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Smart Shoes for the Blind

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Abstract— Blindness is one of the major disability and people who suffer through blindness face lot of problems as they cannot travel or move from one place to another easily compared to the other people. This project is being developed for the help of blind people so that they can move from one place to another without any obstacles and can keep the track of the movement of the blind person and the person wearing the shoe can easily be located if he or she is misdirected to another place or location.

Index Terms— Blindness, GPS Tracking System, Haptic Feedback, Navigation, Obstacle Detection, Smart Shoes, Ultrasonic Sensor.

INTRODUCTION

Blindness is the most prevalent disabilities globally, and presents profound challenges for those affected. Individuals grappling with vision impairment encounter substantial hurdles in navigating their surroundings and maintaining independence. The inability to travel freely diminishes their access to education, employment opportunities, social interaction, and essential services. Recognizing these obstacles, innovative solutions are imperative to empower visually impaired individuals and enhance their quality of life. Those living with blindness encounter difficulties in traveling or relocating, which are not experienced by sighted individuals. An estimated about 253 million people world wide are living with moderate to severe vision impairment or blindness. Among them, approximately 36 million people are blind, with blindness being defined as having a visual acuity of 20/400 or less in the better eye with the best possible correction or a visual field of less than 10 degrees. The vision impairment and blindness represent significant public health consequences. For the blind many global efforts are done in order to help them where various organizations and advocacy groups work to promote the rights and inclusion of blind individuals, advocating for accessible environments, equal opportunities, and greater awareness of the needs and challenges faced by the community and also the WHO has launched initiatives like the "VISION 2020: The Right to Sight" program, which aims to eliminate avoidable blindness.

Blindness affects the mobility and independence. Traditional mobility aids such as canes offer limited assistance and do not provide real-time navigation guidance. Consequently, visually impaired individuals often rely on memorization of routes or assistance from sighted companions, constraining their autonomy and spontaneity. Moreover, the fear of getting lost looms, exacerbating feelings of anxiety and isolation. The lack of reliable means to track their movements heightens vulnerability, making them susceptible to disorientation or potential harm. 2 In this project we have installed an ultrasonic sensor which detects the obstacles which come in their way from which the blind is aware of the obstacles and can pass through those objects without causing accidents or any falls. The sensors will detect obstacles in the user's path and provide timely alerts to prevent collisions. To alert them about the obstacles a buzzer is added when the obstacle is detected the buzzer makes an alert sound so that the blind will be aware of the obstacle and if the person is blind and also deaf a vibrating motor is attached so when the object is detected along with the buzzer sound a vibration occurs which helps to sense the blind about the obstacle. All the sensors and the vibrating motor is mounted to the microcontroller chip called Arduino Nano. In this we have used Arduino Nano because it will be implemented for the shoe so Arduino Nano uses less space and is of lightweight. Complimentary to this an GPS tracking system is mounted where suppose an accident occurs or the blind person trips or falls which causes serious injuries during that time to reach out anybody for help is difficult. At that time These GPS tracking system sends the location of the blind person where the person who takes care of them or the guardians receive their location link so that they can reach the blind person for help easily and keep track of them.

LITERATURE SURVEY

The literature surveys contribute to Knowledge construction by synthesizing existing research findings and identifying research gaps, literature surveys contribute to the construction in the field. They lay groundwork for advancing understanding and generating new insights through the empirical research. Teja Chava, A. Tarak Srinivas et al. [1] proposed complete research on smart shoes which helps to detect the obstacles. Blind people face great difficulty to travel independently. They have to depend on others in many aspects of their life. The Major problem is when they walk on the road. With a stick in hand, they cannot detect every obstacle that comes in their way. The Smart shoe design provides a long term solution for the blind to walk independently. It is built using IoT Technology in which the shoe will be embedded with sensors and buzzers. N. Sohan et al. [2] have stated that their projects consist of assistive system which helps the blind to find obstacle free path based on the voice commands. The main aim of this research work is to provide a better solution regarding navigation system for blind people with all the mentioned functions. This approach aims to improve the mobility and independence of visually impaired people by providing them with a reliable means of navigation and this proposed method significantly increases improves the mobility and independence of blind individuals by providing them real time navigation assistance.Pratik Bhongade et al. [3] have proposed the design, implementation, and potential benefits of IoT-enabled shoes for blind people and the Smart shoe which they have developed consists or is equipped with various kinds of sensors and the entire system is powered by the two sources, two batteries as a primary source and piezoelectric plates as an alternate source that generates power when blind person walks where this feature allows the shoes to generate power during use, potentially extending battery life or providing supplemental power and the shoes may feature a user interface through which the blind can interact with the system with voice commands. Manali Tayade et al. [4] have proposed a system that includes sensors to detect obstacles such as sidewalks, staircases, etc. Entire data received from the

wearable sensors is displayed on the android device which is connected to the shoe where the information about detected obstacles in a user-friendly format possibly through text or graphical representations. The data collected by the sensors embedded in the shoes is transmitted to the android device through Wi-fi or Bluetooth connection and the end user or the person who take care of the blind can view and access the data. Valentina Balas et al. [5] proposed a system which is inserted to the shoe which provides the information about the location for the visually-impaired persons about the closest locations such as marketplaces, supermarkets, hospitals, institutions etc., through voice commands. This feature discussed in the paper is the integration of a location system which utilizes the technologies such as GPS determine the wearer's location and provide information about the nearby points of interest and the method proposed in the paper emphasis on assisting visually impaired individuals in navigating their surroundings and accessing essential services and amenities. Jeffrey Chehade, Ali Hayek et al. [6] presented the design, implementation, and Validation of smart shoes to enhance the security of movement for blind and visually impaired individuals. The system detects obstacles, wet floors, and incidents like patient's falls, notifying users through voice alarms and sharing their location with caregivers via companion mobile application. Incorporating safety measures such as electrical safety. This system demonstrated low faulty errors and achieved an accuracy rate of approximately 96% in testing with five subjects. Pradeep Kumar M, Inchara K M et al. [7] proposed a wearable technology aid visually impaired individuals by providing eyes free-navigation, detecting obstacles, and guiding them into their destination. The light weight controller device and sensors detect obstacles ahead, while the phone module utilizes GPS and smartphone app for navigation. The system ensures dynamic adaptability and cost-efficiency, with reliable and stable software enhancing usability and effectiveness. This solution eliminates the need for additional support instruments, providing a seamless and independent navigation experience for visually impaired individuals. I. Suneetha, Angeri Sandhya et al. [8] proposed an IoT based Smart Shoe system for the blind integrates ultrasonic sensors with Arduino UNO board to aid independent travel for visually impaired individuals, addressing the challenges faced by nearly 40 million blind people in India, including 16 million children. Traditional methods like using cane often fail to detect all obstacles, posing a risk on roads. This innovation solution embeds sensors, microcontrollers, and buzzers into the shoe, providing real-time warnings to users when obstacles are detected, enhancing their safety and autonomy during the navigation. Qianli Xu, Tian Gan et al. [9] designed a wearable system utilizing haptic feedback through vibrating shoes to assist visually impaired individuals in navigation. A mobile phone serves as the control unit, generating directional instructions transmitted to the shoes, which produce unique vibration patterns synchronized with the user's movement. The Research contributes empirical evidence on the effectiveness of vibration patterns for direction sensing, offering guidelines for design improvements. The system shows the potential to provide smart and sensible navigation guidance for visually impaired individuals. Shelena Soosay Nathan, Lim Xin Weoi et al. [10] proposed a system consists of multisensor technology to enhance independent navigation and it also integrates various components such as moisture sensors, ultrasonic sensors, buttons, a DF player, and a speaker. The agile development method is used which involves brainstorming, design, development, quality assurance, and deployment. The preliminary test is been conducted which demonstrates the effectiveness of the smart walking shoes as a navigation aid for visually impaired individuals. Azadeh Kian et al. [11] review the development of shoe-mounted sensor systems for pedestrian safety, focusing on gait assistance and hazard detection. By integrating motion sensors with machine learning algorithms, these wearable technologies can identify tripping risks in real-time and provide corrective feedback to the users. The research represents a crucial step towards practical, low-cost devices that enhance walking safety, aiming to reduce the financial and human toll of fall injuries, and the advancements is been addressed

where the upgradation of the smart wearables signify a critical research front in developing practical and cost-effective solutions to mitigate the growing societal burden of fall accidents. Tshering Tenji Sherpa et al. [12] proposed a design of completely portable aid kit for visually impaired persons. It focuses on detecting the pedestrian traffic lights and obstacles in the way of visually impaired person who crosses a pedestrian crossing. The proposed system recognizes the pedestrian traffic lights in real–time with deep learning and provides signals to the visually impaired person to cross the pedestrian crossing in the form of audio output and system works in both day and night time and have good reliability. For the good reliability of the system, different sorts of images and video data have been collected, edited, and stored in a large amount of training data to get a good model. A. Rohith Kumar, K. Sanjay et al. [13] proposed a system the AIoT Blind Stick is ground breaking assistive device designed to empower visually impaired individuals with enhanced mobility and independence. This solution integrates a Raspberry Pi Zero, high resolution camera, MPU sensor, ultrasonic sensor, Buzzer and speaker to create a comprehensive system that addresses the visually impaired community's unique challenges. The AIoT Blind Stick represents a significant advancement in assistive technology, potentially greatly improving the quality of life for visually impaired individuals worldwide. T. S. Aravinth et al. [14] proposed the technology makes strolling stick smarter which has many applications together with on foot stick indicator in case if they miss the stick through sound beeping, they might walk using utilizing the way themselves. If they face any obstacle, they can sense it by vibration sensor, and also, they can hear the guide directions in the headset. The camera is used to detect the obstacle through an ultrasonic sensor placed on the stick. The captured image is sent to the microcontroller to identify the type of the object and then it is intimated as voice command through the speaker or via earphones connected with Raspberry pi and also GPS is used to identify the exact location. Sarath Sasikumar et al. [15] designed an intelligent shoe for blind individuals so that they can walk independently it is equipped with ultrasonic sensors, voice alert systems, GPS navigation, and smartphone connectivity, the shoe detects obstacles and provides real-time feedback to enhance the safety and social inclusion and this approach promotes the autonomy but also greater inclusion and participation in daily activities for the people with blindness and this paper proposes a system where blind can lead an independent life.

METHODOLOGY

The proposed smart shoe system is implemented using the following steps:

STEP 1: The shoe consists of Arduino Nano to which the ultrasonic sensors, buzzer, battery and vibrating motor, buzzer and GPS system is mounted to it.

STEP 2: The blind person wears this shoe and move towards his desired destination.

STEP 3: If the obstacles occur the ultrasonic sensors detects the obstacles and it detects obstacle from certain distance makes a buzzer sound to alert the blind person.

STEP 4: Suppose the blind person is also deaf he could not hear the buzzer sound about obstacle order to overcome that a vibrating motor is installed to the smart shoe so that along with sound, vibration occurs so that they can sense the obstacle. STEP 5: If the person feels he is lost by pressing a button the current location of the blind person is sent to the guardian's phone or parent's phone this is achieved as we will be installing GPS-GSM tracking system to the shoes.

ARCHITECTURE OF PROPOSED SYSTEM

Smart shoe for blind people system mainly consists of Microcontroller, sensor, battery, motor, buzzer etc. Interfacing microcontroller with ultrasonic sensor to detect the obstacles using ultrasonic waves. The buzzer (sounds) alerts visually impaired people over objects which are coming between their ways and could help them in walking with less accident. It keep's track of the user's location through the GPS module and keep the guardian notified of the user's location as button is been placed where whenever they require help or any injuries occurs they need help at that time this system plays an important role.The Fig.1. Represents the architecture of the proposed system where it gives an idea about which components are present in the project and how it is connected.

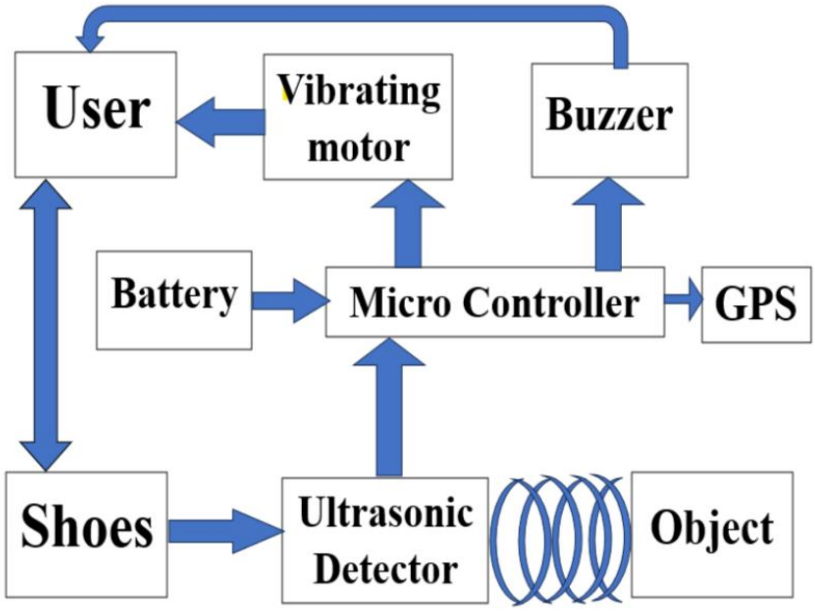

Fig.1.The Architecture of the Proposed System

SYSTEM FLOWCHART

The flowchart of the smart shoe system. First step is to activate the ultrasonic sensor using some power button. As soon as the blind persons encounters any obstacle it is detected using the sensor and it alerts the user using buzzer, along with the GPS. If no then person steps forward. If the person falls or any accident occurs, it will alert the guardian and sends the live location. Fig.2. represents the flowchart where the work flow of the project can be known easily. In which an structured flow of the project is shown.

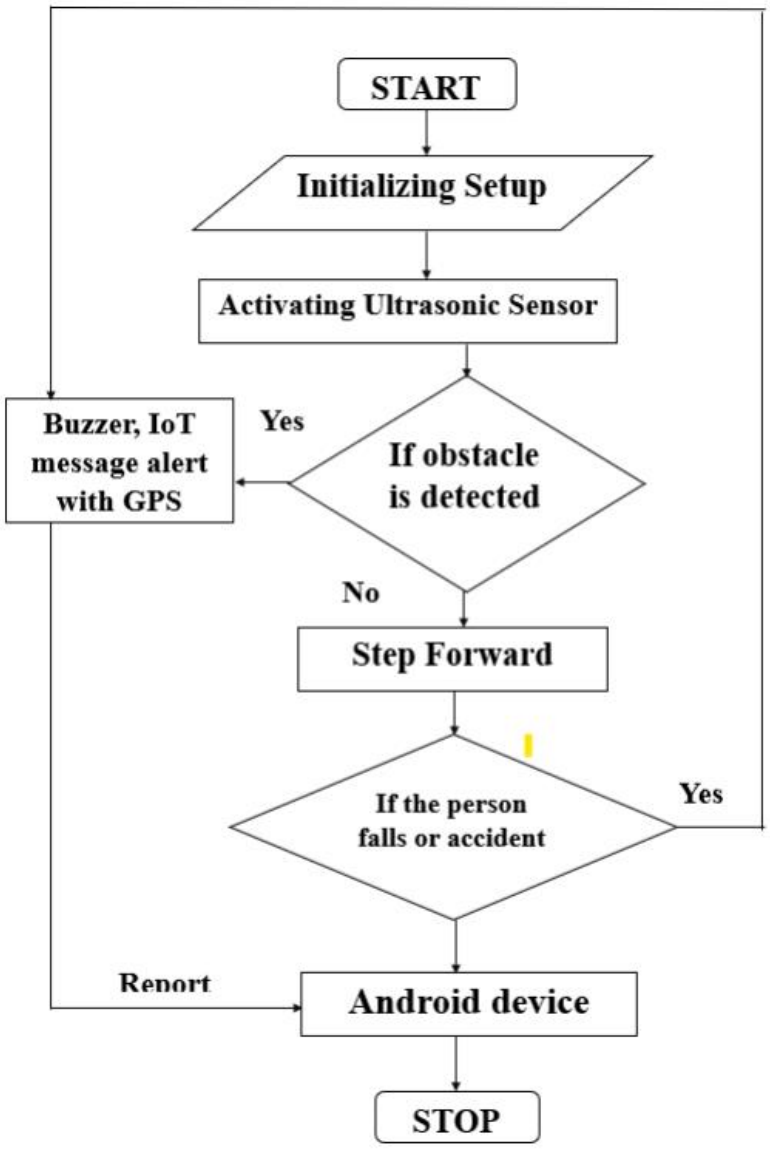

Fig.2.System Flowchart

RESULTS AND DISCUSSION

The Smart Shoes are developed to detect the obstacles which occur in the path of the blind and also vibrating motor is been implemented where the blind can sense the obstacle if he/she is deaf. GPS Tracking System is implemented where suppose the person is lost, or any accidents or injuries has occurred, if the person press the button an live location is sent to the caretaker or guardian's phone.

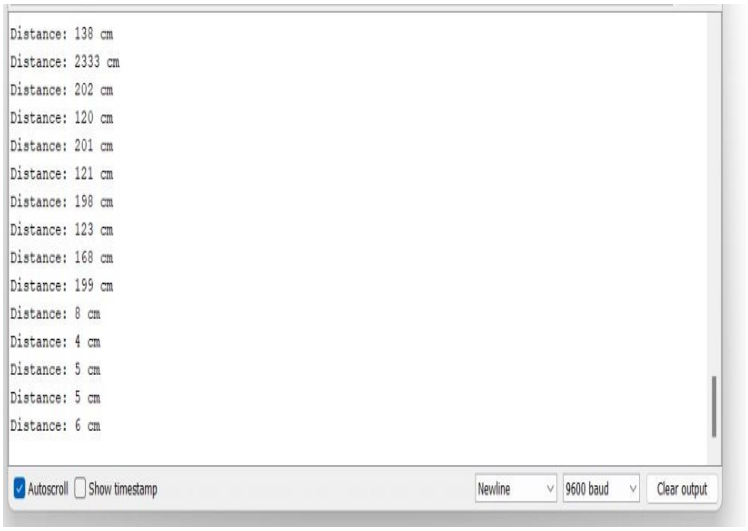

Fig.3.Obstacle Detected Represented in the Serial Monitor

The distance of the obstacle detected by the Ultra Sonic Sensor and output is shown in the serial monitor of Arduino IDE. The Fig.3. shows the window of the serial monitor where the obstacle which is detected by the sensor the distance is measured in terms of centimeters and in this work the distance limit is been set for 20 centimeters where whenever the object id detected within 20 centimeters an alert sound is generated by the buzzer to alert the blind person about the obstacle.

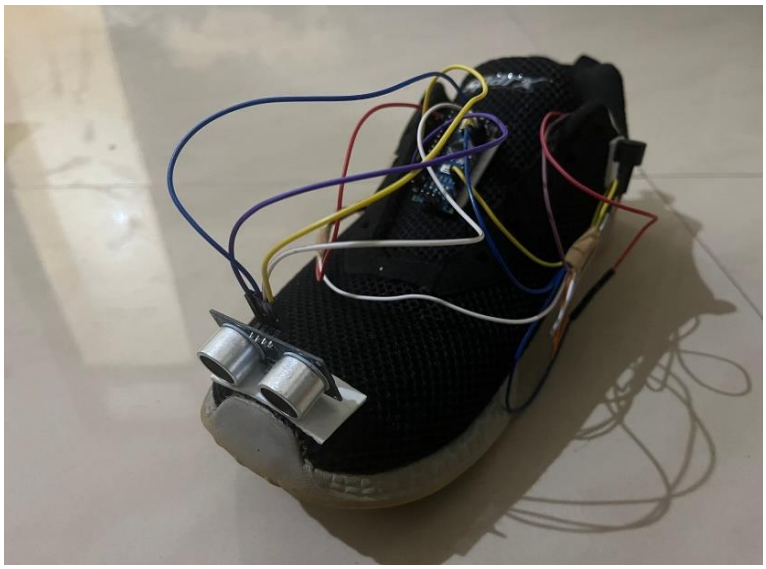

Fig.4.Obstacle Detection Setup

The Obstacle Detection Setup on the Shoe where the Sensor detects the obstacle and alerts the person with the buzzer sound and also alerts through haptic feedback. The Fig.4. represents the Obstacle Detection setup which shows the design of the Obstacle Detection method on the shoe.

Fig.5.GPS Tracking System Setup

The GPS Tracking System Setup is been represented in the Fig.5. where if the person has undergone some accident or injuries or he/she is lost for help purpose a button is clicked so that live location of the blind is sent to guardian's or caretaker's phone and the alert message will be sent to the number which is given in the code and the sim inserted in the GPS-GSM system.

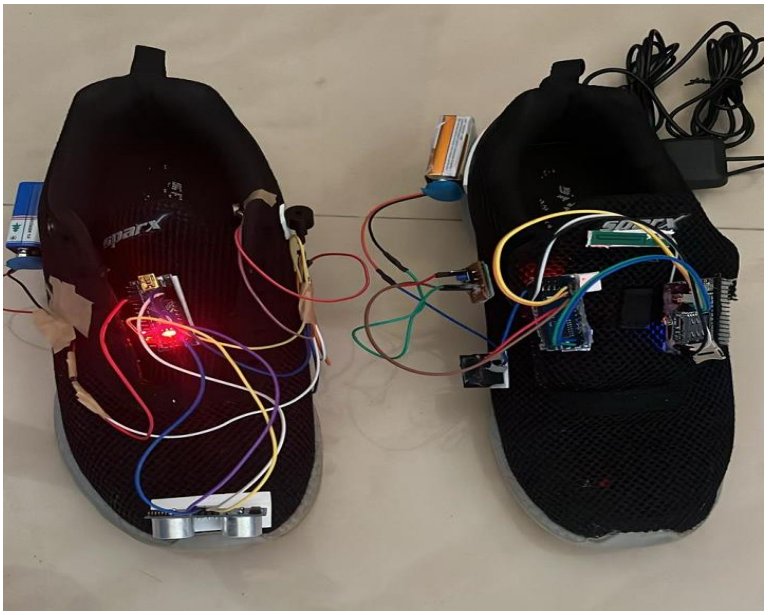

Fig.6.Full Setup

The overall Setup of Obstacle detection and GPS Tracking System implemented on Shoes is shown is the Fig.6. and this is the final image of the completed project and shows both the system is mounted on the pair of shoes and it is very easy to handle and wear.

CONCLUSION AND SCOPE OF FUTURE WORKCONCLUSION

The smart shoe project has the potential to make a significant Impact on the lives of blind people. Most promising outcome of the project is the potential to improve the mobility and independence of people. These shoes may help blind people to participate more fully in all aspects of life. It also offers lots of advantages over blind stick. By leveraging cutting-edge technology, including sensors, GPS and other connecting features, this project aims to enhance mobility, safety of the blind. This project not only highlights the possibilities of integrating technology to address accessibility challenges but also underscores the importance of user centered design in creating impactful solutions. Integration of GPS technology allowed for seamlessly enhancing user's spatial awareness. Further enhancements such as improved battery life, connectivity options, and additional features based on user feedback can be explored to make the smart shoe even more practical and beneficial for blind. Overall, the smart shoe project represents a significant step towards harnessing technology for the betterment of the lives of visually impaired individuals, ultimately fostering inclusively and accessibility in the modern world.

SCOPE OF FUTURE WORK

The future scope of the smart shoe project includes improving battery life and connectivity options. Integration of machine learning and AI can enhance navigation capabilities, while adding safety features like fall detection and emergency alerts. Collaboration for global availability and affordability is crucial for widespread impact and inclusivity. Continuous user feedback will drive ongoing improvements for a practical and beneficial solution for visually impaired individuals.

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