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Electronic Obstacle Detector Spectacles for the Visually-Impaireds without Microcontroller

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Abstract
This study introduces a noble approach to a low budget and easy to use obstacle detector spectacles for visually-impaired people. A normal protection spectacle has been modified using a small circuit made off a driver network and an ultrasonic proximity sensor. The sensing mechanism bashed on transmitting ultrasonic sound signal and processing the reflected signals reflected by the object has to be synced. A NE555 timer IC along with some other passive components (resistors & capacitors) has been used as driver circuit. A piezoelectric buzzer has been used to give the sound output as warning. The whole contraption has powder using a rechargeable lithium-polymer (LIPO) battery. No jumper wires have not used for connection purpose.
Keywords: — *proximity detection, ultrasonic sound, NE555 IC, passive components (resistors & capacitors), piezoelectric buzzer, rechargeable battery, lithium-polymer (LIPO) battery.*

I. INTRODUCTION

Vision is one of the most important senses among other sensory organs. Without that, it will be very difficult to do very basic things. Like eating, writing, reading, and the most difficult are walking in crowded places. People who are born blind or have low vision or who have undergone any temporary eye surgery face such problems. In 2017, the World Health Organization (WHO) estimated that 253 million people worldwide were living with visual impairment, from which 36 million were legally blind, numbers that have already increased to 285 million and 39 million, respectively [1,2]. In such cases, using the surroundings to advantage becomes important. From the different elements present, sound can be used as a highly beneficial factor in developing products for the easy accessibility of the visually impaired. Keeping the same in mind, the final product should not be expensive, accessible, and easy to use for all kinds of people.

Various kind of obstacle detector contraptions already exist, but most of them are made of expensive microcontrollers and components, some of the contraptions are not that much user-friendly and some of them are so bulky in size that cannot be usable in this project.

Darms Michael S., et al. have created a machine luring and image processing bashed high-tech obstacle detector self-driving car that can not only detect but also differentiate between different objects. It is huge in size and also powered by a car battery [3]. On the other hand, Ess, Andreas, et al.

have created a very efficient model for detecting moving objects like cars, humans, etc. A computer monitor has been used as the output display [4]. Paulet et al. have created an ultrasonic sensor-based radar system that has coverage of up to 170^0 and a range of up to 40cm [5]. Latha, N. Anju et al. and M. Seema et al. have made a project using an ultrasonic sensor that not only can detect but also measure the distance between the user and the object. An Arduino uno-based microcontroller has been used as the central processing unit [6][7]. Samuda, Prathima, et al. and Busaeed, Sahar, et al. have made expensive Arduino nano-based smart glasses for blind people. A piezoelectric buzzer has been used as the output device and a non-rechargeable external 9v battery has been used to power the whole setup. Haripriya et al. have created a complex network of multiple ultrasonic sensors. It can sense obstacles in multiple directions. It has some microcontrollers as processing units and vibrations as output [8]. Mustapha, Baharuddin, et al. and Adarsh, S., et al have compared the use of ultrasonic sensors and infrared sensors as obstacle detectors, according to their observation ultrasonic sensor is much superior then infrared sensor because of its
wider range and higher performance [9] [10].

In this present work, we have modified a normal protection glasses into an obstacle detector electronics glasses utilizing an ultrasonic sensors and a NE555 IC instead of expensive microcontroller. Here our main motive is to make a cost effective and a simple setup which can be wearable and very easy to use for every standard of people. The setup is very small, no complex network and wired connections are there. A piezoelectric buzzer has used to give sound output. When an object is detected it will sound and the intensity of the sound will also vary according to the distance. It also has a very small but power full 3.7v rechargeable LIPO battery and charging process is very simple.

II. METHODOLOGY

A. Apparatus used

Very few apparatus have used in this project black safety glass has been procured from nearby medical shop. NE555 IC, resistors, veroboard, piezoelectric buzzer were obtained from the neighborhood market.

B. Working principle

The working principle of this project has been based on ultrasonic sound being transmitted and the reflected signal being processed by the obstacle.

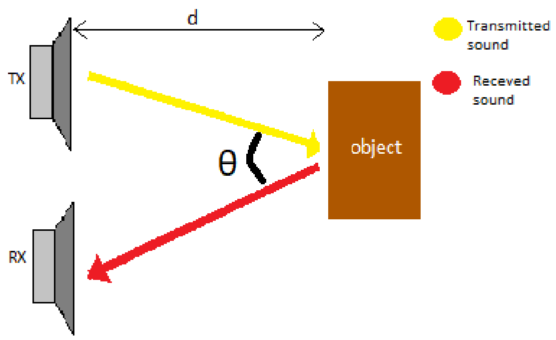


Fig:1, ultrasonic sensor working

This sensor has four pins: Vcc, trigger, echo, and Ground. Here, Vcc and Ground have been used to provide power to the module, trigger has been the input pin, and echo has been the output pin. When a square signal has been fed into the trigger pin, it has enabled the module in the sensor. The module has had an inbuilt 40 KHz crystal oscillator, so it could generate and transmit a sound signal of 40 KHz. When it has received the reflected signal, it has generated a PWM signal as output to the echo pin. The pulse width has depended on the strength of the received signal. The signal strength has also depended on the angle between the transmitted and received signals (θ) as shown in Fig: 1. The angle between the transmitted and received signals has been inversely proportional to the distance (d) between the obstacle and the sensor as shown in Fig: 1. This has meant that depending on the distance (d), the module has varied the PWM signal as shown in Fig: 2.

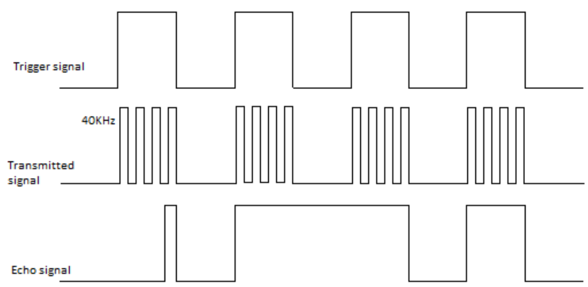


Fig: 2, input, output signal flow diagram

A NE555 IC has been used to generate the trigger signal. When the trigger pulse has been high, the ultrasonic sensor module has generated a 40 KHz sound signal. A 100µF capacitor has been used to smooth out the output PWM signal. A piezoelectric buzzer has been connected in parallel with the capacitor. When the discharge has occurred through the buzzer, the sound has come out. The sound intensity has depended on the on-time of the PWM signal. This has meant that the intensity would increase when the obstacle has been closer and vice versa.

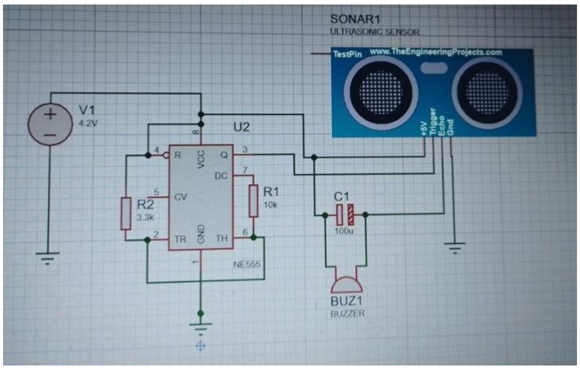


Fig:3, circuit diagram of the setup

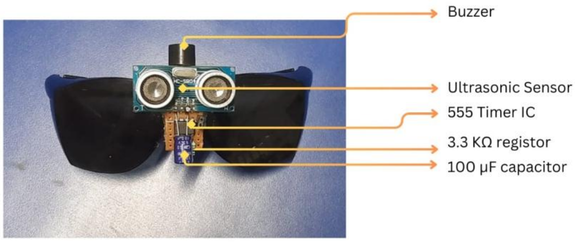
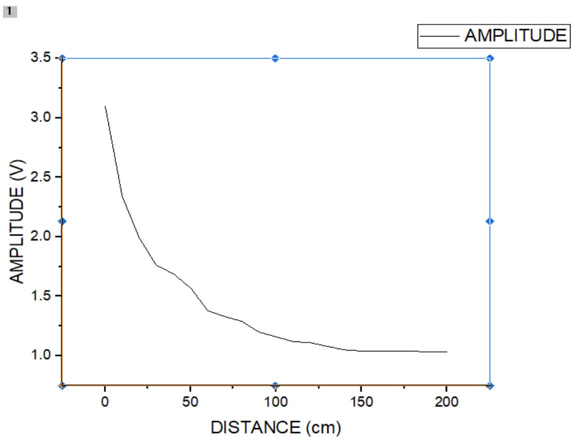


Fig: 4, Full setup

III. RESULT AND ANALYSIS

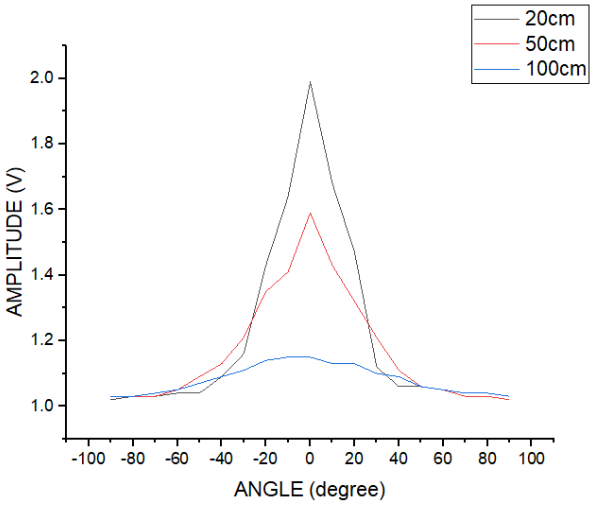
The project has been tested very precisely by varying the distance and measuring the voltage across the capacitor, and the sound intensity of the piezoelectric buzzer. 20 data points of 10cm intervals have been taken. The maximum range of 200cm has been found out experimentally.



Graph 1: Distance(cm) vs Amplitude(V)

According to this observation, the distance vs amplitude relationship is parabolic in nature as shown in graph 1.

The setup has also been tested by varying angle between sensor and the obstacle to calculate the horizontal effective area. The test has been done at fixed distances of 20cm, 50cm, and 100cm.20 data points of +10° intervals has been taken. Considering 0° as initial point of the obstacle, the maximum range has been tested +90° and minimum range has been tested as -90°.



Graph 2: Angle(degree) vs Amplitude(V)

As shown in graph 2, we can say that at 0°, it has maximum sensitivity and the sensitivity gradually decreases with increasing angle. A good effective area of -30° to +30° has been observed at 50cm distance.

From the graph 1 and graph 2 we can say that our setup has a good distance range of 150cm and also a good angular range of 60°.

Observation table:-

1. Net Weight	37 grams
2. Battery life	2.5hrs
3. Minimum distance	2cm
4. Maximum distance	170cm
5. Maximum angular range	60 degrees (at 50cm distance)
6. Total price	Rs- 230

IV. CONCLUSION

The electronic obstacle detector spectacles designed especially for visually-impaired people are ultimately a resource of esteem use for the regular accessibility of a visually-impaired person. With their multiple benefits through a simple circuitry, they would prove to be a model of great importance in the technology industry. From an empathetic point of view, we aim to make the lives of visually-impaired people a little easier with the use of these simple and cost effective smart glasses, given their daily struggles amongst all of the stigma around 'blindness'.

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