NITTE EDUCATION TRUST | NMAM INSTITUTE OF TECHNOLOGY

Course: Microprocessor and Microcontroller Lab.

A Mini Project Report on

ULTRASONIC OBSTACLE DETECTION USING 8051 MICROCONTROLLER

Submitted By

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ABSTRACT

The main objective of this project is to detect obstacle in front of ultrasonic sensor module with the help of 8051 Microcontroller. This application is very useful in areas like vehicle parking, wildlife photography, terrain monitoring robots. There are two main parts in an ultrasonic sensor module first one is an emitter that produces ultrasonic waves of the frequency range 2 MHz- 15MHz and second part of the ultrasonic sensor module is used to detect the ultrasonic waves that are bounced of the obstacle in front of the ultrasonic sensor. In this system ultrasonic module is interfaced with 8051 microcontroller. Signal is transmitted whenever object approaches near the ultrasonic module, which then transmits a signal which is reflected by object and thus is received by module itself. The ultrasonic receiver sends back signal to the microcontroller which actuates the output to take the necessary action. Here an LCD screen is used to display the distance between the ultrasonic module and the obstacle. The mechanism of ultrasonic sensor is similar to the mechanism used by bats to navigate and fly around in the wild.

II. OBJECTIVES OF THE PROJECT

a) Interfacing of ultrasonic sensor module with 8051 Microcontroller to detect objects in front of it.

b) Interfacing of LCD with 8051 Microcontroller used to display the distance between ultrasonic sensor and the obstacle.

c) Interfacing LED with 8051 Microcontroller that serves as a visual warning to the user whenever the obstacle is within 16 cm.

d) Interfacing of Buzzer with 8051 Microcontroller. The buzzer serves as an audible warning whenever the obstacle is within 16 cm.

e) Interfacing of two switches with 8051 Microcontroller. The first switch is used to configure the IC in normal mode and second switch is used to configure the IC in parking mode.

III.BLOCK DIAGRAM

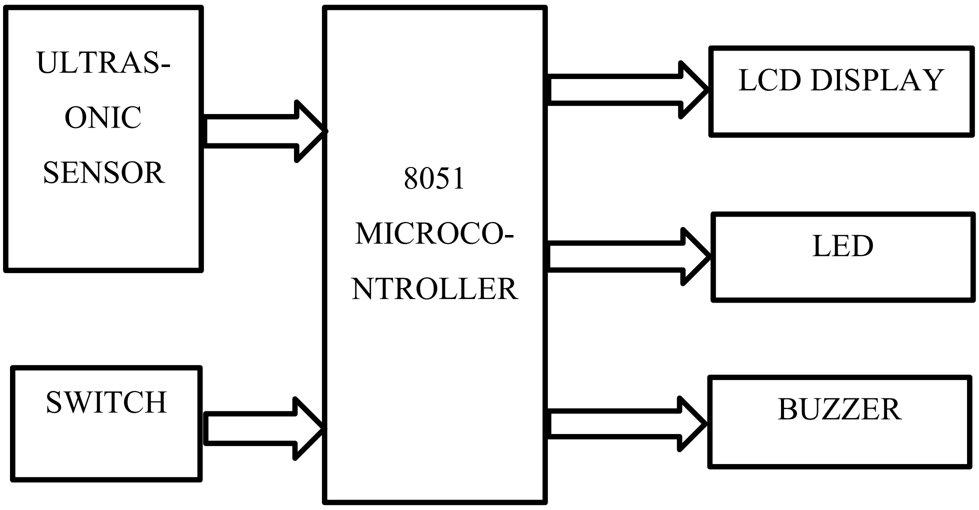

Figure 3.1.1: Block diagram

In the above block diagram ultrasonic sensor is interfaced with 8051 microcontroller. The ultrasonic sensor transmits a ultrasonic sound wave which gets deflected back off the obstacle whenever any obstacle is in front of the ultrasonic sensor module. The deflected ultrasonic sound wave is received by the receiver part of the ultrasonic sensor module from this process ultrasonic module helps in getting the time required for transmission and reception. Using this time required for transmission and reception we can calculate the distance between the obstacle and the ultransonic sensor using 8051 microcontroller. The output of microcontroller is given to LCD display. LCD displays the distance between the sensor and obstacle. Switches are used to set the system in either the normal range finding mode or the parking mode object which uses LED and buzzer usedto give a warning to the user whenever the object is within 16 cm

IV. Method

a. Interfacing of ultrasonic sensor module with 8051 Microcontroller to detect objects in front of it.

Figure 4.1.1:Sensor module

An Ultrasonic sensor is a device that can measure the distance to an object by using sound waves. It measures distance by sending out a sound wave at a specific frequency and listening for that sound wave to bounce back. By recording the elapsed time between the sound wave being generated and the sound wave bouncing back, it is possible to calculate the distance between the sonar sensor and the object.

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 detects whether there is a pulse signal back.

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

Test distance = (high level time×velocity of sound (340M/S) / 2

Wire connection:

VCC – 5V DC supply voltage is connected to this pin.

Trigger Pin – The trigger signal is to start the transmission of waves which must be a pulse with 10uS high time.

Echo Pin – At this pin, the module outputs a waveform with high time proportional to the distance.

GND – Ground is connected to this pin.

Timing diagram:

The Timing diagram is shown below. You only need to supply a short 10uS pulse to the trigger input to start the ranging, and then the module will send out an 8 cycle burst of ultrasound at 40 kHz and raise its echo. The Echo is a distance object that is pulse width and the range in proportion. You can calculate the range through the time interval between sending trigger signal and receiving echo signal. Formula: uS / 58 = centimeters or uS / 148 =inch or the range = high level time * velocity (340M/S) / 2; we suggest to use over 60ms measurement cycle, in order to prevent trigger signal to the echo signal.

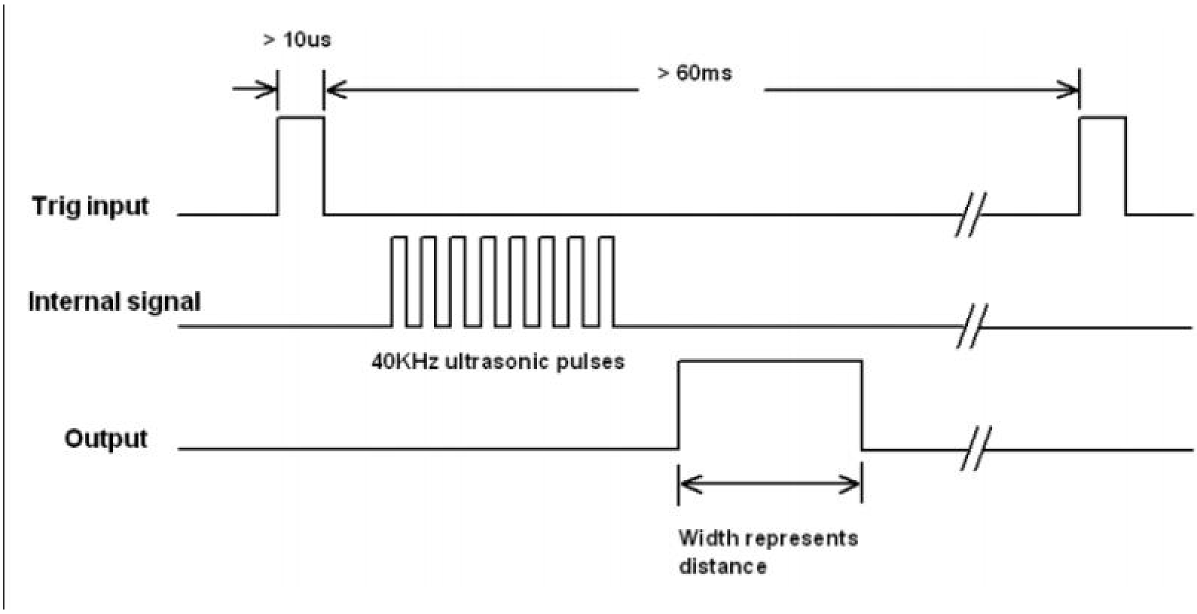

Figure 4.1.2:Timing diagram

b. Interfacing of LCD with 8051 Microcontroller used to display the distance between ultrasonic sensor and the obstacle.

Figure 4.2.1: LCD

16×2 Liquid Crystal Display which will display the 32 characters at a time in two rows (16 characters in one row). Each character in the display is of size 5×7 pixel matrix.

VEE pin is meant for adjusting the contrast of the LCD display and the contrast can be adjusted by varying the voltage at this pin. This is done by connecting one end of a POT to the Vcc (5V), other end to the Ground and connecting the center terminal of the POT to the VEE pin. The 16X2 LCD module has two built in registers namely data register and command register. Data register is for placing the data to be displayed, and the command register is to place the commands. The 16×2 LCD module has a set of commands each meant for doing a particular job with the display.

High logic at the RS pin will select the data register and low logic at the RS pin will select the command register. If we make the RS pin high and the put a data in the 8 bit data line (DB0 to DB7), the LCD module will recognize it as a data to be displayed. If we make RS pin low and put a data on the data line, the module will recognize it as a command. R/W pin is meant for selecting between read and write modes. High level at this pin enables read mode and low level at this pin enables write mode E pin is for enabling the module. A high to low transition at this pin will enable the module. DB0 to DB7 are the data pins. The data to be displayed and the command instructions are placed on these pins.

Here we are using the LM016L 16*2 LCD to display the distance between the obstacle and the ultrasonic sensor module in both the normal range finding mode and the parking mode.

c. Interfacing LED with 8051 Microcontroller.

A light-emitting diode (LED) is essentially a PN junction that emits a monochromatic (single color) light when operated in a forward-biased direction. LED convert electrical energy into light energy.

There are two ways which we can interface LED to the Microcontroller 8051. But the connections and programming techniques will be different.

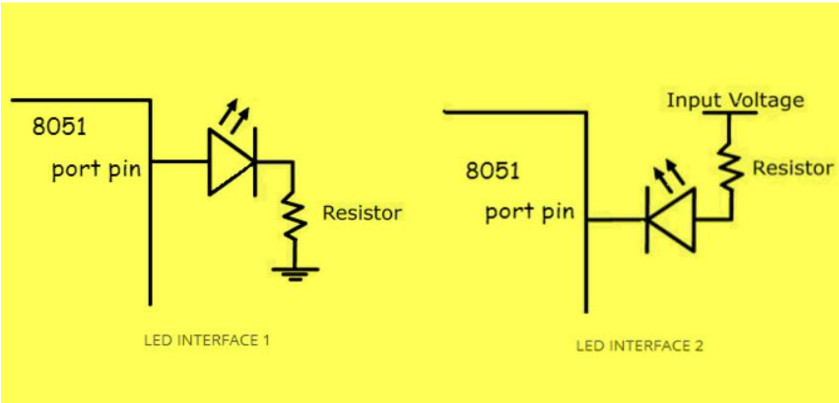

Figure 4.3.1 : LED

Observe carefully the interface LED 2 is in forward biased because the input voltage of 5v connected to the positive terminal of the LED, So here the Microcontroller pin should be at LOW level. And vice versa with the interface 1 connections.

LED Interface 1 will glow LED, only if the PIN value of the MC is HIGH as current flows towards the ground.

LED Interface 2 will glow LED, only if the PIN value of the MC is LOW as current flows towards PIN due to its lower potential.

d. Interfacing Buzzer with 8051 Microcontroller.

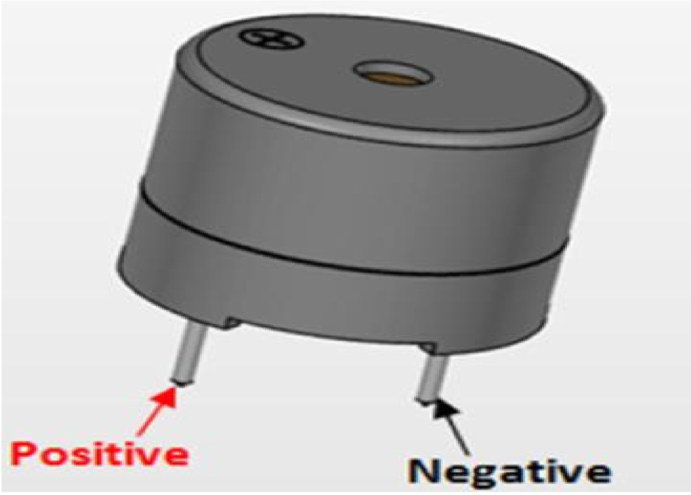

Figure 4.4.1 : Buzzer

This project uses a type of buzzer known as active buzzers.Active buzzers are the simplest one to use and they are typically available in voltages from 1.5V to 24V. All you need to do is apply a DC voltage to the pins and it will make a sound typically buzzers will have polarity and the polarity is the same as an LED and a capacitor – the longer pin goes to positive. One downside of active buzzers is that the frequency of the sound is fixed and cannot be adjusted.

We have used the buzzer as an audible warning device in the parking mode of the project.The buzzer switches on whenever the obstacle is within a distance of 16 cm.

e. Interfacing of switches with 8051 Microcontroller.

Figure 4.5.1 : Switches

The switch is a basic input device, use to control the operation of any output device using the microcontroller or control unit. It basically breaks the electrical circuit and interrupts the flow of current.

We can interface the switch in two ways:

Positive Logic: In this connection, we use a pull-down resistor connected to ground. When we pressed the switch then logic asserts high and when we disconnect the switch logic assert low.

Negative Logic: In this connection, we use a pull-up resistor connected to Vcc. When we pressed the switch then logic asserts low and when we disconnect the switch logic assert high.

In this project we are using negative logic for switches which can be done by defining the two switches as logic high in the program.

Switch1:Used to set the microcontroller in the normal range finding mode.

Switch2:Used to set the microcontroller in the parking mode.

V. Result

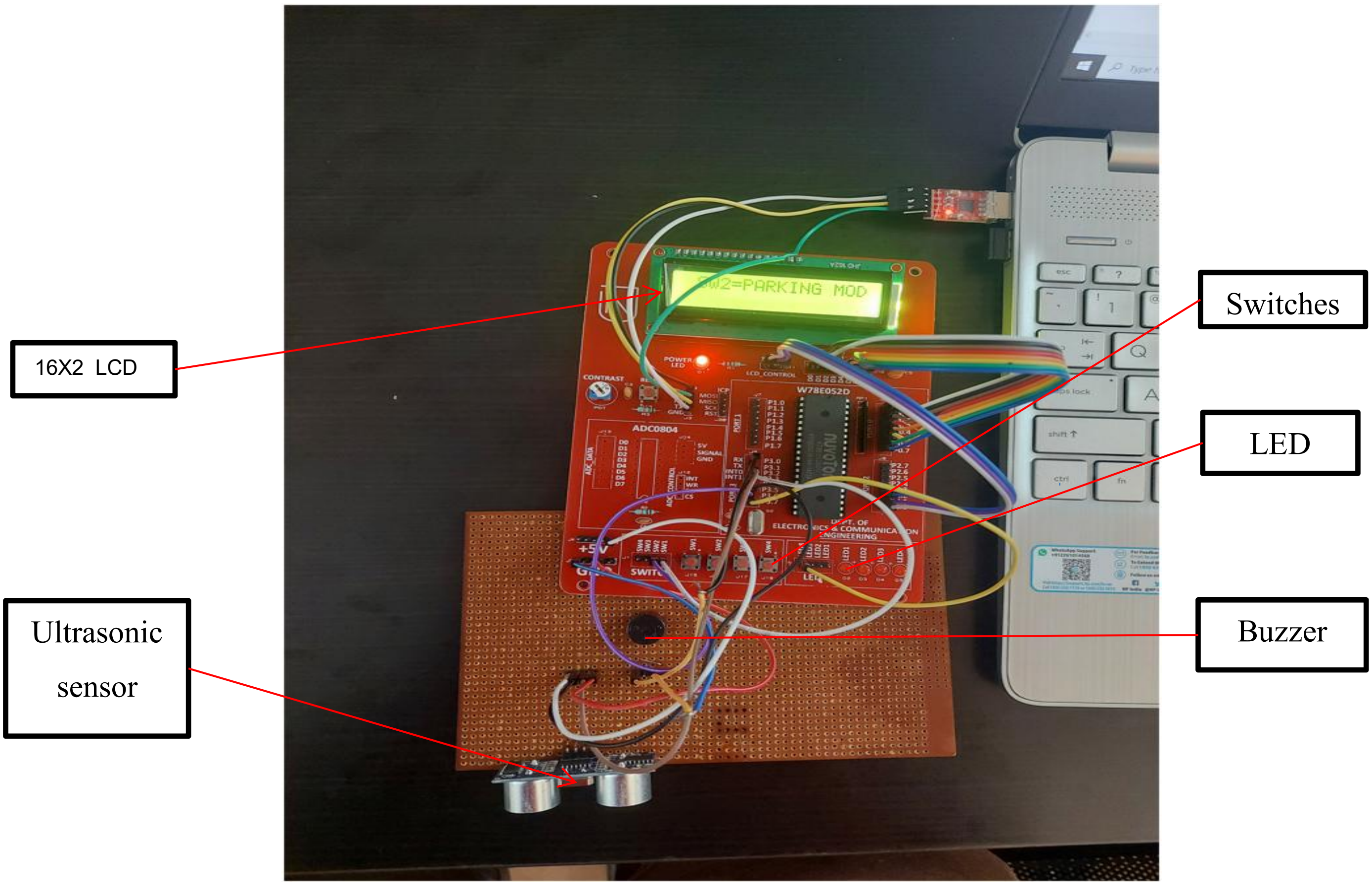

Figure 5.1.1- Project setup

Discussion:

1.After powering on the system the following output is displayed on the LCD

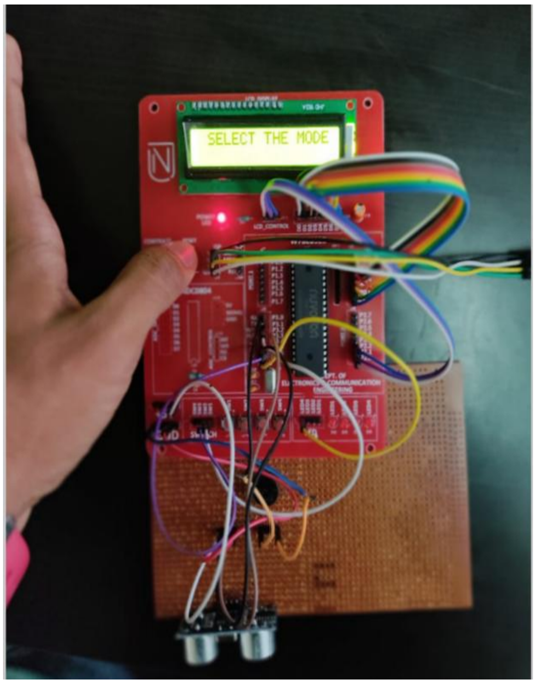

Figure 5.1.2

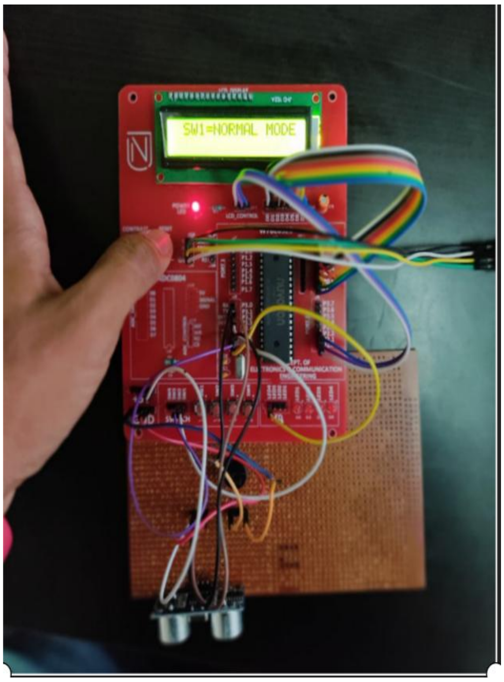

Figure 5.1.3

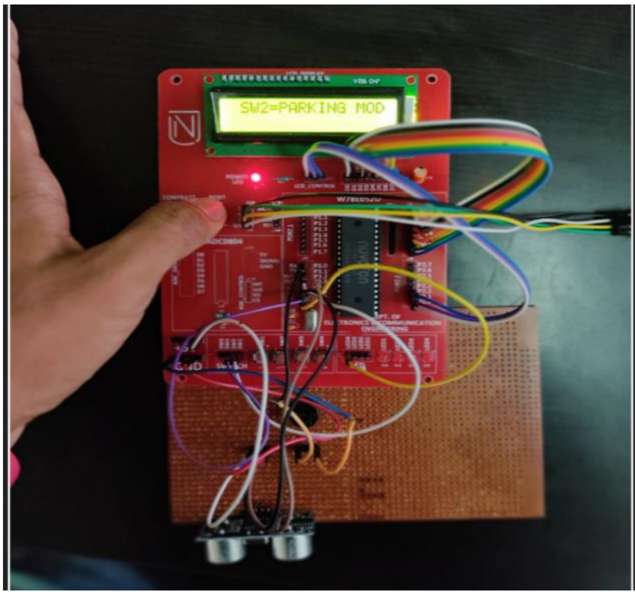

Figure 5.1.4

2. Switch 1 is used to set the microcontroller in normal ranging finding here we are just using the setup to measure the distance between the obstacle and the ultrasonic sensor module

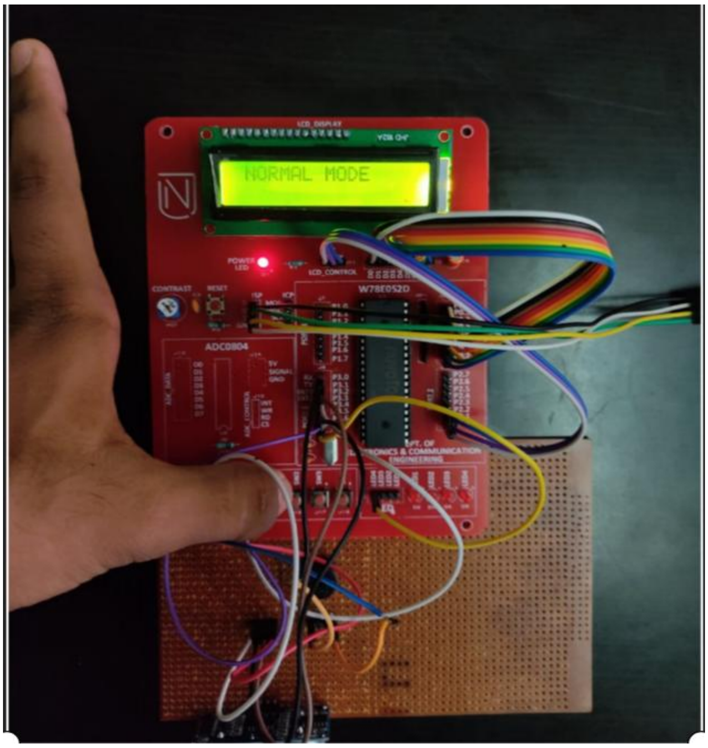

Figure 5.1.5

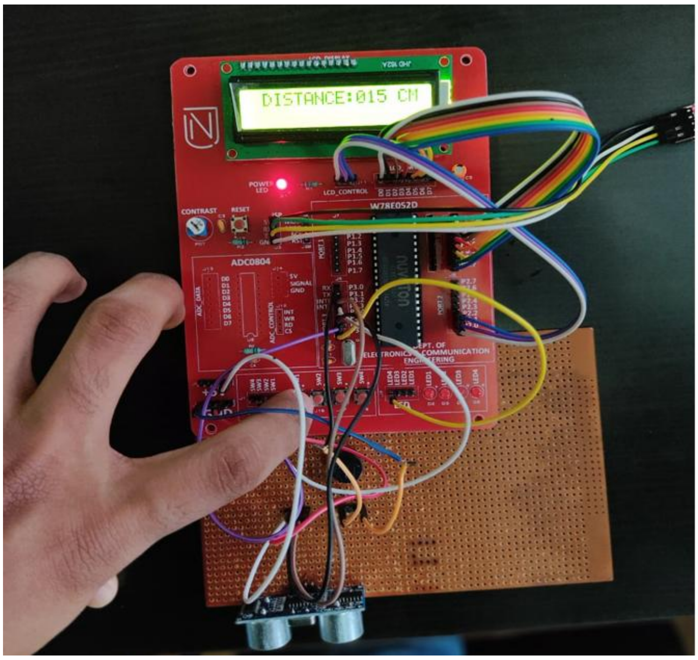

Figure 5.1.6

3.Switch 2 is used to set the microcontroller in parking mode where we are providing a warning system(buzzer and LED) for the user whenever the obstacle is within 16 cm

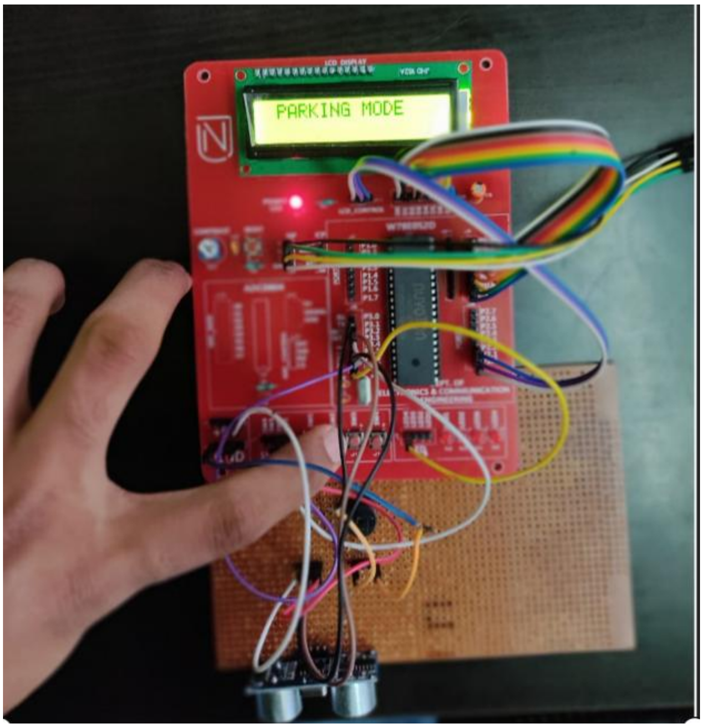

Figure 5.1.7

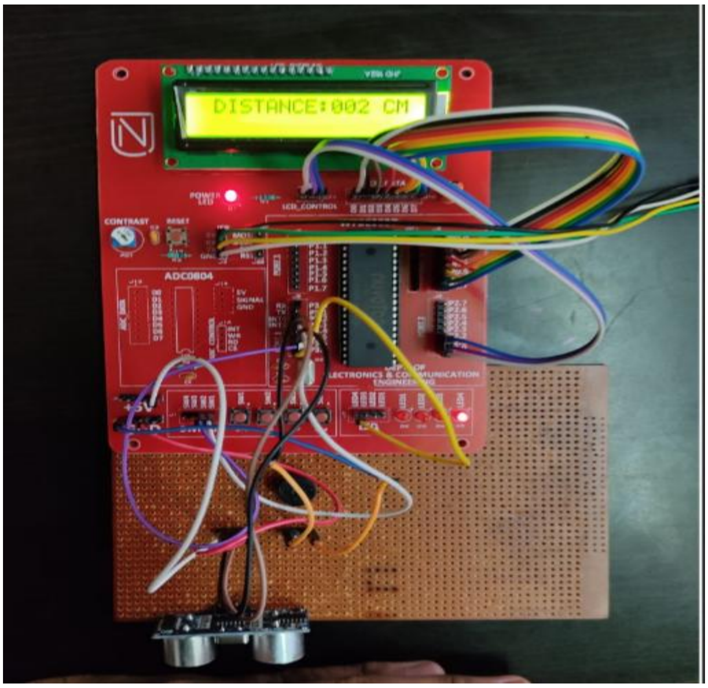

Figure 5.1.8

Code snippet:

```
#include<REGX52.h>
#define dataport P0 //port0 is set as lcd data port
int cms;
sbit trig=P3^5;//to initiallize port pin 3.5 as trigger pin
sbit rs=P2^0;//to initiallize port pin 2.0 as lcd rs pin
sbit rw=P2^1;//to initiallize port pin 2.1 as lcd rw pin
sbit e=P2^2;//to initiallize port pin 2.2 as trigger pin
sbit buz=P3^0;//to initiallize port pin 3.0 for buzzer output pin
sbit led=P3^7;//to initiallize port pin 3.7 for led output pin
sbit parkmode=P3^6;//to initiallize port pin 3.6 for parking mode switch
sbit normalmode=P3^3;//to initiallize port pin 3.3 for normal mode switch
void delay(unsigned int msec)
{
  int i,j;
  for(i=0;i<msec;i++)
  for(j=0;j<1275;j++);
}
void lcd_cmd(unsigned char item) // Function to send command to LCD
{
  dataport = item;
  rs= 0;
  rw=0;
  e=1;
  delay(1);
  e=0;
  return;
}
void lcd_init(void){    //function to initialize lcd
lcd_cmd(0x38);
lcd_cmd(0x0c);
  delay(2);
lcd_cmd(0x01);
  delay(2);
lcd_cmd(0x81);
}
void lcd_data(unsigned char item) // Function to send data to LCD
{
  dataport = item;
```

```
  dataport = item;
  rs= 1;
  rw=0;
  e=1;
  delay(1);
  e=0;
  return;
}
void lcd_data_string(unsigned char *str) // Function to send string to LCD
{
  int i=0;
  while(str[i]!='\0')
   {
    lcd_data(str[i]);
    i++;
    delay(1);
   }
return;
}

void send_pulse(void)
{
  TH0=0x00;TL0=0x00;
  trig=1;                   //Sending trigger pulse
  delay(5);                 //Wait for about 10us
  trig=0;                   //Turn off trigger
}

unsigned int get_range(void)
{
  long int timer_val;
  send_pulse();
  while(!INT0);           //Waiting until echo pulse is detected
  while(INT0);            //Waiting until echo pulse changes its state
  timer_val=(TH0<<8)+TL0;//timer_val value is got by the timer 0
  lcd_cmd(0x81);
  lcd_data_string("DISTANCE:");
```

```
 lcd_data_string("DISTANCE:");
 lcd_cmd(0x8a);
 if(timer_val<38000)
  {
   cms=timer_val/59;  // formula to calculate the distance in cms
   if (cms!=0)
    {
      int a=((cms/100)+48); //ASCII CONVERSION
        int b=(((cms/10)%10)+48);//ASCII CONVERSION
      int c=((cms%10)+48);//ASCII CONVERSION
     lcd_data(a);//to display the first digit on lcd
      lcd_data(b);//to display the second digit on lcd
      lcd_data(c);//to display the third digit on lcd
      lcd_data_string(" CM");

    }
  }
 else
 {
  lcd_cmd(0x06);
  lcd_data_string("Object out of range");
 }
 return cms;
}
void norm_code(void){
delay(200);
     lcd_init();
lcd_data_string("NORMAL MODE");
    delay(200);
 while(1)
 {
  get_range();
  delay(2);
   }
}
void park_code(void){
delay(200);
```

```
delay(200);
lcd_init();
    lcd_data_string("PARKING MODE");
    delay(200);
   while(1)
  {
   get_range();
   delay(2);
    if(cms<=16){
    buz=1;
    led=1;
      }
  else{
  buz=0;
  led=0;
  }
  }
}
void main()
{
  parkmode=0xFFFF;//to intiallize switch 1 as input
  normalmode=0xFFFF;//to intiallize switch 2 as input
  buz=0;
  led=0;
  lcd_init();
  lcd_data_string("SELECT THE MODE");
  delay(200);
  lcd_init();
  lcd_data_string("SW1=NORMAL MODE");
  delay(200);
  lcd_init();
  lcd_data_string("SW2=PARKING MODE");
  while((normalmode==1)&(parkmode==1));//used to wait untill one of either noraml mode sw1 or parking mode sw2 is pressed
  TMOD=0x09;//timer0 in 16 bit mode with gate enable
  TR0=1;//timer run enabled
  TH0=0x00;
  TL0=0x00;
```

```
  TL0=0x00;
  P3|=0x04;//setting pin P3.2
  if(normalmode==0){
    norm_code();//function call for normal switch
}
  else if(parkmode==0){
    park_code();//function call for parking code
  }
}
```