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Ultrasonic Sight

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***Abstract* — Blindness affects more than 10% of the population in poor countries. People with disabilities may experience difficulties at birth or lose their sight.**

The navigation of visually impaired people, just like ordinary people, is the focus of our initiative. The plan's goal is to help visually impaired persons navigate safely. By pulsating and echoing through the headset, it assists the person in getting to their goal by alerting them to difficulties that may be encountered along the road. As a result, they will not collide with any obstructions. It uses an ultrasonic sensor to determine the distance between the obstacle and the person, a vibration motor to alert the person, and an infrared sensor to detect obstructions using infrared beams.

Keywords— ultrasonic sensor; microcontroller; Arduino; infrared sensor; vibration motor.

I. INTRODUCTION

As the world is innovating and technologies develop, we move towards the future where people will live in a much better and improved world. As we move towards the brighter future, we make small steps by improving others life with instruments and material we have during the present time. As people face various threats and problems throughout the whole human history, we always found solutions and improvement. But it's much more difficult for visually impaired people. Globally, it is estimated that 285 million people are visually impaired, with 39 million blind and 246 million with poor vision. Approximately 90% of the world's visually impaired people reside in low-income areas. People over the age of 50 account for 82% of those who are blind. During their lifetime they are facing many difficulties, such as fear of becoming misled or lost on the street which is the major issue. As they face many difficulties, it is rough for them to be dependent on others. To decrease their dependency and difficulty level, we made a prototype on Arduino, which will meet the basic needs of visually impaired person. The goal of this project is to look into the development of navigation devices for visually impaired and blind people. Although new technology has provided numerous options for blind people, but it has not yet reached its full potential. This article will discuss the design and development of a low-cost but useful object that will be controlled by an Arduino microcontroller. In terms of functionality and use, the gadget totally replaces the cane; in fact, blind individuals must constantly move the gadget from right to left or vice versa to keep an eye on the area in front of them, as the gadget does not vibrate or emit sound. So, for the "Ultrasonic Sight" we used Arduino Uno, Ultrasonic sensor, potentiometer, LCD Display, breadboard & jumper wires. Basically, as we connect all the sensors and devices, we get a Arduino which displays the distance on the LCD display by detecting it with the ultrasonic sensor. It is a simple prototype just running the ultrasonic sensor. Besides that, we have another prototype, more advanced, but still unstable and needs further improvement. Instead of the Ultrasonic sensor we used PIR(passive infrared) sensor. In addition to that, we added piezo speaker to make signals. Basically, the function of the second prototype is close to the first prototype, but with a few more functionality. As the infrared sensor detects obstacles it sends signals which the piezo and the LCD display outputs.

II. LITERATURE REVIEW

The goal of the "Ultrasonic Sight" as shown in [3] is to navigate blind and visually impaired people. It is an electronic device based on genuino 101, vibration motor, speaker, ultrasonic sensor and a heart rate and blood oxygen saturation sensor (IR + Led). It is also accompanied by a smartphone app that will be linked to the device by Bluetooth. Basically, the device uses an ultrasonic modulus and an appropriate algorithm to relieve holes, steps, road signs on sidewalks, and cars in reverse. The device can fully replace the stick as for functionality and usage. In use of this device the person has to move the device around for monitoring frequently the area in front. In case if the device detects something, it depends on the detected object distance when to make sounds and vibrate to advise the person of the possible threat on time. But if the device detects objects all around and the heart rate of the person would be abnormal, the device reports by Bluetooth to the app about a possible situation to a person nearby to ensure a first aid. The app will track and use vital data and progress them through API on a map which will be available to allowed users such as friends and relatives. The design of the device is made depending on the size of the person's hand, so that it is comfortable to hold on the hand.

III. THE IMPORTANCE OF THE WORK

The problem is widespread. Result of interviews with over 100 blind people revealed several issues:

- There is too much noise in the streets, both for vehicle traffic and for pedestrians.

- People who are blind City routes are frequently non-existent, worn, or incorrect, causing panic or putting one's life in risk.
- Fear of becoming disoriented or lost on the street.
- Current devices on the market are imprecise, with incorrect or distorted reliefs due to outdated technologies or being insufficient for the task, such as infrared technologies, which are prone to strong brilliant refractions in exterior surroundings.
- Embarrassment in being helped by guide dogs.

IV. MATERIALS AND METHODOLOGY

In this project, an intelligent "cane" will be implemented with the detection of obstacles on the way, whether there is an obstacle ahead or not. To collect information about the forthcoming path in this cane, an ultrasonic sensor will be used to calculate the distance, and the distance from the sensor to the obstacle for the visually impaired will also be displayed on the LCD screen.

This system consists of two stages: the first is the physical model and the second is the coding. Coding is done in C in Arduino. The main task is to create a physical model that will work specifically with sensors.

In the course of this work, an intelligent design for the "cane" will be created and then the sensors used will be explained.

A. Materials

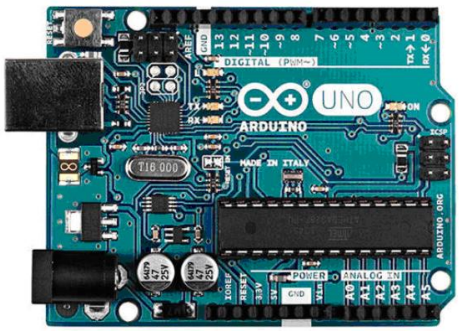


Figure 1. Arduino Uno

4.1. Arduino Uno

The ATmega328 microcontroller is used in the Arduino Uno (datasheet). It has 14 digital inputs/outputs (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal resonator, a USB connector, a power connector, an in-circuit serial programming (ICSP) connector, and a reset button. To get started with the device, simply plug it in using an AC/DC adapter or a battery or connect it to a computer with a USB cable.

Figure 2. Ultrasonic Sensor

4.2. Ultrasonic Sensor

An ultrasonic sensor is an electronic device that uses ultrasonic sound waves to detect the distance between a target item and converts the reflected sound into an electrical signal. Ultrasonic waves travel quicker than audible sound waves. The transmitter and receiver are the two primary components of ultrasonic sensors.

The sensor measures the time between the transmitter's sound emission and its contact with the receiver to compute the distance between the sensor and the item. The formula for this calculation is **D = ½ T x C** (where D is the distance, T is the time, and C is the speed of sound ~ 343 meters/second).

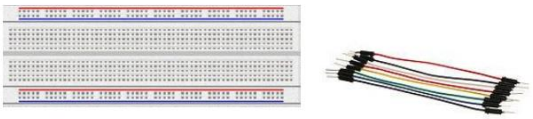


Figure 3. Breadboard and jumper wires

4.3. Jump Wires and Bread board

A breadboard is a solderless construction platform for prototyping electronic circuits and wiring for microcontroller projects. Jumper wires are simply wires having pins on both ends that can be used to connect two places without the need for soldering. With breadboards and other prototype tools, jumpers are widely used to make it easier to tweak the circuit as needed.

Figure 4. Potentiometer

4.4. Potentiometer

A potentiometer is a basic knob that provides variable resistance that can be read as an analog value on the Arduino board. This setting controls the LED's flashing rate in this case. Three cables are connected to the Arduino board.

A servomotor is utilized in this project to open the lid of the smart bin using the signal from the ultrasonic sensor.

Figure 5. LCD

4.5. LCD

LCD stands for liquid crystal display and is used to display character strings in a variety of projects.

B. Sketch Diagram

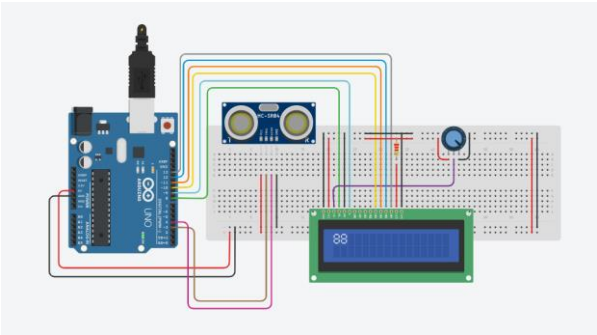
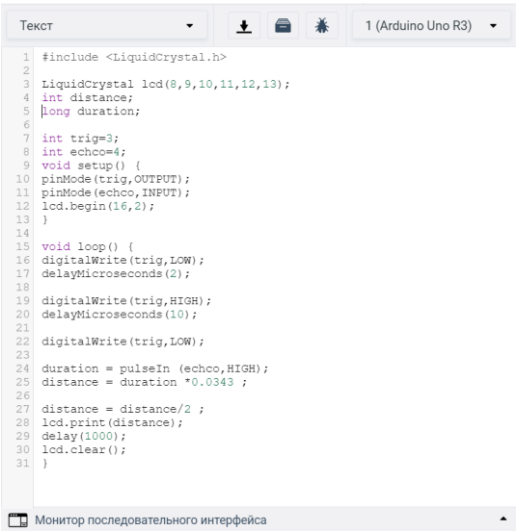


Figure 7. Sketch Diagram

The components that were used to complete this project are listed above. The schematic diagram of the process control system is illustrated in Fig. 7 and is based on the general description and the task for system design.

An example of the code used in the proposed work is shown below.



```
#include <LiquidCrystal.h>

LiquidCrystal lcd(8,9,10,11,12,13);
int distance;
long duration;

int trig=3;
int echco=4;
void setup() {
pinMode(trig,OUTPUT);
pinMode(echco,INPUT);
lcd.begin(16,2);
}

void loop() {
digitalWrite(trig,LOW);
delayMicroseconds(2);

digitalWrite(trig,HIGH);
delayMicroseconds(10);

digitalWrite(trig,LOW);

duration = pulseIn (echco,HIGH);
distance = duration *0.0343 ;

distance = distance/2 ;
lcd.print(distance);
delay(1000);
lcd.clear();
}
```

Figure 8. Piece of Code

C. Design

The system's design aims to be both cost-effective and user-friendly.

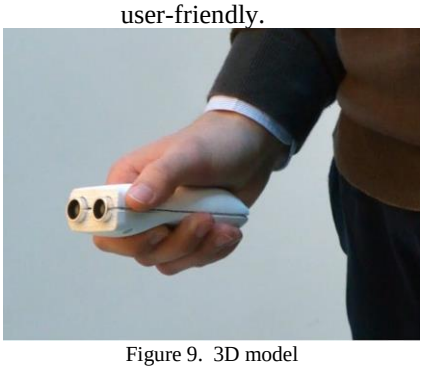


Figure 9. 3D model

Figure 9 shows a model of an ultrasonic sight. Designed so that it is comfortable to hold on the hand, so the size depends on the size of the person's hand.

V. CASE STUDY AND RESULTS

This project was only completed virtually as part of online learning, using platforms such as tinkercad.com to design a circuit from electronic components such as potentiometer, ultrasonic sensors, and other components. As a result, for easier electronic circuit simulation, all test cases were conducted on the tinkercad.com platform.

Test Case 1:

In the first case of testing a smart cane, we positioned three objects exactly in front of us at a distance of 35 inches, which means that it was reachable, the second was on the left at a distance of 10 inches and the third was on the right at a distance of 20 inches between us and the object itself. If you hold the cane in front of you, it will notify that there is an object in front, as for obstacles on the sides - no data was received, and no information was displayed on the serial monitor. Which means - a person himself needs to move the cane around in order be aware of whether the sides are clean.

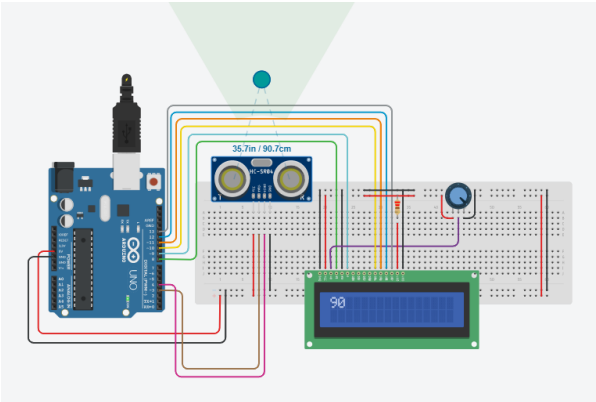


Figure 10. First Sketch Diagram

Test Case 2:

In this test, we decided to check the sensor ranges. The maximum range showed 35 inches, as soon as an obstacle appears at a distance of 35 inches, you will already receive an alert. As for the minimum, at 2 inches, you will soon run into. Therefore, considering - the average range is 16 inches.

Test Case 3:

In the second case of testing the smart cane, we also positioned three objects. And we made several changes to the circuit, we replaced the ultrasonic sensor with a motion sensor, and also added a piezo. So, the thermal motion is found faster and as a return, we receive sound from the piezo, which notifies us of obstacles.

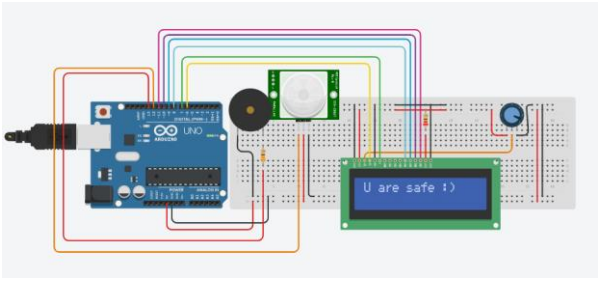


Figure 11. Second Sketch Diagram

TABLE 1. TABLE OF TEST CASE RESULTS FOR THE FIRST SCHEME.

	Alert	Sound	Display on the serial monitor	Vibration
2 inches	yes	no	yes	yes
16 inches	yes	no	yes	yes
35 inches	yes	no	yes	yes

TABLE 2. TABLE OF TEST CASE RESULTS FOR THE SECOND SCHEME.

	Alert	Sound	Display on the serial monitor	Vibration
2 inches	yes	yes	yes	yes
16 inches	yes	yes	yes	yes
35 inches	yes	yes	yes	yes

CONCLUSION

Everyone in the modern world, including the physically impaired, requires their own personal place of comfort. The divide between a normal person and a visually impaired person is noticeable and can be lessened or even abolished. With the use of technology, this can be accomplished. Our project Ultrasonic Sight would enable vision impaired people to travel alone without fear of getting lost or being involved in an accident. This will undoubtedly meet the fundamental requirements of visually challenged individuals. The developed app will be a useful tool for persons who are blind or visually challenged. As a result, our project will be beneficial to the health-care industry. The project was aimed at making life easier for the visually impaired and the blind. Replacing the cane with more convenient Arduino-based hardware. This does not require too much effort, but having achieved the result, the movements will become much easier, less effort and worries.

TABLE 3. TABLE OF ADVANTAGES AND DISADVANTAGES

Advantages	Disadvantages
Construction depending on the size of the hand - for convenience.	Cannot detect side obstacles.
Can run for an extended period of time. Design that is easy to use.	Cannot spot the hole ahead.
Low-cost construction. Operating costs are low. Can work in the dark.	With a motion sensor - may not detect a stationary object.

Future improvement:

Add heart measure. Connect with some device. If the gadget moves things in all directions and the heart rate is abnormal, the gadget synchronizes with the app, which alerts the closest "relative" of a probable panic situation so that first aid can be administered. It is desirable to minimize the strength of ultrasound guiding in this scenario as well, starting with interviews with blind and visually impaired people, in order to avoid panic situations caused by alerts.

The program will take GPS and vital data and load them onto a geographical map using a good API; the map will be viewable exclusively to the user's friends and relatives so that they can always be found in the event of an emergency, as in the previous scenario.

The map can be used for a variety of purposes:

- Reports coordinates and critical parameters in emergency situations.
- Positions for signaling and the ability to be escorted home using audio cues (step by step navigation).
- Possibility to simply connect and communicate with friends via vocal cues.
- It is possible to save common paths and set "safe" places.

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