ISSN 2349-7815

International Journal of Recent Research in Electrical and Electronics Engineering (IJRREEE)
Vol. 2, Issue 3, pp: (20-25), Month: July 2015 - September 2015, Available at: www.paperpublications.org

Annunciator for Blind Person Using Ultrasonic Sensor

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Abstract: **The challenges faced by the blind people in their everyday lives are not well understood, obstacle avoidance problem is an essential part of navigation for the blind. The challenging task is to work with a path where the environment is completely unknown .This paper contains a method to implement a mobility aid for blind person, it provides the information to avoid obstacles distance based on ultrasonic sensors and this also can be used in automatic robots, self-propelling vehicles in automated production factories etc. Model contains signal processing unit with MSP430 microcontroller which receives data from Ultrasonic sensor then process it and gives alert to the blind person using voice processor with earphone/speaker.**

Keywords: **MSP430, Signal Processing unit, Ultrasonic sensor, fire sensor, Voice processor.**

1. INTRODUCTION

Mobility for the blind can be defined as the ability to move with ease, speed and safety through his environment independently. With the advances of modern technologies many different types of devices are available to support the mobility of blind which are generally known as electronic travel aid which aims at conveying information about the environment to visually impaired individuals, so that they can exploit part of the information that sighted people normally use to experience the world and navigate it.

There are various methods to measure the distance of obstacle. One of the methods is by means of ultrasonic. Audible electronic mobility aid and obstacle detector designed for use by individuals who are blind or have low vision, it is a small electronic device aids users who are blind or visually impaired with orientation and mobility. By listening to sounds produced by the device, users can determine the distance and location of objects and some of the object's features.

Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo. The main reason to use ultrasonic sensor is that, the ultrasonic method has unique advantages over conventional sensors are, discrete distances to moving objects can be detected and measured. Less affected by target materials and surfaces, and not affected by colour. Solid-state units have virtually unlimited, maintenance free life.

The device attaches to the golf grip handle of a long cane or onto gloves which is worn by the blind person. A headphone provides audio feedback. The device comes with headphones and an instructional audiotape with sample sounds and a vibrator which vibrates when obstacle is detected. The device also incorporates a fire sensor to alert the blind person if fire is detected. Ultrasonic sensors are based on the output waveform whose pulse width varies with round trip delay time of ultrasonic pulse or distance measured. A fire sensor detects the presence of flame within the coverage area. In An Electronic Travel Aid for Navigation of Visually Impaired Persons [2] a survey was done of various ETAs based on features and performance parameters. In Obstacle Avoidance Electronic Travel Aids for Blind [3] the author develops a navigational/orientation system that uses RFID technology, GPS and computer vision. In Electronic white cane for blind people navigation assistance", World Automation Congress (WAC). In [7] a bus detection mechanism for the blind in travelling from one place to other using RFID system was developed

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2. SYSTEM ARCHITECTURE

The setup consists of different sensors like ultrasonic sensor and the fire sensor as the input units

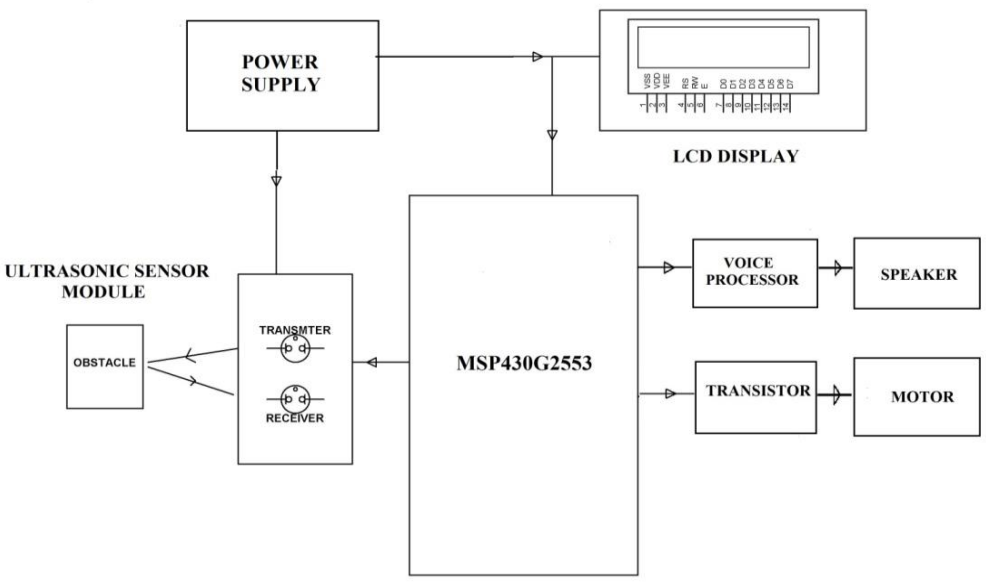

Fig.1: Block Diagram of the Setup

Different types of ultrasonic sensor and fire sensors are available in the market. Ultrasonic sensor measures the round trip delay which is directly proportional to output pulse width of the distance measured. The block diagram of proposed hardware is shown in Fig.1.The microcontroller triggers the ultrasonic sensor and receives echo when it detects any obstacle. The microcontroller collects information from ultrasonic sensor (and fire sensor if any fire is detected) and computes the distance.

The microcontroller works on the 3.3v which receives data signal from Ultrasonic sensor and fire sensor then processes it and gives alert to the blind person using voice processor with earphone/speaker, this project also detects fire and gives alert.

Signal processing unit contains MSP430 microcontroller which is used for interfacing between different sensors. Here as output device audio sound generator are used, the audio tones gives information about the travelling path and can hear through head phone/ speaker. The audio messages given through the headphone/speaker are like STOP when the distance measured is less than 0.3m, DANGER when the distance measured is less than 0.6m, WALK when the distance measured is greater than 0.6m and FIRE when fire is detected.

3. ALGORITHM FOR DISTANCE COMPUTATION

The principle behind ultrasonic distance measurement is that the sensor sends an ultrasound wave that reflects once it hits the object on its path. As the wave bounces off, it travels back to the receiver end of the sensor (as shown in Fig.2).

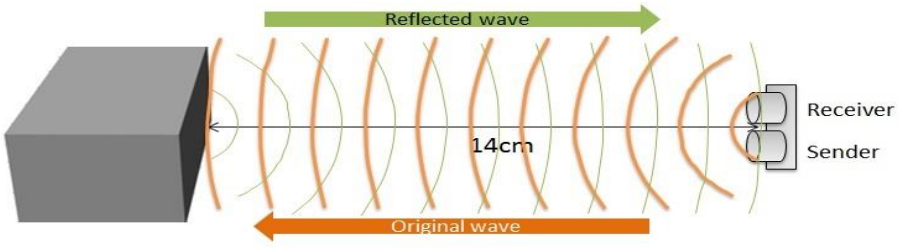

Fig.2: Ultrasonic Sensor uses Sound Waves to Measure Distances.

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The sensor measures the time it takes for the emitted wave to travel from a sender to the object and back to the receiver. Knowing the round-trip travel times and the speeds of the wave in the medium, ultrasonic devices calculate the distance that the sound travelled. We use the following equation to calculate the speed of sound.

Distance that sound travels = speed of sound in the medium x time that sound travels

That is, for calculating the distance that sound travels; distance = velocity x time. Hence, the distance between the sensor and the object is one-half the distance travelled by the sound wave.

Distance between sensor and object = 0.5 X distance that sensor travels

The above equation is the calculation to determine the distance between the sensor and the object.

4. PROPOSED HARDWARE DESIGN

Distance of obstacle depends upon speed of ultrasonic and time required to travelling it. If the time required in travelling the pulse from sensor to object and return back to sensor can be measured than the measurement of distance can be done. This can be achieved by using an ultrasonic module which can give the time waveform on C.R.O. in terms of pulse width. The output pulse width will vary in proportional to the distance travel by the ultrasonic wave.

The sensor transmits an ultrasonic wave and returns an output pulse that is directly proportional to round trip delay. By measuring the pulse width of output wave, the distance to target can easily be calculated.The ultrasonic sensor produces pulse width in the output. Ultrasonic sensor contains 4 pins these are Vcc, Trigger, OUT and GND as shown in Fig. 3. Vcc and GND are supply and ground pins.

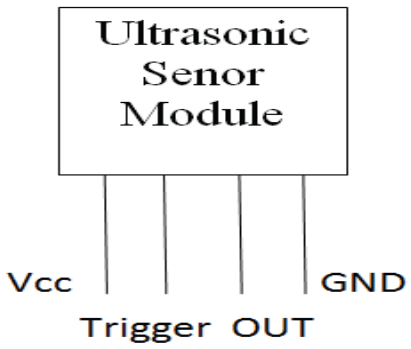

Fig.3: Pin Diagram of Ultrasonic Sensor

Trigger input receives 10µs trigger pulse. Microcontroller will make this pin HIGH then delay for about 10 µs and make pin LOW again. OUT pin gives the Output pulse width depending upon distance travel.

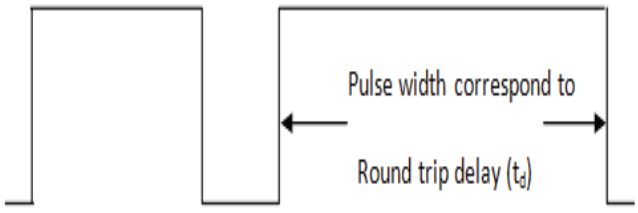

Fig.4: Ultrasonic Sensor Output Wave

After the trigger is given to microcontroller it measures pulse output on OUT pin. Timing diagram of ultrasonic sensor output wave is shown in Fig. 4.The output pulse duration is converted to distance measured and the temperature effect is also considered. Ultrasonic sensor has three pulses first is a short pulse which is transmitted at the time of 10µS trigger input pulse.

Second pulse is the pulse reflected by an object and third pulse is the signal that the sensor receives and converts it to a pulse of variable duration. A flame detector is a sensor designed to detect and respond to the presence of a flame or fire.

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Responses to a detected flame depend on the installation, but can include sounding an alarm, deactivating a fuel line and activating a fire suppression system.. A flame detector can often respond faster and more accurately than a smoke or heat detector due to the mechanisms it uses to detect the flame.

5. ALGORITHM

The process starts when the microcontroller sends trigger pulse to the ultrasonic sensor, the ultrasonic sensor wits for the echo then it calculates the microcontroller measures the time taken by the echo to travel back to the sensor.

It the measured distance is greater than 0.6 meter then the audio play back is "WALK" ,if the distance measured is greater than 0.3meter and less than 0.6 meters then audio play back is "DANGER" and if the distance measured is less than 0.3 meters then the audio play back is "STOP". This project also incorporates a fire sensor as its input module, when fire is detected then the audio play back is "FIRE".

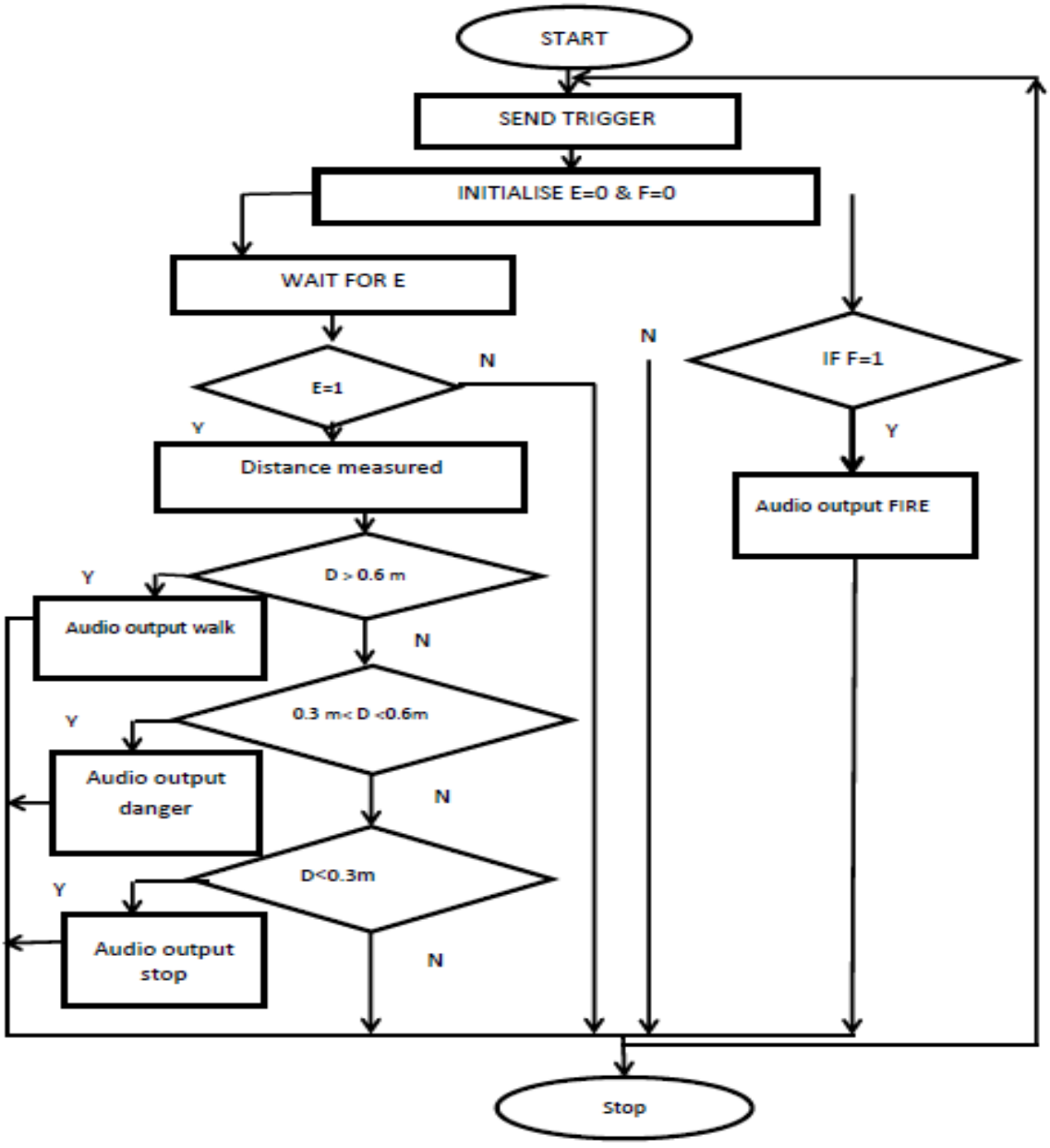

Fig.5: Flow Chart of Project Flow

Where *D=distance , *E=echo .

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6. EXPERIMENTAL RESULTS

The intelligent cane has been evaluated with the ultrasonic sensor the ultrasonic sensors based on the pulse width. The HC-SR04 ultrasonic sensor is used to design this project; it uses sonar to determine distance.

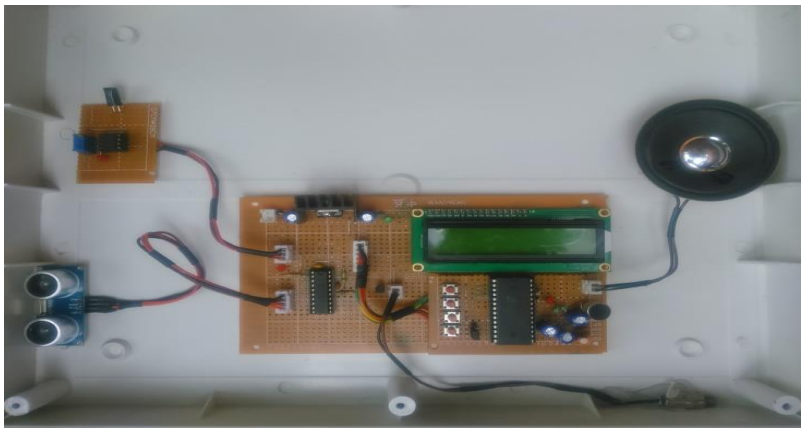

Fig.6: Annunciator for Blind Person using Ultrasonic Sensor module

It offers excellent non-contact range detection with high accuracy and stable readings in an easy-to-use package. From 2cm to 400cm or 1" to 13feet. Its operation is not affected by sunlight or black material like Sharp rangefinders. It comes complete with ultrasonic transmitter and receiver module. Distance information is then conveyed to the user though a buzzer and vibrator.

7. CONCLUSION

In this paper, we have presented new intelligent system for guiding individuals who are blind or partially sighted, and we have described how the system can be used to enable those people to move with the same ease and confidence as a sighted people.

The system has been used to receive the data from the sensing devices and command. We have integrated the ultrasonic sensor data in order to detect obstacles, and to obtain more detailed regarding the blind's environment. Evaluations of the system that we have developed have been conducted by attaching the prototype to the handle of the white cane. The experimental results have shown the usefulness of the system in allowing blind people to move independently, safely and quickly among obstacles and hazardous places

ACKNOWLEDGMENT

We take this opportunity to thank Dr. K. A. Sumithra Devi, Principal, GSSSIETW, Mysuru, our H.O.D, Mr M.V. Sreenivas Rao, Dept.of Instrumentation Technology, Mrs. Lalitha .K , Assistant Professor, Internal guide for their support.

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