Novel approach for Designing of Low Cost High Sensitive Ultrasonic Proximity Detector for Blind Person using Wireless Techniques

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Abstract— Proximity Detection is a technique for realizing any obstruction in a given range. The technique involves an injection of an additional pulse to a piezotransmitter for amplification and calibration of reflecting pulse from the obstruction, which is received by piezoreceiver. The technique "Ultra Sonic Proximity Detector (USPD)" is found useful in particularly to design the Blind Stick1, 2, which can makes the life of a blind person more comfortable during walking. Not much has been done in the field to improve the sensitivity of the blind stick. In this article the proximity detector is design in such a way which is high sensitive and having both option for wireless head phone and buzzer.

Key words: Additional Pulse, Piezo-Transmitter, Piezo-Receiver, Receiving Pulse, Ultra Sonic Proximity Detector, Blind Stick

I. INTRODUCTION

Proximity detection is the detection of an object in a given range. Any objects within the desired range are detected, while objects out of range are ignored. The detected point is independent of size, material, or reflectivity of the object. There are several distance measuring techniques like Infrared, Radio Wave like Radio Detection and Ranging (RADAR), Ultra Sonic Waves like Sound Navigation and Ranging (SONAR), etc. Each of them has some advantages and disadvantages. Most of the time, optical techniques are preferred for their high resolution[5,6], however they are not best suited for transparent objects. Optical performance is also limited in dusty environments. On the other hand, ultrasonic distance measurement performs much better in dusty environments or with transparent objects. Comparing USPD with General Purpose Type Distance Measuring Sensors (GP2D12), USPD can work in dusty environment, detect transparent or black objects, however may not be very efficient in detecting "Acoustically soft or damping" objects. USPD output is linear with distance and since it is low power device it can operate continuously. The proximity detector system having wide range of applications such as Robotics[3,4], Electrified wire barrier, Low velocity projectiles, Electrodes Whips, Automatic Injectors, Tear gas or Pepper Sprayers, Motion detection, Respiration rate measurement[8], Vehicle proximity detection system, Police radar system, Electronic switching etc.

The purpose of the present note is to introduce a proximity detector system, which will detect an obstruction present at the front of a blind person by making an audio frequency (4-5 KHz) via headphone. The present note will also give an idea to design the system in such a way, so that it can work in any medium and can detect any obstruction (transparent, electrically conducting, electrically non conducting etc.). To carry out the requirements the Acoustic Proximity Sensor is the ideal one as the photoelectric proximity sensor and capacitive proximity sensor having problems to detect the transparent and electrically non conducting obstructions respectively.

II. CIRCUITAL DESIGN AND METHODS

The circuit was developed part by part and tested individually to get the preferred result. The output of the individual part was measured by oscilloscope. Mainly the parameters are transmitting frequency range, receiving output signal after amplification, DC level shifting, and output frequency from the oscillator for headphone. Finally the total system was implemented in a Vero Board to measure the final parameters along with its sensitivity. The block diagram of the system is described in Fig 1.

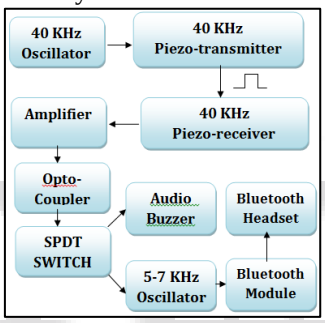

Fig. 1: Block diagram of Ultra Sonic Proximity Detector System.

III. OBSERVATION AND RESULTS

The output of individual part of the system is very much essential for final design of the system to make it as market product. First of all, the transmitter part can transmit the frequency within a range of 30 to 50 KHz, which is good enough. The nature of the transmitting wave is a perfect square, which one is ideal one to get the high efficiency of the piezoreceiver. The result of the amplifier output is quite good. By placing the transmitting and receiving crystals face to face at a distance of 4cm, the amplifier output is around 8V. The Distance Vs Amplifier Output is shown in Fig. - 2. The graph shows the linear response of the system. The data is given in Table-1.

Distance(cm)	Amplifier Output(Voltage)
4	8
6	7
8	6
10	5
15	4
20	3
25	2
30	1
35	0.5

Table 1: Amplifier output with respect to distance.

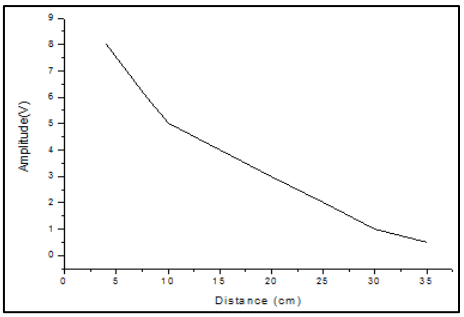

Fig. 2: Distance Vs Amplifier Output.

It is found that when the amplifier output is at least 125mv, the Buzzer or Headphone will be switched on automatically which indicate the high sensitivity of the detector system. Finally we can say that the output result of this USPD system is good enough and the circuit can be implemented for the market product of this system.

IV. DISCUSSION

The transducer is placed in such a way that the signal transmission will be parallel to the ground. The Transmitter and Receiver transducers are placed finally 3 cm apart from each other [Fig 3]. The final circuit has been designed on a Vero Board of size 2.3"× 3.5" [Fig 4]. The angle θ (horizontal angle with transducer axis) of each transducer can vary to change the distance from the obstruction to be detected. We have fixed the angle at 86.5º so that it can detect the obstruction, which is within 24-25 cm ahead from the sensor.

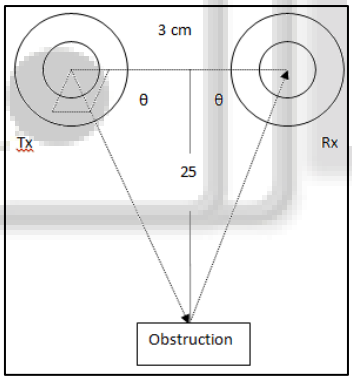

Fig. 3: Transmitter and Receiver Placements within the circuitry.

The circuit on Vero Board was finally placed inside a plastic box of size 4"× 4", which was finally fitted on the bottom of a PVC pipe of length 4' to use as a blind stick for obstruction detector.

Fig. 4: Designing of the final circuit of the proximity detector.

Two portable 9v batteries are connected with each other inside the box to supply +9v, Ground and -9v. The circuit concept is on Fig 5.

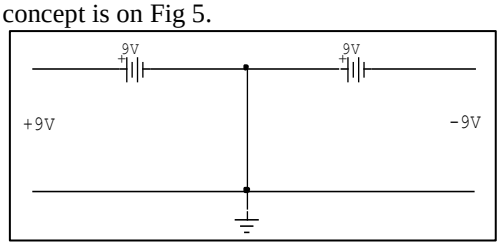

Fig. 5: +/- 9V Power supply using two 9V batteries.

The system is designed in such a way so that the used battery can be easily changed when it is needed. The weight of the full system is more comfortable for use.

One of the main advantage of the system is that the output of the amplifier with respect to distance vary linearly and the sensitivity of the system is quite high with respect to the previous system used as proximity detector[1,2].

The output of the 5-7 KHz is given to a Bluetooth model which in turn is fed to a Bluetooth headset, hence wireless auditory signals can be transmitted making it more easy for the user.

After complete design of the system [Fig: 6], it is working properly and its sensitivity is quite good. It can detect the obstruction easily, which is 10-11 inches ahead from the sensors, which is good enough with respect to available proximity detector. Both the buzzer and headphone are connected finally with the system. In case of metallic obstruction it has been found that the pitch of the audio sound by audio buzzer or headphone is quite high than the other material like wooden. This system can't work if the obstruction absorbs sound energy. The blind person can use any one option, which he or she thinks better for their convenience

Fig. 6: A Blind Stick with the wireless Bluetooth headset

V. CONCLUSIONS

This paper presents a low cost high sensitive Ultrasonic Proximity Detector for blind. The literatures related to this topic were reviewed and analyzed. The proposed system tries to eliminate the flaws in the previous system. It aims to solve the problems faced by the blind people in their daily life. The system also takes measures to ensure their safety by the use of wireless/bluetooth headphones.

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