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E-Stick for Blind and Poor Visibility People with Android Smart Phone

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Abstract - Navigation is unavoidable for humans. The challenging task for blind or poor visibility people is moving from one place to another independently. Travelling in unfamiliar environment without fellowship is harmful for blind or poor visibility people. It is also essential to know the whereabouts of blind or poor visibility people by caretaker when travelling alone. E – Stick, an Electronic Travelling Aid (ETA) will resolve the challenges faced by blind or poor visibility people in doing day-to-day tasks, by detecting obstacle and alerts using buzzer. E – Stick uses Ultrasonic sensors to detect obstacles. LDR sensor will help while travelling at night. Caretaker can trace the location of blind or poor visibility people. Global Positioning system(GPS) is used for the indication of current location of blind or poor visibility people. Current position is sent to the caretaker, where they can trace the location using android app. This E - Stick meets the necessary requirements of blind or poor visibility people to do their day-to-day work without depending on others.

Keywords — Android App, Buzzer, Electronic Travelling Aid, Global Positioning System, LDR Sensor, Ultrasonic sensors, Poor Visibility People

I. INTRODUCTION

According to World Health Organization (WHO), around 253 million people live with vision impairment worldwide, of which 36 million are blind and 217 million have moderate to severe vision impairment [1][2]. India is the country with largest blind population. Currently in India there are around 12 million blind people, which makes India home to one-third of the world's blind population [3]. Blindness is a state when person is unable to see the surroundings. Partial blindness is the blurred vision. Blindness can be caused due to age, genetical disorders, accidents etc. The mobility aids for visually impaired or poor visibility people is walking sticks or trained dogs. These are the traditional methods which are very oldest and it requires lots of time to get used to it. Many improvements are being done in order to make their everyday life simple by installing separate walking path, slopes instead of steps, elevators or handrails [4], but it is limited only in metropolitan cities and is not accessible in rural areas.

As the electronic industry is growing rapidly, there has been tremendous work being carried out in the field of IoT to help visually impaired or blind people navigate independently, without any one's support. E – Stick is one such device which helps blind or poor visibility people to navigate without any one's support. It includes Ultrasonic sensors which are used to detect the obstacles of any kind. Environmental changes don't affect the working of ultrasonic sensor. Buzzer is used to alert the blind or poor visibility people if any obstacle is detected. Global Positioning System(GPS) is used to know the current location of Visually impaired people or poor visibility people. Caretaker can trace the location of blind or poor visibility people using Android App. LDR sensors will turn on lights in the absence of light.

The paper has been organized as follows: Section II describes Related Work. System Architecture is explained in Section III. Results are discussed in Section IV. The paper is concluded in Section V.

II. RELATED WORK

To make our day to day lives and work easy, the advancement of usage of electronics can be included in routine life. Many devices have been developed to improve the mobility of blind people, for example, using GPS, IR, ultrasonic obstacle detectors, etc [5].

The Navbelt consists of belt, a computer and ultrasonic sensors. Ultrasonic sensor identifies the obstacle and sends

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it to the computer. using stereo imaging technique alert messages are given. Disadvantage of this system is it requires long period of training and it is very bulky [6].

Guide cane is an updated version of Navbelt. A guide cane consists of a handle which is connected to the main device which contains wheels, ultrasonic sensors, a steering mechanism and a computer. The user moves with Guide cane, and when an obstacle is found the obstacle avoidance algorithm selects a different direction until the obstacle is cleared and a route is resumed. The disadvantages are the limited scanning area since, small or hanging objects like pavements or tables cannot be identified and that the prototype is bulky, difficult to hold or carry when needed [7].

Echolocation system consists of two ultrasonic sensors which are incorporated in conventional eyeglasses. Ultrasonic sensor detects the obstacle. This data is converted to an audible sound by A/D converter. It creates a localized sound image of the obstacle. But this system requires a lot of training [8].

IoT Based Smart Walking Cane for Typhlotic with Voice Assistance [9], this stick consists of 5 sensors, where as one sensor is placed at downwards and other sensors are placed at 10cm, 25cm, 40cm and 75cm heights respectively. Buzzer alerts as obstacle is detected and motion sensors are also used to detect the motion of objects. Text to speech converter module will convey the alert messages in multiple languages. Stick weighs 2kg it might become difficult to carry [9].

Practicing with the navbelt, the average travelling speed was 0.8m/s in guidecane mode and 0.5m/s in image mode and without practice speed was 0.6m/s in guide cane mode and 0.3m/s in image mode[6].

Guide cane[7] and echolocation[8] are similar to the traditional travelling aids with little advancement. Among all, "IoT Based Smart Walking Cane for Typhlotic with Voice Assistance"[9] gives efficient performance by making blind and poor visibility people life easier.

III. System Architecture

E-Stick is integrated with microcontroller and sensors as shown in Figure 3.1. First it activates Global Positioning System(GPS), Global System Mobile Communication(GSM) and sensors. Sensors and Light Dependent Resistor(LDR) form the input to the microcontroller.

The micro controller is the control unit of the entire structure. It consists of Renesas microcontroller which belongs to family RL-78.RL-78 family is a 16-bit and 8-bit CPU core for embedded microcontroller which is based on accumulator-based register bank CISC architecture [10].

Ultrasonic sensor is used to detect the obstacle such as hump, steps, stones etc. It will recognize the obstacles near to the blind or or poor visibility people. Ultrasonic sensors, on sensing obstacles it passes data to microcontroller. If obstacle is near it will alert the blind or poor visibility people by buzzer sound.

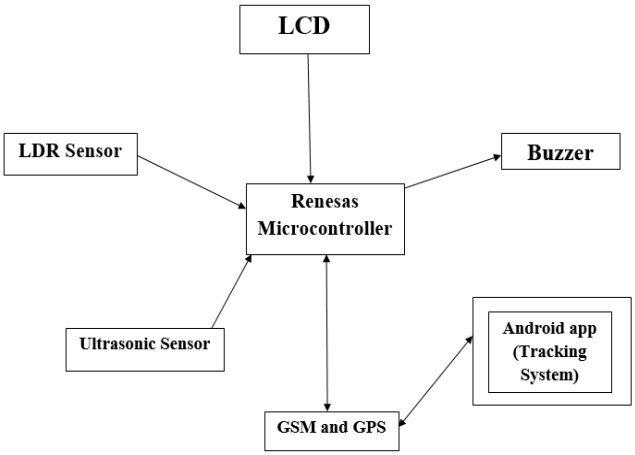

Figure 3.1 E-Stick System Architecture

Lights will be on during the darkness. It is to indicate other people that a blind or poor visibility people is walking. LDR and Light-Emitting Diode(LED) are used for this purpose. When light falls on the surface of the LDR device the LED lamp is OFF and when light does not fall on the surface of LDR device the LED lamp gets ON. If there is approximately 60 percent of darkness detected by LDR, LED gets on.

GSM and GPS are used for tracking location of blind or poor visibility people using android application. In case of any emergency, the blind or poor visibility people has to indicate by pressing emergency button available on E-Stick. As soon as the emergency button is pressed, the blind or poor visibility people location, in terms of latitude and longitude will be sent to care takers smart phone. Caretaker then uses android application for tracking location of blind or poor visibility people. It is required that care taker must have been logged-in into the app by providing valid user ID and password. After successfully login, it need to be registered with a mobile number.

Methodology:

- E-Stick is integrated with microcontroller and sensors and entire system is controlled by microcontroller.
- As stick initializes message is sent to the caretaker. It indicates that all components initialized and working properly.
- Ultrasonic sensor can be used to detect the obstacle such as hump, steps, stones etc.
- On sensing obstacles, it passes data to microcontroller. If obstacle is near it will alerts the blind or poor visible person by buzzer sound.

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- If LDR detects the light intensity less than 60% then LED will turn on automatically. It indicates that a blind person is travelling.
- GSM and GPS are used for tracking location of person using android application.
- Caretaker uses android application for tracking location of visually impaired person. It takes latitude and longitude as the input.
- After entering location information, on pressing the map option, tracking of blind or poor visibility person is activated.
- If stop is pressed, tracking is stopped.

Advantages:

- Aims at providing secure and independent life for blind or or poor visibility people.
- It also helps aged people to navigate through the surroundings without any one's support.
- The E-Stick can be used for both indoor and outdoor navigation.

Disadvantages:

- Stick doesn't detect the obstacle present at higher distances.
- Weight of stick is approximately 2kgs. It might become difficult to carry (especially for small children).
- Cost of the stick is 13,000 it may or may not be affordable to many common people.

IV. EXPERIMENTAL RESULTS

E-Stick is tested outdoor and indoor in real time. It successfully identifies the obstacles and alerts the user with buzzer sound. By which it provides, the safe and secure navigation. Android app is provided for the tracing of blind or poor visibility people. This app helps at knowing the current location of a person. Working model of E-Stick is as shown in Figure 4.1.

When E-Stick is connected to power, an initialization message is displayed on LED screen. It indicates that all components are successfully initialized. Also, a message is sent to the caretaker indicating that an E-Stick is started by blind or visually impaired person as shown in Figure 4.2.

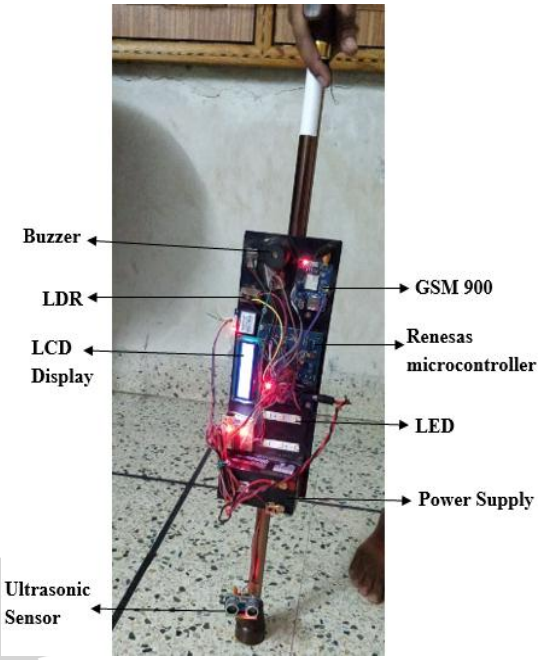

Figure 4.1 E-Stick

Figure 4.2 Initialization of E-Stick

When an obstacle is detected by ultrasonic sensor, it buzzes to alert the user. Ultrasonic detects the humps, steps, stones, dumps etc as shown in Figure 4.3.

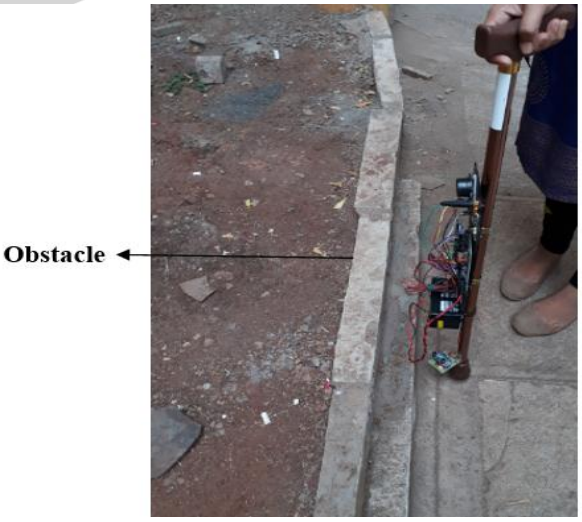

Figure 4.3 Obstacle detection

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When light intensity is below 60% then it will turn on the LED. While in dark, it indicates others that blind or visually impaired person is walking. It is shown in Figure 4.4.

Figure 4.4 LED turned on by LDR

Location information is shared through a message. It consists of longitude and latitude of the current position as shown in Figure 4.5.

Care taker can track the location of the blind or visually impaired person. To log-in, care taker has to enter valid user name and password as shown in Figure 4.6.

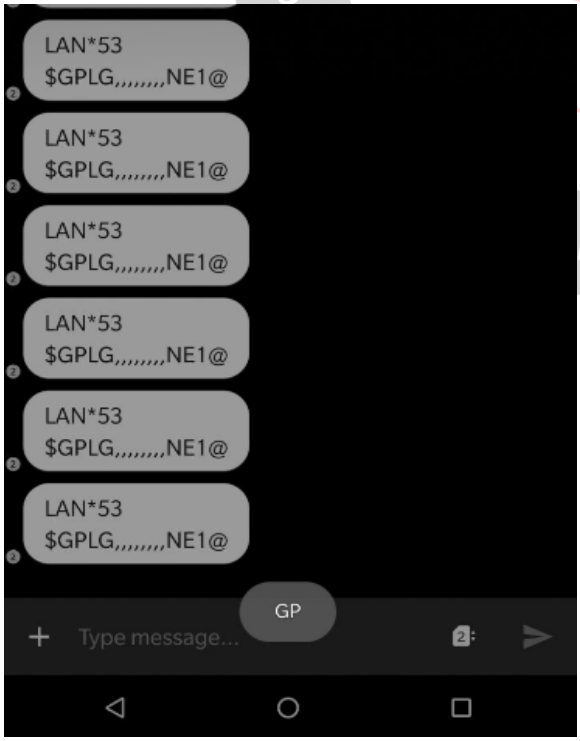

Figure 4.5 Message sent by GSM

Figure 4.6 Login Screen of tracking app

After successful login it redirects to another screen. A mobile number has to be registered. Longitude and latitude information is taken automatically. When track button is pressed it starts tracking the location of blind or poor visibility people as shown in Figure 4.7. By pressing map button, it shows the current location of the blind or poor visibility people. It is shown Figure 4.8.

Figure 4.7 Main screen of tracking app

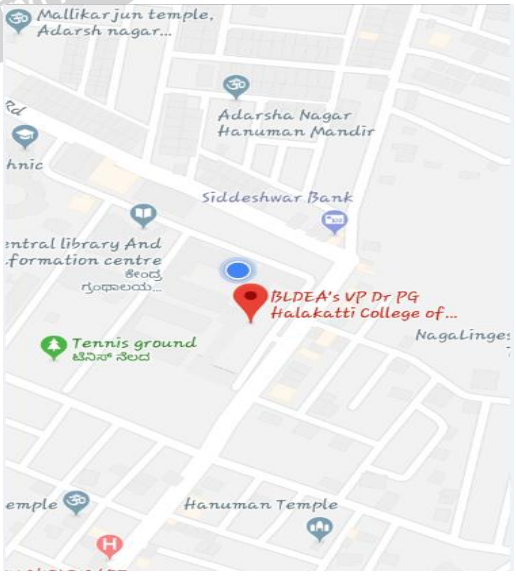

Figure 4.8 Location indicating blind or poor visibility people

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V. CONCLUSION

E-Stick provides the safe, secured navigation experience to the blind or poor visibility people. This can be used in outdoor and indoor. As the stick is initialized, message will be sent to the caretaker indicating that all components are working properly. Ultrasonic sensors detect the obstacle such as stones, humps, steps etc. and user will be alerted by the sound of buzzer. If light intensity is detected less than 60% then automatically LED will turn on. It indicates that a blind or visually impaired person is walking. Care taker can trace the location by android app. E-Stick provides the independent life to the blind or poor visibility people. With the help of E-stick people can improve their walking speed, reduce minor collision, and increase safety as compared to unaided equipment's. E-stick can be the substitution to the traditional travelling aids like white cane or guide dogs. It makes blind person independent and confident.

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