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GPS Operated Smart Walking Stick for Visually Impaired People

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***Abstract*—** This paper represents the architecture and implementation of a smart self obstacle detection stick that will help to navigate the visually impaired people. This system uses GPS and voice recognition along with obstacle avoidance with the help of developed Android application. The visually impaired person issues the command and receives the direction response using audio signal, which encourage blind people to walk on the road without any help of other people. With the advancement of voice recognition system, it is now become easier to issue commands regarding directions to the visually impaired people. The blind person will provide the destination's name as the input to the developed APP, which will plot a path to it. The app navigates the user's progress along the route and issues voice instructions for each turn.

***Keywords*—**Bluetooth module,GPS,Smart walking stick, Ultrasonic Sensor, Voice navigation

I. INTRODUCTION

It is very unfortunate that among 120 cr. Population of India 8.9 cr. People are visually impaired. 90% of those can't walk independently [1]. According to the report of World Health Organization (WHO), India is now home to the world's largest number of blind people [2]. So in present scenario, that is a serious issue. Though various techniques has been applied from last 10 years to make visually impaired or blind people self dependent, but even now, it is not easy for blind people to independently move.

This paper mainly focuses on those visually impaired people who cannot walk independently in unfamiliar environment. The system explained here provides a low cost and reliable solution for above problem and that system assist the visually impaired or blind people without help of any sighted person.

With rapid advancement in modern technology within last few years, mainly advances in wearable computing, voice recognition, wireless communication and GPS system make possible to provide a smart aid for visually impaired people, which can help them to navigate safely and independently. With the help of this modern technology, the authors design a small and simple walking stick which helps a blind people to get navigation directions though audio message depending real time assistance providing by GPS system. Additionally, GPS module from mobile phone is utilized here and used in different areas of human activity like navigation aids to guide blind pedestrian and let them to avoid different obstacles and reach their destination, which make this stick smart. Also, current location of user can be identified by user's family members by android messaging system. It is expected that, this smart walking stick will be helpful tool to improve the quality of life of blind peoples.

In the rest of the paper, related work on this topic is explained in Section II, methodology and block diagram of the whole work is explained in Section III and Section IV describes hardware part. Finally, in section V conclusion and future scope of this work is explained.

II. RELATED WORK

During few previous years, many researchers have been given their full effort to guide visually impaired people and to reduce complicacy in their life. Several methods are utilized and several devices are prepared throughout the world to offer best navigation in terms of cost effectiveness. This section gives a brief review of different works related to this topic.

In ref. [1], a microcontroller based smart walking stick for visually challenged people is described. It uses microcontroller and different sensors to detect obstacles and alert the operator by buzzer sound. In ref. [2], proposed device is linked with a GPS to identify the location of

visually impaired person. It also provides the voice alert to avoid obstacles based on ultrasonic sensors and an emergency button is also added to the system. Ref. [3] describes a navigation device for blind people mainly focused on providing voice output for obstacle prevention and navigation using infrared sensors, RFID technology, and android devices. Another system in ref. [4] and ref. [5] uses GPS and GPRS technology to provide emergency SMS by system registered cell phone number. Similarly, ref. [6, 7, and 8] also provides android based system with RFID module and GPS based voice recognition system. But, all the system described here are either costly or operation is very complicated which is difficult to handle by blind people. Some of the system works indoor only. So, it is required to make a compact system which will work in indoor and outdoor both, easy to handle and also cost effective.

III. METHODOLOGY

Figure 1 shows overall block diagram of proposed smart walking stick unit for blind people. The stick includes Arduino, Sensors, App and other supplementary components. Mobile A-GPS version is used to help user to know information about the destination location.

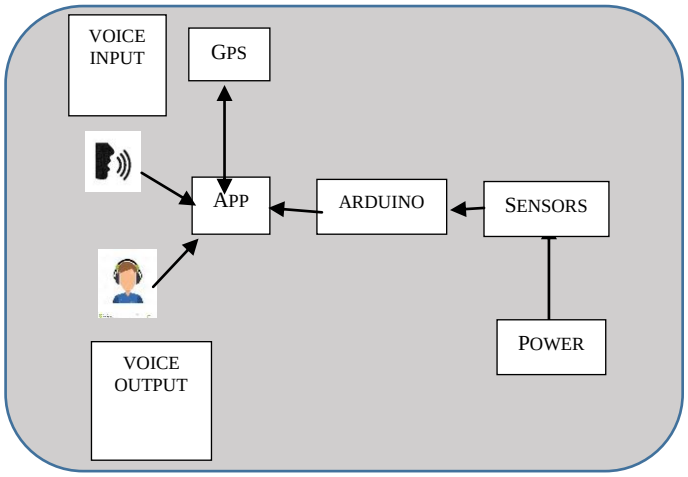


Figure 1. Block diagram of proposed smart walking stick

By getting Satellites broadcast signals from space, GPS module provides 3 dimensional locations like latitude, longitude and altitude and precise time. GPS receiver provided reliable navigation, positioning and timing services for all around the world continuously anywhere on or near the earth.

The overall components of blind stick are interfaced with the application of Android phone via Bluetooth module. A switch has been incorporated on the stick handle which is connected with the hardware module. When the blind person presses the switch, app will automatically turn on and a welcome message will be provided by which the user can ensure that operation has started. Next part the inquiry screen appears through which the user gives his/ her destination name through voice. Then the app will automatically start to navigate with the help of GPS which is prebuilt in android phone. GPS system will constantly track user current location and the blind person gets the navigation directions by voice assistance through headphones.

When visually impaired person moves from one place to another, location will get updated automatically on server. The android screen through which the user gives the destination name is shown in Figure 2.

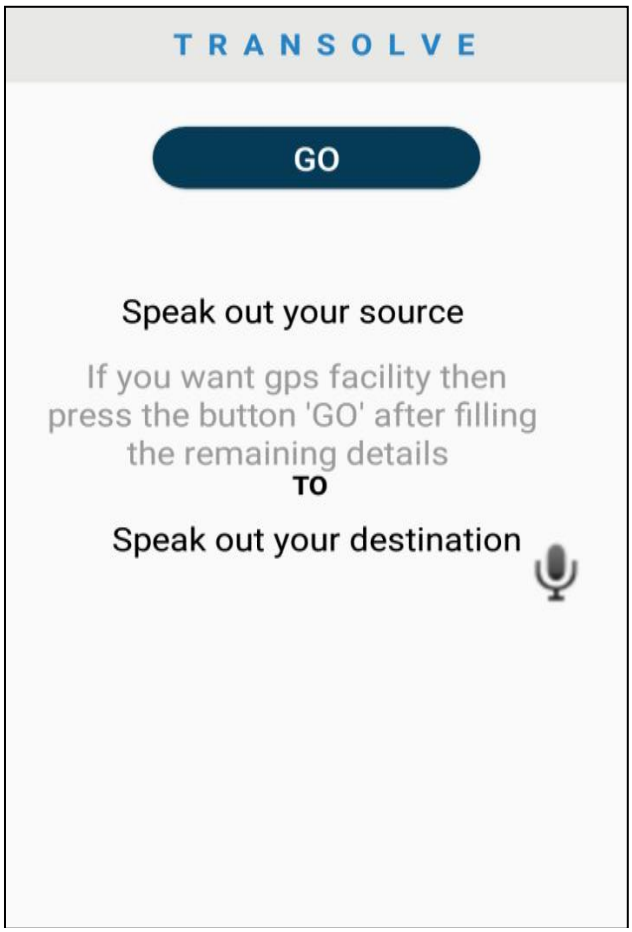
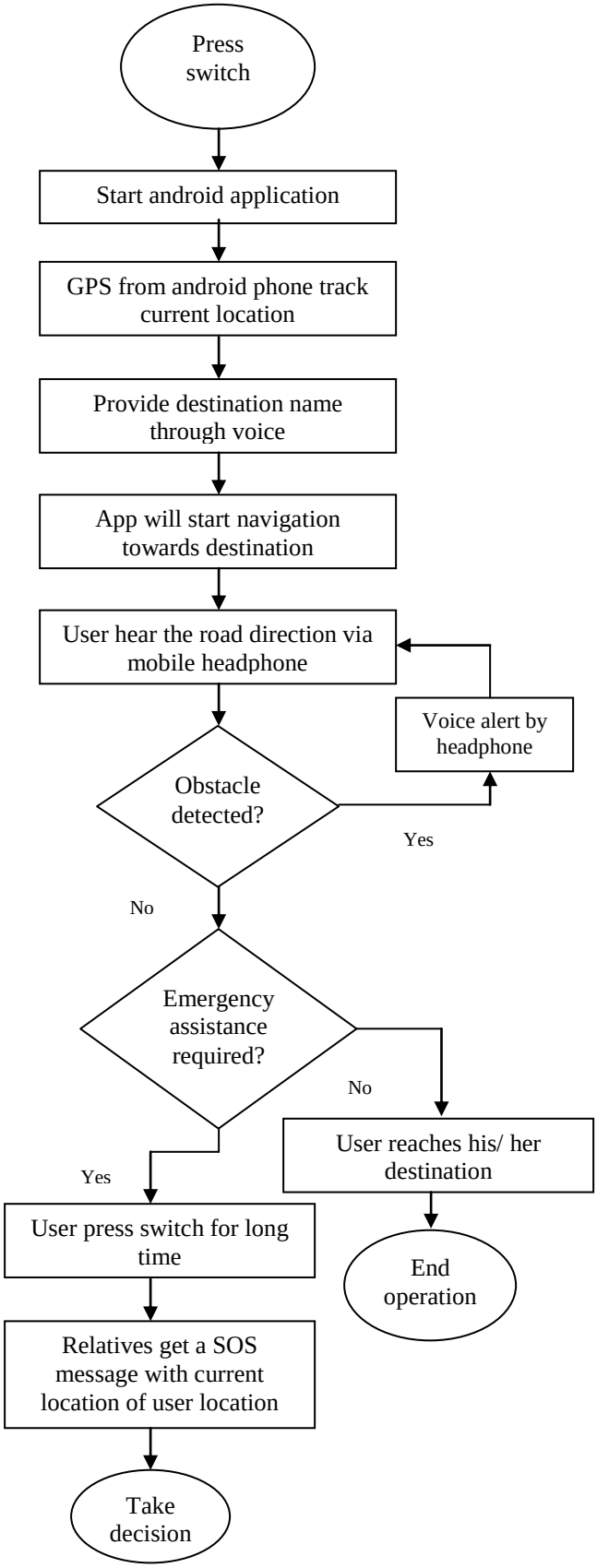


Figure 2. Android application for app development

In emergency purpose, if the user presses the switch long time, a SOS message with current location of user will be delivered to 5 near and dear persons of user (their contact number should be preloaded in the app before using it). The step by step approach of this blind stick is given below:



IV. HARDWARE DESCRIPTION

The main hardware components used here are Arduino Uno with Atmega 328 microcontroller, Ultrasonic ranging module HC – SR04 with 2cm to 400cm non-contact measurement function, a buzzer or beeper, Bluetooth module HC-05 and a 3V, 0.2 A vibrator motor. The main features of HC 05 bluetooth module are

- Typical 80dBm sensitivity and up to +4dBm RF transmit power.
- 3.3 to 5 V Programmable I/O control.
- UART interface with programmable baud rate.
- With integrated antenna and edge connector.
- Slave default Baud rate: 9600, Data bits: 8, Stop bit: 1, Parity bit: No parity.
- Auto connects to the last device on power as default.
- Auto pairing PINCODE:"1234" as default.

Here, 4 nos. of Ultrasonic sensors ranging up to 400 cm are used among which 3 sensors are attached in upper part of stick and 1 sensor is attached in the bottom part. If any obstacle falls in the range of any of upper 3 sensors, then the device activates as synchronized via Bluetooth module and user gets a voice output. On the other hand, if any patches or pot holes appear in the road (distance of road from the bottom of the stick is greater than 10 cm), 4th sensor in bottom part of stick can identify this. The position of ultrasonic sensors in blind stick is shown in Figure 3.

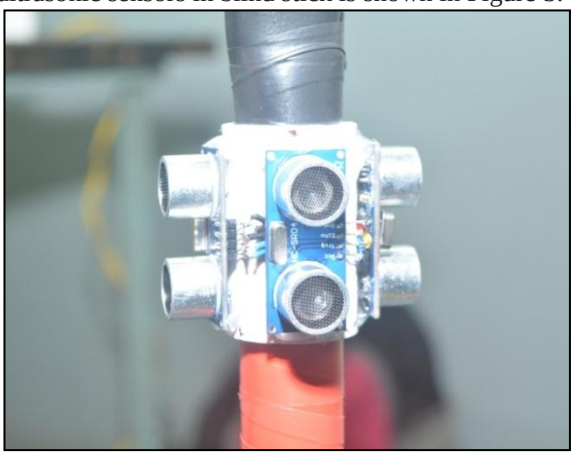


Figure 3. Ultrasonic sensors in self obstacle detecting stick

As explained earlier, the operation of this smart stick mainly based on android application in visually impaired person's Smartphone. Any family member of that person will have to configure this application. The whole device is designed to be small and is used in conjunction with the white cane. The overall structure of this smart walking stick is shown in Figure 4.

Figure 4. Overall structure of smart walking stick

V. CONCLUSION AND FUTURE SCOPE

As mentioned earlier, India has world's largest population of blind people. Initially, many visually impaired people were not able to use electronic aids due to relatively high costs and poor levels of user satisfaction associated with existing electronic systems. In this work, the authors tried to develop a low cost and user friendly smart blind stick with self obstacle detecting capability, which offers innovative solutions in order to replace the conventional methods of guiding blind person. The main advantage of this system is here the user only has to provide destination name via voice, then the app will automatically start to navigate with its current location. Furthermore the users often need to learn for a period of time to trust the system.

In future, the authors will use industrial controller packages and BLE IC for faster, and more power efficient proof of concept. Also, this blind stick can be made smarter by incorporating the features of image processing. After incorporating this, user can surely guided about the obstacle more accurately with the idea of its shape.

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