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Comparative Study of Third Eye for Visually Challenged with Alternate Solution

Ms. Nandhini P[1], Ms.Sathanika M[2], Ms. Sarulatha J[3], Mr. Vignesh M[4], Mr. Yougan Bhalaji S R[5]

[1]Assistant Professor, Dept. of ECE, Velalar College of Engineering and Technology, Thindal, Erode, Tamil Nadu, India

[2,3,4,5]Student, Dept. of ECE, Velalar College of Engineering and Technology, Thindal, Erode, Tamil Nadu, India

E-mail: [1]nandhinivlsi14@gmail.com, [2]msathanika@gmail.com, [3]sarulatha2711@gmail.com, [4]sarulatha2711@gmail.com, [5]vigneshmurugesan1003@gmail.com, [6]youganbhalaji@gmail.com

Abstract

Deficiency that cannot be reformed in the eye is the blindness. This research aims to investigate the potential benefits and limitations of incorporating electronic sensors and assistive technologies into traditional blind sticks to create a smart blind stick. A smart blind stick is a wearable device that provides additional functionality and features to help visually impaired individuals navigate their surroundings more safely and independently. A smart stick is planned with impediment identification module and object detection. A stick is made in a way that it can sense obstacles and staircases by using sensors. It also intimates the presence of water and manhole. Global Positioning System (GPS) is used to locate the visually impaired person as it is incorporated in the stick used. Global system for Mobile Communication (GSM) is also used. Status of the blind person will be notified to the guardian with the image and location. Overall, this research contributes to the development and improvement of assistive technologies for visually impaired individuals and provide insights for researchers, healthcare professionals, and policymakers on how to better support individuals with visual impairments.

Keywords: Smart stick, Sensors, GPS, GSM

1. Introduction

Eye is a vital organ to lead a normal life. World Health Organization (WHO) reports that 284 million people in the world are partially visually impaired and 39 million people are

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blind (completely visually impaired). In this research, a smart blind stick, which is an eye opener for visually challenged people, is proposed. Unfamiliar places make the situation even worse for the visually impaired person. Commonly, visually challenged people use normal stick to detect obstacles. However, stick with sensors performs effectively and provides better guidance. Therefore, the designed smart blind stick improves the accuracy and makes it quite easy to get along with the surroundings without the help of others.

2. Related Works

B.Manikandan et al., developed a Blind Stick using Ultrasonic Sensor with Voice Announcement (2022). Arduino Nano and Raspberry Pi were used here. Voice announcement system was incorporated along with water sensors, Infrared sensors and Ultrasonic transducers. LDR sensor used is the unique factor. It acts as a flashlight and it will be easily notified by others in night time, so that others can identify the presence of a blind person [1]. Jeevitha S et al., proposed a Smart Blind Stick using IoT" (2022). Node MCU was used along with the ultrasonic sensors. Pulse sensor to detect the heart pulse and SPO2 sensor to detect the oxygen level were used. The visually impaired person will understand the above parameters with the help of voice announcement [2]. Sushma Patwardhan et al., designed a Smart Blind Stick using Arduino UNO" (2022). Arduino was used along with ultrasonic sensors for obstacle detection [3].

Vyshnavi Buragadda et al., created an Effective Fast Response Smart Stick for Blind People (2022). Microcontroller was used as an interface. Along with ultrasonic sensors to detect obstacles, infrared sensors was used to detect stair-cases, fire sensor to detect the presence of flame or fire and soil moisture sensor to detect the presence of water and to avoid slipping mishaps in case of wet land. Alert message will be sent to the guardian. Blind people will be intimated through buzzer [4].

Madhumati Pol et al., suggested a Smart Stick for Blind People (2022). Obstacles are detected with the help of ultrasonic sensors and blind people will be intimated through buzzer. If a person feels that he/she is not safe, they can shake their mobile phone, which would send an alert message to their guardian along with the location through android application [5]. Namrata Kataki and Dibyani Darsha Borah, designed and implemented a smart stick for visually impaired person using Arduino (2022). Ultrasonic sensor HC-SRO4 and ATmega328P microcontroller were integrated. Ultrasonic sensor detects the obstacles. Threshold value is set for intimating the distance of obstacles. The frequency of the buzzer

sound varies when going near to the obstacle, which provides clear path to the user. Incorporated LED also performs the same function as the buzzer [6].

Soumyajyoti Kumar designed a “Smart Blind Stick” (2021). Ultrasonic sensors senses obstacles and passes the data to the microcontroller. If the obstacle is close, signal will be sent to sound the buzzer [7]. Amit Kumar Thakur, Rajesh Singh, and Anita Gehlot proposed Smart Blind Stick for obstacle detection and navigation system. It detects the obstacles through ultrasonic sensors [11]. Priyanka Kedar, Piyush Rane, and Devansh Singh, developed Smart E-Stick for visually impaired using mobile applications (2019). With the incorporation of all sensors, emergency messages are sent to the caretaker through mobile applications [12].

Table 1. Comparison table

Research Topics with year	**Sensors used**	**Detectable parameters**	**Demerits**
Blind Stick using Ultrasonic Sensor with Voice Announcement-2022	IR sensor and ultrasonic sensors	Staircases and obstacles	Can’t pass emergency messages to the guardian
Smart Blind Stick using IoT-2022	Pulse sensor, oxygen level sensor and ultrasonic sensors	Staircases, obstacles and oxygen level	Can’t pass emergency messages to the guardian
Smart Blind Stick using Arduino UNO-2022	Ultrasonic sensor	Staircases and obstacles	Can’t pass emergency messages to the guardian
Effective Fast Response Smart Stick for Blind People-2022	IR sensor, soil moisture sensor, water sensor and ultrasonic sensor	Staircases, obstacles, flame and water	Stick is not compact. There is no voice announcement.
Smart Stick for Blind People-2022	Ultrasonic sensor	Obstacles	Only used for special purpose like sending alert messages and location. Not able to detect manholes, flame or water.
Design and implementation of a smart stick for visually impaired person using Arduino - 2022	Ultrasonic sensor	Obstacles in different positions using threshold value	Did not detect fast moving obstacles efficiently. Not able to detect manholes, flame or water.
Smart Blind Stick - 2021	Ultrasonic sensor	Obstacles	No voice alert. Not able to detect manholes, flame or water.

3. Proposed Work

PIC microcontroller is programmed to interface with several controllers to carry out vast range of tasks. PIC microcontrollers are popular due to their ease of programming, wide availability, easy interfacing with other components, low cost, access large users and serial programming capability (reprogramming with flash memory). It is used as an interfacing device between the variety of sensors, GPS, GSM, vibrator, and speaker as shown in figure 1.

The Global Positioning System (GPS) is also called as a network of satellites. These devices are used to receive and determine the location of any object on Earth. GPS receivers provide location in latitude wise, longitude wise, and altitude wise. Infrared (IR) sensor detects the objects when the radiation sent is reflected back. It is used for the detection of staircases, pits, and manholes with respect to the distance. Water sensor is used for the detection of presence of water [8].

Ultrasonic sensors are used for the detection of obstacles by using ultrasonic sound waves. Echo is the principle for working of ultrasonic sensors. An ultrasonic sensor is an electronic device sensitive to distance that measures the distance of objects by emitting ultrasonic sound waves, and the reflected sound is converted into an electrical signal. Other special feature is that, ultrasonic waves travel faster when compared with the speed of audible sound [9-10].

Fire sensor is used to detect parameters like flame or fire. ADXL or gyro sensors are used in finding the fall of the blind person by detecting the position of the stick, as it measures the orientation and angular velocity. These are devices that sense angular velocity. In simple terms, angular velocity is nothing but the change in rotational angle per unit of time.

Camera used in the stick captures the location of the blind person in case of fall or emergency and sends to his guardian. LCD is incorporated which will display the detection of objects and voice announcement is made regarding the direction of object. GPS and GSM are used for determining the location and sending the messages. Vibrator used gives the sudden alert. The blind people can detect any kind of obstacles by the sensors used. They understand it with the help of the speaker through voice announcement.

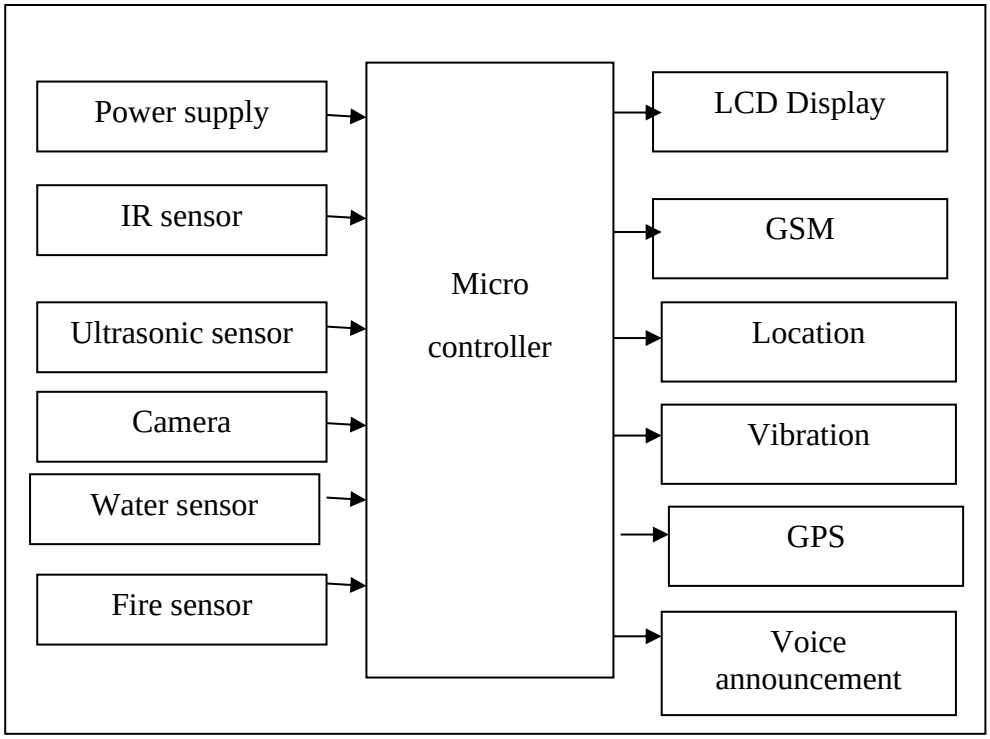

Figure 1. Block diagram

4. Results and Discussion

4.1 Hardware results

Figure 2 depicts the entire hardware module of the smart stick for visually impaired. With the help of ultrasonic sensors, it is possible to detect the direction of the obstacle and it is displayed in the LCD module with respect to the distance. Gyro sensor detects the change in position as it considers the factors like orientation and angular velocity. Pits, manholes or manholes in front the stick will also be identified through IR sensor. Vibrator produces vibration in case of detecting obstacles. This smart stick incorporates sensors that detect the presence of objects to the left, right or in front of the user and provide feedback to the user through audible alerts. Here are some features included in the smart blind stick with fall detection:

1. Accelerometer: The stick incorporates an accelerometer that can detect sudden changes in the motion, such as when the user falls.

2. Gyroscope: The stick includes a gyroscope that can detect changes in orientation, which can help distinguish between falls and other types of motion.

3. Vibration or sound alerts: When a pit, object, or manhole is detected, the device warns the user through vibration or sound alerts.

4. Automatic notification: The device is designed to automatically notify a caregiver or the emergency services when a fall is detected, providing the user with prompt assistance.

5. GPS tracking: The device includes GPS tracking capabilities, allowing the user's location to be tracked in the event of a fall. This can help emergency services locate the user quickly and efficiently.

Figure 2. Hardware module

Considering the following features, the output is displayed as shown in Figure 3. The left, right and front object detection work in the following way:

1. The smart stick has sensors on either side that can detect the presence of objects.

2. When an object is detected on the left side, the stick would warn the user, through vibrations or an audible alert, indicating the presence of the object on the left.

3. Similarly, when an object is detected on the right side, the stick would warn the user, indicating the presence of the object on the right [13-14].
4. Likewise, when an object is detected on the front side, the stick would warn the user, indicating the presence of the object on the front [15].
5. The device could also provide information about the location of the object and the image around them to the guardian, allowing the user to navigate around it more effectively.

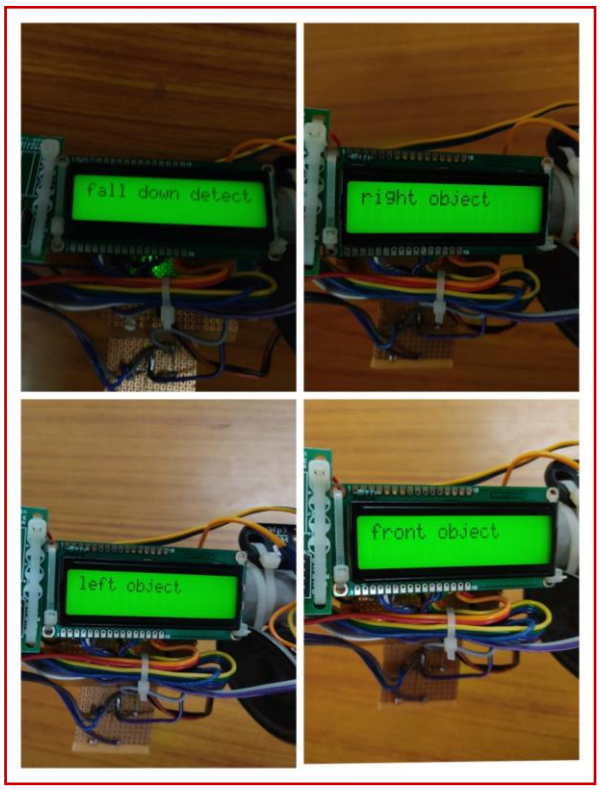

Figure 3. Obstacle direction and fall detection

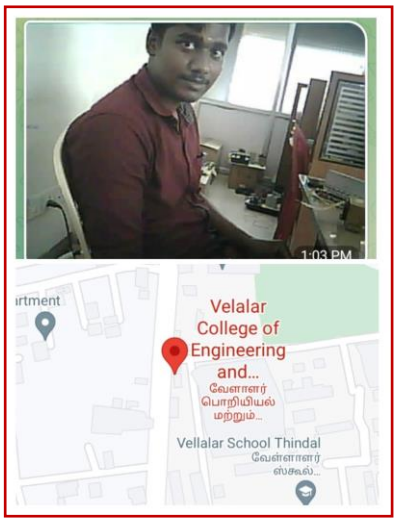

Figure 4. Image and live location shared to the guardian

Figure 4 is the image shared to the guardian. The upper part shows the image captured around the blind person, while the lower part shows the shared location. This stick is a valuable tool for the visually impaired individuals, helping them navigate their surroundings more safely and efficiently. By providing real-time feedback about the location and image of objects in the user's path, this device can help reduce the risk of collisions and increase the user's confidence and independence in navigating their environment.

4.2 Simulation software

Embedded C program is the used programming language since it is highly reliable and have very few interconnections. In Embedded C, programming gets converted to hex file and it is written into IC AT89S52 by the process of burning through USB asp-IC Programmer for 89s51 which is a development software. The code is compiled using compilers according to the type of microcontrollers used to feed the program. Compiled version of code is finally updated to the microcontroller.

4.3 Simulation and output

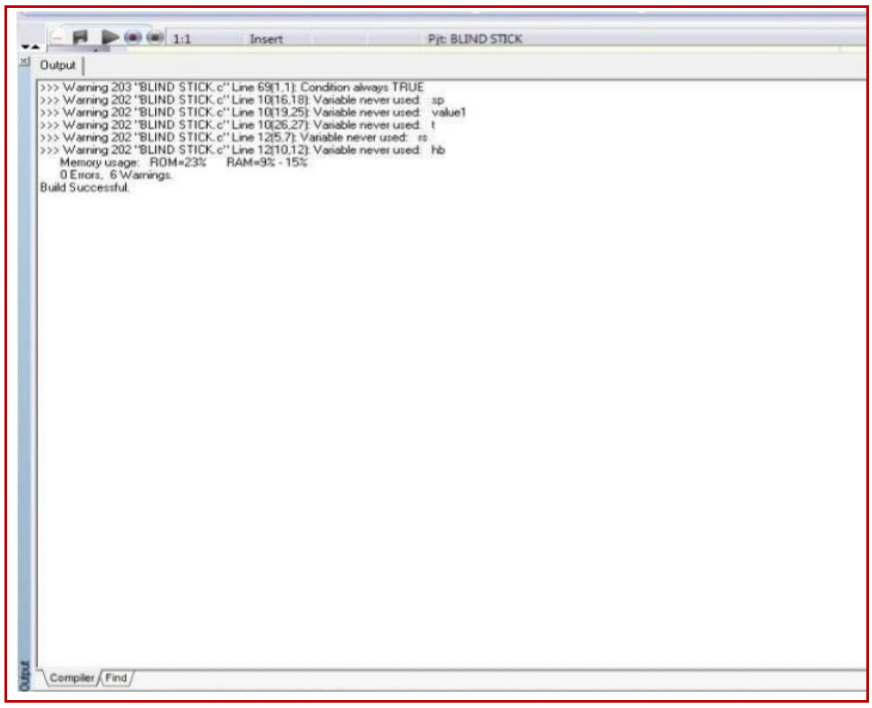

Figure 5. Output of simulation

Figure 5 shows that the program was built successfully considering the factors like timer, delay, LCD, etc. Distance between stick and obstacle was programmed for each ultrasonic sensor. Timer is also given to know the duration the detection is indicated. Delay factor is also fed to determine the break between different directions of obstacle detection. Program was built successfully with the inclusion of all the above factors. LCD and voice announcement will be followed further with the detection of obstacles.

5. Future scope

In addition to these features, smart blind sticks can also incorporate machine learning algorithms and artificial intelligence to improve their performance and adapt to users' needs. For example, a smart blind stick may learn from the user's walking patterns and adjust the sensitivity of its sensors accordingly to provide more accurate obstacle detection. Moreover, smart blind sticks can also incorporate other sensors such as temperature and

humidity sensors to provide additional information about the user's environment, which can be useful for individuals with multiple disabilities.

In future, it is aimed that an image processing obstacle and person recognition be employed for tackling further real-life problems associated with the travel of blind people. The technology has created reading machine, talking books, and computer that translate Braille. Hence, text before them should be announced through voice so that it is more comfortable to go anywhere without help.

Overall, smart blind sticks have the potential to significantly enhance the mobility and independence of individuals with visual impairments. However, it is crucial to test and evaluate these technologies to ensure they are reliable and meet the needs of users effectively. Additionally, it is important to ensure that smart blind sticks are affordable and accessible to all users, including those living in developing countries or with low-income backgrounds.

6. Conclusion

The blind stick guides the person to reach the destination safely. Blind people get notified with the help of voice announcement and vibrator in case of any obstacles or emergency. The guardian receives the information of surroundings and status of a blind person to their mobile phones and can reach out to them. Overall, a smart stick that indicates left and right objects could be a valuable tool for visually impaired individuals, helping them navigate their surroundings more safely and efficiently. By providing real-time feedback about the location and size of objects in the user's path, this device can help reduce the risk of collisions and increase the user's confidence and independence in walking around. Visually impaired people feel more secure with this stick. Furthermore, the gap between visually challenged and normal people will be bridged.

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Author's biography

Ms.P.Nandhini is an Assistant Professor in Department of ECE, Velalar College of Engineering and Technology. She received B.E., in Electronics and Communication Engineering from Velalar College of Engineering and Technology, Erode in 2009, M.E in VLSI Design from Kongu Engineering College in 2012. She has a teaching experience of 10 years. Her area of interest are Electron Devices, Digital Electronics and VLSI Design. She has presented papers in conferences and has attended workshops. She has published two books named “Basic Electrical Engineering” and “Fundamentals of Electric Circuits and Electron Devices”. She has published 5 papers in international journals.

Ms. Sathanika M., Ms. Sarulatha J., Mr. Vignesh M., and **Mr. Yougan Bhalaji S.R** are the students of final year ECE at Velalar College of Engineering and Technology, Erode.