IARJSET ISSN (O) 2393-8021, ISSN (P) 2394-1588

International Advanced Research Journal in Science, Engineering and Technology

ISO 3297:2007 Certified ⁜ Impact Factor 8.066 ⁜ Peer-reviewed / Refereed journal ⁜ Vol. 10, Issue 6, June 2023

DOI: 10.17148/IARJSET.2023.10682

Navigation system and speech assistive device for visually impaired people

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Abstract: One of the biggest problems faced by the visually impaired is navigating from place to place, be it indoors or outdoors. They have to be alert at all times to avoid consequences like colliding with stable or moving obstacles, ascending or descending staircases. Also, at times they may be in distress and might want to send an alert message to their relatives or friends about their whereabouts. These problems of blind people can be addressed with the intervention of technology. Although efforts have been made to provide innovative solutions for the blind, these solutions' shortcomings mean that the issues faced by those who are visually impaired remain unresolved. Hence, one of the competent solutions is to use embedded system. The proposed solution employs the WSN to provide a medium between the blind and the environment. Several sensors can be used to detect anomalies like obstacles, staircases**.**

Keywords: Ultrasonic Sensors, Arduino Uno, Global Positioning System, Global System for Mobiles, Speech assistance, Visually impaired.

I. INTRODUCTION

The survey of WHO (World Health Organization) carried out in 2011 tells us that in world about 1% of the human population is visually impaired and amongst them about 10% is fully blind.

The main problem with blind people is mobility. This paper proposes a tool for visually impaired people that will provide them navigation. Long white cane is a traditional mobility tool used to detect obstacles in the path of a blind person. We are modifying this cane with some electronics components and sensors so that cane can become smart cane. We noticed that normally blind canes used by blinds have certain limitations like detecting pot-holes, stairs, distant objects, above knee obstacles, etc. So, we came up with the idea of developing an economical sensor equipped cane capable of assisting blind to navigate easily.

In this project, we are using ultrasonic sensors, GSM module, GPS, voltage regulator, APR9600 module, Arduino Uno. Ultrasonic sensor is used to detect any obstacle. It has detection distance of 9cm-14cm so whenever the obstacle is in this range it will alert the person. The speech output is provided through speaker. Whenever the person is in danger, he can press the provided switch and his location will be sent to his relatives or friends.

II. PROBLEM IDENTIFICATION

Generally Blind People use a Cane Stick to detect the object in their path which is difficult for them to identify the distance of the objects.

Drawbacks:

- It is a limited source
- It cannot find the object from a few feet distance
- Cane sticks can be heavy and cumbersome to carry.
- They can only detect obstacles at ground level.
- It is difficult to navigate in unfamiliar environments using cane stick.
- Cane sticks don’t provide any information about the height, width, or distance of obstacles, which can make it difficult to navigate in unfamiliar environments.
- Cane sticks sometimes miss obstacles or fail to detect them accurately.
- It can be dangerous for blind people who rely on them for mobility.

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Some problems that visually impaired people face with existing navigation and speech assistive devices include:

1. Inaccuracy of GPS and sensor-based navigation systems, which can lead to incorrect directions and confusion.
2. Difficulty in using touchscreens and other visual interfaces, which can make it challenging to interact with speech assistive devices.
3. High cost of some devices, which can make them inaccessible for people with limited financial resources.
4. Limited availability of devices in certain regions, which can make it difficult for people to access the technology they need.
5. Limited battery life and other technical issues, which can make devices unreliable and frustrating to use.

III. EXISTING SYSTEM

Generally Blind People use a Cane Stick to detect the object in their path which is difficult for them to identify the distance of the objects.

Drawbacks:

- It is a limited source
- It cannot find the object from a few feet distance

IV. LITERATURE SURVEY

- Sylvain Cardin, Daniel Thalmann and Frederic Vexo [1] used stereoscopic architecture to develop new obstacle sensing abilities. First they determine from which direction the obstacles are coming from. There are vibrators on left and right shoulder of user. With these vibrators he can detect the position of the obstacle. Then user in this system will be able to position himself.

- Osama Bader AL-Barrm, JeenVinouth [2] proposed that detects the obstacles in the path of the blind using ultrasonic sensors. It consists of these sensors to scan three different directions, a microcontroller, buzzer and DC vibration motor. The buzzer and vibration motor is activated when any obstacle is detected. In addition, the stick is equipped with GPS and SMS message system.

- B.Mohan Sitaramaiah, M.Naganaik [3] this system has ability of overcoming the drawbacks with the existed technologies like guide cane and talking signs that they are only giving a support while they are walking, but not avoiding the accidents due to some vehicles and man holes. The existed systems are also failed in information sending in case of emergencies. This system enhances blind system assistance with ultrasonic sensors. The system consists of two ultrasonic sensors modules, voice playback module, and a vibration motor. The ultrasonic sensors will monitor the objects in front of them. The sensor placed in front direction to the system will detects if any obstacles are present in front of the blind person path. Another sensor placed in back direction of the system will measure the distance from the objects to the blind person. The voice module will play the corresponding voice for intimating the blind person about the danger happening. The vibration motor is useful in case of person is in traffic and if the voice output is not audible in busy areas. In an addition, there is a GSM module connected to the system, for providing the information exchanging from the blind people.

- F. van der Heijden, P.P.L. Regtien [4] this paper describes the system architecture for a navigation tool for visually impaired persons. The major parts are: a multi-sensory system comprising stereo vision, acoustic range finding and movement sensors, a mapper, a warning system and a tactile human-machine interface. There are three main sensors in this project stereovision, optical flow, and sonar.

- Srirama Divya, B. Navya, P. Suma manasa, S. Chitra [5] the paper presents a theoretical model and a system concept to provide a smart electronic aid for blind people. The system is intended to provide overall measures – Artificial vision and object detection. The aim of the overall system is to provide a low cost and efficient navigation aid for blind which gives a sense of artificial vision by providing information about the environmental scenario of static and dynamic objects around them. Ultrasonic sensors are used to calculate distance of the obstacles around the blind person to guide the user towards the available path. Output is in the form of voice which the blind person can hear e.g., right, left etc. The hardware consists of Arduino Uno board, ultrasonic sensors and speaker.

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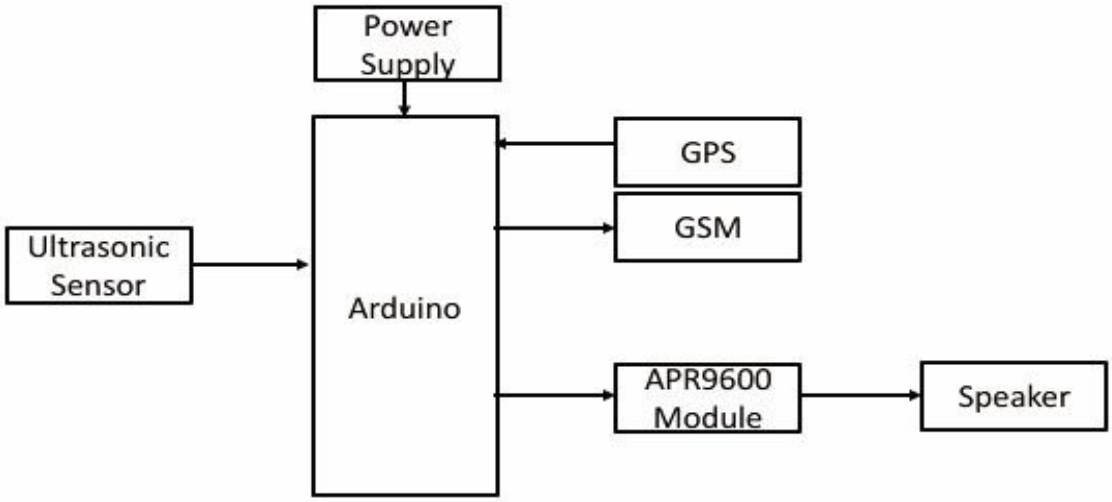
• Ankit Agarwal, Deepak Kumar, Abhishek Bhardwaj [6] this paper proposes an economical ultrasonic stick for visually challenged people, so as to gain a personal independence and free from the external help. A portable user-friendly device is developed that can identify the obstacles in the path using ultrasonic sensors and Camera. Ultrasonic sensors can scan three different directions (at 180o). Camera can be used as an alternative tool in the places that surrounds with the low signal coverage, a microcontroller, buzzer and vibrating motor. The buzzer and vibration motor is activated when any obstacle is detected. GPS system provides the information regarding to his current location. SMS system is used by the blind to send SMS message to the saved numbers in the microcontroller in case of emergency.

V. PROPOSED SYSTEM

In this proposed system an ultrasonic sensor is arranged to detect the obstacles and the person and to send the latitude longitude values will be sent through the GSM. Ultrasonic Sensors are for detecting obstacles. Whenever the obstacles are detected the output will played as “Obstacle presented” by speaker.

Ultrasonic sensors to detect obstacles and provide haptic feedback to the user, allowing them to navigate more safely and independently. GPS technology to provide accurate directions and location information to the user. GSM technology to allow the user to receive text-to-speech messages and to communicate with others in case of an emergency. A simple, intuitive interface that is easy for visually impaired users to navigate using touch or voice commands. Long battery life and durable design to ensure that the device is reliable and can be used for extended periods of time. Affordable cost to make the device accessible to as many people as possible.

VI. METHODOLOGY



We here propose a system that allows visually challenged people to navigate with ease using advanced technology. The components used are Arduino Uno Atmega 328p, GSM module, GPS, speaker, APR9600 module, Arduino IDE software.The ultrasonic sensor is arranged to detect the obstacle. Ultrasonic sensors work by emitting sound waves at a frequency too high for humans to hear. They then wait for the sound to be reflected back, calculating distance based on the time required.

On sensing obstacles, the sensor passes this data to the Arduino Uno. The Arduino uno then processes this data and calculates if the obstacle is close enough. The Arduino board sends a short pulse to trigger the detection, then listens for a pulse on the same pin using the pulseIn() function.

APR9600 is a low-cost high performance sound record/replay IC incorporating flash analogue storage technique. The message 'obstacle detected' is stored in the APR9600 module and replayed whenever obstacle is detected. The speaker is connected to this module and finally speech output is provided whenever an obstacle is detected in 9cm-20cm distance.
A switch is provided, which is emergency button. Whenever the blind person needs help, he/she needs to press and release the switch once. The switch initially will be in state '1', when pressed it transits to state '0'. Whenever we press

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the switch, the arduino will communicate with GSM module by using AT commands and sends "MESSAGE" to the programmed mobile number.

GPS module finds the location (latitude, longitude) from the signals received from the satellite. Arduino reads information from the GPS module via serial communication (UART). The location of the blind person is sent to the programmed mobile number through global system for Mobile communication.

VII. FUTURE SCOPE OF WORK

Enhanced Navigation Systems: These systems can use cameras and sensors to detect obstacles, recognize landmarks, and offer real-time audio cues or haptic feedback for navigation.

AI-Powered Object Recognition: Speech assistive devices can incorporate AI algorithms for object recognition, enabling them to describe and identify objects in the environment.

Integration with Smart Home and: Internet of Things (IOT): They can help visually impaired individuals control and manage various aspects of their home environment, such as adjusting lighting, controlling appliances, or accessing information from connected devices through voice command.

Wearable Technology: Wearable devices, such as smart glasses or haptic feedback devices, can provide real-time audio or tactile cues to assist with navigation and object detection. These devices can also integrate with other technologies like navigation systems, speech assistive devices, or health monitoring tools to create a comprehensive assistive ecosystem.

VIII. CONCLUSION

In this project, the method to make a blind stick to be more functionally powerful is presented. The main target of this project was also implemented successfully to provide an efficient way and multifunction blind stick to ease the life of visually impaired people. Apart from that, the problem of insufficient provide guide dog has also been solved by this solution. project proposed the design and architecture of a new concept of smart electronic guiding stick for blind people.

The advantage of system lies in the fact that it can prove to be very low-cost solution to millions of blind person worldwide. GPS system provides the information regarding his current location by SMS system to the saved numbers in case of emergency. The system combines both navigation system as well as speech assistance.

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