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# Blind Protection System from Surrounding Obstacles

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***Abstract: -*** There are around 285 million people worldwide who have a visual impairment or are blind. This has a significant impact on their abilities to interact with their surroundings, reducing their ability to work and produce and making their daily lives difficult. There are many technologies working to provide solutions to these problems, one of which is the "blind protection system from surrounding obstacles", a device developed to help them interact more efficiently with the environment by avoiding obstacles and traveling. By wearing it on the body parts, it will alert the user by audible sounds due to ultrasound wave sensors connected to modern microchip technology called Arduino Pro Mini and piezoelectric buzzers that convert electric signals to sound waves.

***Keywords:*** Arduino mini pro, ultrasonic sensor, piezo buzzers, obstacle, impair people.

## I. INTRODUCTION

Globally, 285 million individuals are estimated to be visually impaired, including 246 million with limited vision and 39 million blind [1]. Among all the senses, vision is most important for perception and situations encountered in daily life. The majority of the information required to comprehend the world and interact with it is provided by

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vision in combination with another sense, typically hearing. Hence, losing one's sight results in a host of difficulties in life, such as navigating, accessing information, interacting with the environment and other individuals, and avoiding obstacles. The research we propose in this paper is based on using modern technology to increase the mobility of people who are visually impaired. Our study focuses on the detection of obstacles to lessen navigational challenges for visually impaired people. When we can't rely on our own sight, navigating an unfamiliar situation becomes really difficult [2]. Blind persons use their sense of hearing to locate dynamic impediments since they frequently make sounds as they move [3]. Because touch is the strongest sense, blind people depend on it to locate objects precisely [ 4].

There are several ways that impaired people use to travel and sense the environment around them. The walking cane is a basic and entirely mechanical instrument used for mobility using simple tactile-force feedback to detect moving possible risks on the ground, uneven surfaces, holes, and steps. Although this gadget is small and lightweight, its range is only as large as its own size, and it cannot be used to detect moving objects or obstacles that are not on the ground.

Service animals are still an additional option. However, in order for this relationship to work and be effective, it must go through difficult training to create a strong bond between the animals and their people, as this is the key to success. Service animals can manage complex scenarios, such as potential threats and known paths. The handle that is fastened to the animal transmits the majority of the information through tactile feedback. The owner can sense his dog's mood, assess the circumstances, and give him the necessary commands. Nonetheless, guide dogs are still quite expensive, and they only typically work for 7 years on average [5].

We created a unique wearable equipment based on the Arduino board that can be worn as a blinds cloth. This device is equipped with four ultrasonic sensors, consisting of four modules that are connected to body parts. There are two of them for each shoulder and two more for each knee. Blind people may comfortably move around and recognize items in a four-dimensional environment using the four ultrasonic sensors. The device will beep to alert the user when an obstruction is detected by the ultrasonic sensor. This is a fully automated device, and the rate of beeping gets louder as you get closer to it.

Several studies have been conducted to enhance the independence of people who are blind, particularly in terms of their capacity to explore their surroundings. New technologies have been used to create wearable systems that use lasers, sonar, or stereo camera vision to sense the environment and audio or tactile stimuli to provide user feedback [6].

one of the earliest instances of those systems is the C-5 Laser Cane [7], which uses optical triangulation to identify obstacles up to 3.5 m ahead. It necessitates scanning of the area and uses audio feedback to deliver information on the nearest impediment at a time. A sound proportional to the distance to the obstacle is played once the laser system measures it.

At the University of Verona, more current research using stereoscopic cameras, a laser pointer, and an audio system has been developed [8]. The conversion of the 3D visual information into relevant stereoscopic audio stimuli is one of the major focuses here. Depending on the location of the obstruction is, the sound produced by earphones simulates a distant noise source.

Other commercial products are already being introduced to the market, such as the Ultra-Cane [9], which uses an integrated sonar system to send back vibrations via the handle in response to the presence of impediments. By providing information on obstacles before coming into contact, the ultra- cane improved upon the conventional white cane. However, it doesn't add any new features to the conventional cane, and localization is still carried out by moving the cane; it also doesn't detect items above the head.

## II. Materials and Methods

### *A. Arduino Pro Mini*

The Arduino Uno is a microcontroller board that is considered open-source software developed by Arduino and is based on the Microchip ATmega328P microprocessor [10][11][12].

Arduino features 6 analog inputs, an on-board resonator, 14 digital input/output pins (six of which can be used as PWM outputs), a built-in board reset button, and pin header mounting sockets to supply USB power and connectivity to the board. Connect a six-pin header to an FTDI cable or Sparkfun breakout board. The Arduino Pro Mini has been designed for interim installation in displays or prototyping. The shortage of pre- mounted ports on the board allows for the use of a variety of connectors or wire directly soldering. The Arduino Mini can use the pin layout. The Arduino can be powered up using an FTDI cable or a breakout board, or by connecting a 3.3 or 5 volt power supply to the Vcc pin, according to on the type. It supports voltages of up to 12VDC related to an on-board voltage regulator. The ATmega328P includes 32 kB of flash memory (0.5 kB of which is used for the bootloader) for saving code. It includes a 1 kB EEPROM and a 2 kB SRAM. The 14 digital pins can be used as inputs or outputs through the pinMode, digitalWrite, and digitalRead functions. The pins operate at either 3.3 or 5 volts. Each pin has a pull-up resistor of 20–50 kOhm and a maximum current capacity of 40 mA. The Arduino Pro Mini features eight analog inputs and an overall resolution of ten bits. Two of them (inputs 4 and 5) are on board holes, while the other four are on the tops of the board's edges. The analog inputs collect measurements between VCC and ground. Fig .1 shows an example of an Arduino Pro Mini.

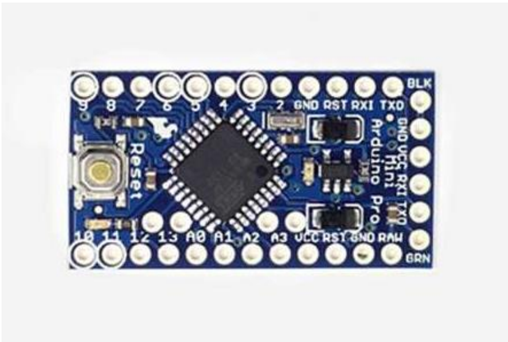


Fig. 1 Arduino Pro Mini board.

*B. Ultrasonic Sensors*

Similar to how bats interact with their environment by using ultrasound waves to locate obstacles and estimate distance, the HC-SR04 ultrasonic sensor (shown in figure 2) operates in the same way. One of its features is that it is suitable for non-contact distance measurements ranging from 2 cm to 400 cm (1 inch to 13 feet) in a simple and accurate manner.

One of the most difficult aspects is the difficulty in detecting soft materials such as cloth acoustically; yet, the ultrasonic wave has the advantage of being unaffected by sunlight or black materials. The sensor contains an ultrasonic transmitter and receiver module built into the same board.

The time between the wave emitted and the wave received is measured by the ultrasonic sensor using sound reflection. At the transmission terminal, it typically sends a wave and then receives the reflected waves. The distance between the sensor and the obstruction is calculated using the elapsed time and the average sound speed in air (340 ms-1) , fig 2 shown Ultrasonic .

Some researchers have employed the ultrasonic sensor to sense the movements of the items when they go close to it [13,14].

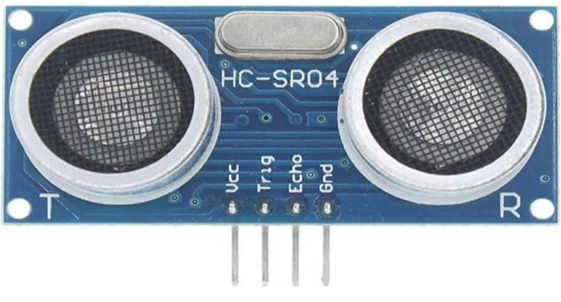


Fig. 2 Ultrasonic Wave Sensors (the HC-SR04 ultrasonic sensor)

## C. *Piezoelectric buzzers*

Piezoelectric buzzers is a device used to produce standard sounds by converting electric signals to sound waves and vice versa using a Piezoelectric crystal, a unique material that changes its shape in response to an applied voltage. The crystal can generate acoustic waves that reach the human ear and interact with the eardrum by making it vibrate at the same frequency as the received waves. The vibrations are then transmitted by the eardrum to the middle ear, which converts them into mechanical pressure waves and sends them to the inner ear.

Simply change the voltage value applied to the Piezoelectric, and it will start generating an acoustic wave by rapidly changing the shape of the crystal [15]. In addition, Piezoelectric Buzzers are easily accessible on the market at the majority of electronics retailers. In addition to several advantages, this technique is inexpensive and highly effective in converting mechanical energy into ultrasonic wave energy [16]. When the sensor detects an obstacle by calculating the rebound ultrasonic wave, it sends a signal to the Piezoelectric buzzer, which operates and generates audible sound, the intensity of which depends on the distance between the object and the sensor. It was used in many motion detector devices to generate a sound alarm [17].

The blind protection system from surrounding obstructions was constructed and compiled using the following hardware: 1 Arduino Pro Mini, 4 Ultrasonic sensors 1 breadboard, 1 Piezoelectric buzzer, 1 Red LED, 1 switch, PH and FH Header Pins, 4 Cables, 1 Power supply bank, 1 (3.3 volt) portable battery a few ties and stickers.

The materials were connected as follows: The ground tip of the LED and piezoelectric are linked to the Arduino (GND) pin, the (+ve) tip of the LED interfaces with a 221 ohm resistor and is connected with the middle leg of the switch to Arduino pin (5), the (+ve) part of the Piezoelectric Buzzer is connected to the first leg of the switch, an ultrasonic sensor is connected;

To power the ultrasonic sensor, we link pin (VCC) to Arduino pin (VCC) and ultrasonic sensor pin (GND) to Arduino pin (GND) to make a complete electrical circuit. To transform signals from the Arduino to the ultrasonic sensor, we connected pin (Trig) to Arduino pin (12) as an output and ultrasonic sensor pin (Echo) to Arduino pin (10) as an input (transfer data from sensor to Arduino) as shown in fig 3.

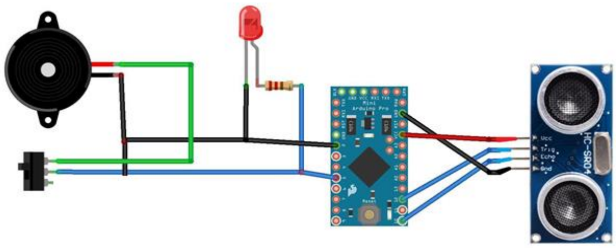

Fig 3. Circuit Diagram Schematics

To operate the Arduino, special code must be produced on a computer using the Arduino IDE tool and then transferred to the Arduino microcontroller via a cable connected to the computer to accomplish the operation. The experiment data was collected and compared to the real distance. The user is walking in an environment full of obstacles when the piezoelectric buzzers start making a sound, alerting the user to the localization of obstacles. To ensure that we have accurate readings, we use the measuring tape to compare the given value in Arduino to the actual distance. This device is unique in the manner it can be used. It is a wearable designed with Arduino board technology, consisting of four ultrasonic sensor modules connected to all four body parts, two hands and two legs, providing a full environment scan, allowing impaired people to easily interact with their environment and detect obstacles by sound beeps from a piezoelectric crystal, which helps them get more efficient movement. To make it more effective, the intensity of the beeping changes depending on the distance between the user and the objects, which the intensity is higher when the distance decreases. This is a totally automated technique.

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## III. Results and Discussion

In this section, we explain the performance evaluation of the presented system, which included detection performance utilizing various object shapes and distance performance between various obstacles, also a warning clients by a sound. To evaluate our system accurately, we made a two user wear the project inside a crowded area by obstacles and in low obstacles a private place also to make sure of the stability of the system.

The experiments were done in two places, first one in an empty place as shown in fig 4, and the second one in an crowded place as shown in fig 5.

Fig 4. The project without obstacles place.

Fig 5. The project with obstacles place.

When the user move and an obstacle became inside the range of sensor it make a noise by a buzzer in this project we use multi ranges to sense the obstacles during the test we found out that 50cm is the best range to make sure the user can interact with the environment easily, fig 6 Shown the ultrasound waves direction spread in environment.

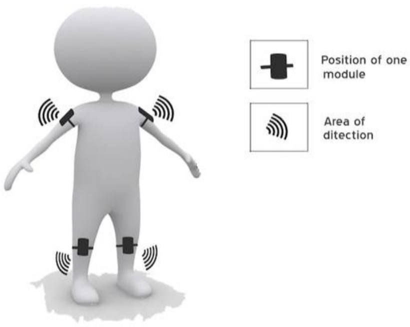


Fig 6. The ultrasound waves direction spread in environment.

TABLE I Compare between the range and the accuracy of ultrasonic sensor.

| S/No. | Range by ultrasonic ( cm ) | Range by ultrasonic using ARDUINO ( cm ) |
|---|---|---|
| 1 | 20 | 20 |
| 2 | 40 | 40.3 |
| 3 | 50 | 49 |
| 4 | 60 | 61 |
| 5 | 94 | 90 |
| 6 | 104 | 100 |

We measure the mobility depending on the accuracy and the range and be attentive that the user must can avoid the obstacle in normal way.

TABLE II Compare between the range and the mobility of ultrasonic sensor when the blind use it in street.

| Reasons | Mobility | Range by ultrasonic using ARDUINO ( cm ) | S/No. |
|---|---|---|---|
| the range is very close to user cannot avoid obstacles | very bad | 20 | 1 |
| user can avoid in obstacles normally | good | 40.3 | 2 |

| | | | |
|---|---|---|---|
| user can avoid in obstacles normally | very good | 49 | 3 |
| user can avoid in obstacles normally | good | 61 | 4 |
| long range and early warning of obstacles | low | 90 | 5 |
| long range and early warning of obstacles | low | 100 | 6 |

One of the early technologies for blind and impaired people, which can be a solution for all the problems of present technologies. There are numerous technologies and smart devices available to assist visually impaired and blind people in navigating and interacting with their environment, but the majority of them are heavy and difficult to use without training. One of the most important features of this invention is that it is inexpensive and that everybody can afford it; the whole cost is less than $25. There is a paucity of wearable, low-cost, and simple-to-use equipment out there. When implemented on a big scale, with further improvements to the prototype, it will substantially alter the community. There is many ways use to help blind people to interaction with their environment like a blind cane, service animals, and intelligent equipment, Braille: Printed materials can be transcribed into braille for blind readers. Braille can be produced using braille embossers or by printing on swell paper, which creates a raised print that can be read by touch. But it have some disadvantage when it came to use in field, white canes are prone to breaking, and the stick can become trapped in sidewalk fractures or in various things. Service animal are expensive. About ($42,000), common Problems (Including Intelligent Equipment) It is difficult to transport and requires training to use. A blind cane, service animals, and intelligent equipment.

This project have big advantage and adds a value to the health system in helping the blinds people with low cost and good performance but it still in the beginning it need more improvement and hard work to be able to use in large range like use the AI in the programing to be able to detect the obstacle more accurate in different range instead of use only one range, and minimize it to became more mobility for blind kids.

## IV. Conclusions

In this paper, we have introduced several technologies that are interested in assisting impaired people to improve their interaction with the environment and make traveling more convenient by detecting and avoiding objects. Each of these technologies has its own set of advantages and disadvantages, with the main disadvantage being the high cost the user must pay to obtain the device, as well as the hard training required to use it properly, which costs both money and time, without talking about maintenance, All of this is solved in the blind protection system by utilizing simple configuration technology based on ultrasound sensors and Arduino, with high efficiency avoiding obstacles and mobility due to it being a wearable device. It is inexpensive equipment, costing about $25, and does not require hard training to use because it is fully automatic technology. There is also no need for high repair costs as all it consists of are sensors, Arduino, and a piezo buzzer. However, it has some disadvantages, such as difficulty detecting soft impediments, inability to discriminate between distinct objects, and so on. However, this technology is still in its early phases and needs more work before it can be used in the field. It is still a prototype that uses raw materials, However, it can be more professional by using the best sensor model and having its own AI to improve the user experience.

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