Chittagong University of Engineering and Technology

Department of Electrical and Electronic Engineering

Project Report On

Design and Implementation of Sonar Radar

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Introduction:

In this project, we will show you how to design a simple Radar Application using Arduino and Processing. This Arduino Radar Project is implemented with the help of Processing Application.

Radar is a long-range object detection system that uses radio waves to establish certain parameters of an object like its range, speed and position. Radar technology is used in aircrafts, missiles, marine, weather predictions and automobiles.

Even though the title says Arduino Radar Project, technically the project is based on Sonar technology as we will be using an Ultrasonic Sensor to determine the presence of any object in a particular range.

Project Overview:

The Arduino Radar Project is more of a visual project than it is a circuit implementation. Of course, we will be using different hardware like Arduino UNO, HC-SR04 Ultrasonic Sensor and a Servo Motor but the main aspect is the visual representation in the Processing Application.

In this project,we used a processing IDE to draw a radar.The values from ultrasonic sensor was given to the processing ide.

Here, we will collect the information from the Ultrasonic Sensor with the help of Arduino and pass it to Processing where a simple Graphics application is implemented to mimic a Radar Screen.

Components Required:

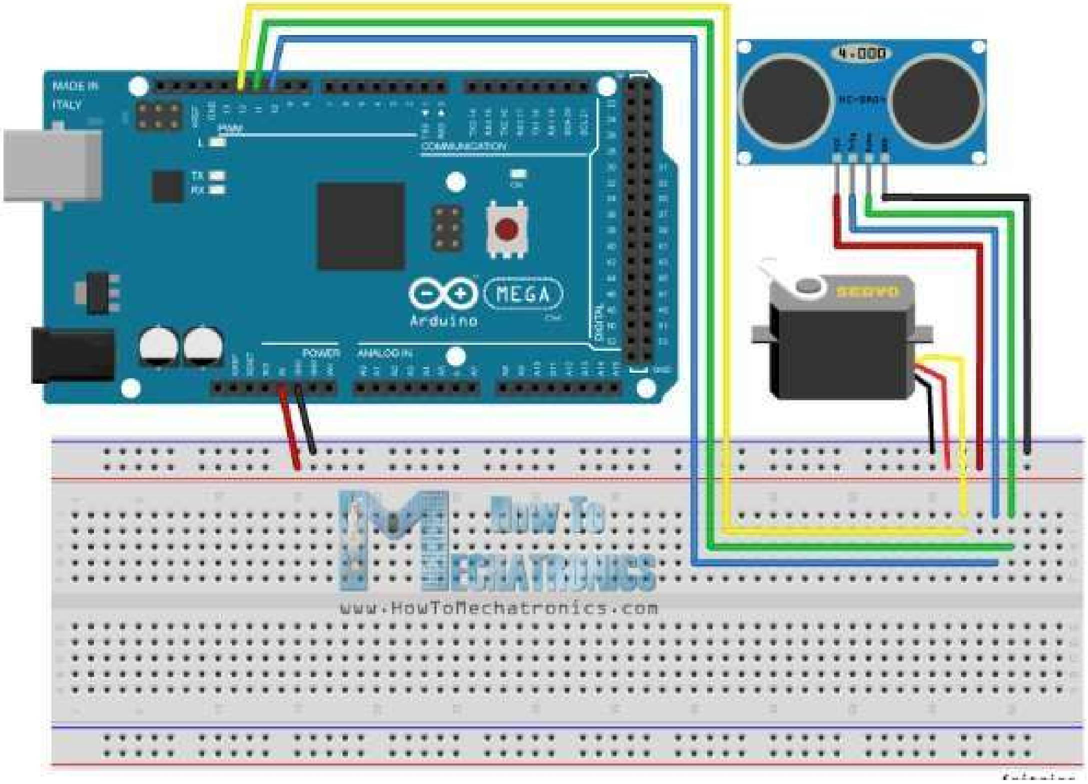
Hardware

- Arduino UNO
- HC-SR04 Ultrasonic Sensor
- TowerPro SG90 Servo Motor
- Mounting Bracket for Ultrasonic Sensor (optional)
- Connecting Wires
- Jumper Cables
- 5V Power Supply
- USB Cable (for Arduino)

Software

- Arduino IDE
- Processing Application

Circuit Diagram:



Arduino Code:

Now we need to make a code and upload it to the Arduino Board that will enable the interaction between the Arduino and the Processing IDE.

Source code for Arduino: //

```
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;
}
```

Now we will receive the values for the angle and the distance measured by the sensor from the Arduino Board into the Processing IDE using the ***SerialEvent()*** function which reads the data from the Serial Port and we will put the values of the angle and the distance into the variables iAngle and iDistance. These variable will be used for drawing the radar, the lines, the detected objects and some of the text.

For drawing the radar I made this function ***drawRadar()*** which consist of ***arc()*** and ***line()*** functions.

```
void drawRadar() {
pushMatrix();
```

```
  translate(960,1000); // moves the starting coordinats to new location

noFill();   strokeWeight(2);   stroke(98,245,31);   // draws the arc

lines   arc(0,0,1800,1800,PI,TWO_PI);

arc(0,0,1400,1400,PI,TWO_PI);   arc(0,0,1000,1000,PI,TWO_PI);

arc(0,0,600,600,PI,TWO_PI);

  // draws the angle lines
  line(-960,0,960,0);

  line(0,0,-960*cos(radians(30)),-960*sin(radians(30)));

line(0,0,-960*cos(radians(60)),-960*sin(radians(60)));

line(0,0,-960*cos(radians(90)),-960*sin(radians(90)));

line(0,0,-960*cos(radians(120)),-960*sin(radians(120)));

line(0,0,-960*cos(radians(150)),-960*sin(radians(150)));

line(-960*cos(radians(30)),0,960,0);   popMatrix();

}
```

For drawing the line that is moving along the radar I made this function ***drawLine()***. Its center of rotation is set with the translate() function and using the line() function in which the iAngle variable is used the line is redrawn for each degree.

```
void drawLine() {

pushMatrix();

strokeWeight(9);

stroke(30,250,60);

  translate(960,1000); // moves the starting coordinats to new location

line(0,0,950*cos(radians(iAngle)),-950*sin(radians(iAngle)));   //   draws

the line according to the angle   popMatrix();

}
```

For drawing the detected objects I made this ***drawObject()*** function. It gets the distance from ultrasonic sensor, transforms it into pixels and in combination with the angle of the sensor draws the object on the radar

```
void drawObject() {

pushMatrix();

  translate(960,1000); // moves the starting coordinats to new location

strokeWeight(9);   stroke(255,10,10); // red color

  pixsDistance = iDistance*22.5; // 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)),950*cos(radians(iAngle)),950*sin(radians(iAngle)));

  }

  popMatrix();

}.
```

For the text on the screen we made the ***drawText()*** function which draws texts on particular locations.

All of these functions are called in the main ***draw()*** function which repeats all the time and draws the screen. Also here I am using this ***fill()*** function with 2 parameters for simulating motion blur and slow fade of the moving line.

```
void draw() {



  fill(98,245,31);

textFont(orcFont);

  // simulating motion blur and slow fade of the moving line

noStroke();   fill(0,4);
```

```
  rect(0, 0, width, 1010);


  fill(98,245,31); // green color

  // calls the functions for drawing the radar

drawRadar();    drawLine();

drawObject();   drawText();

}
```

Here’s the complete Processing Source Code of the Arduino Radar:

```
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 (1920, 1080);
smooth();
```

```
 myPort = new Serial(this,"COM17", 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.

 orcFont = loadFont("OCRAExtended-30.vlw");

}

void draw() {


  fill(98,245,31);

textFont(orcFont);

  // simulating motion blur and slow fade of the moving line

noStroke();

  fill(0,4);

  rect(0, 0, width, 1010);


  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(960,1000); // moves the starting coordinats to new location
noFill();   strokeWeight(2);   stroke(98,245,31);   // draws the arc lines
arc(0,0,1800,1800,PI,TWO_PI);    arc(0,0,1400,1400,PI,TWO_PI);
arc(0,0,1000,1000,PI,TWO_PI);    arc(0,0,600,600,PI,TWO_PI);    //
```

```
draws the angle lines   line(-960,0,960,0);   line(0,0,-
960*cos(radians(30)),-960*sin(radians(30)));   line(0,0,-
960*cos(radians(60)),-960*sin(radians(60)));   line(0,0,-
960*cos(radians(90)),-960*sin(radians(90)));   line(0,0,-
960*cos(radians(120)),-960*sin(radians(120)));   line(0,0,-
960*cos(radians(150)),-960*sin(radians(150)));   line(-
960*cos(radians(30)),0,960,0);   popMatrix();
}
void drawObject() {
pushMatrix();
  translate(960,1000); // moves the starting coordinats to new
location   strokeWeight(9);   stroke(255,10,10); // red color
  pixsDistance = iDistance*22.5; // 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)),950*cos(radians(iAngle)),-
950*sin(radians(iAngle)));
  }
  popMatrix();
}
```

```
void drawLine() {
pushMatrix();
strokeWeight(9);
stroke(30,250,60);
  translate(960,1000); // moves the starting coordinats to new
location
  line(0,0,950*cos(radians(iAngle)),-950*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, 1010, width, 1080);
fill(98,245,31);   textSize(25);
text("10cm",1180,990);
text("20cm",1380,990);
text("30cm",1580,990);
text("40cm",1780,990);
textSize(40);
  text("Object: " + noObject, 240, 1050);
text("Angle: " + iAngle +" °", 1050, 1050);
text("Distance: ", 1380, 1050);   if(iDistance<40)
{
  text("        " + iDistance +" cm", 1400, 1050);
  }
  textSize(25);
fill(98,245,60);
  translate(961+960*cos(radians(30)),982-960*sin(radians(30)));
rotate(-radians(-60));
  text("30°",0,0); resetMatrix();
  translate(954+960*cos(radians(60)),984-960*sin(radians(60)));
rotate(-radians(-30));   text("60°",0,0);   resetMatrix();
```

```
 translate(945+960*cos(radians(90)),990-960*sin(radians(90)));
rotate(radians(0));   text("90°",0,0);   resetMatrix();
 translate(935+960*cos(radians(120)),1003-960*sin(radians(120)));
rotate(radians(-30));   text("120°",0,0);   resetMatrix();
 translate(940+960*cos(radians(150)),1018-960*sin(radians(150)));
rotate(radians(-60));   text("150°",0,0);   popMatrix();
}
```

Cost Estimation:

Arduino Uno-420 Taka

Ultrasonic sensor-200 Taka

Servo Motor-130 Taka