asks for details. The necessary information for the user is stored earlier with appropriate answers. The application able to provides answer for a previously stored statements at any time. The mobile application provides all the necessary details for the visually impaired people. So the user able to travel in an unfamiliar environment without the help of sighted persons.

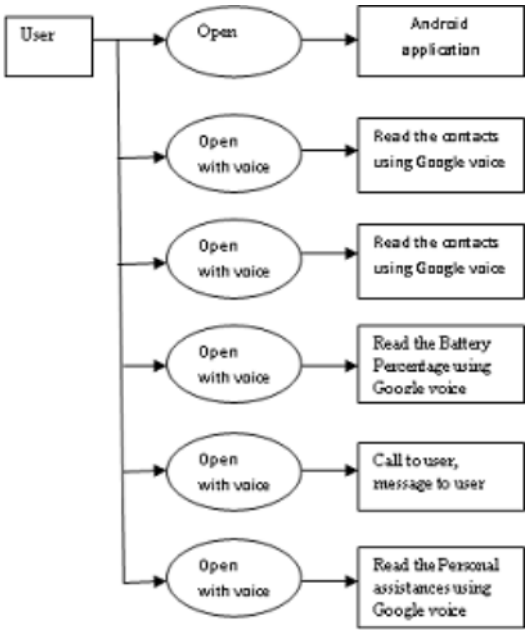

Fig 3: Flow Diagram of Mobile Application

IV. CONCLUSION

The system will be efficient and unique in its capability in specifying the distance of the objects that may encounter the visually impaired. The system reduces the dependence of visually challenged people on sighted assistance while navigating in an unfamiliar environment. In future work, the application has been developed by introducing more facilities and by optimizing the hardware implementation.

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