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A PROJECT REPORT ON

"OBSTACLE DETECTION RADAR SYSTEM"

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Last but not the least we express our deep gratitude and affection to our parents who stood behind us in all our endeavors.

ABSTRACT

This project is about Arduino based radar system using ultrasonic sensor. This RADAR system consists of an ultra-sonic sensor and servo motor; these are the most important components of the system. Basic working of the system is that it has to identify objects in its defined range.

Ultra-sonic sensor is attached to the servo motor it rotate on 180 degree and gives visual representation on the software called processing IDE. Processing IDE gives graphical representation and it also gives angle or position of the object and distance of the point.

In this project we used Arduino. Arduino UNO board is sufficed to control ultrasonic sensor and also to interface the sensor and display device. We learn about existing navigation and obstacle detection innovation and different systems where ultrasonic sensors are used efficiently.

Main application of this RADAR system comes into different field of navigation, positioning, object detection, mapping, spying or tracking and different applications. The effectiveness of the proposed design is measured using a statistical analysis of the distance error between the radar andthe obstacles.

The results obtained for all types of obstacles are tabledand graphed to prove that a very small error can be achieved using the proposed design.

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1. INTRODUCTION

RADAR is an object detection system which uses radio waves to verify the range, altitude, direction, or speed of objects. Radar systems come in a variety of sizes and have different performance specifications. Some radar systems are used for air-traffic control at airports and others are used for long range surveillance and early-warning systems. A radar system is the heart of a missile guidance system. Small portable radar systems that can be maintained and operated by one person are available as well as systems that occupy several large rooms.

An obstacle detection system is a device or system that is designed to detect the presence of obstacles in a specific area. These systems can be used in a variety of applications, such as in vehicles to assist with driving, in robotics to help with navigation, and in industrial settings to protect workers and equipment. These systems use different techniques to detect obstacles, such as measuring distance, using infrared radiation, or analyzing images.

An obstacle detection system with Arduino can be implemented using ultrasonic sensors. These sensors emit ultrasonic waves and measure the time it takes for the waves to bounce back to the sensor. By measuring the time and the speed of sound, the distance to the obstacle can be calculated. The Arduino can then be programmed to take actions based on the distance, such as stopping a robot or activating alarm.

1.1 Aim of the project

This project aims at the use of Ultrasonic Sensor by connecting to the Arduino UNO R3 board and the signal from the sensor further provided to the screen formed on the laptop to measure the presence of any obstacle in front of the sensor as well as

determine the distance, range, and angle at which the obstacle is detected by the sensor. In this study ultrasound sensor worked asa radar.

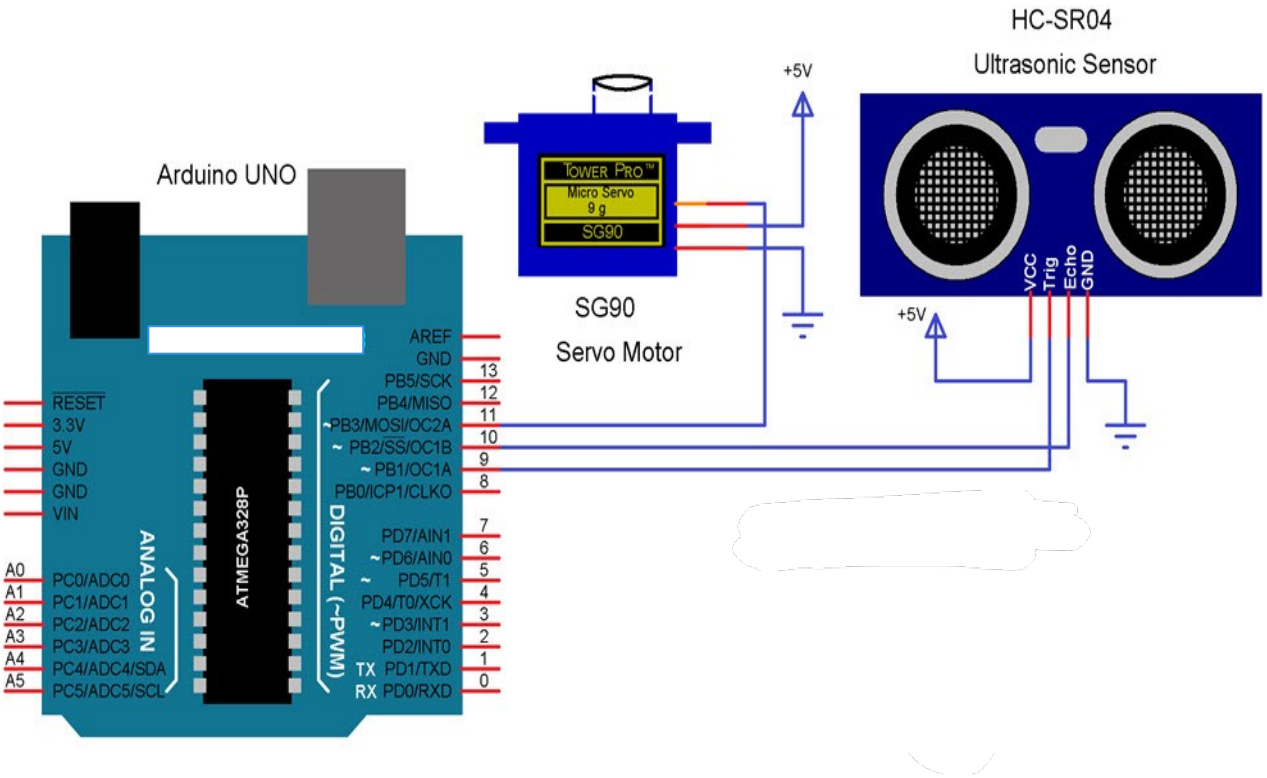
1.2 Basic Concept of Radar System

Radar is an electromagnetic system for the detect and determine the locations of objects and determine distance, and ranges. It operates by transmitting a particular type of waveform, a pulse-modulated, and detects the nature of the echo signal.The distance to the target is determined by measuring the time taken for the radar signal to travel to the target and back.The radar generates a signal, which is transmitted through an antenna into the desired direction. The antenna is designed to concentrate the radar energy in a particular direction. Only a small proportion of the transmitted radar energy reaches the target, with the rest missing it or illuminating other nearby objects.

1.3 Historical Review of Radar

The word RADAR is an acronym derived from the words Radio Detection and Ranging. In the United Kingdom it was initially referred to as radio direction finding (RDF) in order to preserve the secrecy of its ranging capability . Radar system arrives in an assortment of sizes and have distinctive performance particulars. Some radars are utilized for aviation authority at air terminals and others are utilized for long range observation and early-cautioning frameworks

2.CIRCUIT DIAGRAM



The control pin of the servo is connected to the Arduino pin 11, and the TRIG and ECHO pins of the Ultrasonic sensor are connected respectively to pin 9 and 10 of the Arduino. Power supply with common GND is connected to the Servo Motor and Ultrasonic

Sensor.

Components : Arduino Uno R3

SG90 Servo Motor

HC-SR04 Ultra-sonic Sensor

Jumper Wires

3.ASSEMBLY OF PROJECT

This RADAR system consists of an ultrasonic sensor and servo motor. Ultra-sonic sensor is attached to the servo motor it rotates about 180 degrees and gives a visual representation of the software called processing IDE.

Processing IDE gives graphical representation and it also gives an angle or position of the object and the distance of the object. This system is controlled through Arduino.

Radar (sonar) able to detect the presence of fixed and moved targets and can determine the distance between it and the targets in different angles (0-180)0 which is the range can sweep by TowerPro SG90 Servo used in this project.

The detection of objects (targets) doesn't depend on the type of the material that the target made from it; it can detect all the types of objects in the range.

4.WORKING OF PROJECT

To start the Arduino Radar Sensor, you should know the programming code. There are two programming codes need to start the radar. One is the Arduino UNO code and another one is the processing code.

After uploading the code, the servo motors start running from 0 to 180 degrees and again back to 0 degrees. An ultrasonic sensor also rotates along with the servo as it is mounted on the motor. Now, open the processing application and paste the above code. In this code, update the COM port number where your Arduino board is connected.

Now, run this processing code. If your code is right then, you will get a new window. This is the graphical representation of data from the Ultrasonic Sensor is represented in a radar type display.If an ultrasonic sensor detects any object within its range, you can see the same on the graphical representation

4.1 Arduino uno 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 distancelong
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;
}
```

4.2 Processing Code:

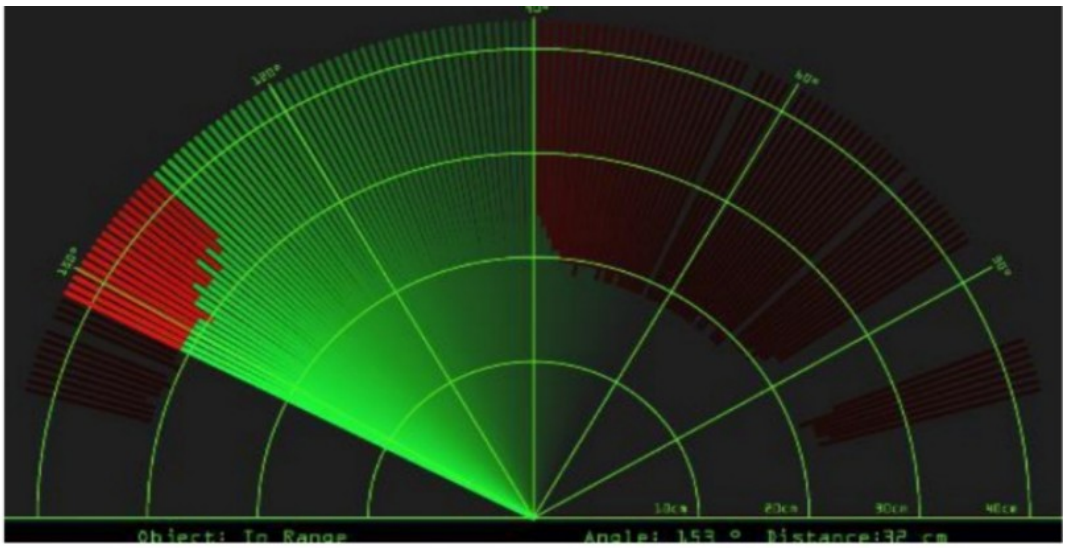
```
import processing.serial.*; // imports library for serial communication
import java.awt.event.KeyEvent; // imports library for reading the data from
the serial port
import  java.io.IOException;
Serial myPort; // defines Object Serial
// defubes variables
String angle="";
String distance="";
String 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
```

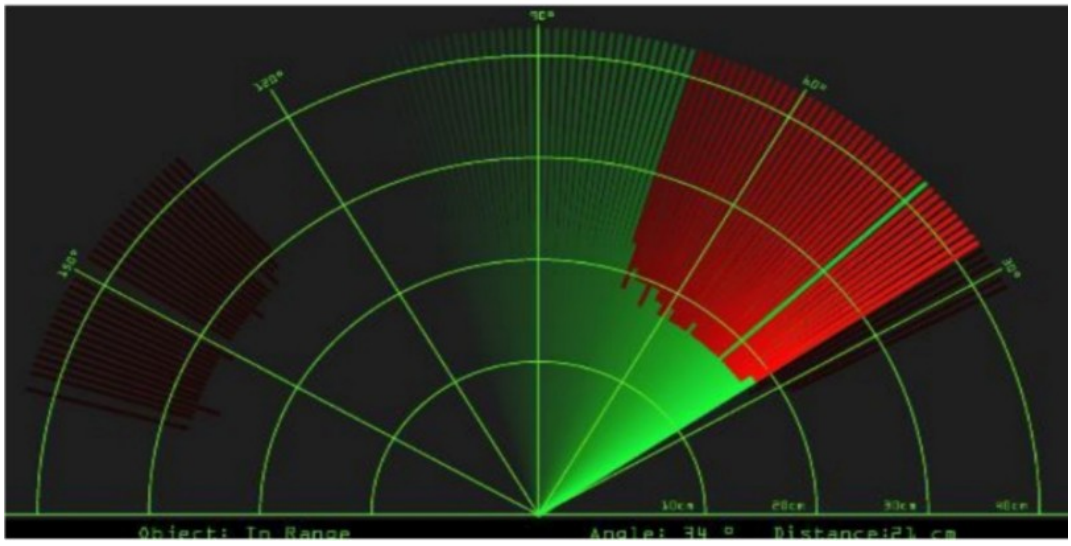
```
the String variable "data".
  data = myPort.readStringUntil('.');
  data = data.substring(0,data.length()-1);
   index1 = data.indexOf(","); // find the character ',' and puts it into the variable "index1"
  angle= data.substring(0, index1); // read the data from position "0" to position of the variable 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("Sakshi Khondge ", 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();
}
```

Graphical Representation





5.APPLICATIONS

Military - In air defense, it is used for target detection, target recognition, and weapon control

Air Traffic Control - The Air Surveillance RADAR is used to detectand display the aircraft's position in the airport terminals.

Space - To guide the space vehicle for a safe landing on the moon

Remote sensing of environment - It can be used for observing whether or observing planetary positions and monitoring sea iceto ensure a smooth route for ships.

Law Enforcement and Highway safety - The radar speed meter, familiar to many is used by police for enforcing the speed limits.

Ship Navigation - Ships are guided through high resolution RADARs situated on the shores. Because of poor visibility in bad weather conditions, RADARs provide safety by warning threats. These ships often use this technology to measure the proximity of other ships and their speed on the water.

Mining and Geophysical Exploration- Radars are used in the mining and geophysical exploration industries to locate minerals and other subsurface resources. This information is used to determine the potential for resource extraction and to guide drilling and excavation operation.

6.ADVANTAGES

1. It is not affected by color or transparency.

2. Any dark environments have no effect on this Arduino radar sensor's detection procedure. So, it can also use at night.

3. Easy to design and low price. The ultrasonic sensors are available at the market with very cheap price.

4. It has high frequency, high sensitivity, therefore, it can easily detect the external or deep objects.

5. The Ultrasonic sensor can easily interface with any types of the microcontroller.

6. Radarsignals do not require a medium of transportation. Radar employs the use of radio signals that can travel in air or space. They do not require any medium to be transported.

*7.*It allows for 3D Imaging based on the various angles of return. The data captured by Radar systems can be used to map an area and provide 3D images of the area based on the varying angles of return.

7. DISADVANTAGES

1. The Arduino Radar Sensor conduct sound to continue the work.

2. A very soft fabric can absorb more sound waves. Therefore, it is hard to detect objects which are covered with soft fabric.

3. If temperature changes of 5 to 10 degree or more then it is the effect on the sensing accuracy.

4. Another limitation is the detection range. This depends on which Ultrasonic sensor have used to make the Arduino Radar Sensor.

5. While the radar using for inspection purpose, make sure it should be water resistive. Otherwise highly chances of damage.

*6.*Radar takes more time to lock on an object. Since radio signals travel freely in air and space, it takes more time to get to the object and back.

7. It is not very accurate. The data collected by RADAR systems are accurate only up to a certain extent. Some details may be omitted due to a lack of accuracy.

8.CONCLUSION

This project aim on the use of Ultrasonic Sensor by connected to the Arduino UNO R3 board and the signal from the sensor further provide to the screen produced on the laptop to measure the presence of any barrier in front of the sensor as well as determine the range and angle at which the obstacle is detected by the sensor.

Radar (sonar) able to detect the presence of fixed and moved targets and can determine the distance between it and the targets in different angles (0-180) degrees which is the range can sweep by TowerPro SG90 Servo used in this project.

We have tremendous applications in which radar system have been implemented or used. There is a lot of future scope of this design because of its security capacity. It can be used in many applications. This construction can also be developed or modified according to the rising needs and demands.

It is very important to use these techniques for security in government offices, street, banks, and so and instead of the camera system because it is more accurate, not affected by the weather conditions like (rain , snow, and fog)