Priyadarshini College Of Engineering

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Department Of Robotics & Artificial Intelligence

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Project Report

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Section: -A

Subject: - Intelligence Embedded System

Topic: - Ultrasonic Sensor Radar

Under the Guidance of: - Dr.Mrs.A.P.Khandait

Content: -

Introduction

Radar (Radio Detection and Ranging) is a technology that uses radio waves to detect, locate, and track objects in the surrounding environment. It plays a crucial role in various fields, including aviation, meteorology, military applications, navigation, and automotive safety.

Radar systems work on the principle of transmitting electromagnetic waves and analysing the echoes received from objects. By measuring the time it takes for the waves to bounce back, radar can determine the distance, speed, direction, and other characteristics of the detected objects.

Ultrasonic Sensor

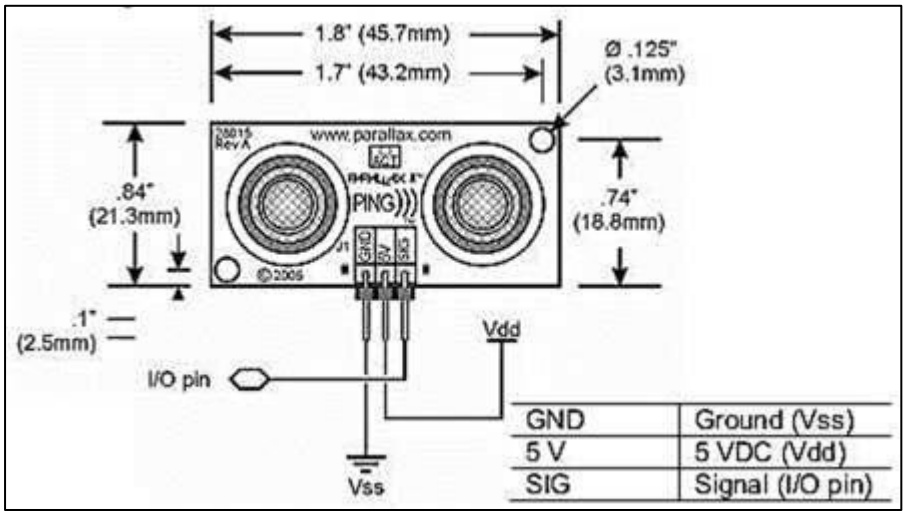


Fig1.1- Diagram of Ultrasonic Sensor

An ultrasonic sensor is a device that uses sound waves of high frequency (ultrasonic waves) to measure the distance to an object or detect its presence. It works based on the principle of echolocation, similar to how bats navigate and locate objects in their environment.

The sensor consists of two main components: a transmitter and a receiver. The transmitter emits short bursts of ultrasonic waves, typically in the range of 20 kHz to 200 kHz, which are beyond the range of human hearing. These waves propagate through the air and when they encounter an object, they bounce back or reflect off its surface. The receiver of the ultrasonic sensor detects the reflected waves. By measuring the time it takes for the waves to travel back to the sensor, the sensor can calculate the distance to the object using the speed of sound in the medium (usually air). The speed of sound is approximately 343 meters per second at room temperature.

Working: -

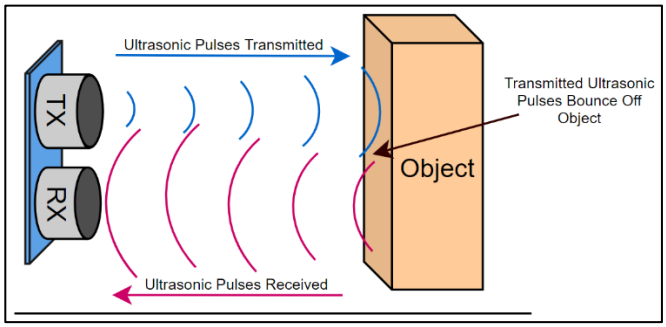


Fig1.2- Working of Ultrasonic sensor

Ultrasonic sensors consist of two main components: a transmitter and a receiver. The transmitter emits high-frequency sound waves (typically above 20 kHz) into the environment. These sound waves propagate through the air and bounce off objects in their path. The receiver then detects the reflected waves or echoes.

The sensor measures the time it takes for the sound waves to travel from the transmitter to the object and back to the receiver. By knowing the speed of sound in the medium (usually air), the sensor can calculate the distance to the object using the formula:

Distance = (Speed of Sound × Time) / 2

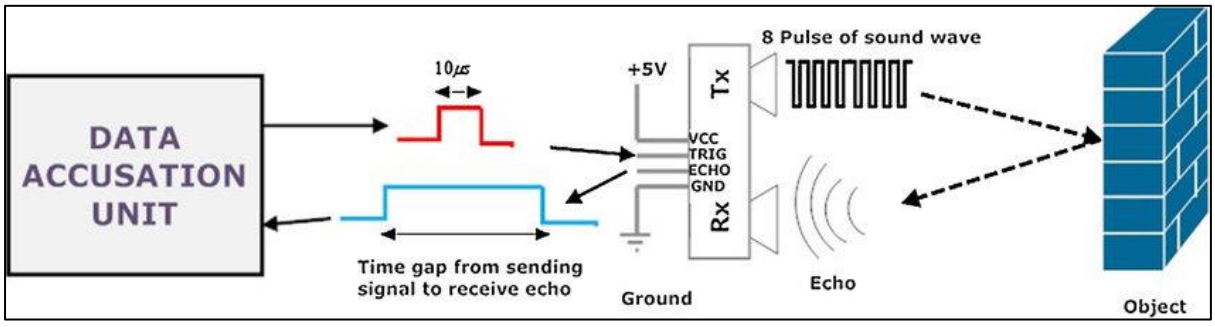


Fig1.3-

Distance = (343m/s × X) / 2

Where:- X= Time gap from Sending signal to Receiver signal

Arduino Code: -

```
// Includes the Servo library
#include <Servo.h>.
// Defines Tirg and Echo pins of the Ultrasonic Sensor
const int trigPin = 10;
const int echoPin = 11;
// Variables for the duration and the distance
long duration;
int distance;
Servo myServo; // Creates a servo object for controlling the servo motor
void setup() {
  pinMode(trigPin, OUTPUT); // Sets the trigPin as an Output
  pinMode(echoPin, INPUT); // Sets the echoPin as an Input
  Serial.begin(9600);
  myServo.attach(12); // Defines on which pin is the servo motor attached
}
void loop() {
  // rotates the servo motor from 15 to 165 degrees
  for(int i=15;i<=165;i++){
  myServo.write(i);
  delay(30);
  distance = calculateDistance();// Calls a function for calculating the distance measured by the Ultrasonic sensor for each degree

  Serial.print(i); // Sends the current degree into the Serial Port
  Serial.print(","); // Sends addition character right next to the previous value needed later in the Processing IDE for indexing
  Serial.print(distance); // Sends the distance value into the Serial Port
  Serial.print("."); // Sends addition character right next to the previous value needed later in the Processing IDE for indexing
```

```
  }
  // Repeats the previous lines from 165 to 15 degrees
  for(int i=165;i>15;i--){
  myServo.write(i);
  delay(30);
  distance = calculateDistance();
  Serial.print(i);
  Serial.print(",");
  Serial.print(distance);
  Serial.print(".");
  }
}
// Function for calculating the distance measured by the Ultrasonic sensor
int calculateDistance(){

  digitalWrite(trigPin, LOW);
  delayMicroseconds(2);
  // Sets the trigPin on HIGH state for 10 micro seconds
  digitalWrite(trigPin, HIGH);
  delayMicroseconds(10);
  digitalWrite(trigPin, LOW);
  duration = pulseIn(echoPin, HIGH); // Reads the echoPin, returns the sound wave travel time in microseconds
  distance= duration*0.034/2;
  return distance;
}
```

Processing Code: -

```
import processing.serial.*; // imports library for serial communication
import java.awt.event.KeyEvent; // imports library for reading the data from the serial port
```

```
import java.io.IOException;
Serial myPort; // defines Object Serial
// defubes variables
String angle="";
String distance="";
String data="";
String noObject;
float pixsDistance;
int iAngle, iDistance;
int index1=0;
int index2=0;
PFont orcFont;
void setup() {

 size (1200, 700); // ***CHANGE THIS TO YOUR SCREEN RESOLUTION***
 smooth();
 myPort = new Serial(this,"COM5", 9600); // starts the serial communication
 myPort.bufferUntil('.'); // reads the data from the serial port up to the character '.'. So actually it reads this: angle,distance.
}
void draw() {

  fill(98,245,31);
  // simulating motion blur and slow fade of the moving line
  noStroke();
  fill(0,4);
  rect(0, 0, width, height-height*0.065);

  fill(98,245,31); // green color
  // calls the functions for drawing the radar
  drawRadar();
```

```
  drawLine();
  drawObject();
  drawText();
}
void serialEvent (Serial myPort) { // starts reading data from the Serial Port
  // reads the data from the Serial Port up to the character '.' and puts it into the String variable "data".
  data = myPort.readStringUntil('.');
  data = data.substring(0,data.length()-1);

  index1 = data.indexOf(","); // find the character ',' and puts it into the variable "index1"
  angle= data.substring(0, index1); // read the data from position "0" to position of the variable index1 or thats the value of the angle the Arduino Board sent into the Serial Port
  distance= data.substring(index1+1, data.length()); // read the data from position "index1" to the end of the data pr thats the value of the distance

  // converts the String variables into Integer
  iAngle = int(angle);
  iDistance = int(distance);
}
void drawRadar() {
  pushMatrix();
  translate(width/2,height-height*0.074); // moves the starting coordinats to new location
  noFill();
  strokeWeight(2);
  stroke(98,245,31);
  // draws the arc lines
  arc(0,0,(width-width*0.0625),(width-width*0.0625),PI,TWO_PI);
  arc(0,0,(width-width*0.27),(width-width*0.27),PI,TWO_PI);
  arc(0,0,(width-width*0.479),(width-width*0.479),PI,TWO_PI);
  arc(0,0,(width-width*0.687),(width-width*0.687),PI,TWO_PI);
  // draws the angle lines
```

```
  line(-width/2,0,width/2,0);
  line(0,0,(-width/2)*cos(radians(30)),(-width/2)*sin(radians(30)));
  line(0,0,(-width/2)*cos(radians(60)),(-width/2)*sin(radians(60)));
  line(0,0,(-width/2)*cos(radians(90)),(-width/2)*sin(radians(90)));
  line(0,0,(-width/2)*cos(radians(120)),(-width/2)*sin(radians(120)));
  line(0,0,(-width/2)*cos(radians(150)),(-width/2)*sin(radians(150)));
  line((-width/2)*cos(radians(30)),0,width/2,0);
  popMatrix();
}
void drawObject() {
  pushMatrix();
  translate(width/2,height-height*0.074); // moves the starting coordinats to new location
  strokeWeight(9);
  stroke(255,10,10); // red color
  pixsDistance = iDistance*((height-height*0.1666)*0.025); // covers the distance from the sensor
from cm to pixels
  // limiting the range to 40 cms
  if(iDistance<40){
    // draws the object according to the angle and the distance
  line(pixsDistance*cos(radians(iAngle)),-pixsDistance*sin(radians(iAngle)),(width-
width*0.505)*cos(radians(iAngle)),-(width-width*0.505)*sin(radians(iAngle)));
  }
  popMatrix();
}
void drawLine() {
  pushMatrix();
  strokeWeight(9);
  stroke(30,250,60);
  translate(width/2,height-height*0.074); // moves the starting coordinats to new location
  line(0,0,(height-height*0.12)*cos(radians(iAngle)),-(height-height*0.12)*sin(radians(iAngle))); //
draws the line according to the angle
  popMatrix();
```

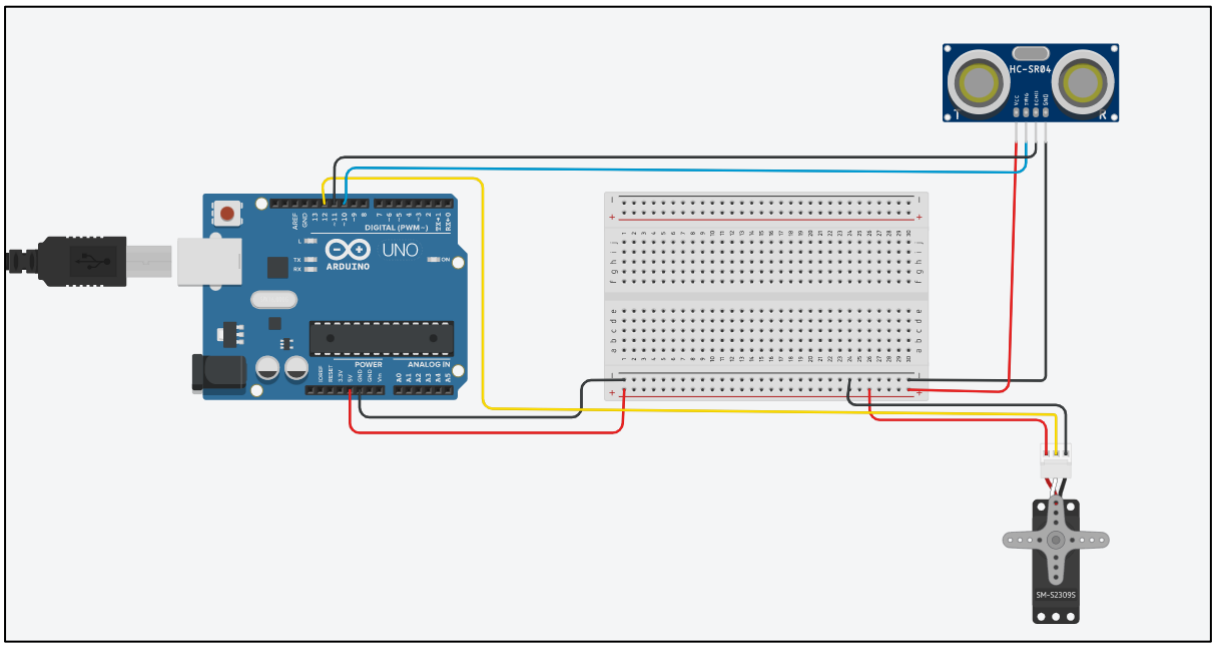
```
}
void drawText() { // draws the texts on the screen


 pushMatrix();
 if(iDistance>40) {
 noObject = "Out of Range";
 }
 else {
 noObject = "In Range";
 }
 fill(0,0,0);
 noStroke();
 rect(0, height-height*0.0648, width, height);
 fill(98,245,31);
 textSize(25);


 text("10cm",width-width*0.3854,height-height*0.0833);
 text("20cm",width-width*0.281,height-height*0.0833);
 text("30cm",width-width*0.177,height-height*0.0833);
 text("40cm",width-width*0.0729,height-height*0.0833);
 textSize(40);
 text(" Team Radar", width-width*0.875, height-height*0.0277);
 text("Angle: " + iAngle +" °", width-width*0.48, height-height*0.0277);
 text("Distance: ", width-width*0.26, height-height*0.0277);
 if(iDistance<40) {
 text("       " + iDistance +" cm", width-width*0.225, height-height*0.0277);
 }
 textSize(25);
 fill(98,245,60);
 translate((width-width*0.4994)+width/2*cos(radians(30)),(height-height*0.0907)-
width/2*sin(radians(30)));
```

```
  rotate(-radians(-60));
  text("30°",0,0);
  resetMatrix();
  translate((width-width*0.503)+width/2*cos(radians(60)),(height-height*0.0888)-
width/2*sin(radians(60)));
  rotate(-radians(-30));
  text("60°",0,0);
  resetMatrix();
  translate((width-width*0.507)+width/2*cos(radians(90)),(height-height*0.0833)-
width/2*sin(radians(90)));
  rotate(radians(0));
  text("90°",0,0);
  resetMatrix();
  translate(width-width*0.513+width/2*cos(radians(120)),(height-height*0.07129)-
width/2*sin(radians(120)));
  rotate(radians(-30));
  text("120°",0,0);
  resetMatrix();
  translate((width-width*0.5104)+width/2*cos(radians(150)),(height-height*0.0574)-
width/2*sin(radians(150)));
  rotate(radians(-60));
  text("150°",0,0);
  popMatrix();
}
```

Circuit Diagram:-



Radar Interface: -