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# ULTRASONIC SPECTACLES & WAIST- BELT FOR VISUALLY IMPAIRED & BLIND PERSON

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***Abstract*— This paper presents an electronic navigation system for visually impaired and blind people. This system understands obstacles around it and in front, left and right direction using a network of ultrasonic sensors. It effectively calculates distance of the detected object from the subject and prepares navigation path accordingly avoiding obstacles. It uses speech feedback to aware the subject about the detected obstacle and its distance. Using the distance ultrasonic sensor distance is calculated from obstacles to subject. Through the microcontroller the alert to subject or user.***

***Keywords*— Blind people, Ultrasonic sensors, AT89S52 microcontroller, Detected obstacle, Speech message, Voice playback & circuit.***

## I. INTRODUCTION

There are many traditional and advanced navigation aids are available for visually impaired and blind people. Usage of all these travel aids for detecting obstacles for smooth navigation requires a good training. Although many advanced electronic navigation aids are available these days for visually impaired and blind people, very few of them are in use.

In existing method IR sensor is attached to stick of blind person is used to detect obstacles. When sensor detect obstacle it just give buzzer sound as indication, but this buzzer sound does not indicate person exact direction of obstacle.

The main aim of the project is to design a voice based alerting system for the blind people based on ultrasonic distance sensor for obstacle detection and voice circuit for voice based announcements. The advantage of this device is voice based announcement for easy navigation that is the user gets the voice which pronounces the directions he needs to move to reach his destination. Ultrasonic Sensor senses the obstacles in its path by continuously transmitting the ultrasonic waves. If any obstacle comes in its vicinity then the ultrasonic waves get reflected back to the system. The ultrasonic receiver senses these ultrasonic waves and this information are passed to the Microcontroller. The microcontroller gives alerts through voice message.

When the blind person wears this ultrasonic waist-belt at stomach or at head, which consist of an ultrasonic distance sensor, Ultrasonic distance sensor, which is capable of detecting obstacles in its path of a blind person, senses the obstacles. This information is passed to the microcontroller which then alerts the user through voice circuit in case of

any obstacles in that particular direction, which helps the user to avoid obstacles in its way. The controlling device of the whole system is a Microcontroller. The user gets alerts through ultrasonic distance sensor and voices using voice circuit. Although many advanced electronic navigation aids are available these days for visually impaired and blind people. Very few of them are in use. Therefore user acceptability assessment of such system is very important. The most influencing parameter in this regard are size, portability, reliability, useful functionality, simple user interface, training time and affordability in terms of cost. Considering all these requirements, a tailor made low cost and reliable navigation system is proposed in this paper for visually impaired and blind people.

## II. DESCRIPTION OF SYSTEM

An embedded system integrating five ultrasonic sensor pairs Voice and play back circuit, earphone with microcontroller. Fig 1 shows the proposed system for visually impaired and blind navigation. In this wearable system, two ultrasonic sensor pairs are mounted on the eye glass and rest three pairs are mounted on customized waist belt [1]. These three ultrasonic sensor pairs are placed 12 cm apart facing towards front left, centre and right direction. Using this placement and alignment of ultrasonic sensor pairs, subject can detect obstacles from waist level height to head level height in the range of 500 cm in any direction.

These five pairs of ultrasonic sensor collect real time data after every 20 m/sec and send to microcontroller. Voice and play back circuit is used to give voice alert information to subject or blind people. Voice play back circuit is used for storing pre-recorded speech message. Variable duration of speech message up to 42 sec [2]. Duration can be stored in voice and play back circuit. When the blind person wears this ultrasonic waist-belt at stomach or at head, which consist of an ultrasonic distance sensor, Ultrasonic distance sensor, which is capable of detecting obstacles in its path of a blind person, senses the obstacles. The user gets alerts through ultrasonic distance sensor and voice using voice circuit.

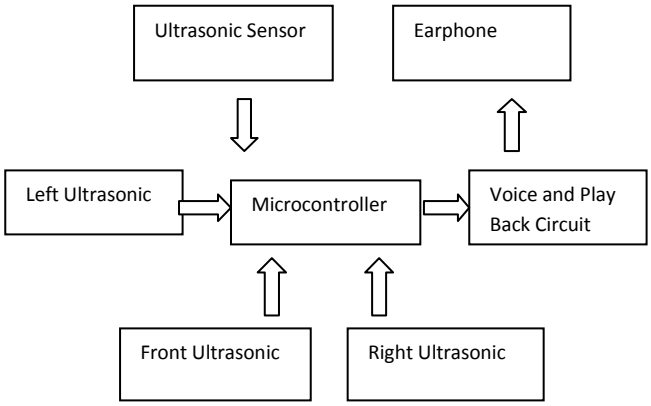



**Figure.1**

## III. OBSTACLES DETECTION AND DISTANCE CALCULATION MODULE

### A. *Obstacles detection:*

Ultrasonic sensors are used for obstacles detection and calculation of its adaptive distance from the visually impaired person. Ultrasonic sensors are used in pair as transceivers. One device emits sound wave is called transmitter and other who receives echo is known as receiver [3]. These sensors work on principle similar to radar or sonar which detects the object with the help of echoes from sound waves. The time interval between sending the signal and receiving the echo is calculated to determine the distance to an object. As the sensors use sound wave rather than light for object detection. so can be comfortably used in ambient outdoor application.

Five ultrasonic sensor pairs are used in this system [1].

Input Requirement:

Working Voltage: 5V (DC)

Working Current: 15mA

Output Signals:

Echo signal: PWM signal. Time required for signal to travel twice between source and obstacles.

Range: 5 meters.

### *B. Distance Calculation:*

For distance calculation following equation is used:

D=[(EPWHT)*(SV)/2]

Where,

| | | |
|---|---|---|
| D | = | Distance in cm |
| EPWHT | = | Echo pulse width high time |
| SV | = | Sound velocity in cm/s |

Before concluding the obstacles distance from the subject, repeated information sampling and averaging is performed. As ambient light condition do not affect ultrasonic sensors, object detection and distance calculation can be performed accurately.

## IV. HARDWARE AND SOFTWARE

### A. HARDWARE

#### *1. MICROCONTROLLER (AVR ATmega16):*

The ATmega16 is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega16 achieves throughputs approaching 1 MIPS per MHz allowing the system designed to optimize power consumption versus processing speed. The ATmega16 provides the following features: 16 Kbytes of In-System Programmable Flash Program memory with Read-While-Write capabilities, 512 bytes EEPROM, 1 Kbyte SRAM, 32 general purpose I/O lines, 32 general purpose working registers, a JTAG interface for Boundary scan, On-chip Debugging support and programming, three flexible Timer/Counters with compare Modes, Internal and External Interrupts, a serial programmable USART, a byte oriented Two-wire Serial Interface, an 8-channel, 10-bit ADC with optional differential input stage with programmable gain (TQFP package only), a programmable Watchdog Timer with Internal Oscillator, an SPI serial port, and six software selectable power saving modes.

#### *2. ULTRASONIC SENSOR:*

Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object [2].

Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact Measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal.

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Wire connecting direct as following:

1. 5V Supply
2. Trigger Pulse Input
3. Ec1ho Pulse Output
4. 0V Ground


**Figure.2 Ultrasonic sensor**

### *3. VOICE OPTIC IC:*

AP8942A high performance Voice OTP is fabricated with Standard CMOS process with embedded 1M bits EPROM. It can store up to 42sec voice message with 4-bit ADPCM compression at 6 KHz sampling rate. 8-bit PCM is also available as user selectable option [1]. Two trigger modes, simple Key trigger mode and Parallel CPU trigger mode facilitate different user interface. User selectable triggering and output signal options provide maximum flexibility to various applications. Built-in resistor controlled oscillator, 8-bit current mode D/A output and PWM direct speaker driving output minimize the number of external components. PC controlled programmer and developing software are available.

## B. SOFTWARE:

### *1. PROTEUS SOFTWARE:*

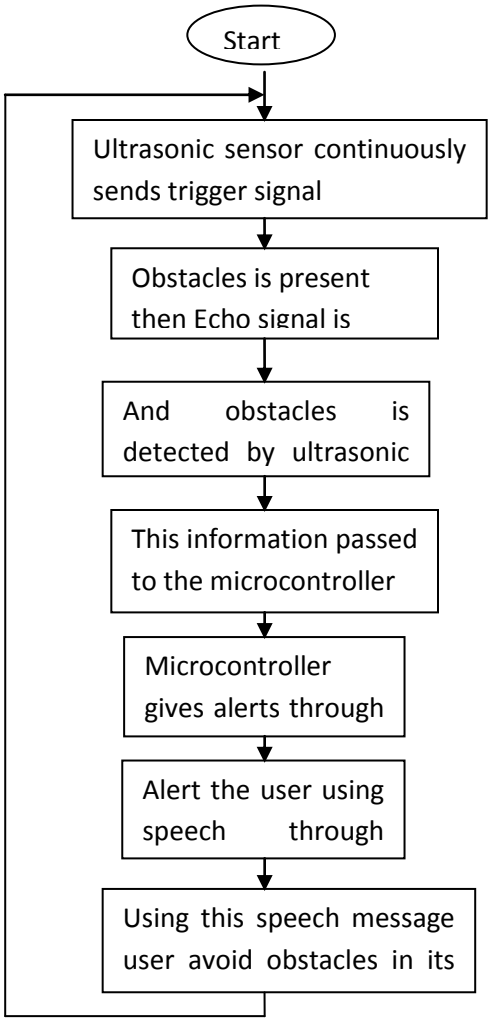
Proteus is one of the most famous simulators. It can be uses to simulate almost every circuit on electrical fields. It is easy to use because of the GUI interface that is very similar to the real Prototype board. Moreover, it can be used to design Print Circuit Board (PCB). The Proteus Design Suite is wholly unique in offering the ability to co-simulate both high and low-level micro-controller code in the context of a mixed-mode SPICE circuit simulation. With this Virtual System Modeling facility, you can transform your product design cycle, reaping huge rewards in terms of reduced time to market and lower costs of development .If one person designs the hardware and the software then that person benefits as the hardware design may be changed just as easily as the software design. In larger organizations where the two roles are separated, the software designers can begin work as soon as the schematic is completed; there is no need for them to wait until a physical prototype exists.

### *2. AVR STUDIO:*

AVR studio is an Integrated Development Environment (IDE) by ATMEL for developing applications based on 8-bit AVR microcontroller. Prior to installation of AVR Studio you have to install the compiler WinAVR. This will allow AVR Studio to detect the compiler. AVR microcontroller units (MCUs) all have the same core, i.e. same instruction set and memory organization. The AVR Studio 4 is an Integrated Development Environment for debugging AVR software. The AVR Studio allows chip simulation and in-circuit emulation for the AVR family of microcontrollers. The user interface is specially designed to be easy to use and to give complete information overview. The AVR

uses the same user interface for both simulation and emulation providing a fast learning curve. The AVR Studio uses a COF object file for simulation. This file is created with through the C compiler by selecting COF as the output file type. For more information on creating this file, see the C compiler documentation. Launch the AVR Studio by either selecting it through the Start Menu or by selecting the program icon (if available). Once the IDE is running, select File Open through either the File Pull-down Menu or by clicking on the File Open Button.

## V. SYSTEM FLOW:




Above flow chart is shows the flow of system. How the system is actually works as navigation of obstacles is describe in above flowchart. This system is used for blind person and visually impaired person. In this system ultrasonic sensor continuously send trigger signal from transmitter side and if any obstacles are in front, right and left are detected then Echo signal is received by receiver side of ultrasonic sensor. In this system ultrasonic sensor acts as obstacles detector. In voice and play back circuit speech message is recorded in this IC. Received signal is passed to the microcontroller. Microcontroller gives alert through voice to blind people. After detecting the obstacles this recorded speech message is alert to blind people through earphone.

## VI. ADVANTAGES

- Accurate detection of obstacles in front left and right direction using the recorded speech message.
- Detection of waist level height to head level height obstacles is possible in this system.
- There is minimum physical interface in the system.
- Low power consumptions required for the system.
- Less training time is required for works the system accurately.

## VII. FUTURE SCOPE

This system can also used by patients suffering with various eye ailments like cataract, post eye operative situations and others. This system can be used to navigate by everyone not only visually impaired under certain circumstances, like foggy mornings with low visibility. Where the visibility is

very low, then this system can be used. This system can be modified into a more sophisticated version of itself by using high intensity ultrasonic waves to be used as a navigation system for geological explorations. Hence this device has a good future scope. By improvising it depending on our requirement like effective sensors and controllers example PIC, ARM, we can use it for various purposes as mentioned above.

## VIII. RESULT

A wearable system is developed by using five ultrasonic sensor pairs on waist belt or spectacles, AP8942A voice IC and earphone with ATmega16 microcontroller. To check the performance of this electronic system, testing is performed in laboratory level on trained blind peoples. At the time of testing the different type of obstacles has been placed within 10 meter range. During the experiment user's walking on the way he find this different obstacles. Time taken by the users for successfully walking through the obstacles is measured and travel speed for test has been calculated by distance sensor. Less training time is required to use this system.

## IX. CONCLUSION:

This system **"Ultrasonic Spectacles and Waist-belt for Visually Impaired and Blind people"** is mainly developed to design a voice speech message based alerting system for the blind people based on the ultrasonic distance sensor for obstacle detection and voice an play back circuit for voice speech message based announcements. The advantage of this device is voice speech message based announcement system is easy for navigation i.e. the user gets the voice message which announced the directions he needs to move to reach his direction. Considering all the requirements this system is more reliable, low cost and low power consumption for the path navigation.

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