Smart Blind Stick For The Visually Impaired

Jehan Batliwala[1], Sachin Chauhan[2], Karan Dedge[3], Prof. Rahul Patil[4]
[1, 2, 3] Dept of Computer Engineering Department
[4]Professor, Dept of Computer Engineering Department
[1, 2, 3, 4] Bharati Vidyapeeth's College of Engineering, Navi Mumbai, Maharashtra, India

Abstract- *The smart blind stick comes as a proposed solution to enable the visually impaired people to navigate in the world around them. Blind stick is an innovative stick designed for visually impaired people for improved navigation. The smart blind stick comes with a pair of ultrasonic sensors to detect any other obstacles in front of the user, within a specific range. Furthermore, another sensor is placed at the bottom of the stick for the sake of avoiding puddles. Further, vibration motor is activated when any obstacle comes within the proximity range. The smart blind stick is a low cost, low power consumption, light weight and innovative solution to aid the lives of several visually impaired individuals.*

Keywords- Arduino Uno, Battery, IR sensor, Ultrasonic sensors.

I. INTRODUCTION

Visually impaired people are the people who find it difficult to recognize the smallest detail with their eyes. The people having the visual acuteness of 6/60 or the horizontal range of the visual field with both eyes open less than or equal to 20 degrees. These people are regarded as blind. A survey conducted by IAPB (The International Agency for the Prevention of Blindness) carried out in 2015 estimates a total of 253 million people worldwide are visually impaired. Out of which 36 million are completely blind whereas the rest 217 million people are suffering from low vision. The main problem for blind people is how to navigate their way to wherever they want to go. Such people always need to rely for assistance from others with good eyesight. As described by WHO, 10% of the visually impaired have no functional eyesight at all to help them move around without assistance and safety. Our study proposes a new method for designing a smart stick to help the visually impaired people by providing better navigation. The traditional and archaic navigation aids for the people with visual impairments include the walking cane (also called white cane or stick) and guide dogs which are characterized by many imperfections.

These aids come with their own shortcomings, most critical of which include: essential skills and training phase for guide dogs, range of motion of the stick, and very insignificant information communicated been communicated. In our approach, we modified this cane stick with some electronic components and sensors, the electronic aiding devices are designed to solve such issues. The ultrasonic sensors, Infrared sensor, buzzer and vibrator motor are used to record information about the presence of obstacles on the road and convey it to the user.

Ultrasonic sensor has the capacity to detect any obstacle within the distance range of 2cm-450cm. Hence, whenever there is an obstacle in this range it will alert the user. With the ever- increasing rapid advances in the field of modern technology both in hardware and software it has become easier to provide intelligent navigation system to the visually impaired. Recently, much research efforts have been focused on the design of Electronic Travel Aids (ETA) to aid the successful and free navigation of the blind. Several high-end technological solutions have also been introduced recently to help blind persons navigate independently. Another reason why ultrasonic is prevalent is that the technology is reasonably cheap. Furthermore, ultrasonic sensors are portable components that can be carried without the need for complex circuit. [1].

Our proposed system is intended to provide a low cost, convenient and efficient navigation aid for the blind people, which give them a sense of artificial vision by providing information about the environmental scenario of objects around them. The solution hereby proposed is a moderate budget navigational aid for the visually impaired. The cost effectiveness of the proposed solution leads to compromises in performance. One of the drawbacks of the proposed method is that the capability of the prototype is limited as the sensors have a very limited working range. Another drawback of the system is that the prototype cannot be used in highly crowded places as the sensors would not be able to function appropriately. Other significant improvements that could have further improved the proposed system include: Increasing the range of the ultrasonic sensor and implementing a technology for determining the speed of approaching obstacles. Synchronization with various navigation software applications available on the internet so that new, un-programmed destinations can also be chosen such as integration of a GSM module for safety purposes.

II. LITERATUREREVIEW

A. Previous projects for blindpeople

"Voice operated outdoor navigation system for visually impaired persons done by Somnath and Ravi (2012). Uses a stick equipped with ultra-sonic sensors, GPS. The stick contains GPS which will have SD memory card which used to store different locations. The user can set the location by GPS will guide the person to his/her destination. This system will also provide the speed and the remaining distance to reach the destination. When the ultra-sonic sensors detect any obstacle directly the buzzer will activate the vibration motor. Thissystem can be classified as a low cost system affordable by the user. The system uses the ARM processor which has more memory space, so that the operating speed is high. However, this system cannot operate indoors because there will be no signal for the GPS system. The accuracy of the GPS signal needs to be improved because it only can be controlled within 5 meters radius. Finally, the blind person needs to be trained on the system so that he or she can use it effectively. A system done for using smart stick for blind people: obstacles detections, artificial vision and real time assistance via GPS. This system operate by using GPS, artificial vision system, obstacle detection.. This system also contains ultra- sonic sensors to detect the obstacles. Furthermore, this system includes GPS system is to reach the required destination. Once any obstacle is detected or the destination is reached the voice circuit will activate providing certain type of voice. All these sub systems are connected to microcontroller which controls the entire operation of the system. This system can be classified as a low cost system. The accuracy of the artificial vision unit provides a high accuracy output for the user[2].

B. System Used by the U.S. Military

Another study in the same field to help blind people uses the pulse echo technique in order to provide a warning sound when detecting the obstacles. This technique is used by the United States military for locating the submarines. They used pulse of ultrasound range from 21 KHz to 50 KHz which hit the hard surface to generate echo pulses. By calculating the difference between signals transmit time and signal receiving time we can predict the distance between the user and the obstacles. This system is very sensitive in terms of detecting the obstacles. It has a detection range up to 3 meters and a detection angle between 0 degree and 45 degree. However, this system requires more power to operate because of the transmitter and receiver circuits [3]. So, this system need to be re- designed to operate with less power consumption (Anon., n.d.) another study done by (Sung, Young, Kim and IN, 2001) for developing an intelligent guide stick for blind people used an intelligent CPU called MELDOG which uses artificial intelligence. It can identify the accurate position of obstacles using ultrasonic sensors and laser sensors. In order to identify the position the "map matching technique" was used by using the ultrasonic sensors. This system includes a DC motor controller which connected to the encoder. When the wheels rotate 18 degree the infrared sensors attached to both wheels will transmit the signal to the CPU in order to provide a location update. This system is an accurate detecting system can provide the user continuous update for detecting the obstacles with detection angle between 0 degree and 18 degree. However, this system is expensive and is complex in designing. It is heavy compared to other similar system. The weight of the system is around 5.5 Kg [4]. The detectiondistanceforthesystemisverylowwhichisaround87.5 cm to 105 cm. a study done by (Jayant, Pratik and Mita, 2012) proposed a smart cane assisted mobility for the visually impaired. The system is based on normal ultrasonic sensors and ATMEL microcontroller. It operates with two rechargeable battery (7.4v) it can be recharged using USB cable or AC adaptor. The control unit is programmed using ATMEL AVR microcontroller ATMEGA328P microcontroller. Once any obstacles are detected vibration and buzzer will start in order to warn the user. This system is a non-complex system to use. It has the ability to cover a distance up to 3 meters and has the rechargeable feature of the buttery. Also, this system can be folded in small piece so that the user can carry it easily. However, this system has only one direction detection coverage and it is inaccurate in detecting the obstacles. All the studies which had been reviewed shows that, there are many types of smart sticks for blind people and all of them uses different techniques to give the required assistance for the blind person. However, the studies show that, using the ultra- sonic sensors is an efficient solution to detect the obstacles with maximum range of 7 meters and 45 degree coverage. In addition to that, using a noncomplex microcontroller will help the blind person to use the device (stick) easily and without any problems. Finally, the device should work for a long time with minimum power and it could bere charged.

III. SOFTWAREREQUIREMNETS

The Arduino UNO microcontroller is an easy to use yet powerful single board computer that has gained considerable traction in the hobby and professional market. The Arduino UNO is open- source, which means hardware is reasonably priced and development software is free. This guide is for students in ME2011, or students anywhere who are confronting the Arduino for the first time. For advanced Arduino users, prowl the web; there are lots of resources. The

Arduino project was started in Italy to develop low cost hardware for interaction design[5].

IV. EXPLANATION OFCOMPONENTS

ARDUINOUNO:

The Arduino UNO microcontroller is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The Arduino board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields and other circuits.)

FIG 1 - Arduino Uno

ULTRASONICSENSOR:

Ultrasonic is the production of sound waves above the frequency of human hearing and can be used in a variety of applications such as, sonic rulers, proximity detectors, movement detectors, liquid level measurement. Ultrasonic Ranging Module HC - SR04.

FIG 2 – Ultrasonic Sensor HC – SR04

INFRAREDSENSOR:

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detectingmotion.

FIG 3 – Infrared Sensor

VIBRATORMOTOR:

These tiny motors have offset weights that make them vibrate when they spin. They're normally called "pager motors" because they're the type found in pagers and cell phones that have a "vibrate" feature.

FIG 4 – Vibrator Motor

BUZZER:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

FIG 5 – Buzzer

Few other components include:

- Jumper Wires
- Blind Stick (upon which sensors would be connected)
- Battery andSwitch
- Miscellaneous

V. CIRCUITDIAGRAM

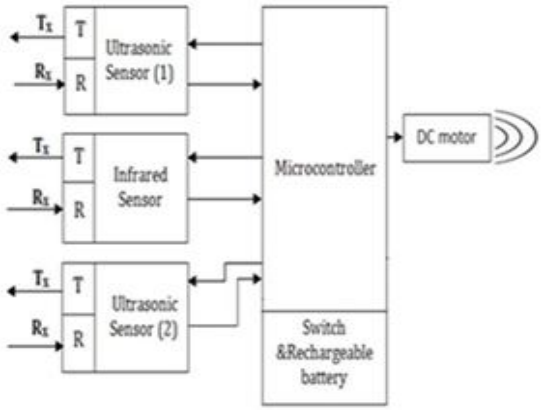

FIG 6 – Circuit Diagram

VI. WORKING PRINCIPLE

Smart Blind stick is an innovative stick designed for the visually impaired people for improved navigation. We propose an advanced blind stick that allows visually impaired people to navigate with ease using advanced technology. The blind stick is integrated with ultrasonic sensor along with infrared sensor. Our proposed project first uses ultrasonic sensors to detect obstacles in front of the user using ultrasonic waves. On sensing the obstacles in the path, the sensor passes this data to the microcontroller. The microcontroller then processes this dataand calculates if the obstacle is close enough. If the obstacle is not in the pre-defined proximity range then the circuit does nothing. If the obstacle is close the microcontroller sends a signal to activate the vibrator motor. It also has an infrared sensor at the bottom of the stick which detects potholes or staircases. The IRsensor sends the signal to the microcontroller and upon the processingof the signal the microcontroller activates the buzzer in case a pothole or staircase is detected. The whole circuit is embedded as part of a complete device often including hardware and mechanical parts. Nowadays, embedded systems control many devices in common use, today 98% of all microprocessors and microcontrollers are manufactured as components of embedded systems.

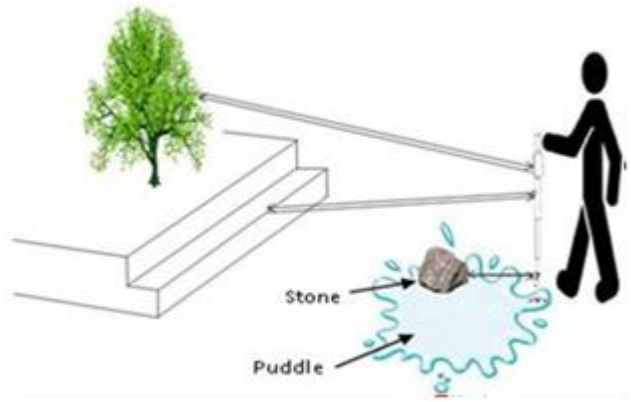

FIG 7 – Working Principle [6]

VII. CONCLUSION

Hence, it is worth mentioning that at this point the aim of this study, i.e. to design and implement the working of a smart walking stick for the blind has been fully achieved. The Smart Blind Stick acts as a basic platform for the coming future generation of more aiding devices that will help the visually impaired to navigate safely both indoor and outdoor. The Smart Blind Stick is effective and affordable. It leads to good results in detecting the obstacles in the path of the user in a pre-defined proximity range. The Smart Blind Stick offers a low-cost, reliable, portable, low power consumption and robust solution for navigation of the blind. Though the system is hard-wired with sensors and other components, it is light in weight. Further aspects of this system can be improved to make it even more efficient by adding wireless connectivity between the system components, thereby, increasing the range of the ultrasonic sensors and implementing a technology for determining the speed of approaching obstacles. Therefore, a better and more effective device can be constructed using ultrasonic sensors, arduino Uno and other devices that employ audio commands to alert the user of what is in his path of movement. In the future, further modifications to enhance the performance of the system will be added. These include: A global positioning technique to find the position of' the user using GPS, and use of GSM modules which will communicate the location of the user to a relative or caregiver.

VIII. WORKING PROTOTYPE

FIG 8 – Working Prototype

REFERENCES

[1] M. S. Nowak and J. Smigielski, “The Prevalence and Causes of Visual Impairment and Blindness among Older Adults in the City of Lodz, Poland.” Medicine, vol 94, number5,pp.e505, February-2015 doi:10.1097/MD.0000000000000505

[2] G. Gayathri, M. Vishnupriya, R.Nandhini and M.Banupriya “Smart Walking Stick for VisuallyImpaired.”

[3] International Journal of Engineering and Computer Science, vol. 3, number 3, pp. 4057-4061,2014.

[4] R. Radhika, P.G. Pai, S. Rakshitha and R. Srinath “Implementation of Smart Stick for Obstacle Detection and Navigation.” International Journal of Latest Research

in Engineering and Technology, vol. 2, number 5, pp. 45-50,2016.

[5] M.H.Mahmud,R.SahaandS.Islam"SmartWalkingStick An Electronic Approach to Assist Visually Disabled Persons."International Journal of Scientific and Engineering Research, vol. 4, number 10, pp. 111-114, 2013.

[6] https://www.researchgate.net/profile/Ahmed_Seddik2/publication/273452928/figure/fig11/AS:668638533148678@1536427257 451/Smart-stick-detects-obstacles-in-front-of-the-blind.jpg