North South University

Center of Excellence in Higher Education

Report

Title: **Unwanted Object Detector**

CSE331.03

Group Members:

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Submitted to:

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Submission date: 28 April 2019

1. Title: Unwanted Object Detector

2. Objective:

Objective of this project is to implement a Radar System using ultrasonic sensor which is based on Peripheral Interface Controller. The goal is to detect any unwanted object/people in a particular area and the location as well. Also for keep watching that areas, which are prohibited for human or animal access such as military areas or other purposes areas.

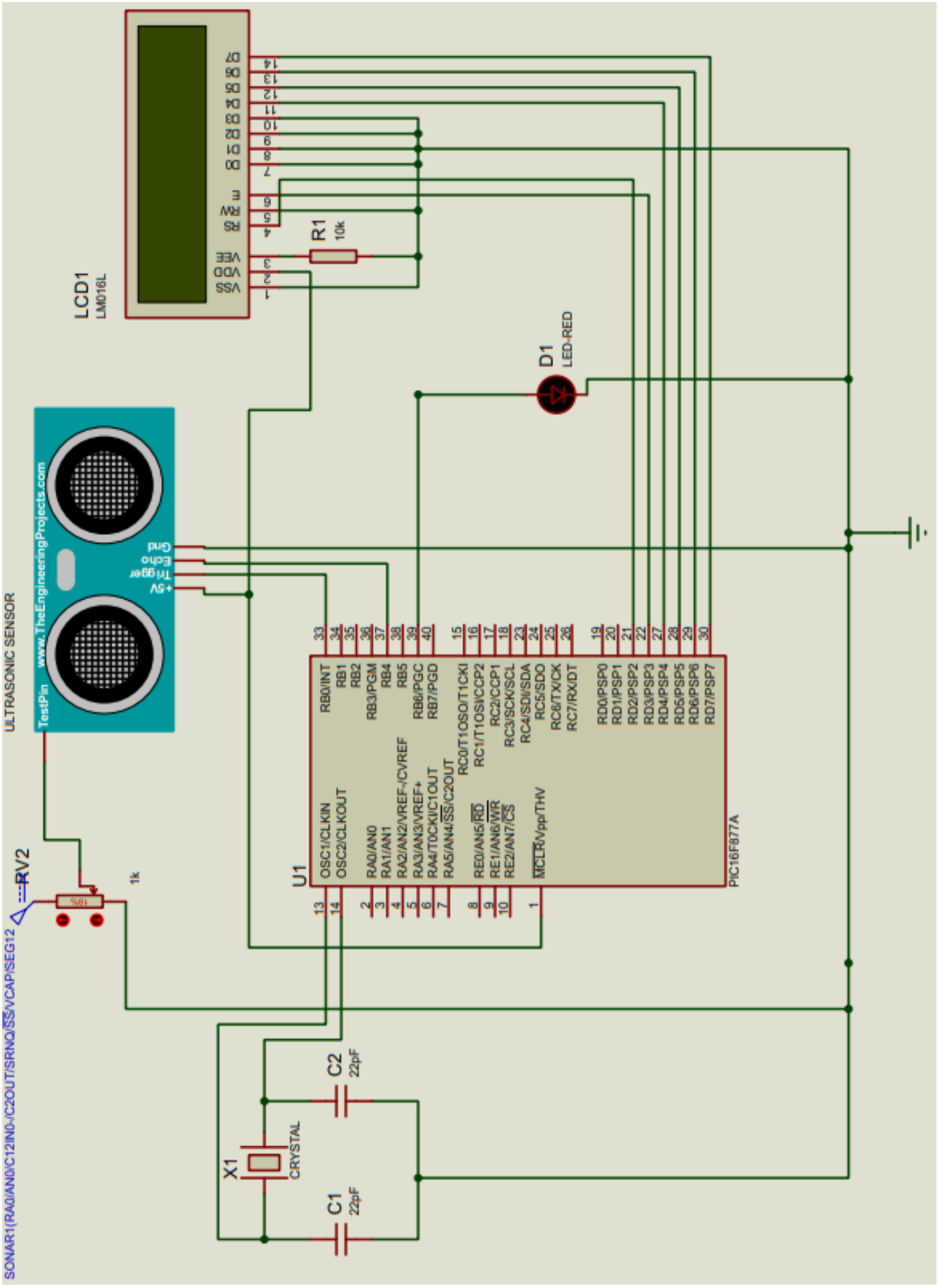
3. List of components::

- PIC 16F877A microcontroller
- PICKit 2
- HC-SR04 Ultrasonic Module
- HD44780 LCD Display
- Crystal Oscillator
- Buzzer
- LED
- Resistors
- Potentiometer
- Capacitors
- Jumper Wires
- Bread Board
- Potentiometer
- Power Connector
- 9V Power Source

4. Estimated Cost for the project:

Name of Component	Price
1. PIC16F877A Microcontroller	200 ৳
2. PICKit 2	950 ৳
3. HC-SR04 Ultrasonic Module	85 ৳
4. HD44780 LCD Display	175 ৳
5. Crystal Oscillator	10 ৳
6. Buzzer	15 ৳
7. LED	2 ৳
8. Resistors	4 ৳
9. Capacitors	4 ৳
10. Jumper Wires	30 ৳
11. Brade Board	70 ৳
12. Potentiometer	15 ৳
13. Power Connector	15 ৳
14. 9V Power Source	25 ৳
	Total Cost: 1600 ৳

5. Design in Proteus:



6. Working Procedures:

This pic based ultrasonic radar system works on the principle of high frequency sound pulse. When these pulses are sending through the ultrasonic transmitter which is rotating from 0 degree to 180 degrees. These pulses are reflected after the collision of unidentified object or person, then these pulses are received by the ultrasonic receiver. After receiving these pulses the ultrasonic module gives the intimation or information signal to the microcontroller. Then the microcontroller check the status of that object or person means it measures the distance and angle of that one. After checking the angle and distance it gives the intimation signal to the LCD display which shows the distance and angle of that object or person, during this it also gives the logic high signal to the buzzer. Then the buzzer is switched on. By switched on this buzzer, the operated person can easily know about the unidentified person or object with their respective distance and angle. For the demonstration purposes, we can check this system by placing anything in front ultrasonic module when it is moving through the servo motor. Then it tells the distance and angle of that thing with giving beep through the buzzer.

Ultrasonic Distance Sensor is able to measure distances from 2cm to 400cm with an accuracy of about 3mm. This module includes ultrasonic transmitter, ultrasonic receiver and its control circuit.

HC-SR04 module has 4 pins :

- VCC – 5V, +ive of the power supply
- TRIG – Trigger Pin
- ECHO – Echo Pin
- GND – -ive of the power supply
- TRIG and ECHO pins can be used to interface this module with a microcontroller unit. These are TTL (0 – 5V) input output pins.

HC-SR04 Ultrasonic Module Working:

Fig: HC-SR04 Ultrasonic Module Working

Provide TRIGGER signal, at least 10μS High Level (5V) pulse. The module will automatically transmit eight 40KHz ultrasonic burst.

If there is an obstacle in-front of the module, it will reflect the ultrasonic burst.

If the signal is back, ECHO output of the sensor will be in HIGH state (5V) for a duration of time taken for sending and receiving ultrasonic burst. Pulse width ranges from about 150μS to 25mS and if no obstacle is detected, the echo pulse width will be about 38ms.

Fig: Interfacing HC-SR04 Ultrasonic Distance Sensor with PIC Microcontroller

Interfacing with PIC Microcontroller:

Fig: Circuit Diagram of PIC Based Ultrasonic Radar System

PIC 16F877A is the heart of this circuit. VDD and VSS of PIC Microcontroller is connected to +5V and GND respectively which will provide necessary power for its operation. A 8MHz crystal is connected to OSC1 and OSC2 pins of PIC, to provide clock for its operation. 22pF capacitors connected along with the crystal will stabilize the oscillations generated by the crystal. 16×2 LCD is connected to PORTD which is interfaced using 4 bit mode communication. 10KΩ preset is used to adjust the contrast of the LCD. A 100Ω resistor is used to limit current through the LCD backlight LED.

TRIGGER pin of HC-SR04 sensor is connected to RB0 (pin 33) of PIC which is to be configured as an Output PIN (TRIS bit is 0) and ECHO pin is connected to RB4 (pin 37) which is to be configured as an Input PIN (TRIS bit is 1).

Basic Steps :

- Provide TRIGGER to ultrasonic module
- Listen for Echo
- Start Timer when ECHO HIGH is received
- Stop Timer when ECHO goes LOW
- Read Timer Value
- Convert it to Distance
- Display it

Timer1 Module:

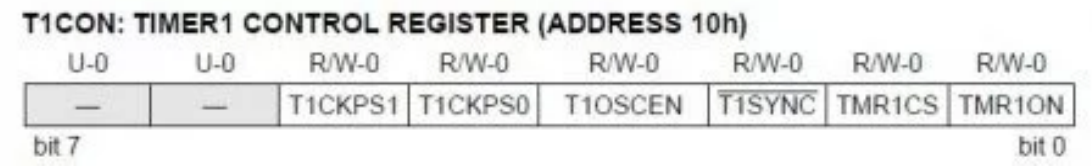


Fig: Timer1 Control Register

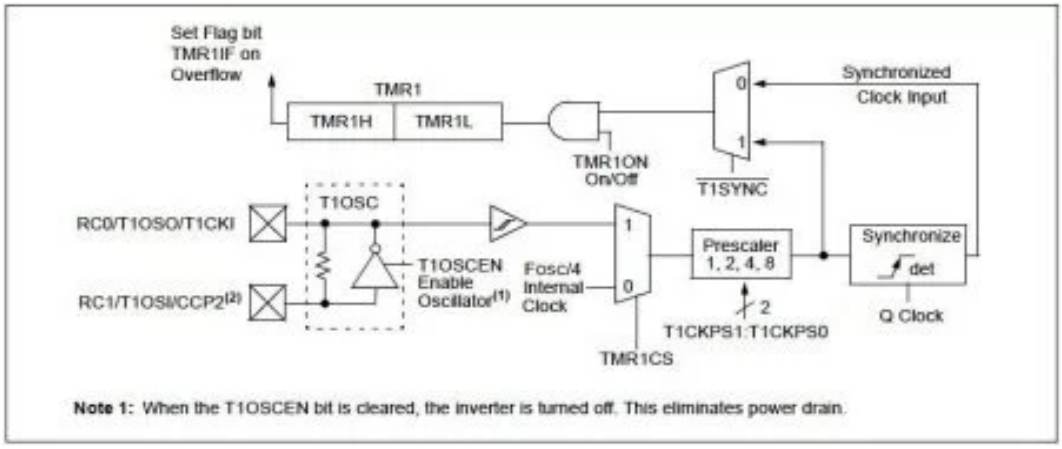


Fig: Timer1 Module Block Diagram

Since we are using Timer1 module as a Timer, we should use internal clock (Fosc/4), ie TMR1CS = 0. Prescaler is used to divide the internal clock (Fosc/4). Here we can set Prescaler as 2, ie T1CKPS1 = 0 & T1CKPS0 = 1. T1SYNC bit is ignored when TMR1CS = 0. As we are using internal clock (Fosc/4) we can disable oscillator, ie T1OSEN = 0. TMR1ON bit can be used to ON or OFF timer as per our requirements.

- Thus we can initialize timer as : T1CON = 0x10
- To TURN ON the Timer : T1CON.F0 = 1 or TMR1ON = 1
- To TURN OFF the Timer : T1CON.F0 = 0 or TMR1ON = 0

Fosc is the oscillator frequency, here we are using 8MHz crystal hence Fosc = 8MHz.

Time = (TMR1H:TMR1L)*(1/Internal Clock)*Prescaler

Internal Clock = Fosc/4 = 8 MHz/4 = 2MHz

Therefore, Time = (TMR1H:TMR1L)*2/(2000000) = (TMR1H:TMR1L)/1000000

Distance Calculation:

- Distance = Speed * Time
- Let d be the distance between Ultrasonic Sensor and Target
- Total distance traveled by the ultrasonic burst : 2d (forward and backward)
- Speed of Sound in Air : 340 m/s = 34000 cm/s
- Thus, d = (34000*Time)/2, where Time = (TMR1H:TMR1L)/(1000000)
- Therefore, d = (TMR1H:TMR1L)/58.82 cm
- TMR1H:TMR1L = TMR1L | (TMR1H<<8)

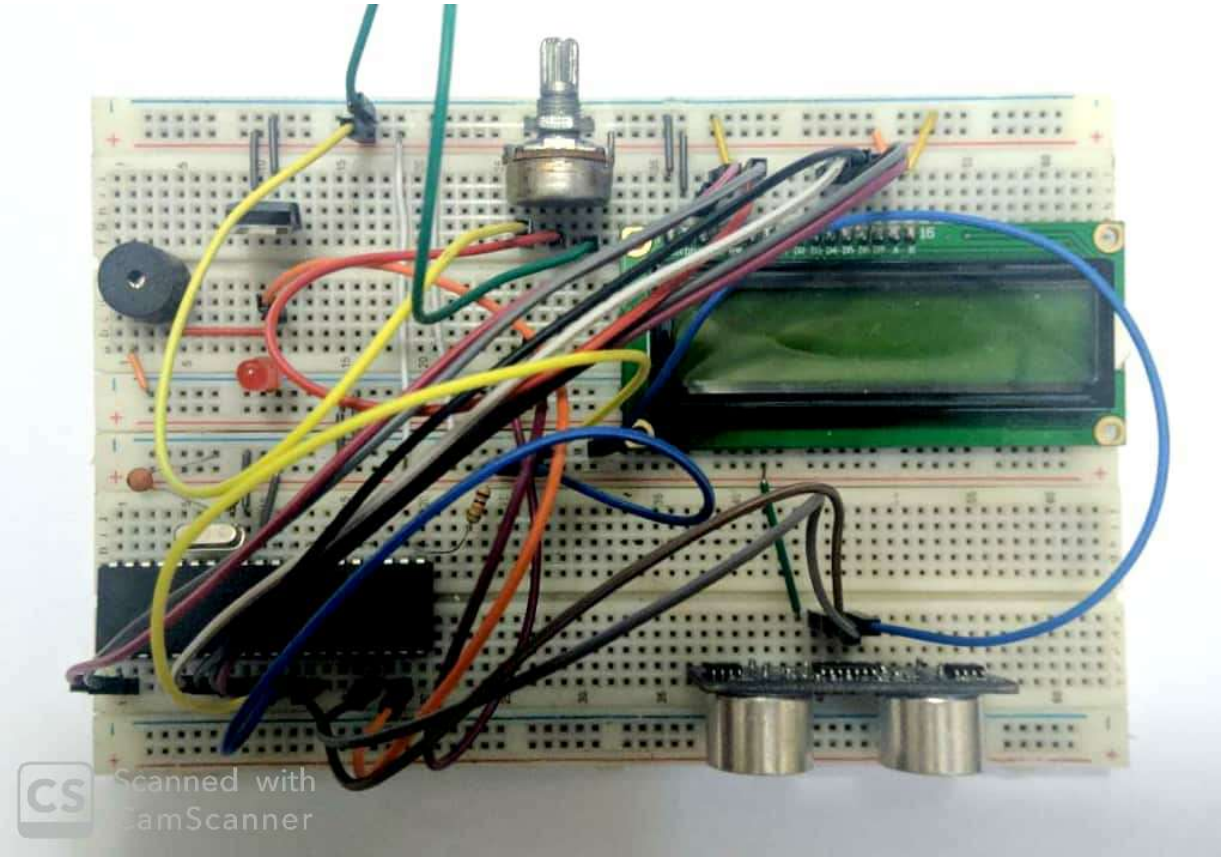
7. Interfacing language:

MikroC Code:

```
// LCD module connections
sbit LCD_RS at RD2_bit;         //LCD reset
sbit LCD_EN at RD3_bit;         //LCD enable

sbit LCD_D4 at RD4_bit;         //Data
sbit LCD_D5 at RD5_bit;         //Data
sbit LCD_D6 at RD6_bit;         //Data
sbit LCD_D7 at RD7_bit;         //Data


 //LCD Pin Direction

sbit LCD_RS_Direction at TRISD2_bit;
sbit LCD_EN_Direction at TRISD3_bit;
sbit LCD_D4_Direction at TRISD4_bit;
sbit LCD_D5_Direction at TRISD5_bit;
sbit LCD_D6_Direction at TRISD6_bit;
sbit LCD_D7_Direction at TRISD7_bit;

// End LCD module connections

void main()
{
 int a;
 char txt[7];
 Lcd_Init();
 Lcd_Cmd(_LCD_CLEAR);                 // Clear display
 Lcd_Cmd(_LCD_CURSOR_OFF);        // Cursor off

 TRISB = 0b00010000;

 Lcd_Cmd(_LCD_CLEAR);

 T1CON = 0x10;

 while(1)
 {
   TMR1H = 0;
```

```
    TMR1L = 0;

    PORTB.F0 = 1;            // trigger
    Delay_us(10);
    PORTB.F0 = 0;

    while(!PORTB.F4);
    T1CON.F0 = 1;
    while(PORTB.F4);      // while there is an echo
    T1CON.F0 = 0;

    a = (TMR1L | (TMR1H<<8))/58.82 + 1;

    if(a>=2 && a<=100)
    {

      PORTB.F6 = 1;          // debugger LED
      IntToStr(a,txt);
      Ltrim(txt);
      Lcd_Cmd(_LCD_CLEAR);
      Lcd_Out(1,1,"Object detected!");
      Lcd_Out(2,1,"Distance = ");
      Lcd_Out(2,12,txt);
      Lcd_Out(2,15,"cm");
    }
    else
    {
      PORTB.F6 = 0;
      Lcd_Cmd(_LCD_CLEAR);
      Lcd_Out(1,1,"No object");
      Lcd_Out(2,1,"detected!");
    }
    Delay_ms(400);
  }
}
```

8. Image(s) of hardware implementation:



9. Plausible Application(s):

Radar systems have a number of defence as well as civil applications. Air traffic control uses radars to track aircrafts on the ground and in the air, and to guide planes for smooth landings. Police use radars to detect the speed of passing vehicles. Geologists use radars to map the Earth and other planets. Military uses these for surveillance. Meteorologists use radars to track storms, hurricanes and tornadoes. The list is endless.

This electromagnetic system can be used for detecting and locating of target objects such as aircraft, ships, spacecraft, vehicles, people in sensitive area, for instance near the border.

1. This pic based ultrasonic radar system could be used in military agencies for security purpose.
2. This system could be used in that areas, where you want to don't enter the unidentified person or objects.
3. This system could be used in that industries for keep watching the industrial machine, where the human or any other object interference is not allowed.
4. By using this system there is no chances of any negligence.
5. This system is less expensive, more compact and more reliable.

10. Discussion:

The pic based ultrasonic radar system is a system that could use for keep watching that areas, which are prohibited for human or animal access such as military areas or other purposes areas. In this terrorism world, the security is mandatory 24 hours of the day for every region or area and it is almost not possible through the man power because the man could show the negligence sometimes and this could also be costly. The alternate way, of keep watching the area or region is only an automatic system, which automatically provides the intimation about unidentified person or object in that prohibited area. Different companies are offering such type of security systems each one have different cost and characteristics. Here we have designed a system that is called a pic based ultrasonic radar system with help of microcontroller PIC16F877A belongs to a pic family, ultrasonic module, LCD display and servo motor. This system could be installed in any prohibited areas and this provides the security 24 hours of the day. This also tells the distance of the object in that prohibited areas with different angles. This is not so much expensive as compared the other security systems.

This radar system consists of a transmitter that transmits a beam towards the target, which is then reflected by the target as an echo signal. The reflected signal is received by a receiver. This receiver processes the received signal and provides such information as the presence of a target, distance, position (moving or stationary) or speed, which is displayed on a display unit.

In this work, an ultrasonic radar system was designed and implemented experimentally for distance measurements purposes to be used in various applications. ultrasonic sensor and computer for distance calculation of objects or obstacles placed at different angles (from 0 to 180 degrees) within a range. The error between the actual distance and measured distance was used statistically to validate the design. The results show that the percentage distance error is less than 3%.