MADRAS INSTITUTE OF TECHNOLOGY

SUB NAME: BASICS OF ELECTRICAL AND ELECTRONICS ENGINEERING

SUBCODE: EE6351

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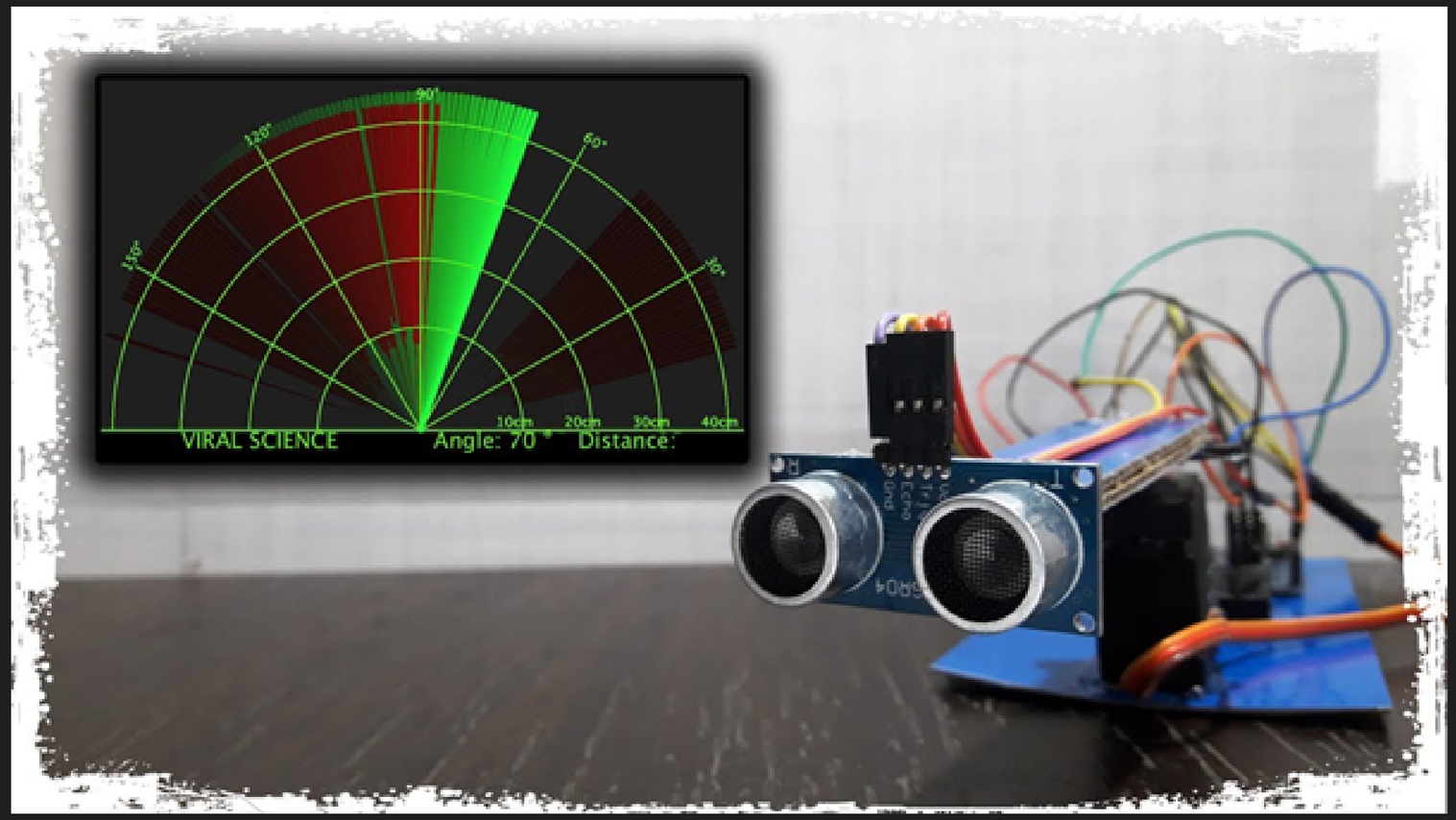
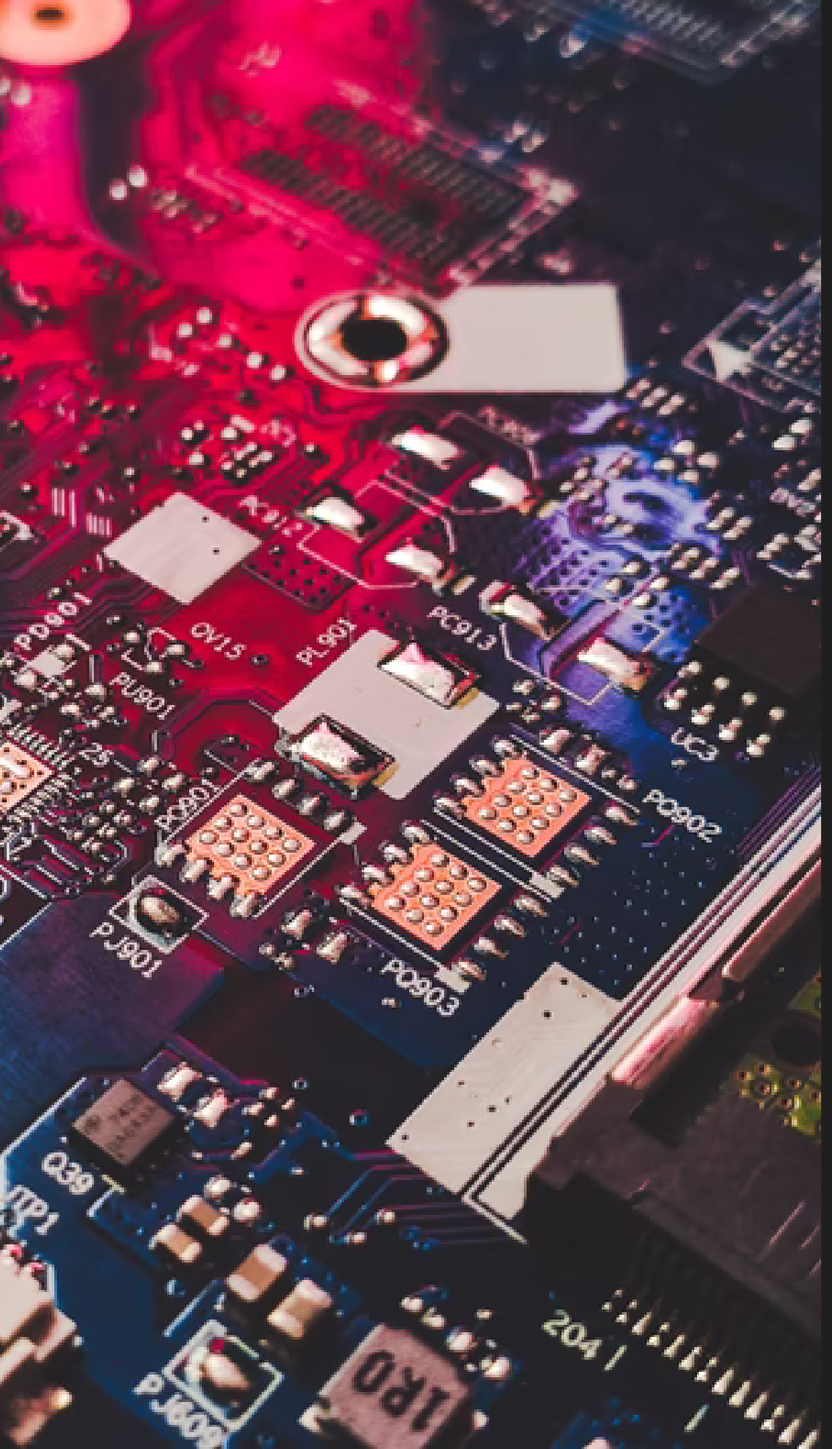
Radar Detector

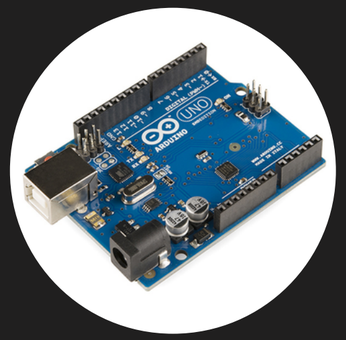




AIM

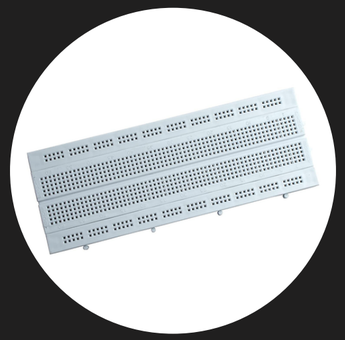
To design a Radar Detector using electrical and electronic circuits and components

Materials Required



Arduino Uno

Ultrasonic sensor
HC-SR04



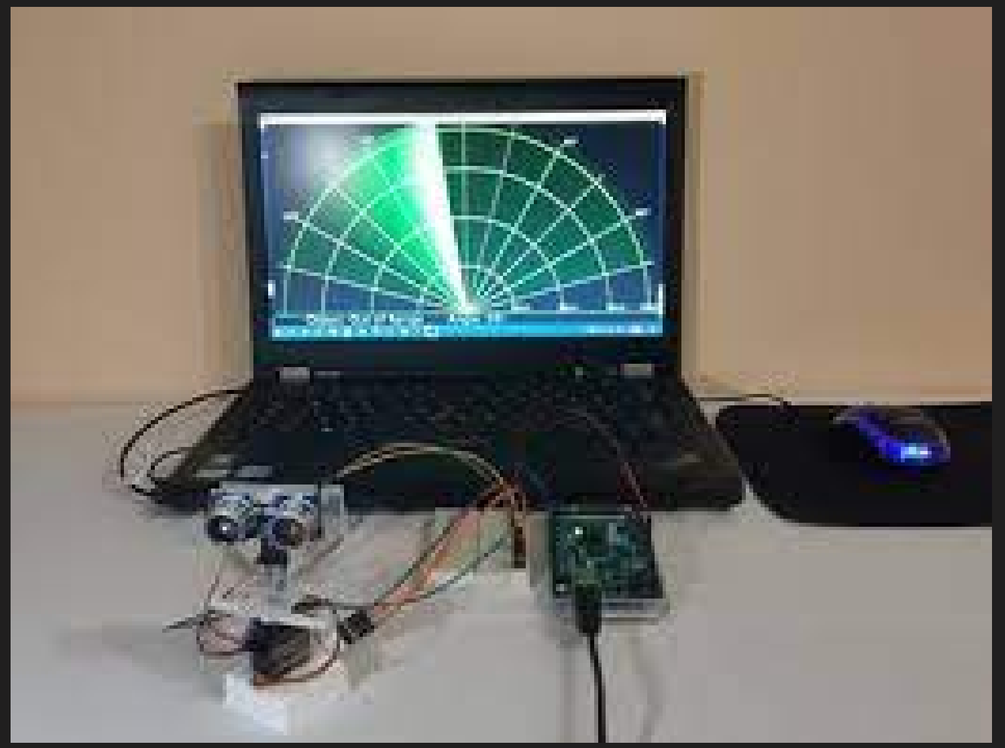
BreadBoard

Jump wires

Micro Servo

Theory

The word RADAR means Radio Detection And Ranging. Radar is an object detection system that uses microwaves to determine the range, altitude, direction, and speed of objects within about a 100-mile radius of their location. The radar antenna transmits radio waves or microwaves that bounce off any object in its path. Due to this, we can easily determine the object in the radar range.



ULTRASONIC SENSOR

It has two main components: the transmitter & receiver. The transmitter emits the sound using a piezoelectric crystal, and the receiver encounters the sound after it has traveled to and from the target.

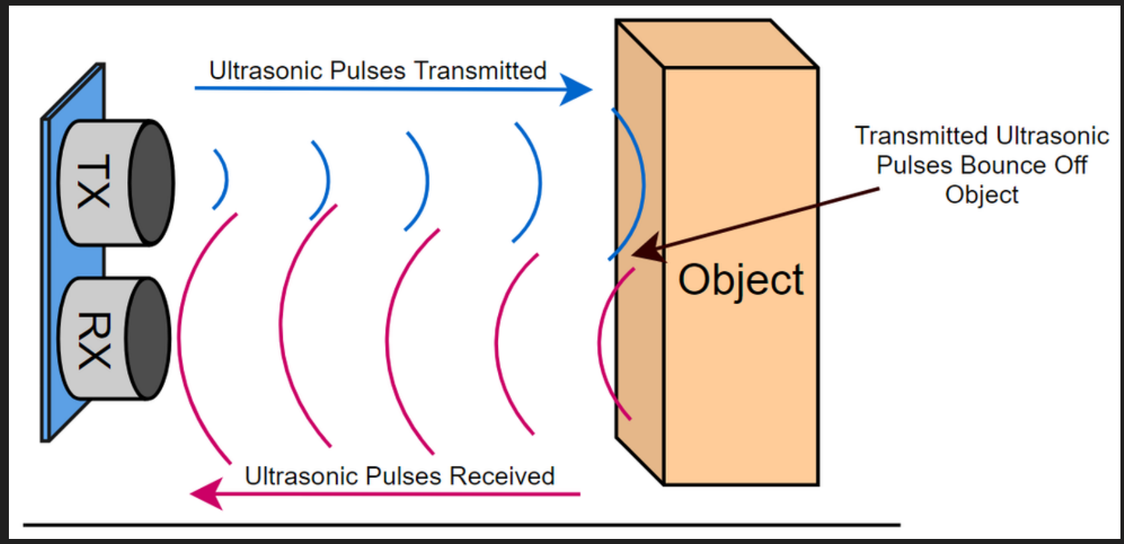
For the calculation of the object distance, the sensor measures the time taken by the signal to travel between the transmission of the sound by the transmitter to the reflecting back towards the receiver.

The formula for this calculation is,

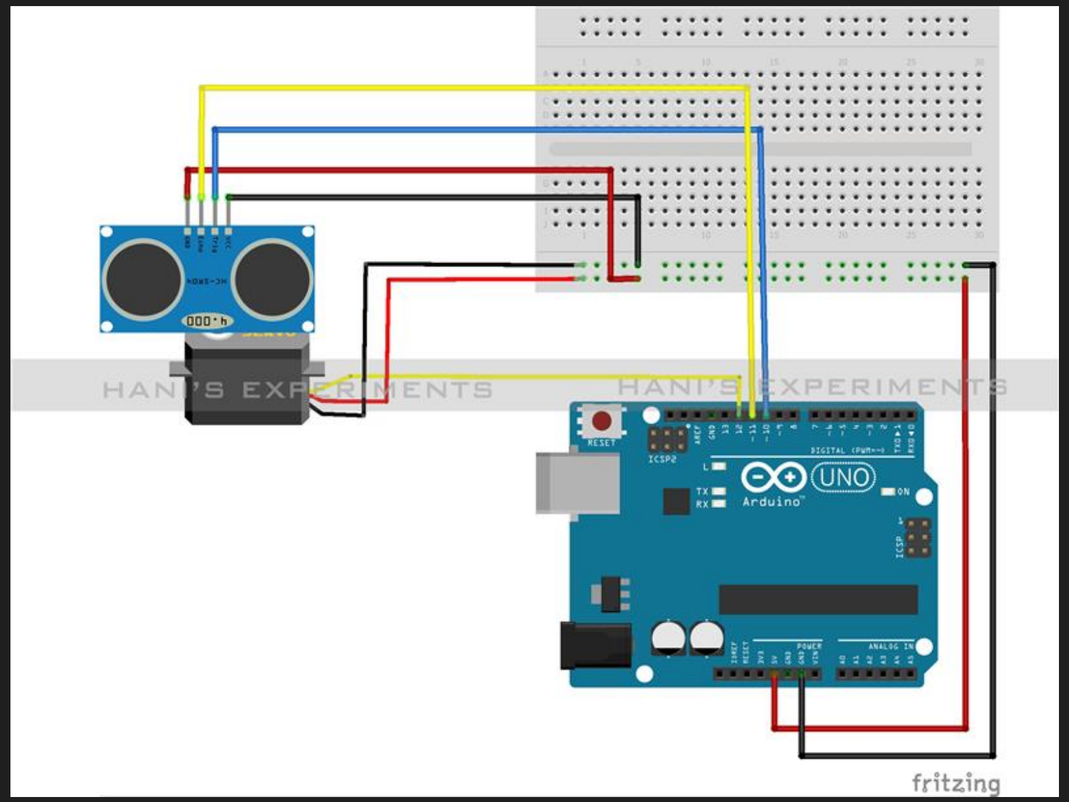
$D = \frac{1}{2} T \times C$

Where,

- D = distance,
- T = time
- C = speed of sound which is 343 meters/second.



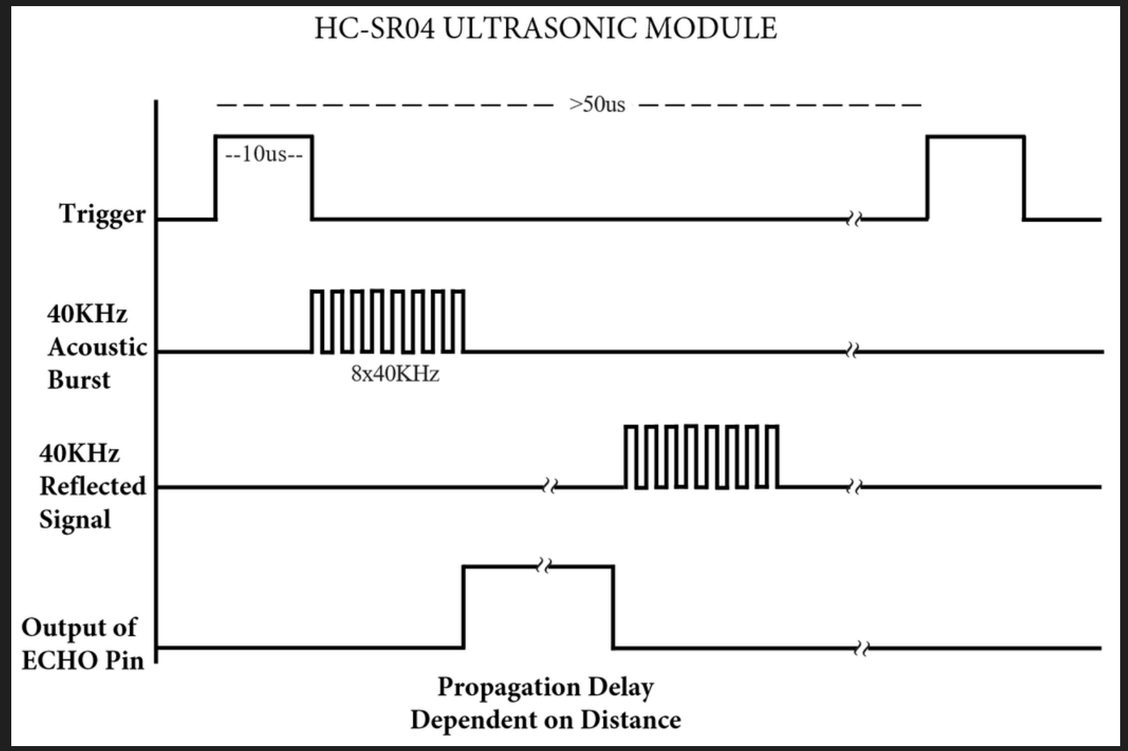
Procedure



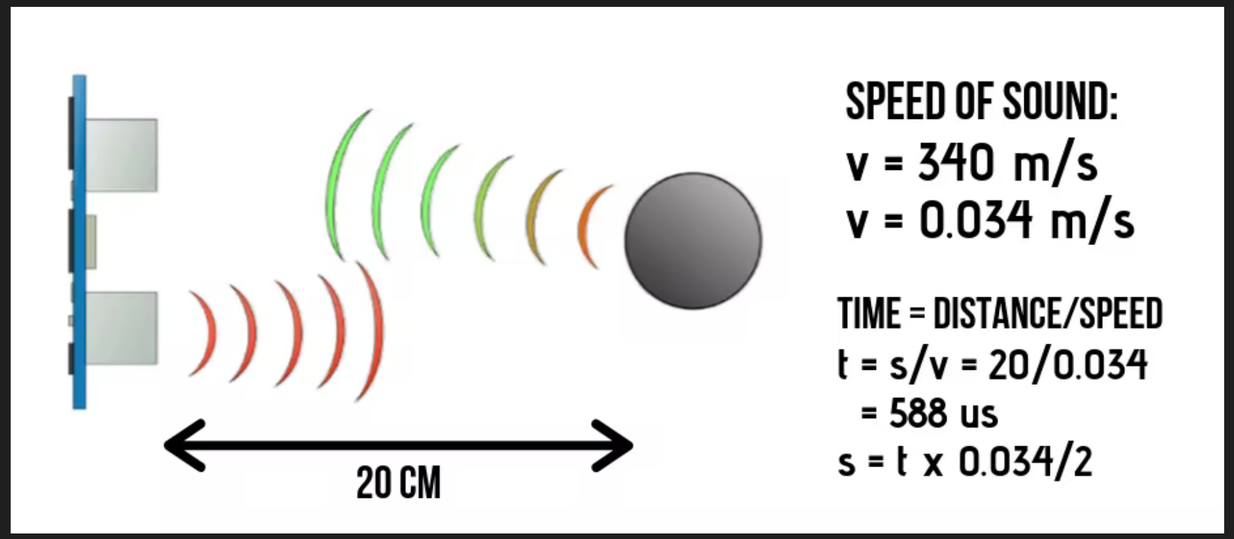
The Micro Servo Motor has 3 pins, Ground, VCC, Signal. The Ground and the VCC pins of the motors need to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the Signal pin to the 12th Digital I/O pin on the Arduino Board.

The HC-SR04 Ultrasonic Module has 4 pins, Ground, VCC, Trig, and Echo. The Ground and the VCC pins of the module need to be connected to the Ground and the 5 volts pins on the Arduino Board respectively and the trig and echo pins to any Digital I/O pin on the Arduino Board.

In order to generate the ultrasound, you need to set the Trig on a High State for 10 µs. That will send out an 8 cycle ultrasonic burst which will travel at the speed of sound and it will be received in the Echo pin. The Echo pin will output the time in microseconds the sound wave traveled.



Example



For example, if the object is 10 cm away from the sensor, and the speed of the sound is 340 m/s or 0.034 cm/μs the sound wave will need to travel about 294 u seconds. But what you will get from the Echo pin will be double that number because the sound wave needs to travel forward and bounce backward. So in order to get the distance in cm, we need to multiply the received travel time value from the echo pin by 0.034 and divide it by 2.

Arduino and HC-SR04 Ultrasonic Sensor Code

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
}
```

Code

```
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
  }
```

Code

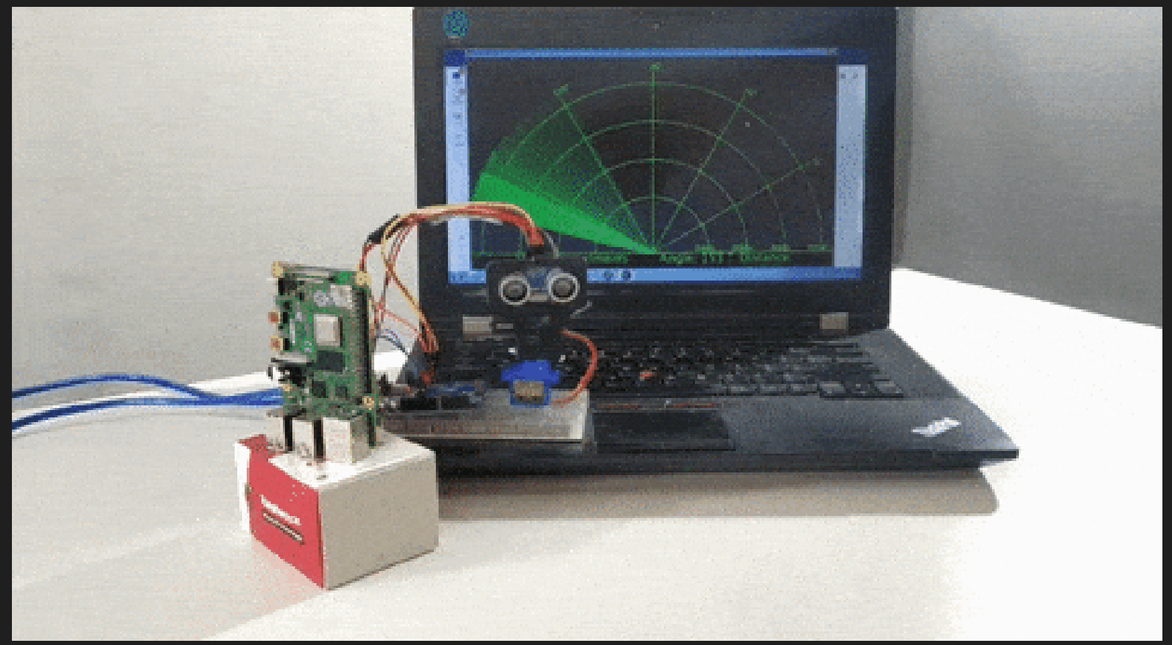
```
 // Repeats the previous lines from 165 to 15 degrees
  for(int i=165;i>15;i--){
  myServo.write(i);
  delay(30);
  distance = calculateDistance();
  Serial.print(i);
  Serial.print(",");
  Serial.print(distance);
  Serial.print(".");
  }
}
```

Code

```
// 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;
}
```

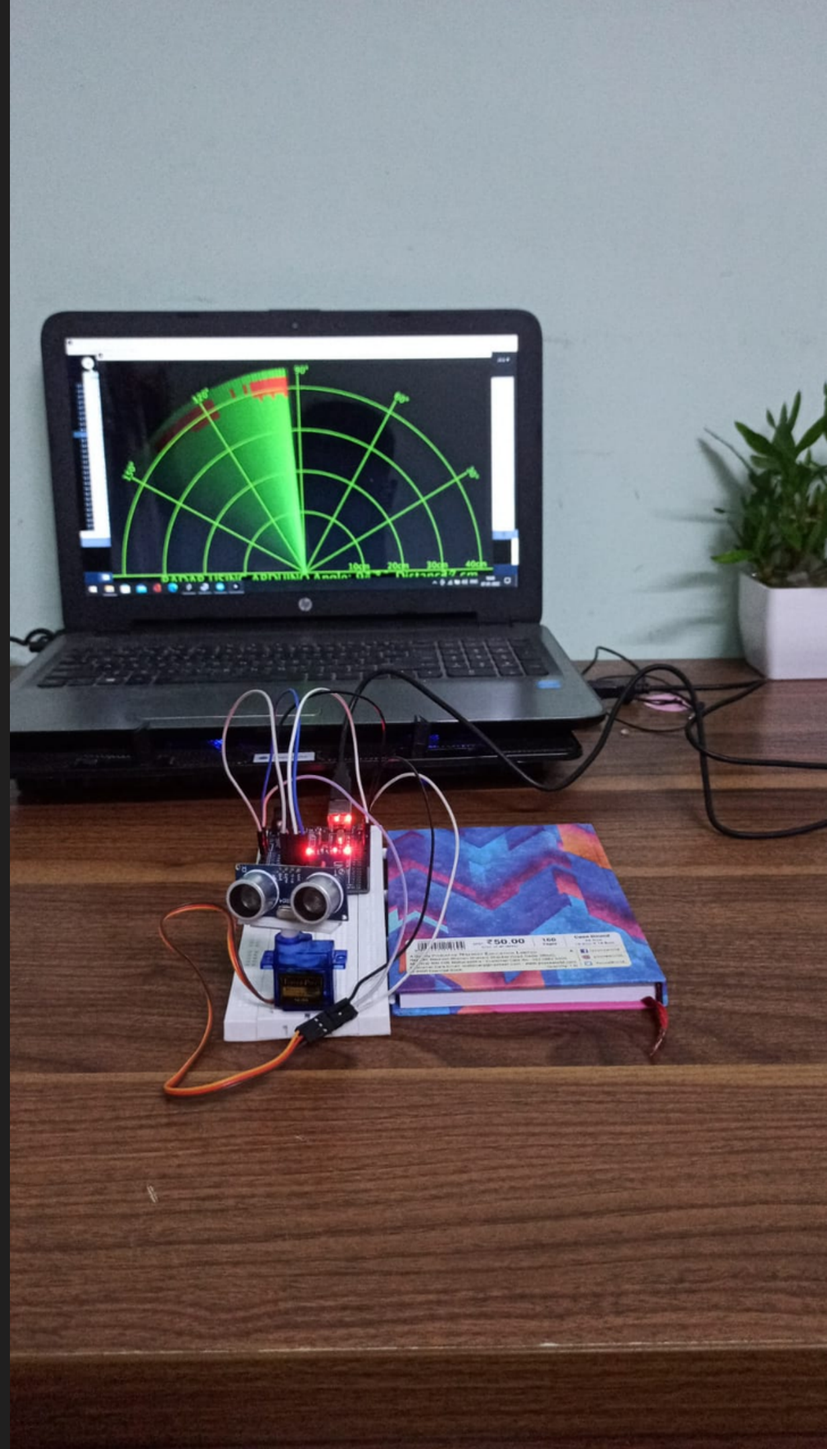
Output



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. If an ultrasonic sensor detects any object within its range, you can see the same on the graphical representation. The below gif shows the output of the Arduino radar project.

Result

The Final working Model we Designed



Advantages

- RADAR signals 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.
- RADAR can penetrate mediums such as clouds, fogs, mist, and snow. The signals used by RADAR technology are not limited or hindered by snow, clouds, or fog. This means that even in the presence of these adverse conditions, data will still be collected.
- It can give the exact position of an object. RADAR systems employ the use of electromagnetic to calculate the distance of an object and its exact position on the earth's surface or space.
- It can measure the distance of an object. RADAR systems work by measuring the exact distance of an object from the transmitter.
- It is cheaper as compared to other systems. RADAR systems are relatively cheaper especially if used for large-scale projects.

Disadvantages

- 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.
- RADAR has a wider beam range (Over 50ft Diameter). The beam range for RADAR is quite wide and not target specific.
- It has a shorter range (200ft). Unlike LiDAR, RADAR signals operate at a limited range of 200ft.
- Large objects that are close to the Transmitter can saturate the receiver. The radio signals work best when the object is further away from the receiver and not closer.
- It cannot distinguish or resolve multiple targets. If there are several targets, the radio signals may not tell the objects apart.

Applications:

Military Applications

It has 3 major applications in the Military:

- In air defense, it is used for target detection, target recognition, and weapon control (directing the weapon to the tracked targets).
- In a missile system to guide the weapon.
- Identifying enemy locations on the map.

Air Traffic Control

It has 3 major applications in Air Traffic control:

- To control air traffic near airports. The Air Surveillance RADAR is used to detect and display the aircraft’s position in the airport terminals.
- To guide the aircraft to land in bad weather using Precision Approach RADAR.
- To scan the airport surface for aircraft and ground vehicle positions

Applications:

Remote Sensing

It can be used for observing whether or observing planetary positions and monitoring sea ice to ensure a smooth route for ships.

Ground Traffic Control

It can also be used by traffic police to determine the speed of the vehicle, controlling the movement of vehicles by giving warnings about the presence of other vehicles or any other obstacles behind them.

Space

It has 3 major applications

- To guide the space vehicle for a safe landing on the moon
- To observe the planetary systems
- To detect and track satellites
- To monitor the meteors

Hardware and Software Used

Hardware: Laptop, USB wire.
Software: Arduino IDE, processing4

Total Expenditure

Arduino - 490
Servo - 199
Wires, breadboard, usensor - 270
Total - 959

Thank You