ULTRASONIC RADAR SYSTEM

PROJECT REPORT

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1.0 About the Problem

The aim of this **Ultrasonic Radar System project** is to achieve a radar system prototype based on an Arduino board that detects stationary and moving objects.

In this project , we are going to design an Arduino radar project using Ultrasonic Sensor for detection and a Application for Monitoring. An Arduino microcontroller makes electronics more disciplined.

System's objective is to track the distance and angle of the object and to represent this information graphically, meaning its output should be in graphical form which will be represented through processing software on computer and on mobile devices using android app.

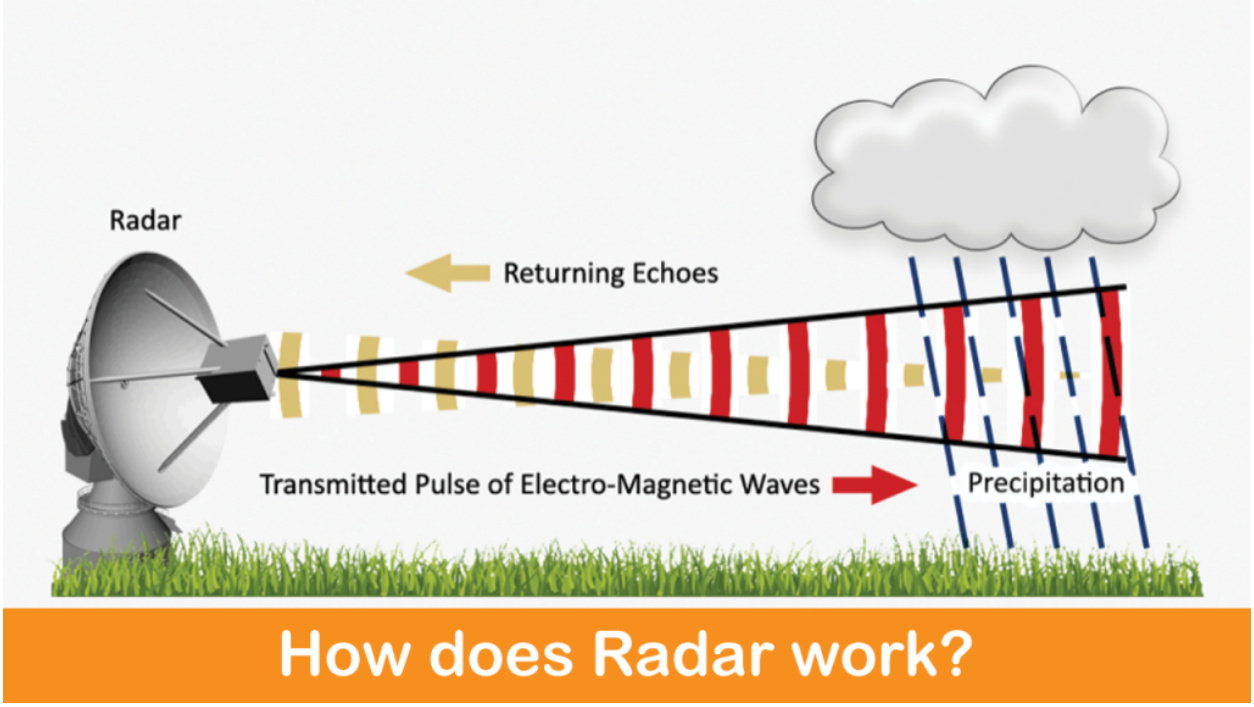
2.0 Scope of the Project

The field that we have chosen for our design "Radar System" is a very vast field and the future scope of this technology is very high. It has tremendous applications in which radar systems 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 framework can also be developed or modified according to the rising needs and demand.
The modern radar system is very advanced and used in highly diverse applications such as Air traffic control, Air defense system, radar Astronomy, Antimissile system, Outer space Surveillance system, and many more.

3.0 Working Methodology

3.1 The basic principle of operation:

A radar is an electromagnetic sensor that is used to detect and locate an object. The radar antenna transmits radio waves or microwaves that bounce off any object in their path. Due to this, we can easily determine the object in the radar range.



Radio waves or microwaves are radiated out from the radar into free space. Some waves are intercepted by reflecting objects. These intercepted radio waves hit the target and are reflected in many different directions. Some of these waves can be directed back toward the radar, where they are received and amplified.If these waves are received again at their origin, then it means an object is in the propagation direction.

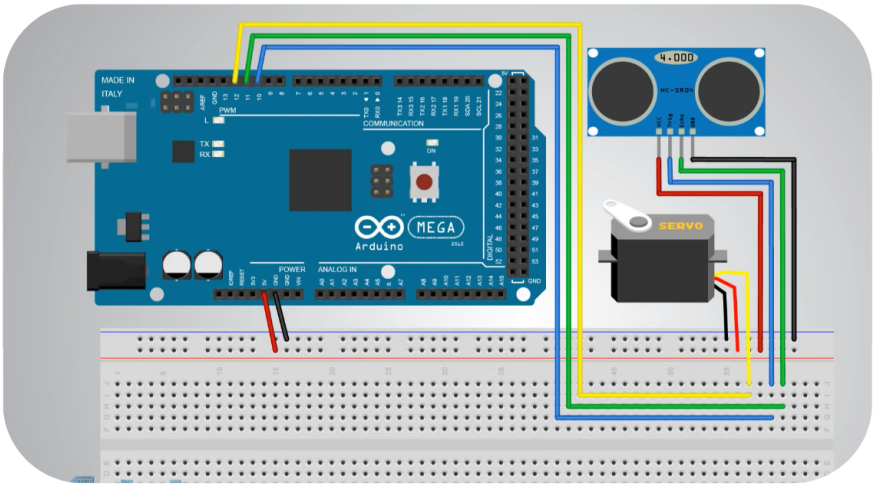
3.2 Step by Step Working :

i) Hardware Connection : Connection of hardware resources like ultrasonic sensor, servo motor, jumper wires, Arduino and breadboard.

ii) Software and Code installation : Installation of necessary softwares like Arduino IDE and uploading the codes in the Arduino.

iii) Working : The system consists of a basic ultrasonic sensor placed upon a servo motor which rotates at a certain angle and speed. This ultrasonic sensor is connected to Arduino digital input output pins and servo motors also connected to digital input output pins.
After uploading the code, the servo motor starts running from 0 to 360 degrees and again back to 0 degrees. The ultrasonic sensor also rotates along with the servo as it is mounted on the motor. The Radar is then connected with the Application with the Help of bluetooth.
Then, there is the graphical representation of data from the Ultrasonic Sensor which is represented in a radar type display. If an ultrasonic sensor detects any object within its range, you can see the object graphical representation on sonic app . The buzzer also creates sound in case the sensor detects any object within its range.

Circuit Diagram :



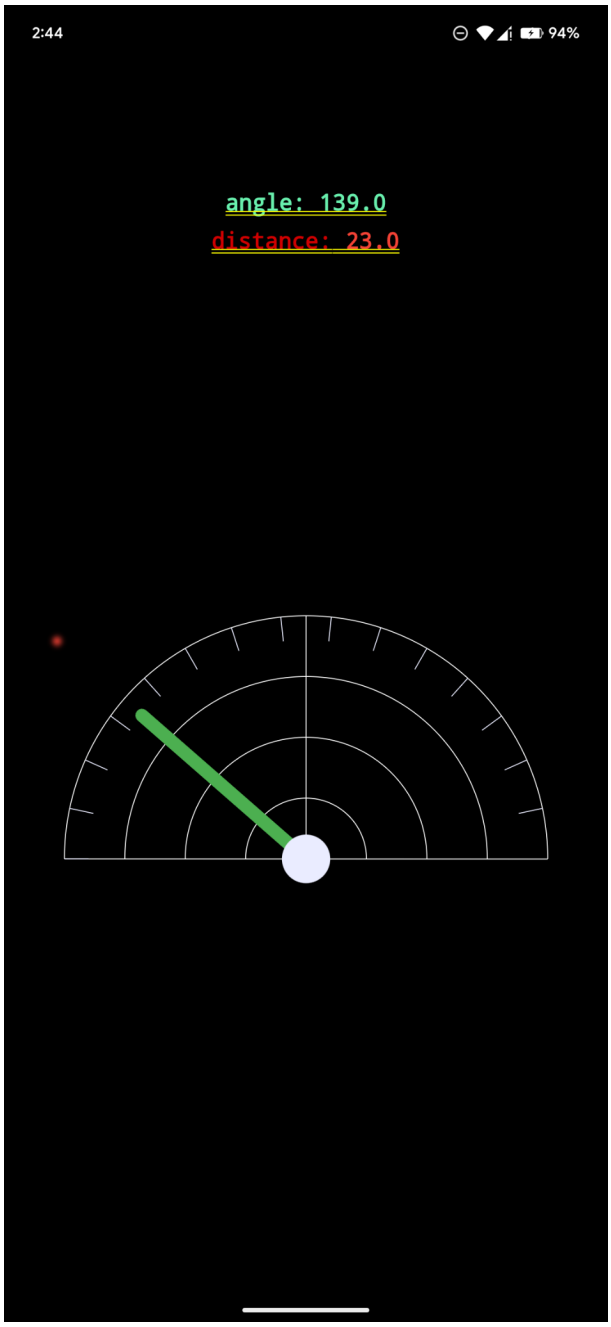
3.3 Code / Sketch : -

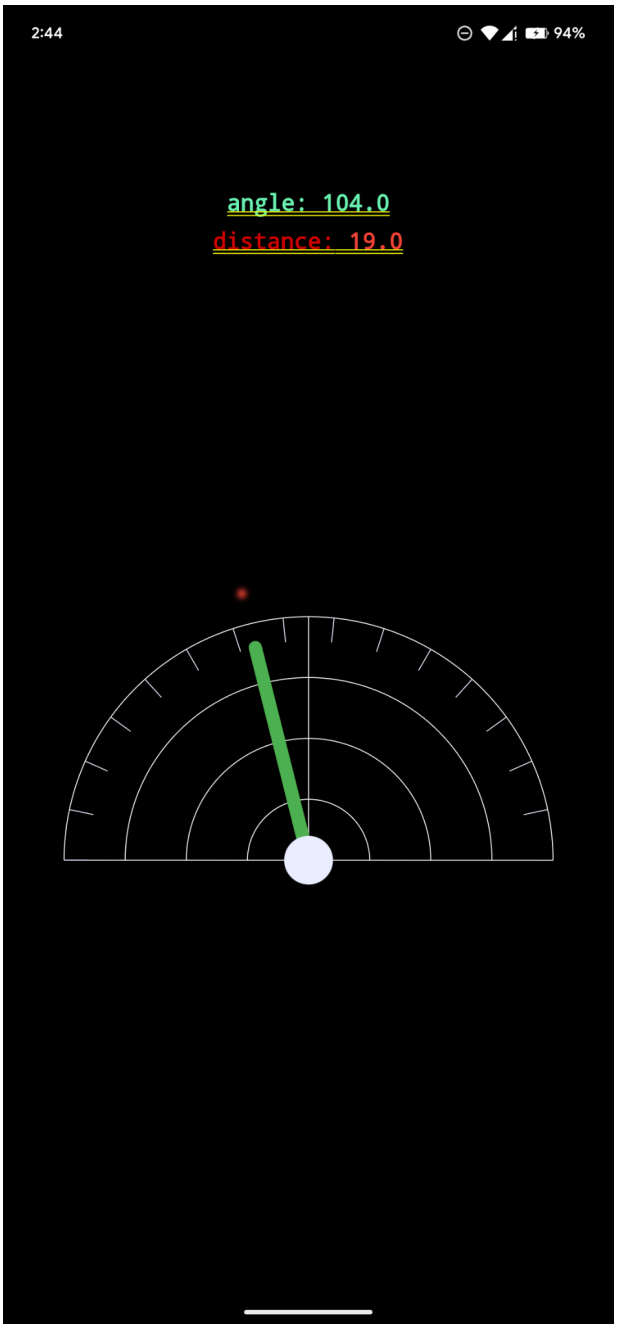
```
// Includes the Servo library
#include <Servo.h>
// Defines Tirg and Echo pins of the Ultrasonic Sensor
const int echoPin = 11;
const int trigPin = 10;
const int buzzerPin = 8;
const int ledPin  =  7;

// 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
  pinMode(ledPin,OUTPUT);
  pinMode(buzzerPin,OUTPUT);
  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=10;i<=165;i++){
   digitalWrite(ledPin,LOW);
  myServo.write(i);
  delay(30);
   distance = calculateDistance();// Calls a function for calculating the distance measured by the Ultrasonic sensor for each degree
  if(distance<40){
   digitalWrite(ledPin,HIGH);
   tone(buzzerPin,1000,100);
  }
```

```
  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>10;i--){
   digitalWrite(ledPin,LOW);
  myServo.write(i);
  delay(30);
  distance = calculateDistance();
  if(distance<40){
   digitalWrite(ledPin,HIGH);
   tone(buzzerPin,1000,100);
  }
  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;
}
```

Working Model :





4.0 Hardware & Software used

4.1 Ultrasonic Sensor :

An ultrasonic sensor is a proximity sensor that is used to measure the distance of a target or object. It detects the object by transmitting ultrasonic waves and converts the reflected waves into an electrical signal. These sound waves travel faster than the speed of the sound that humans can hear.

4.2 Servo motor :

The servo motor is a simple DC motor that can be controlled for specific angular rotation with the help of additional servomechanism. This motor will only rotate as much as we want and then stop. The servo motor is a closed-loop mechanism that uses positional feedback to control the speed and position.

4.3 Bluetooth Module :

It is used to connect small devices like mobile phones using a short-range wireless connection to exchange files. It uses the 2.45GHz frequency band. The transfer rate of the data can vary up to 1Mbps and is in the range of 10 meters.

4.4 Android Studio :

Android Studio provides a unified environment where you can build apps for Android phones, tablets etc. Structured code modules allow you to divide your project into units of functionality that you can independently build, test, and debug

4.5 Arduino IDE :

The Arduino IDE is an open-source software, which is used to write and upload code to the Arduino boards. The IDE application is suitable for different operating systems such as Windows, Mac OS X, and Linux. It supports the programming languages C and C++.

4.6 Breadboard and Jumper Wires:

A breadboard, solderless breadboard, or protoboard is a construction base used to build semi-permanent prototypes of electronic circuits. Unlike a perfboard or stripboard, breadboards do not require soldering or destruction of tracks and are hence reusable.

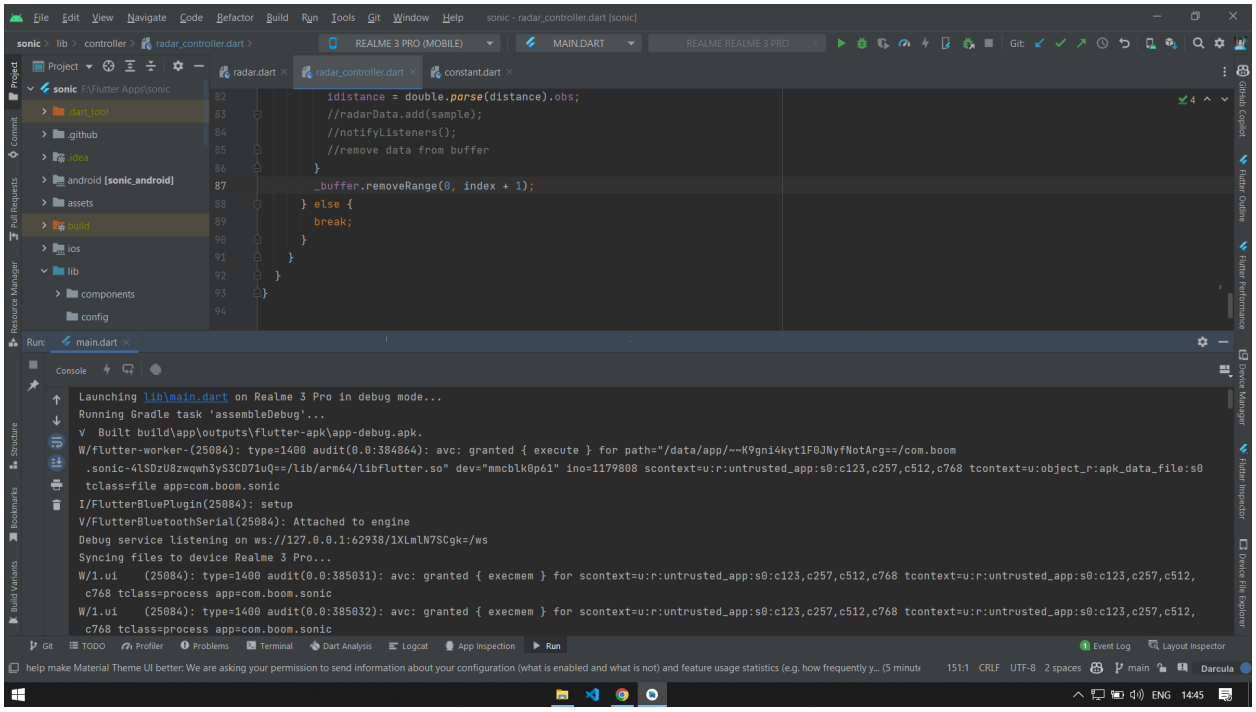
4.7 Buzzer:

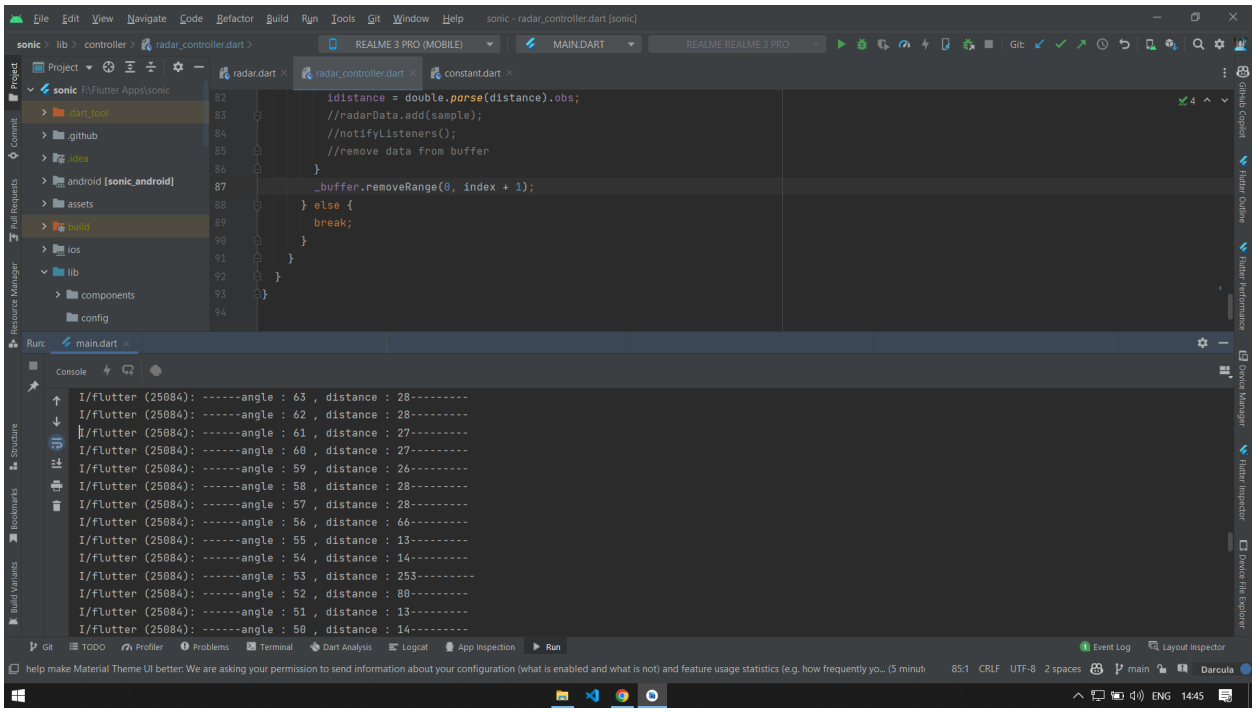
An arduino buzzer is also called a piezo buzzer. It is basically a tiny speaker that you can connect directly to an Arduino. You can make it sound a tone at a frequency you set. The buzzer produces sound based on reverse of the piezoelectric effect.

5.0 Listing out the Testing Technologies

5.1 Android Application Testing

Performance measure using Flutter Inspector , Debugger and Dart Dev Tools Generating profile of app and then identifying problems in UI of graph and GPU , performance overlay graph, Threads - UI Threads , I/o Threads platform threads





6.0 Limitations of the System proposed

6.1 Unidirectional

The ultrasonic radar system system is unidirectional at a particular timestamp and hence it is unable to detect entities which are out of bound in a particular omnidirectional space within a given range in a particular timestamp.

6.2 Confidentiality Loss

Since the bluetooth module broadcasts the data any unverified person within a particular range could listen to data and make use of it, hence there is a threat to confidentiality.

6.3 Object Distance Precision

Object 1 is placed 30.5 far from the radar, radar gives the distance 32 cm, so:
error =((32-30.5)/30.5)*100= 4.918%

7.0 Conclusion

In this Project , a system radar system was designed with the help of Arduino, servo motor and ultrasonic sensor which can detect the position, distance of obstacle which comes in its way and converts it into visually representable form. This system can be used in robotics for object detection and avoidance systems or can also be used for intrusion detection for location sizes. Range of the system depends upon the type of ultrasonic sensor used.