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RESEARCH ARTICLE OPEN ACCESS

Design of Advanced Wearable Device for Visually Impaired People

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Abstract:
According to WHO, 39 million individuals worldwide are predicted to be blind. They face numerous challenges in their daily lives. For many years, those affected have needed to rely on the traditional white cane, which is useful, but has a number of drawbacks. The primary challenger with dazed people is figuring out how to overcome their lack of vision by leveraging other senses such as sound and touch. A buzzer is also included in the framework to provide a warning sound and vibration signals. The framework employs sound and vibration signals to warn the customer of impending problems. The recurrence of both the sound and vibration signals increases as the distance between the glove and the obstacle decreases. As a result, the framework aids in the facilitation of the poor's routing cycle. The framework, provides a low-cost, robust, compact, low-force use, and strong solution got routes with obvious quick reaction times.
Keywords—Blind person, Wearable, Arduino, Vibrating motor, Language, Independent

I. INTRODUCTION

The WHO estimates that there are 39 million blind persons globally. They deal with a lot of hardship on a daily basis. The traditional white cane, however helpful, has numerous drawbacks, and has been used by those who are affected for a long time. Another option is to keep a dog as a pet, although this is very expensive. Therefore, the project's goal is to provide an affordable and more effective method of assisting visually impaired people to travel with more ease, quickness, and confidence. Vision is the most exquisite and significant gift that God has given to all of his creatures, notably humans. Unfortunately, some people are unable to appreciate the beauty of the world with their own eyes because they lack it. So the main idea behind this project is to provide virtual vision for blind people. The third eye for blind is a technological advancement that integrates several disciplines, including software engineering, hardware design, and science, and it allows visually impaired people to see and explore the world with confidence and independence by detecting nearby objects with ultrasonic waves and alerting the user

with a beep ring or vibration. This technology could be a game changer for the blind. An ultrasonic sensor is incorporated into a module in this. Using this sensor-module, the user can travel more efficiently and see close items. When it detects an object, this sensor warns the user by beeping or vibrating at any area. In this sense, it becomes a computerised gadget. As a result, the blind will benefitgreatly from this technology, which will give them the confidence to roam freely.

II. LITERATURE REVIEW

A. Third Eye for Visually challenged Using Echolocation Technology

It is essentially an integrated framework with two ultrasonic sensors and two infrared sensors to detect obstacles the way, stairs, and puddles of water. The sensors collect continuous or real-time data and transmit it to the Arduino UNO board for processing. After processing, the Arduino UNO board plays the message, which is regarded as a warning, through a headphone. A power bank powers the entire system. The main oddity of this development is that it is accessible to anyone..

B. Design, Simulation and Implementation of connected IoT for Disabled People

It is a connected framework in IoT Healthcare for persons with disabilities, which can be n easily monitored and managed via a flexible application and coordinated wearable devices. The combination of the application and wearable technology will make it possible to record a variety of information about the patient's vitals, support the Alzheimer's community, and help those who are visually, verbally, and audibly impaired.

C. Third Eye: An Eye for the Blind to Identify Objects Using Human Powered Technology

It is an application that uses accessibility capabilities in smart phones and a built-in camera, along with human resources, to provide descriptions of all the images or videos that visually impaired persons have taken. In reality, a lot of work goes into choosing the best technology that can be applied to the creation of the suggested application. In order to help blind persons, identify objects, a thorough assessment of assistive technology is being produced.

D. Electroactive elastomeric actuators for biomedical and bioinspired systems

The article demonstrates how combining fluid-based hydrostatic transmission with dielectric elastomer actuation can be a useful way to create novel devices that enable biomedical and bioinspired systems that would be unattainable with existing technologies. They showed and discussed three examples of applications that our lab is currently working on.

E. Virtual-Blind-Road Following-Based Wearable Navigation Device for Blind People

In this a navigation gadget is created. The basic parts of a navigation system are locating, wayfinding, route following, and obstacle avoiding modules, but it is still difficult to take obstacle avoiding into account during route following because the indoor environment is complicated, variable, and maybe filled with dynamic items. To solve this problem, they have used a novel method that simultaneously directs users to their objective and helps them avoid barriers by employing a dynamic subgoal selection mechanism. This plan is the main element of a comprehensive navigation system that is mounted on a set of wearable optical see- through glasses for the convenience of blind individuals on their everyday walks.

F. Methodology to Build a Wearable System for Assisting Blind People in Purposeful Navigation

a wearable device with eyesight that helps the blind in navigational challenges in ambiguous indoor settings. The suggested system can recognize objects, barriers, and walkable areas of interest, including, among others, doors, chairs, stairs, and computers planning a route that enables the user to get to the others, and achieving goals safely (purposeful navigation). The device includes six modules, including one for floor segmentation, one for building a grid for occupancy, for avoiding obstacles, for identifying objects of interest, for route planning, and to provide the user with haptic feedback

III. PROPOSED SYSTEM

The Arduino nano is made to connect to the ultrasonic sensor. The input signal from the ultrasonic sensor is carried to Arduino which has some coding instructions to perform the next actions. The output of the Arduino is connected to a buzzer which helps the blind person recognize the obstacles near him or her. LED, battery and jump wires are included in the system design of the device. These jump wires help to connect various hardware components of the prototype like an ultrasonic sensor, buzzer and an LED as shown in the Fig.1

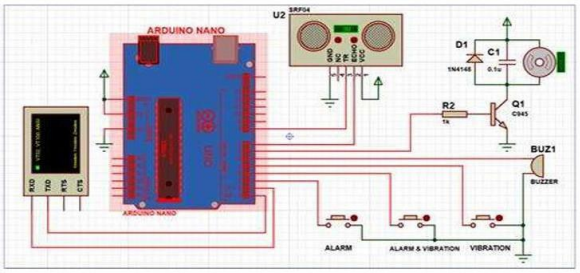

Fig.1 Proposed System

The intensity i=of vibration and rate of beeping increases with decrease in distance and this is a fully automated device. The Arduino Nano is prepared to connect to the ultrasonic sensor. Using the five sensors, blind people can detect the objects in a 5 dimentional view around them.

IV. OBJECTIVES

The main objective is to develop a advanced wearable device for blind people that fixes all the issues with earlier models. There are many tools and technological advancements available today to help the blind and visually impaired navigate, but many of them are bulky and require extensive training to use. The key distinction of this invention is that it is accessible to everyone. It should greatly help the community when implemented on a big scale and with enhancements to the prototype. The project's goal is to provide an affordable and more effective method of assisting visually impaired people to travel with more ease, quickness, and confidence.

This innovation could be a game-changer for the visually impaired community. An ultrasonic sensor is integrated into a discrete module here. The sensor-module allows the user to see what is in their immediate vicinity, allowing them to move more quickly and safely. If an object is detected, the user will receive a beep or vibration alarm. In this sense, it is transformed into a digital tool. Thus, the blind will benefit much from this tool, and they may even get the confidence to venture out into unfamiliar territory

V. METHODOLOGY

A. Proposed System Algorithm

Define the pin configurations and constants for buttons, buzzer, motor, and ultrasonic sensor. Initialize variables for Alarm and Vibrator modes, and a variable for distance measurement. Set up the serial communication. Set the pin modes for buttons, buzzer, motor, and ultrasonic sensor. Enter the main loop:

a. Read the state of the buttons to determine the mode of operation (Alarm only, Vibrator only, or both).

b. Trigger the ultrasonic sensor by sending a pulse.

c. Measure the response time from the ultrasonic sensor to calculate the distance.

d. If the distance is within a specific range (20cm to 100cm):

i. Map the distance to a delay time for feedback.

ii. Turn on the buzzer and/or motor based on the selected mode.

iii. Wait for a brief period.

iv. Turn off the buzzer and motor.

v. Delay for the mapped time.

e. If the distance is less than 20cm:

i. Turn on the buzzer and/or motor based on the selected mode.

f. If the distance is greater than 100cm:

i. Turn off the buzzer and motor.

g. Delay for a short period before repeating the loop.

B. Flow Diagram

The Fig.2 shows the architecture diagram of the flow of the proposed system. The obstacle before the person is identified by the sensor and signals sent to Arduino process the obstacle. The output is given in the form of buzzer.

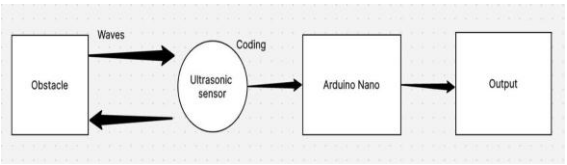

Fig.2 Architecture Diagram

C. Design Approach

The Arduino Nano serves as the central hub for the system, facilitating the connection with the ultrasonic sensor. Through this connection, the Arduino receives input signals from the ultrasonic sensor, which are then processed according to pre-defined instructions coded into the Arduino.

The output of this processing is directed to a buzzer, which serves as an auditory feedback mechanism for individuals with visual impairments, aiding them in detecting obstacles in their vicinity. Additionally, the system design incorporates other essential components such as LEDs, batteries, and jumper wires as in Fig.3.

These jumper wires play a crucial role in linking various hardware elements of the prototype together, including the ultrasonic sensor, buzzer, and LED, ensuring seamless communication and functionality among the interconnected components.

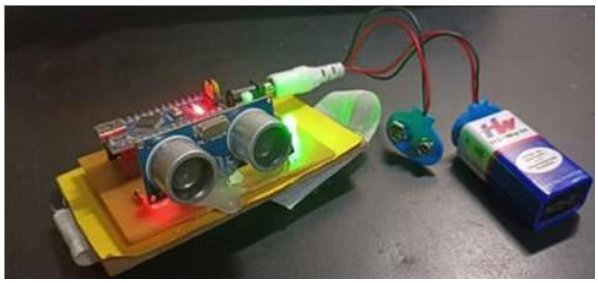

Fig.3 Prototype

VI. IMPLEMENTATION

The Arduino Nano is set up to establish a connection with the ultrasonic sensor. Signals received from the ultrasonic sensor are directed to the Arduino, which is programmed to execute specific actions based on the input it receives. The resulting output from the Arduino is then routed to a buzzer, which serves as an aid for visually impaired individuals in detecting obstacles.

In addition to the ultrasonic sensor and buzzer, the system architecture of the Arduino-based "Third Eye" for the blind incorporates other essential components such as an LED bulb and a battery. Jumper wires are utilized to facilitate connections between various parts of the system, including the Arduino, ultrasonic sensor, buzzer, LED, and other hardware components.

Furthermore, this system is enhanced with the inclusion of five ultrasonic sensors strategically positioned to provide a comprehensive five-dimensional view of the user's surroundings. This multi-sensor setup enables blind individuals to detect obstacles from different angles,enhancing their ability to navigate their environment effectively.

When an obstacle is detected by the ultrasonic sensors, the device notifies the user through a combination of vibrations and sound beeps emitted by the buzzer. The intensity of vibration and frequency of beeping are adjusted based on the proximity of the obstacle, providing users with real-time feedback about their surroundings. This device operates fully autonomously, offering a reliable solution to assist visually impaired individuals in their daily activities.

A. Technical Specifications

a) Arduino nano: The Arduino is an electronic device that combines hardware and software to create an electronic Arduino-based project. Arduino is a type of microcontroller that has additional features such as [11] a USB connector and GPIO pins.

b) Ultrasonic sensor: The ultrasonic sensor is made up of three parts: a transistor receiver, a transceiver, and a transmitter. The transistor converts electrical signals into soundwaves, the receiver converts soundwaves from the obstacle into electrical signals, and the transceiver, which is generally the receiving item, does both the transistor and receiver job. It basically aids in measuring the distance to an obstacle by producing sound waves.

c) Perf Board: Perf board, also known as DOT PCB, is a material used for formed of a thin, stiff sheet with suitable drilled at equal intervals of area. A drilled dot is preferable over a square area. It allows for the simple coupling of electronic circuits.

d) Buzzer: A buzzer resembles an electrical instrument that sends a sound signal to a channel. A buzzer can be mechanical, electromechanical, or piezoelectric. It is a device that converts audio signals into sound signals.

e) Battery: When a battery is supplying power, the positive terminal is referred to as the cathode, and the negative end is referred to as the anode. The negative terminal is the source of electrons that will flow to the positive terminal via an external electric circuit. When a battery is linked to an external electric load, a redox reaction occurs, converting high-energy reactants to lower-energy products and delivering the free-energy difference to the external circuit as electrical energy.

f) Arduino software: Arduino UNO is one of the greatest programming software for all of the above- mentioned operations that complete the total project. The Arduino software is written in the C++ programming language, with some extra unique functions and methods added.

VII. RESULTS OBTAINED

The Arduino Nano is interfaced with an ultrasonic sensor, which is tested individually. According to the person's age, the findings that are required for the suggested system are seen and recorded. Through the buzzer sound, an audio signal is activated to alert the user. The prototype changes the intensity of the audio output when it detects a potential objection. Overall, the proposed system can meet the needs of those with visual impairments.

Fig.4

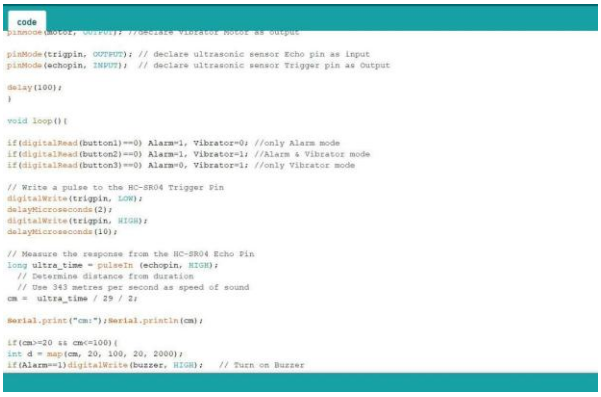

Fig.5 Demonstration of code

According to Fig.4 and Fig.5 the arduino works with the code and sends out the buzz signal whenever an obstacle comes in the radius of the sensor.

VIII. GRAPHS AND COMPARISION

As shown in Table.1, the current available systems are compared with the proposed system. The proposed method, Alternate Eyes for Blind, has the highest values in all four metrics: Precision: 97.10%, Recall: 98.70%, Accuracy: 96.50%, F Measure: 98.40%. It has the best possible outcome among the current systems available.

Table.1 *Statistical Analysis*

Statistical Analysis	**Statistical Analysis**			
	Precision	***Recall***	***Accuracy***	***F_Measure***
Methodology to Build a Wearable System for Assisting Blind People in Purposeful Navigation	91%	90%	94%	90.80%
Virtual-Blind- Road Following-Based Wearable Navigation Device for Blind People	92.30%	91.40%	92.10%	91.50%
Electroactive elastomeric actuators for biomedical and bioinspired systems	93%	91%	92.70%	91%

Statistical Analysis	**Statistical Analysis**			
	Precision	***Recall***	***Accuracy***	***F_Measure***
Third Eye: An Eye for the Blind to Identify Objects Using Human Powered Technology	92%	91%	95%	91%
Alternate Eyes for Blind [Our Proposed Research]	**97.10%**	**98.70%**	**96.50%**	**98.40%**

Fig.4 shows the bar graph analysis of the current systems based on the accuracy, recall, precision, f-measure. The proposed system is also cost effective. It is efficient and cost effective and can be made available to everyone.

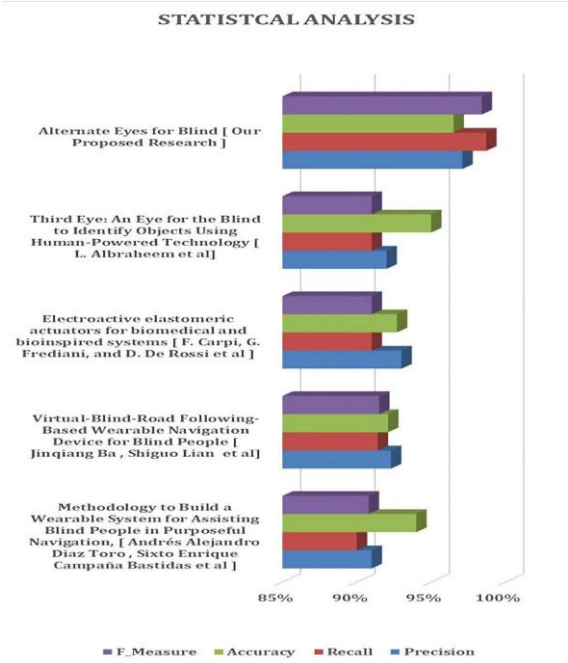

Fig.4 Statistical Analysis

IX. CONCLUSION

As a result, the project that our team created completely explains the model and architecture of an Arduino-based third eye or additional vision for blind persons. An electronic guidance system with proper and simple usage guidance, easy configuration, and manageable hardware helps to provide the amazing properties so that it helps the needy blind people. It's simple architecture, effectiveness in use, affordability, portability, and ease of handling makes it a great device. Speaking of this project, it has a feature to measure object distance, which is a significant problem for blind people. As distance decreases, intensity of sound increases. With our given task guidance assuming it is made as exact as we were appearing in our examination paper that helps the visually impaired individuals to move toward any path without taking the third individual assistance it additionally makes somebody autonomous from the others and in the event that they have some work so they do without help from anyone else. Our undertaking is effectively eliminating the issue of existing route procedures like convey the stick with us while strolling, utilization of someone else while moving one spot to one more and a lot more issue was effectively settled by this task. This task, whenever utilized on a more extensive scale and conveyed to every one of the visually impaired individuals it truly has a greater effect to the general public also, the local area.

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