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Third Eye For Blind Person

Arun Kumar D[1], Avinash S[2], Jyotsna Bhuwaneswari S[3], Supriya S[4], Tarun Kumar P[5]

[1]Assistant professor, Dept of Electronics and Communication Engineering, Raghu Institute Of Technology, Visakhapatnam, Andhra Pradesh, India
[2,3,4,5] Student, Dept of Electronics and Communication Engineering, Raghu Institute Of Technology,Visakhapatnam, Andhra Pradesh, India

Abstract:
One of the most important sense organs is the eye. Consider crossing a street without being distracted by obstacles. Yet, some blind people require the assistance of another person or a reliance object in order to avoid hazards. Taking this into account, we created a jacket and knee module. The main objective of the project is to design a system that makes blind people's lives easier and better. The developed system makes them move with confidence and speed in society. We propose an ultrasonic sensor that operates on the SONAR principle, which works by transmitting ultrasound and then reading the reflected rays to estimate the object distance for tracking the observer's journey. The jacket's flame sensor detects thermal radiation and alerts the blind person. As a result, a vibrating motor for the knee modules and an audio device for the jacket were deployed to alert the user.

Keywords: *SONAR, Ultrasonic sensor, Flame sensor, Obstacle detection, Voice message.*

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I. INTRODUCTION

Life is significantly influenced by vision. People primarily learn about nature through their sense of sight. Those who are visually impaired and lack this perspective experience ongoing challenges in gaining safe and unfettered mobility. Based on recent analysis and research, millions of people suffer from vision loss and need technological assistance to survive. Around 39 million people worldwide suffer from a vision impairment issue that may have been avoided or is still going unsolved [1].

Reading, navigating their surroundings, and identifying items can be difficult for persons who are visually impaired. Yet, visually impaired people can live freely and participate in many of the same activities as those with normal vision thanks to assistive technologies such as screen readers, braille displays, and speech recognition software[2]. A blind person can navigate the path utilising instruments such as white canes, however holding them and walking may be difficult due to the cane becoming stuck or damaged while defining the path[3]. Employing trained dogs to guide the blind is an alternative, but it is not cost effective[4]. Yet, existing approaches may identify the item without mentioning the distance or direction. These systems have limitations such as identifying staircases, item distance, and direction, which may be dangerous to the visually impaired user.

The suggested system is a wearable prototype that addresses some of the shortcomings of existing systems. The prototype has 5 ultrasonic sensors for determining object distance in various directions and staircases, as well as one flame sensor for detecting fire in the surrounding region. Real-time data obtained by the sensors is collected by the respective microcontroller boards to be analysed, and based on that, voice signals are sent to the user for object detection. For stairwells, the Arduino Nano informs the user via vibrations from vibrating motors mounted on the knee module. This prototype is a wearable jacket with all necessary sensors installed on it that is powered by a powerbank and has additional knee modules for stairway that are powered by 9v batteries. Because of the mild upgrade from existing technologies, the entire system is cost effective and has a large scope.

II. LITERATURE SURVEY

Equipment used to aid visually impaired individuals has evolved dramatically over time, from traditional methods such as a white cane and a trained dog to the usage of various sensors and microcontrollers that serve blind people[3][4]. Aside from these, technology is evolving at a fast pace, which also includes the electronic gadgets and systems used to make the lives of blind people better[5].

Assistive technology, such as the smart cane, can greatly enhance the independence and mobility of visually impaired individuals. The smart cane is a particular type of electronic travel aid that uses a combination of ultrasonic and infrared sensors to detect obstacles and stairs within a range of up to 4 meters. The sensors are mounted on a cane, which can be easily carried and maneuvered by the user.The smart cane is designed to provide users with various output signals, including a buzzer, vibrator, or voice signal, depending on their preferences. This flexibility allows users to choose the most effective means of receiving feedback about their surroundings. The cane is also designed to be lightweight, portable, and power-efficient, making it a practical and affordable option for many users.[6].

Smart eyewear is another promising prototype in the field of assistive technology for the visually impaired. This technology involves a pair of spectacles equipped with low-cost sensors that can detect obstacles and provide directional guidance to the user.Studies have shown that smart eyewear has the potential to greatly improve the travel experience of visually impaired individuals, while also serving as a useful consumer gadget. By providing real-time information about the user's surroundings and offering directional guidance, smart eyewear can enhance the user's sense of confidence and independence.[7].

Next comes the wearable helmet. The system uses echolocation technology, similar to that used by bats and dolphins, to help users navigate their surroundings. The system works by emitting a series of ultrasonic waves, which bounce off of objects in the user's environment and are detected by a sensor. The system then uses this information to create a 3D map of the user's surroundings, which is conveyed to the user via a haptic feedback device, such as a vibrating belt or wristband[8].

This paper deals with understanding the assistance provided to blind people by different systems. It also discusses the project that is being developed by adding some extensions to the existing systems to improve assistance for blind people. It is a wearable system that removes the need to hold visually assistive devices separately.

III. SUGGESTED SYSTEM

The Suggested system improves upon previous methodologies. It aims to make existing procedures more productive, beneficial, and simple to utilise. Five HC-SR04 ultrasonic sensors are employed in this application, three put on a jacket to detect obstacles and the remaining two attached to the knee module to detect staircases. The sensors are linked to different microcontrollers for reading the collected data. Based on the detection of the object, voice instructions are issued that may be heard through headphones for each detected obstacle in each direction, and vibrations are issued if staircases are detected.

Hardware Requirements

Fig. 1. Ultrasonic Sensor

Ultrasonic Sensor: In this project, five ultrasonic sensors are used, each with its own purpose. The sensor has four pins, i.e., VCC,GND, TRIG, and ECHO. The VCC pin is for power supply to the sensor, the TRIG pin is used to activate the transmitter for generating waves, and the ECHO pin is used for sending the data that is received from the receiver to the microcontroller. The sensor consists of a transmitter and a receiver. The transmitter sends the ultrasonic sound waves, and when those waves hit the object, they are bounced back and collected by the receiver. Here, distance is calculated by considering the speed of the sound with respect to the travel time taken by the waves. Three sensors are attached to the jacket to find the distance in the front, left, and right directions. The Arduino UNO calculates and stores the distance. Two sensors are attached to the bands at knee level and are used for detecting the staircases; the data is stored and processed by the Arduino Nano.

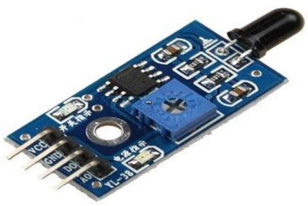

Fig.2 Flame Sensor

Flame Sensor: The main purpose of this sensor in the project is to identify the nearby fire for the user and send the signal to the microcontroller in analogue or digital form. It is sensitive to overheating, which needs to be taken care of by the user. The power supply is provided by the microcontroller in the required amount. The sensor contains a thermal diode, which takes in thermal radiation. Fire generates thermal radiation, which is collected by the sensor and processed to detect fire. It has a detection radius of 100cm.

Fig. 3. Coin vibration motor

Coin vibration motor: This device is compact, occupies less space, and provides sufficient vibration feedback. It has a motor with a shaft for generating vibrations and brushes for cleaning while avoiding unwanted charge carriers, which may decrease the efficiency of the motor. A coin-vibration motor is attached to the knee band to provide feedback on staircase detection. Due to its compactness, it consumes less power, which makes battery life last longer.

Fig.4. Earphones

Audio Device: Earphones are used for giving voice instructions based on the obstacle detection range and about flame to the user.

Fig.5. Arduino UNO R3

Arduino UNO R3: The Arduino UNO is the central hub for the components that are attached to the jacket. The device is the processing and power supply unit for all connected components. The power supply is handled efficiently due to the presence of an in-built voltage regulator. It has required digital and analogue pins for the project. To power up the Arduino battery, a minimum of 9 volts or a USB port can be used. It is programmed using the Arduino IDE.

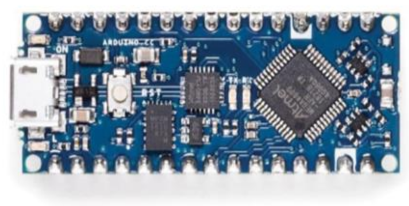

Fig.6. Arduino nano

Arduino nano: Arduino Nano is used in the knee module due to its low space occupancy, and it serves as the microcontroller, which is powered by ATmega328p and ATmega628.The connectivity is identical to that of the Arduino UNO board. The Nano board is a long-lasting, tiny, reliable, and adaptable microcontroller board. It is much smaller than the UNO board. The Arduino Mini is organised using the Arduino (IDE), which is available for a variety of platforms. IDE is an abbreviation for Integrated Development Environment.

Software Requirements

Arduino IDE: Arduino IDE, where IDE stands for Integrated Development Environment official programming provided by Arduino.cc, is primarily used for writing, collecting, and transmitting code in the Arduino device. Almost all Arduino modules are compatible with this open-source solution, which is simple to install and begin compiling code as well as transferring machine code to the microcontroller.

Audio message generator (Arduino talkie software): This is a speech library for Arduino. Talkie has over 1000 expressions of speech information or data that can be remembered for tasks. It is a product implementation of the Texas Instruments voice synthesis architecture (linear predictive coding) from the late 1970s and early 1980s. The voice is from the Texas Instruments Speak and Spell educational product line.

Block Representation of the Suggested system

Figure 7 depicts the Suggested system's block representation as well as all of its components. It includes an Arduino module and all the required sensors and the audio instruction as its output.

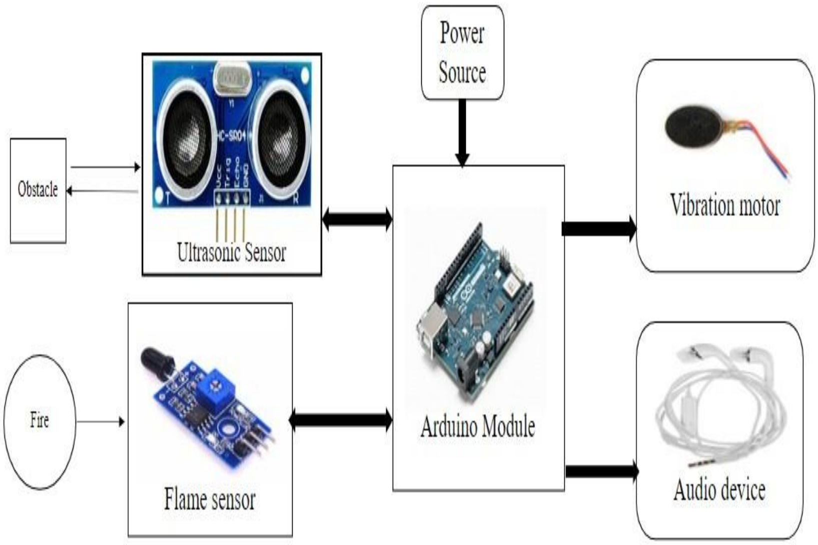

Fig. 7. Block Representation of the Suggested System

Flow Chart

Regardless of the complexity of the algorithm, a flowchart is used to visualise it. Fig. 8 shows the step-by-step process from start to end with accurate decision-making based on data collection from all the components to choose the right flow of the project, which include the jacket and knee modules.

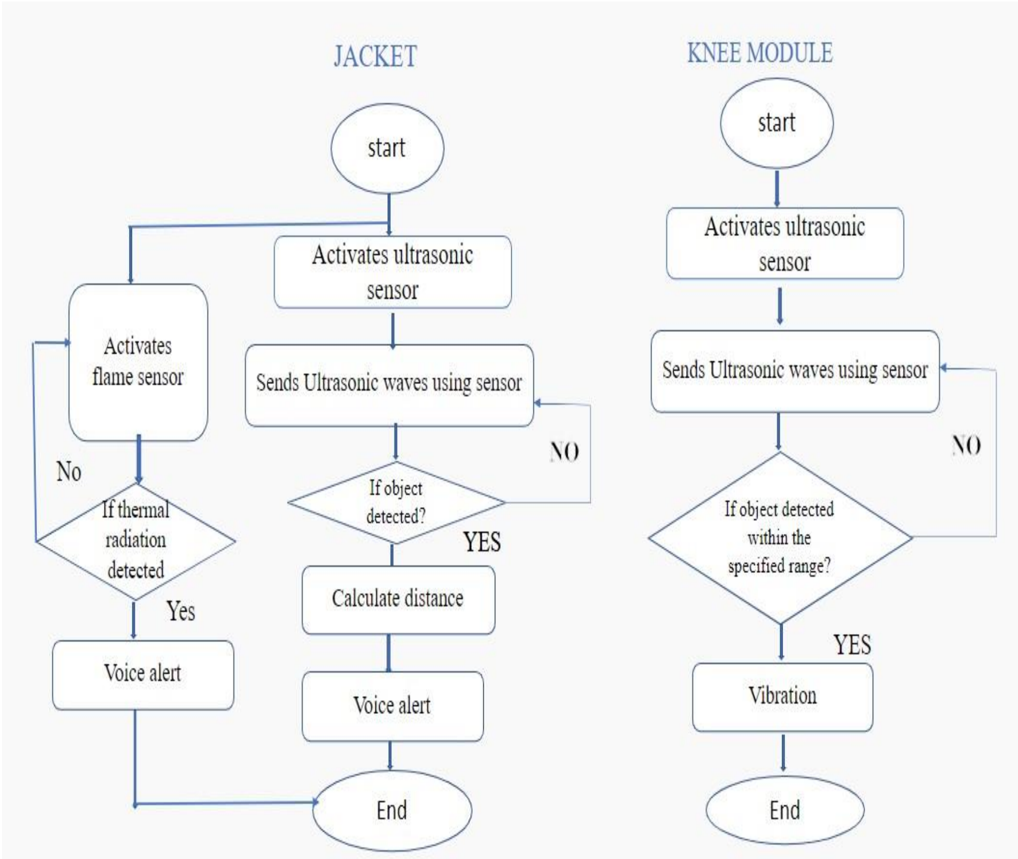

Fig.8. Flow Chart of Suggested System

Schematic Diagram of Suggested System

Fig. 8,9 depicts the proposed system's circuit schematics as well as the connections of all components. Section III-F explains how the circuit works.

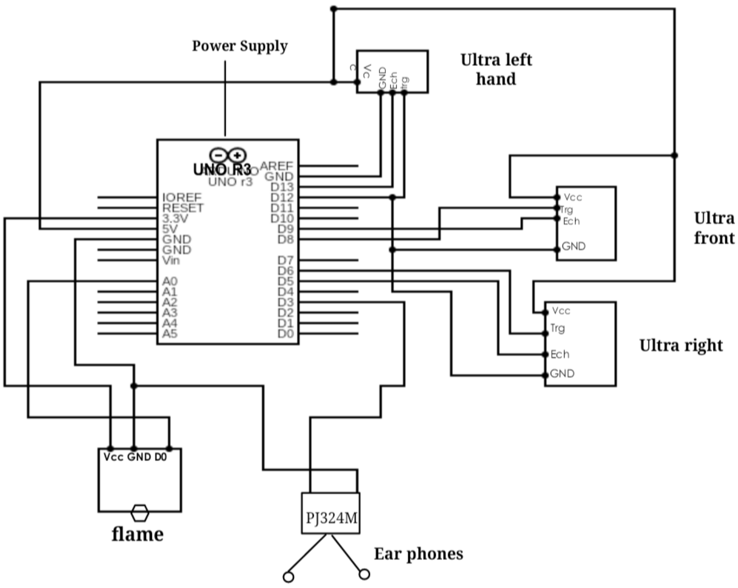

Fig.9. Schematic Diagram of Jacket Module

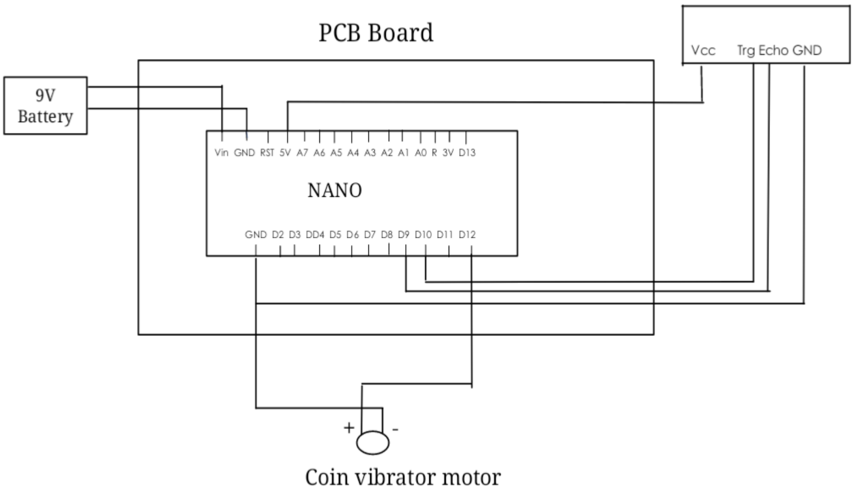

Fig.10. Schematic Diagram of Knee Module

Working of the Prototype

The power supply through the power bank is given to the Arduino UNO, which is the microcontroller used for interfacing the components attached to the jacket. The given power is shared among all the components as per the requirements. Three ultrasonic sensors are attached to the jacket in the front, left, and right directions; the range of each sensor is fixed at 90cm. When the obstacle enters the specified range of any of the mentioned sensors, audio instructions are invoked by the Arduino UNO based on the direction in which the obstacle is detected. The invoked instructions are sent to the user through earphones so that the user can take the required actions to avoid the obstacle. A flame sensor is attached at shoulder level to the jacket to detect nearby fires more accurately. When flame sensor detects the fire, Arduino UNO obtains the value change from flame sensor and invokes required audio instructions to the user.

The power supply for the knee module is provided by the 9-volt battery. The main objective of this module is to detect staircases, which is done by distance calculation through ultrasonic sensors. If the distance is in the specified range, it indicates no staircases, but if the distance is out of the specified range, it alerts the user by generating vibrations. The range differs depending on the user's height.

IV. FINAL VERIFICATION

The jacket with components mounted on it and knee modules are worn by the person for testing its accuracy. The system was made to be tested in different conditions. At first, the person is taken to the new location because of his unfamiliarity with the surroundings and is instructed to close his eyes. Then using another person as the moving obatacle for the person who wore the system. The person was made to move with respect to the obastacle in different directions to check the accuracy of the distance calculation and audio commands to the user. A flame sensor is tested by bringing a lighted matchstick near the sensor.The knee modules are for low-level object and staircase detection. Knee modules are tested by bringing the user near the staircases; the user is notified above the staircase through vibrations. All the tests were successful, with accurate results.

V. TESTED PROTOYPE

Figures 11 and 12 depict the final working prototype, which includes the jacket and knee module. When any obstacles are recognised, the voice instructions and vibrations will be activated.

Fig.11. jacket Module

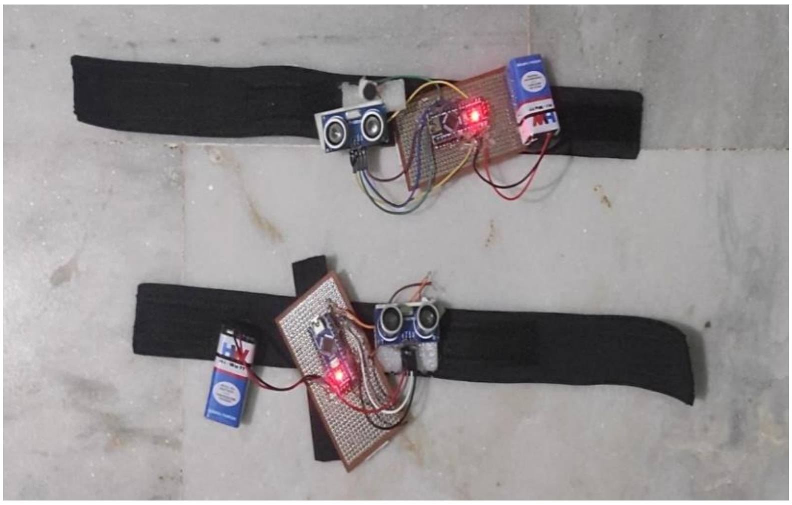

Fig.12. Knee Module

VI. CONCLUSION

Finally, the developed project aims to rectify the basic problems of people with lost vision. This technology assists them in recognising obstructions in their path, allowing them to walk freely everywhere. For the vision impaired, the third eye aids in the detection of flames and impediments. If the person is in danger, it will provide them voice guidance. This is a low-cost device.

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