Tinker Lab Activity

ULTRASONIC RADAR

Branch: CSE –A1

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PROBLEM STATEMENT

Ultrasonic transmitters are used to detect nearby objects for the smooth functioning of the system. It can be used by the army, air force, etc. It is an excellent choice for solid as well as liquid level measurement. They are widely used for presence detection and object profiling.

What is AI?

Artificial intelligence is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. In its simplest form, artificial intelligence is a field that combines computer science and robust datasets to enable problem-solving.

Importance of AI

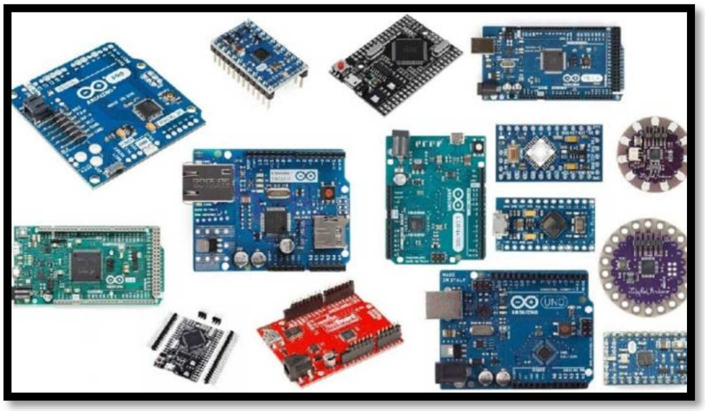
A great tool for almost any modern company, artificial intelligence technology offers a number of important advantages, including:

- ✓ Automation
- ✓ Accuracy
- ✓ Enhancement
- ✓ Analysis
- ✓ Instant

Components and Software Used

- ❑ Microcontroller (Arduino UNO)
- ❑ Sensor (Ultrasonic Sensor)
- ❑ Servo Motor
- ❑ Jumper Wires
- ❑ Output Device
- ❑ Processing IDE
- ❑ Arduino IDE

What is a Microcontroller?



A microcontroller is a compact integrated circuit designed to govern a specific operation in an embedded system. A typical microcontroller includes a processor, memory and input/output (I/O) peripherals on a single chip.

Microcontrollers are found in: -

- ❑ Vehicles
- ❑ Robots
- ❑ Office machines
- ❑ Medical devices
- ❑ Mobile radio transceivers
- ❑ Vending machines
- ❑ Home appliances

Various Types of Microcontrollers: -

- ❑ Arduino UNO R3
- ❑ Arduino PRO Mini
- ❑ Raspberry Pi (IoT)
- ❑ Arduino Nano
- ❑ Esp8266 (IoT)
- ❑ Teensy 3.6

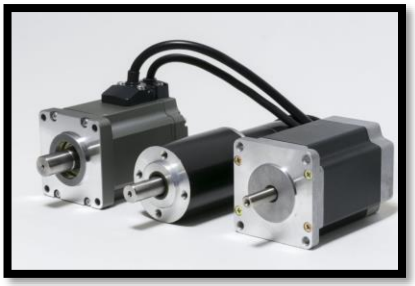
What is Sensor?

A sensor is a device that detects and responds to some type of input from the physical environment. The input can be light, heat, motion, moisture, pressure, or any number of other environmental phenomena. The output is generally a signal that is converted to a human-readable display at the sensor location or transmitted electronically over a network for reading or further processing.

Various Types of Sensors: -

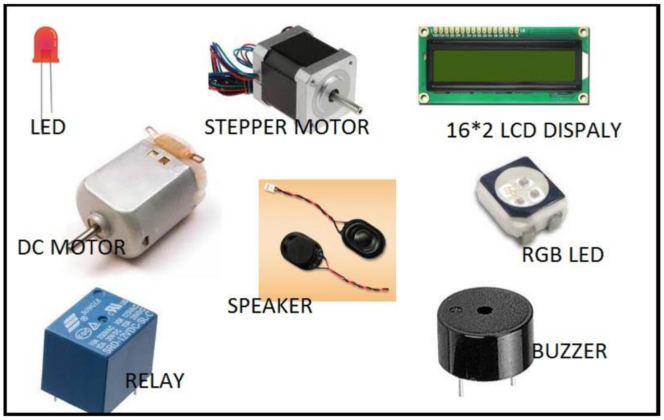
- ❑ Touch sensor
- ❑ IR sensor
- ❑ Pressure sensor
- ❑ Temperature sensor
- ❑ Moisture sensor
- ❑ Ultrasonic sensor
- ❑ Humidity sensor
- ❑ Motion Sensor

What is a Servo Motor?



A servo motor is an electrical device that is mainly used on angular or linear positions and for specific velocity, and acceleration.

What are Output Devices?



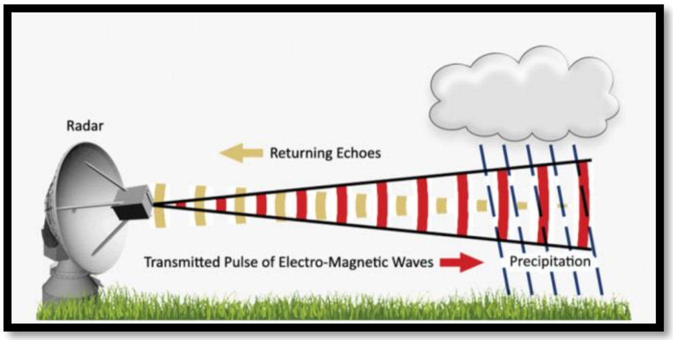
The output device displays the result of the processing of raw data that is entered in the computer through an input device.

Many microcontroller projects require some form of user input, like a button press, and produce some output to inform the user of the device's current state or errors. Inputs are often simple components such as push buttons, switches, and dials. Users can utilize LEDs, Buzzers, Motors, etc. as simple output devices.

Costing

Name of Components	Cost	Quantity
Ultrasonic Sensor	Rs. 300	1
Servo Motor	Rs. 300	1
Jumper Wire	Rs. 100	7
Arduino	Rs. 1200	1
Adhesive	Rs. 100	1
Total	Rs. 2000	11

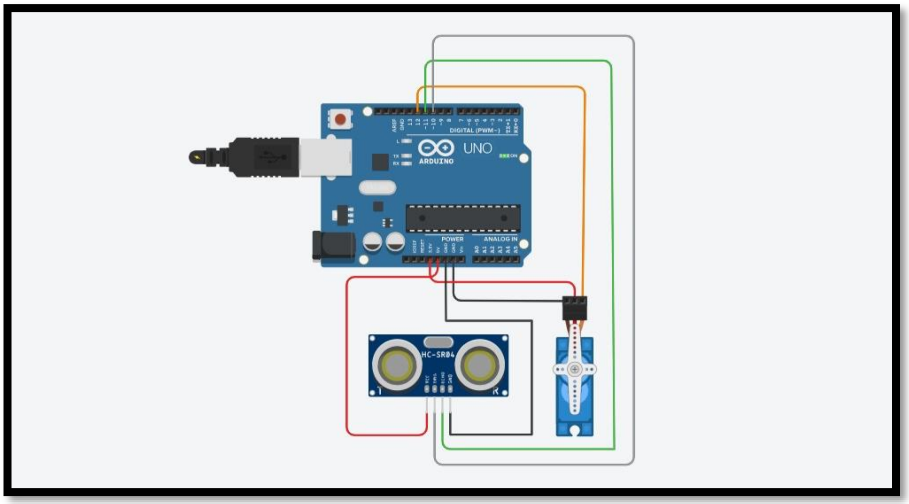
Methodology



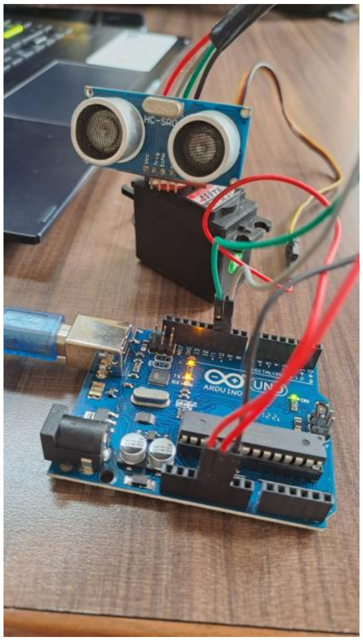
The word RADAR means Radio Detection and Ranging. Radar is an object detection system that uses microwaves to determine the range, altitude, direction, and speed of objects within about a 100-mile radius of their location.

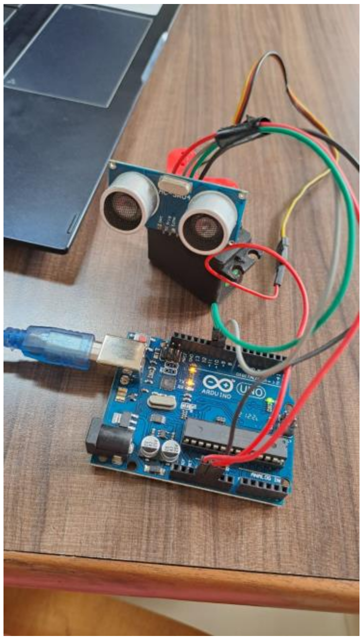
The radar antenna transmits radio waves or microwaves that bounce off any object in their path. Due to this, we can easily determine the object in the radar range.

Wire Connections

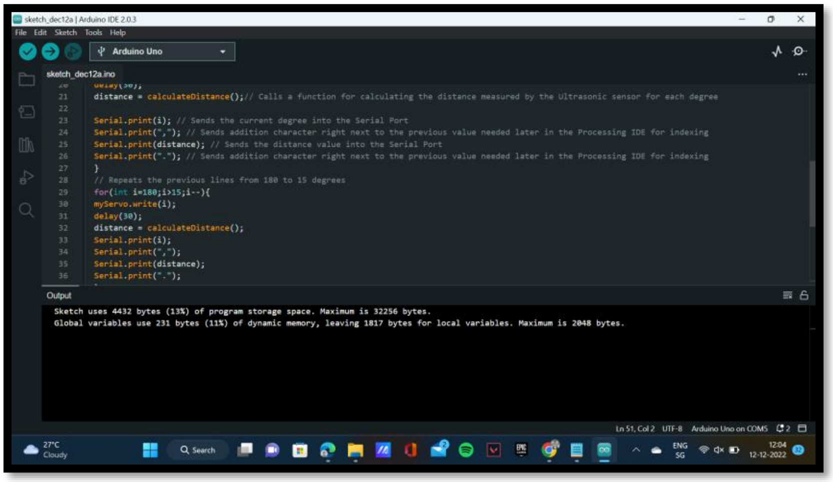


Model Outlook





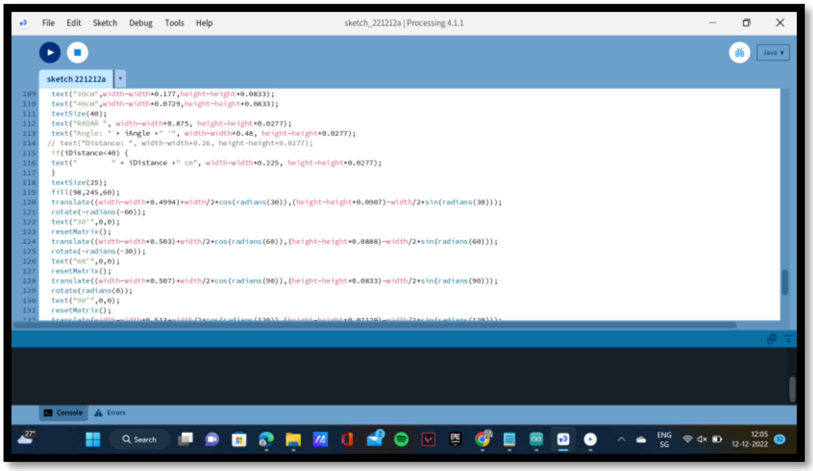
Output of the Working


sketch_dec12a | Arduino IDE 2.0.3
File Edit Sketch Tools Help
Arduino Uno
sketch_dec12a.ino
Output

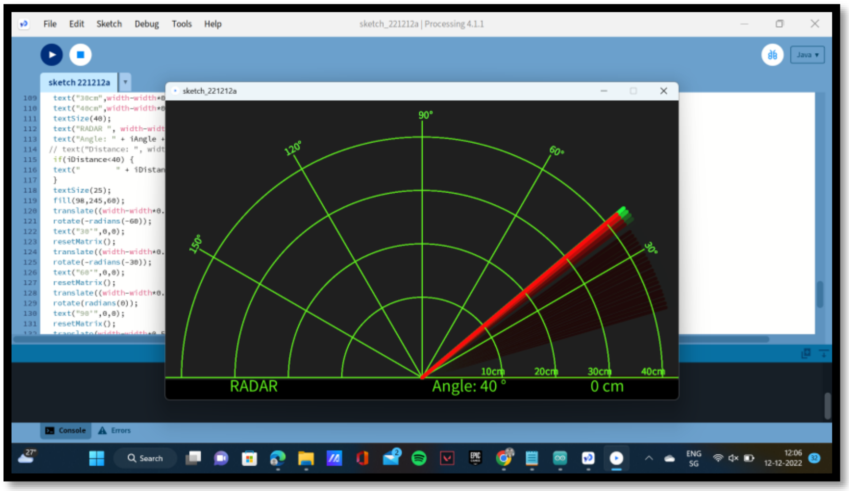
```
distance = calculateDistance();// Calls a function for calculating the distance measured by the Ultrasonic sensor for each degree

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 180 to 15 degrees
for(int i=180;i>15;i--){
myServo.write(i);
delay(30);
distance = calculateDistance();
Serial.print(i);
Serial.print(",");
Serial.print(distance);
Serial.print(".");
```

```
Sketch uses 4432 bytes (13%) of program storage space. Maximum is 32256 bytes.
Global variables use 231 bytes (11%) of dynamic memory, leaving 1817 bytes for local variables. Maximum is 2048 bytes.
```


File Edit Sketch Debug Tools Help
sketch_221212a | Processing 4.1.1
sketch 221212a
Console
Errors

```
 text("30cm",width-width*0.177,height-height*0.0833);
 text("40cm",width-width*0.0729,height-height*0.0833);
 textSize(40);
 text("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();
```



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 180 degrees
  for(int i=0;i<=180;i+=1){
  myServo.write(i);
  delay(15);
  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 180 to 15 degrees
  for(int i=180;i>0;i-=1){
  myServo.write(i);
  delay(15);
  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("Radar ", width-width*0.875, height-height*0.0277);
 text("Angle: " + iAngle +" °", width-width*0.48,  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();
}
```

References

- ❑ https://www.techtarget.com/searchenterpriseai/definition/AI-Artificial-Intelligence
- ❑ https://en.wikipedia.org/wiki/Microcontroller
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