ULTRASONIC NAVIGATION FOR BLIND USING EMBEDDED MICROCONTROLLER

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Abstract

The aim of this project is to investigate the development of a navigation aid for blind and visually impairedpeople. The paper represents an innovative project design and implementation of an Ultrasonic Navigation system in order to provide fully automatic obstacle avoidance with audible notification for blind pedestrians. This blind guidance system is safe reliable and cost-effective. Ultrasonic sensor and ATtmega328 are used. The distance between the object and the sensor is below 100 cm beep sound is thecircuit. The circuit may be further improved technologically so that it can be used by the blind people.

Keywords*: Atmega328, ultrasonic sensor, IR sensor, embedded microcontroller.*

1. INTRODUCTION

This project is aimed to help the visually handicapped people. The idea of this project is based on the principle how the bats find the distance of the obstacle namely echolocation. Moreover, the torch also capable of finding a distance from 10cm upto 2m. Ultrasonic sensor and ATmega328 microcontroller has to be used in this project work.

The advantage of our proposed system is its voice based announcements for easy navigation which can assist a blind pedestrian to pass through a busy road.Moreover, this system is an auditory guide system for the visually impaired pedestrian using ultrasonic-to-audio signal transformation.[1],[2].Many researchers are being conducted on building a navigation system for the visually impaired people. [3]. Forexample,occlusion result in shadows creating blind spots which cannot be used to obtain distance.Neverthless, researchers have already employed the Kinect to produce navigation system[5].

2.MATERIALS & METHODALOGY

2.1. MATERIALS

The required components are,

1.ATMEGA328

2.LCD DISPLAY

3.ARDUINO BOARD

4. BUZZER

5.ULTRASOUND

6.EMBEDDED MICROCONTROLLER

7.ULTRASONIC SENSOR

3.METHODALOGY

3.1. ULTRASOUND PRINCIPLES

The sonar system is based on two ultrasonic sensors mounted together. One emits an ultrasonic wave while the other measures the echo. By differentiation of the input and output signals, the computes the distance to the nearest obstacle.The focus is to overcome the limitations of vision algorithms in detecting and matching features subject to geometric and photometric transformations[4].

Sound is a mechanical vibration transmitted by an elastic medium he ranges of frequencies that humans can hear are approximately between 20HZ and 20,000HZ as show in fig [1]. This range is by definition the audible spectrum and varies by individual and generally reduces with range. Sound above 20,000HZ is known as ultrasound, and sound below 20 HZas infrasound

The obstacle detection part of the system contains two ultrasonic transmitters-receivers and two vibrators. It uses a 40KHz ultrasonic signal to acquire information and can detect the presence of any obstacle within the specified measurement range of approximately 0.03to6m.

Fig.1 Bats use Ultrasonic Echolocation to find their prey

3.2. PRINCIPLE OF OPERATION

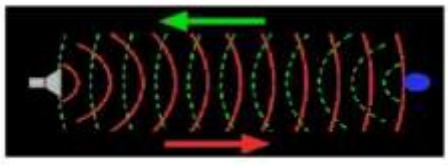

Fig.2Formation of Ultrasonic waves

3.3. EMBEDDED MICROCONTROLLER

An Embedded processor is a processor that is used in an embedded system. These processors are usually smaller, use a surface mount form factor and consume less power. Microcontrollers have more peripherals on the chip. In essence an embedded processor is a chip used in a system which is not a general-purpose workstation laptop or desktop computer.

An embedded system is a special purpose is used to perform one or few dedicative functions. Embedded system is made to perform few tasks only after implementation you cannot use them for another system as shown in fig [3].

Eg. Camera, kitchen applicants, cell phone, etc.

But a microprocessor cannot do all the functions of a computer system on its own and needsanother circuit to support it like I/O devices, RAM, ROM, ADC, DMA Controllers, Timer[6].

Fig. 3 Embedded Microcontroller

3.4. TYPES OF EMBEDDED PROCESSORS

There are many different kinds of programmable embedded processors and at Future Electronics we stock many of the most common types categorized by Clock Frequency, RAM size, data Bus Width, packaging type, MMAC/MIPS/FLOPS and I/O voltage. The most common sizes for RAM are 4KB, 8KB, 32KB and 64KB. We also carry embedded processors with RAM sizes up to 128 KB. We also carry embedded processors with RAM sizes up to 128KB. Cache memory size can range rom 32B to 320KB with the most common sizes being 32KB and 64KB as shown in fig [3].

3.5. ULTRASONIC SENSOR

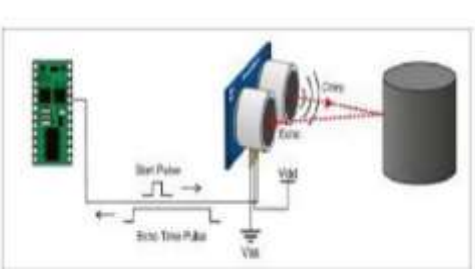

Fig. 4 Working of Ultrasonic sensors

An ultrasonic transducer is a device that converts energy in to ultrasound, or sound waves above the normal range of human hearing as shown in fig [4]. Ultrasonic sensors generate high frequency sound waves of 4HMz 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.

The sensor emits a short 40KHz (ultrasonic) burst. This Travels through the air at about 330 mt/s, hits an object and then bounces back to the sensor as shown in fig [5]. The ultrasonic sensor provides an output pulse to the host that will terminate when the echo is detected; hence the width of this pulse corresponds to twicethe distance to the target. The time difference between the transmission of the ultrasonic wave and the reception of the reflected wave is proportional to the count N stored in the counter.Use of ultrasonic sensors, GPS & GSM technology to implement alert & tracking system for Blind Man.[6]

Distance=(speed)x(time/2); speed=29.6cm per msec

Distance= 29.6cm per ms x t msec=S cm

(L.C 1 inch= 2.5 cm)

Fig. 5 Ultrasonic sensor

3.6. Ultrasonic construction

There are four basic components of an ultrasonic proximity sensor:

- Transducer/receiver
- Comparator
- Detector circuit
- Solid-state output

Ultrasonic Transducer work on a principle which evaluate attributes of a target by interpreting the echos from radio or sound waves respectively. Ultrasonic sensor generates high frequency sound waves and evaluate the echo which is received back by the sensor. This circuit maybe further improved technologically so that it can beused by the blind people.Visual SLAM and related system have also been developed using matching of local image features.[7].

Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. Ultrasonic transducers are divided into three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals, and transceivers and receive ultrasound.

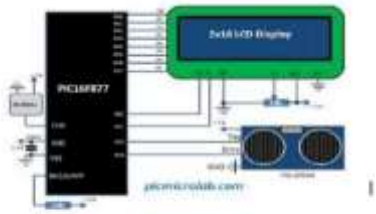

Fig. 6 Circuit Diagram

The Embedded Microcontroller ATmega328 uses pin Nos D2, D3, D4, D5 as output pins connected to the LCD Display for displaying the messages. A 10K Pot connected between pin no. 2&3 of the Display van be adjusted to vary the Brightness of the display. The D6 pin acts as an output pin to send the TRIGGER PUSE to the Ultrasonic Sensor at its Tx terminal. The D7 pin as an input pin to receive the ECHO from the Ultrasonic Sensor from its Rx terminal as shown infig[6] .

When the Embedded microcontroller is powered the Range, finder comes into action displaying the ACTUAL DISTANCE from the object to an accuracy of 1 inch (=2.5 cm). This gadget can measure up to 10 feet distance. This limit can be overcome if ahigh-power range ultrasonic sensor is used.

3.7. ATMEGA328

The Arduino is a microcontroller board based on the Atmega328 chip.

It has 14 digital input or output pins of which six can be used as pulse with modulation outputs, six analog inputs, a sixteen MHZ crystal oscillator or USB connection, a power jack, an ICSP heater, and a reset button as shown in fig[7].

Simple, low powered, low cost microcontroller isneeded.

Fig.7 ATmega328

3.8. LCD DISPLAY

The Liquid Crystal library allow you to controldisplays that are compatible with the Hitachi HD44780 driver. There are many of them out there, and you can usuallytell them by the16-pin interface.

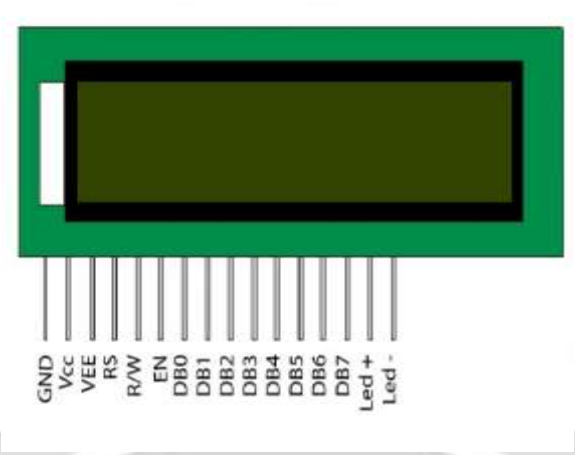

Fig.8 LCD display

The LCDs have a parallel interface, meaning that the microcontroller has to manipulate several interface pins at once to control the display. The interface consists of the following pins as shown in fig [8].

A register selects (RS) pin that controls where in the LCD's memory you're writing data to. You can select either the data register, which holds what goes on the screen, or an instruction register, which is where the LCD's controller looks for instruction on what to do next. Top vibrator indicates the stair condition, middle vibrator indicates obstacle in front of the user and lower vibrator indicate the ditches on the road[8].

A Read/Write (R/W) pin that selects reading mode or writing mode 8 data pins (D0-D7). The states of these pins (high or low) are the bits that you're writing to a register when you read.

My project consists of 3 sections,

1) Sensor
2) Processor
3) Display

Measurement of distance is the primary role of this project the Ultrasonic sensor (IC)helps is to determine the distance very accuracy up to 1 cm. Bread board connection and Hardware image of final project as shown in fig[9]&[10]

Fig. 9 Bread board connection

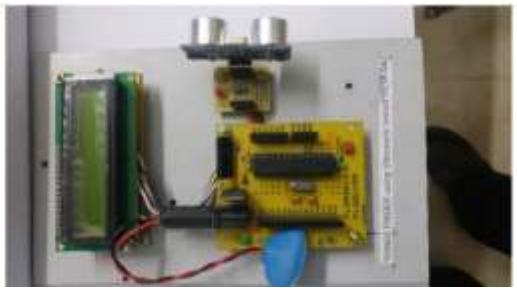

Fig. 10 Hardware image of final project.

3.9. EMBEDDED C PROGRAM

The following c program is constructed and the microcontroller is programmed so that when the distance between the object and the ultra-sonic sensor is less than 100 cm microcontroller will give beep sound .

```
#include<LiquidCrystal.h>
LiquidCrystallcd(12,11,5,4,3,2);
int trigpin=6;
int echopin=7;
int i;
long duration;
long inches;
long cm;
void setup()
{
Serial.begin(9600);
pinMode(trigpin,OUTPUT);
pinMode(echopin,INPUT);
pinMode(13,OUTPUT);
lcd.begin(16,2);
}
void loop()
{
digitalWrite(trigpin,LOW);
delayMicroseconds(5);
digitalWrite(trigpin, HIGH);
delayMicroseconds(10);
digitalWrite(trigpin, LOW);
pinMode(echopin,INPUT);
duration = pulseIn(echopin, HIGH);
inches=( duration / 2) / 74;
cm=2.54*inches;
if (cm<100)
for (i=1;i<20;i++)
        {
        digitalWrite(13,HIGH);
        delay(20);
        digitalWrite(13,LOW);
        delay(20);
        }
else{digitalWrite(13,LOW);
delay(200);}
```

```
Serial.print ln(cm);
delay(500);
lcd.print("Distance");
lcd.print(cm);
lcd.print("cms");
delay(500);
lcd.clear();

}
```

4. TEST AND RESULTS

Result part presents two important cases here. Those are:

When any obstacle is detected

When more than one obstacle is detected

The system has been used on some preliminary trials. The first field trial of the route planning was tested on a blind person. The test routes were of about 100 meters along roads and the results are shown in fig.9.In this system three vibrators are used for the sensation to the user. This provides the real world information to the user if they are not. using android application

Fig.11 circuit testing

5. CONCLUSION

A torch for the blind has been successfully constructed in this project using the principle of ultrasonic echolocation. Ultrasonic

sensor and ATmega328 are used. The ATmega328 is programmed using C. When the distance between the object and the sensor is below 100 cm a beep sound is emitted by the circuit. This critical distance can be varied by changing the embedded C program. The program can be easily modifiedby connecting the Arduino board with the Laptop and using C.

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