Design of Ultrasonic sensors based spectacles and waist belt for blind using low cost Arduino

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ABSTRACT:

Due to rapid growth of ultrasonic sensor based recognition techniques for friendly hardware designing, introduced an integrated approach to real time obstacle detection, and direction based alerts which is intended to be used as a human-machine interaction interface for the intelligent spectacles and blind stick designed with audible alerts. This paper demonstrates that the ultrasonic sensors are interfaced to the waist belt and spectacles of a blind person and can be used effectively for obstacle detection and produce alerts through buzzer module when ultrasonic waves were interpreted.

For obstacle detection the sensor based data is calibrated and filtered. 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 sensed data are passed onto the Microcontroller. The microcontroller gives alerts through buzzer alarming unit.

Keywords:

AVR 8-bit microcontroller, Ultrasonic sensors, buzzer module.

I INTRODUCTION:

Highly interaction in human machine in daily lives has made user interaction progressively very important. Expansion of sensor based advanced technology sophisticated human force and stress to physically disabled persons.

The electronic circuits has been greatly reduced the weight and area of consumer electronics products such as design of an ultrasonic sensor based spectacles and waist belt for blind, speaking microcontroller for deaf and dumb, gesture recognition based controlling of devices and handheld based wheel chair controls for physically challenged etc.

Automation is the most frequently spelled term in the field of electronics and electrical. The hunger for automation brought many revolutions in the existing technologies. One among the technologies, which had greater developments, is the sensor based alerting technology and applications designing. These had greater importance than any other technologies due its user-friendly nature. In nowadays, we must make use of various high-tech tools and equipments to get our jobs done and make our life comfortable. And the sensor is the inseparable part of human lives today. With the help of sensors detection for human can done many works related to their civil life.

At today's repaired technology the ultrasonic sensor is also become smart one. With the help of this smart gadget we can provide helping support for blind people using audible alerts and also make this task as smart one. We proposed a new technology so that the ordinary services of the sensors are very best in use to detect and provide alerts through modules like buzzer, Voice module, speakers, etc. When the blind person wears this ultrasonic spectacles and waist-belt at stomach or at head, which consist of ultrasonic sensors are capable of detecting obstacles in its path of a blind person, senses the obstacles.

This information is passed to the AVR 8- bit microcontroller which then alerts the user through buzzer alarm 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 sensor and audible alerts through buzzer alarm. The ultrasonic sensor and buzzer circuit interfaced to Arduino Microcontroller. This system is very helpful for blind people. The Microcontroller is programmed using Embedded C language.

II. RELATED WORK:

An ultrasonic transducer is a device that converts energy into ultrasound, or sound waves above the normal range of human hearing. While technically a dog whistle is an ultrasonic transducer that converts mechanical energy in the form of air pressure into

ultrasonic sound waves, the term is more apt to be used to refer to piezoelectric transducers that convert electrical energy into sound. Piezoelectric crystals have the property of changing size when a voltage is applied, thus applying an alternating current (AC) across them causes them to oscillate at very high frequencies, thus producing very high frequency sound waves. The location at which a transducer focuses the sound can be determined by the active transducer area and shape, the ultrasound frequency, and the sound velocity of the propagation medium.

The example shows the sound fields of an unfocused and a focusing ultrasonic transducer in water. Since piezoelectric crystals generate a voltage when force is applied to them, the same crystal can be used as an ultrasonic detector. Some systems use separate transmitter and receiver components while others combine both in a single piezoelectric transceiver.

Non-piezoelectric principles are also used in construction of ultrasound transmitters. Magnetostrictive materials slightly change size when exposed to a magnetic field; such materials can be used to make transducers. A capacitor microphone uses a thin plate which moves in response to ultrasound waves; changes in the electric field around the plate convert sound signals to electric currents, which can be amplified.

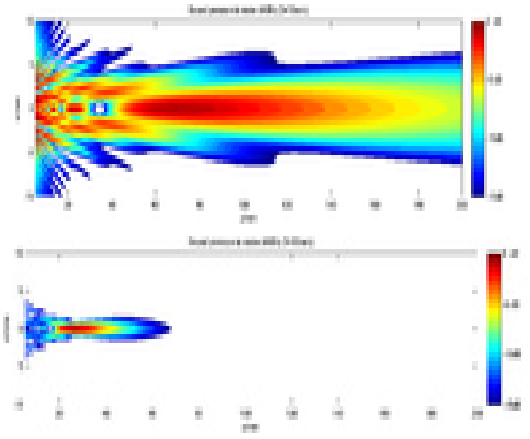

Fig I: Sound wave Propagation image

Ultrasonic sensors are used to detect the presence of targets and to measure the distance to targets in many automated factories and process plants. Sensors with an on or off digital output are available for detecting the presence of objects, and sensors with an analog output which varies proportionally to the sensor to target separation distance are commercially available. They can be used to sense the edge of material as part of a web guiding system. Ultrasonic sensors are gaining popularity in a number of uses including ultrasonic people detection and assisting in autonomous UAV navigation.

Because ultrasonic sensors use sound rather than light for detection, they work in applications where photoelectric sensors may not. Ultrasonic are a great solution for clear object detection, clear label detection and for liquid level measurement, applications that photoelectric struggle with because of target translucence. Target color and/or reflectivity don't affect ultrasonic sensors which can operate reliably in high-glare environments.

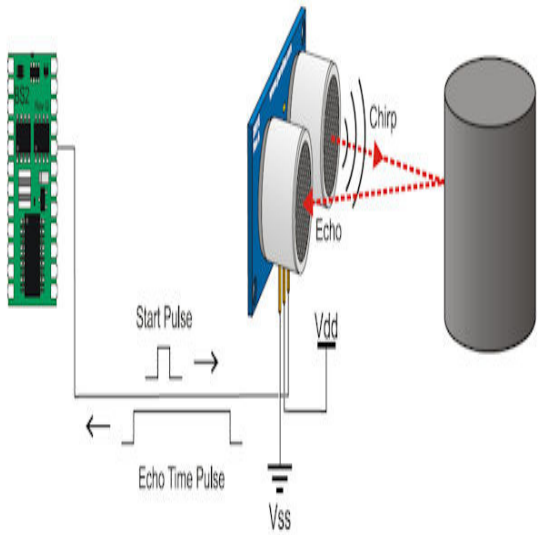

Fig I: Working of Ultrasonic sensor

Other types of transducers are used in commercially available ultrasonic cleaning devices. An ultrasonic transducer is affixed to a stainless steel pan which is filled with a solvent (frequently water or isopropanol) and a square wave is applied to it, imparting vibrational energy on the liquid. Ultrasonic sensors present the ideal solution for non-contact position and distance measurement in all industrial areas where environmental conditions such as dust, smoke or steam may affect the sensors. Objects consisting of a variety of materials can be detected to within millimeters regardless of color or shape. The ultrasonic sensor produces a data carrier utilizing very high frequencies that are outside the human's audible range.

The time it takes for that ultrasonic wave to pass between the sensor and the object is the value for the distance or the position. Bats are wonderful creatures. Blind from the eyes and yet a vision so precise that could distinguish between a moth and a broken leaf even when flying at full speed. No doubt the vision is sharper than ours and is much beyond human capabilities of seeing, but is certainly not beyond our understanding. Ultrasonic ranging is the technique used by bats and many other creatures of the animal kingdom for navigational purposes. In a bid to imitate the ways of nature to obtain an edge over everything, we humans have not only understood it but have successfully imitated some of these manifestations and harnessed their potential to the greatest extent.

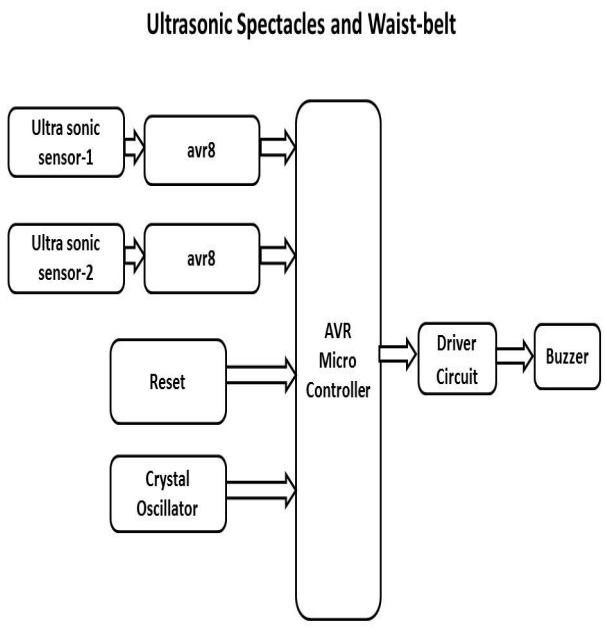

Fig II: Block diagram of working model

This proposed system results in a device which is helpful for physically challenged like blind. The main aim of the project is to design ultrasonic sensors based spectacles and waist belt for the blind people based on AVR 8 bit microcontroller.

The controlling device of the whole system is a Microcontroller. The user gets alerts through ultrasonic sensor and buzzer circuit for alerting. The ultrasonic sensor and buzzer circuit interfaced to Atmel AVR Microcontroller. This system is very helpful for blind people. The Microcontroller is programmed using Embedded C language.

Microcontroller used is ATMega16L .It is one of the high performance low power 8 bit microcontroller. The controller is embedded with four PWM channels, Real-time counter with separate oscillator, and has 8-channel 10bit inbuilt ADC. JTAG interfacing with boundary scan capabilities. It also has 16K Bytes in system programmable flash.

The AVR Microcontroller also consists of six sleep modes of operation, like Ideal mode, ADC Noise Reduction mode, Power Save Mode, Power Down mode, Standby mode and Extended Standby mode. The Controller operates on 2.7 to 5.5V, With Speed Grades of 0 to 8 Mhz. The Controller having two special Features, first one is Power-on Reset and Programmable Brown-out Detection and second one is External and Internal Interrupt Sources.

AVR microcontroller perfectly fits many uses, from automotive industries and controlling home appliances to industrial instruments, remote sensors, electrical door locks and safety devices. It is also ideal for smart cards as well as for battery supplied devices because of its low consumption. EEPROM memory makes it easier to apply microcontrollers to devices where permanent storage of various parameters is needed (codes for transmitters, motor speed, receiver frequencies, etc.). Low cost, low consumption, easy handling and flexibility make ATmega8 applicable even in areas where microcontrollers had not previously been considered (example: timer functions, interface replacement in larger systems, coprocessor applications, etc.).

In System Programmability of this chip (along with using only two pins in data transfer) makes possible the flexibility of a product, after assembling and testing have been completed. This capability can be used to create assembly-line production, to store calibration data available only after final testing, or it can be used to improve programs on finished products.

III. HARDWARE DESIGN FOR PROPOSED METHODOLOGY:

In the proposed system we introduce an ultrasonic sensor and its importance for design of spectacles and waist belt models for helping the blind persons. We use Power supply at sensor section which is used for supplying electrical or other types of energy to an output load or group of loads is called a power supply unit or PSU. The present system uses an onboard mini computer named as AVR 8- bit microcontroller which consists of number of input and output ports. The input and output port of the micro controller are interfaced with different input and output modules depending on the requirements. The current system uses Ultrasonic sensors module, as input to the microcontroller and the buzzer as output module. In other words micro controller acts as a communication medium for all the modules involved in the project. The system also performs a health check indication of microcontroller using LED indicators.

1. ULTRA SONIC 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. This technology can be used for measuring: wind speed and direction (anemometer), tank or channel level, and speed through air or water.

For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure tank or channel level, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultrasonography, burglar alarms and non-destructive testing.

Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed.

The technology is limited by the shapes of surfaces and the density or consistency of the material. Foam, in particular, can distort surface level readings.
a. Ultrasonic principle:

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.

As the distance to an object is determined by measuring the time of flight and not by the intensity of the sound, ultrasonic sensors are excellent at suppressing background interference. Virtually all materials which reflect sound can be detected, regardless of their color. Even transparent materials or thin foils represent no problem for an ultrasonic sensor.

Micro sonic ultrasonic sensors are suitable for target distances from 30 mm to 10 m and as they measure the time of flight they can ascertain a measurement with pinpoint accuracy. Some of our sensors can even resolve the signal to an accuracy of less than 0.18 mm. Ultrasonic sensors can see through dust-laden air and ink mists. Even thin deposits on the sensor membrane do not impair its function.

Fig II: Ultrasonic sensor

Sensors with a blind zone of just 30 mm and an extremely narrow beam spread are finding totally new applications these days: measuring levels in yoghurt pots and test tubes as well as scanning small bottles in the packaging sector - no trouble for our sensors. Even thin wires are reliably detected.

b. Specification:

The ultrasonic range sensor detects objects in it's path and can be used to calculate the range to the object. It is sensitive enough to detect a 3cm diameter broom handle at a distance of over 2m.
Voltage - 5v
Current - 30mA Typ. 50mA Max.
Frequency - 40 KHz
Max Range - 3 m
Min Range - 3 cm
Sensitivity - Detect 3cm diameter broom handle at > 2 m
Input Trigger - 10uS Min. TTL level pulse
Echo Pulse - Positive TTL level signal, width proportional to range.
Small Size - 43mm x 20mm x 17mm height

c. Electrical connection:

The SRF004 ultrasonic range finder has 5 connections pins. The power supply is connected to the 5V and 0V ground connections on the SRF004. (Note that BOTH the 'Mode' (hole 4) and '0V Ground' (hole 5) connections MUST be connected to 0V for correct operation with the PICAXE system).

Take care not to overheat, and therefore damage, the solder connection pads whilst making connections.
The SRF004 Trigger Input is connected to a PICAXE output pin.
The SRF004 Echo Output is connected to a PICAXE input pin.

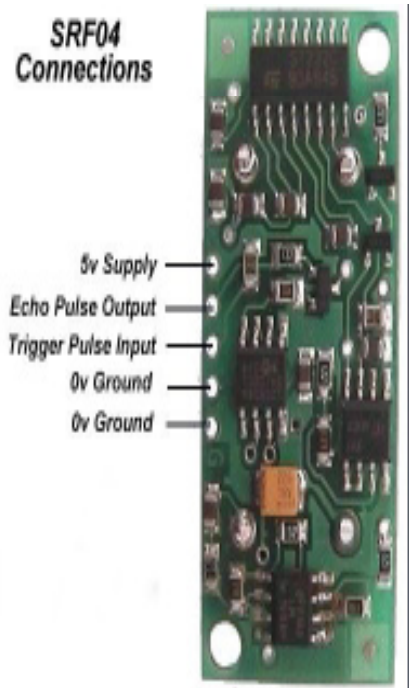

Fig III: Pin diagram of an Ultrasonic sensor

d. Pin Connection:

The SRF004 must be mounted above the buggy (e.g. by using a small home-made aluminum bracket (not supplied)). The SRF004 has five solder connections which must be connected via wires to the solder joints on the bottom of the buggy PCB.

1. Hole 1 – 5v Supply – to PIC chip leg 14 (V+ Supply)
2. Hole 2 – Echo Output – to PIC chip leg 15 (input 6)
3. Hole 3 – Trigger Input – to PIC chip leg 9 (output 3)
4. Hole 4 – Mode – to PIC chip leg 5 (0V Ground)
5. Hole 5 – 0V Ground – to PIC chip leg 5 (0V Ground)

Note that both holes 4 and 5 must both be connected to 0V. It is recommended that the wire links across the bottom of the Buggy are secured in place using a glue-gun or similar.

2. Buzzer:

The paper related to finger based voting system uses a buzzer module for audible alerts when any wrong finger print was detected. The buzzer or beeper is an audio based signaling device.

It is mainly designed as mechanical, electromechanical, or piezoelectric. There are many typical uses of buzzers and beepers which include alarm devices, timers and also based on confirmation of user inputs such as a mouse click or keystroke.

Fig IV: Figure of Buzzer

IV. CONCLUSION:

The existing "Design of an ultrasonic sensor based spectacles and waist belt for blind" system is an Integrating feature of all the hardware components been used and developed in it. The Presence of each and every module has been reasoned out and placed very carefully.

Hence the contributing to the best working unit for physically challenged has been designed perfectly. Secondly, using highly advanced sensors' like ultrasonic sensor module, Arduino microcontroller and programming with the help of growing technology, the project has been successfully implemented with a unique idea. Thus the project has been successfully designed and tested.

This project can be extended using an ALR voice module for instant voice messages about the navigation route to the blind person. We can also extend by interfacing GPS and GSM modules using which the tracking of the presence of person can be done from an unlimited distance. Using GPS module blind person can we get location based alerting voice messages using APR module.

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