ULTRASONIC RADAR.

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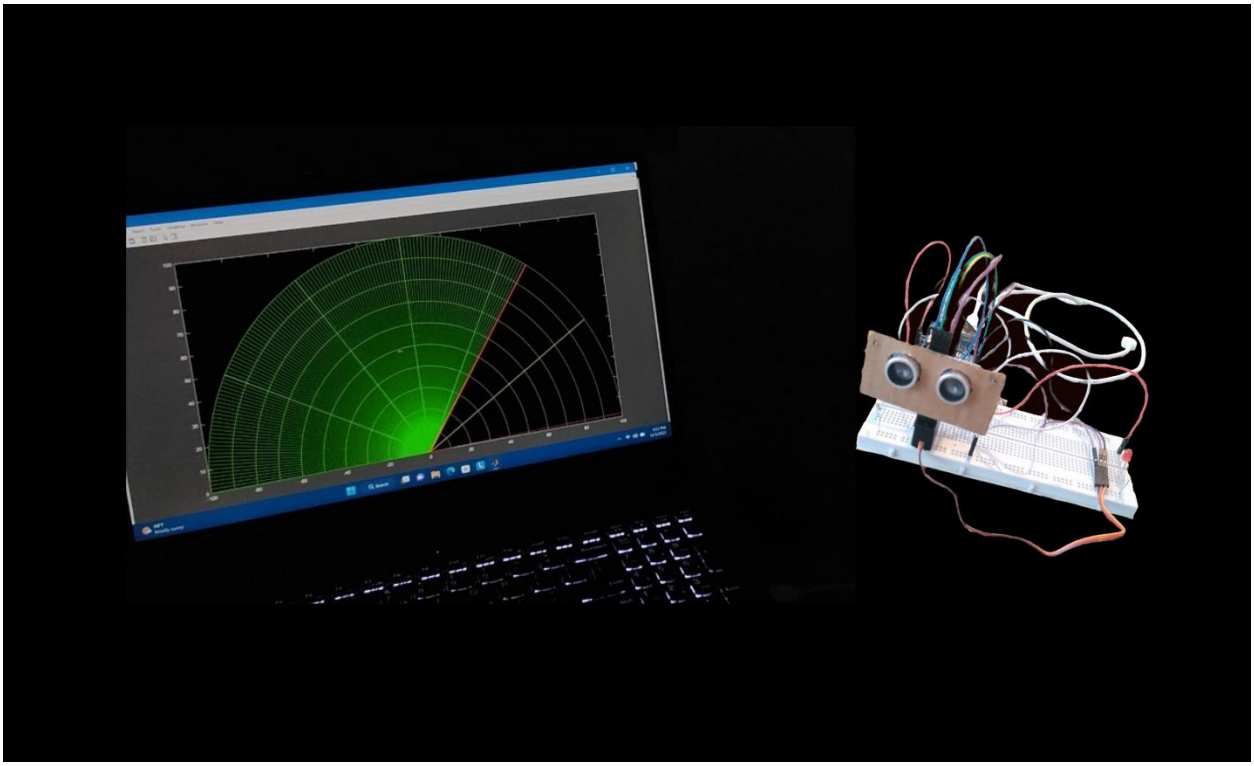


Abstract.

The application of radio detection and ranging in different places such as military installation, commercial use is done with the help of RADAR SYSTEM which uses electromagnetic waves for detection of different physical components such as distance, speed, position, range, direction, size etc. which can be either fixed or be in motion. The use of radar systems has been developed greatly, especially in the field of navigation. In this research we study existing navigation technologies and proposed an Arduino based radar system. It has advantages over other radar systems as the kit reduces power consumption and connects programmers to wide range or Arduino programmers and open-source code. 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 motor also connected to digital input output pins. This application can be used in detection and location of objects, speed check in roads, driverless car to detect obstacles, used in large number of applications such as radar for robotics, blind man walking stick etc.

Introduction.

We know everything produces sound waves just by existence and effect flow of air around them with their natural frequency. These frequencies are beyond the hearing range of humans. Waves of frequency range of 20000hz and thereabouts are called ultra-sonic wave and these waves can be detected by an ultrasonic sensor which helps us to get various knowledge. An Ultrasonic detector usually has a transducer which convert sound energy into electrical energy and electrical energy into sound energy. They are used for measuring object position and orientation, collision avoidance system, surveillance system etc. Ultrasonic technology provides relief from problems such as linear measurement problems, as it allows the user to get non-contact measurements in this way distance between object and its speed etc. can be easily measured. Speed of travel of sound wave depends upon square root of ratio between medium density and stiffness. Also, the property of speed of sound can also be changed by natural environment conditions like temperature. So basically, an ultrasonic sensor sends ultrasonic waves which travel in air and get reflected after striking any object. By studying the property of reflected waves, we can get knowledge about objects distance, position, speed etc. A processing software and an Arduino software is used with hardware system for detection of objects various parameters. One of the most common applications of ultra-sonic sensor is range finding. It is also called as sonar which is same as radar in which ultrasonic sound is directed at a particular direction and if there is any object in its path it strikes it and gets reflected back and after calculation time taken to come back, we can determine distance of objectin real life this method is used by bats.

Component List Details.

ITEM	QUANTITY
Solderless Breadboard	1 NO
Arduino Uno	1 NO
Servo Motor (GS – 9025MG)	1 NO
Ultrasonic Sensor (HC – SR04)	1 NO
Resistors (100R)	2 NO
LED (GREEN)	1 NO
LED (RED)	1 NO
Male to Male Jumper Wires	5 NO
Male to Female Jumper Wires	5 NO

Working Procedure.

My final project for Mechatronic Systems is an Ultrasonic Radar complied on MATLAB/Arduino IDE.

The aim of this project is to calculate the distance position and speed of the object placed at some distance from the sensor. Ultrasonic sensor sends the ultrasonic wave in different directions by rotating with the help of servo motor. This wave travels in the air and gets reflected back after striking some object. This wave is again sensed by the sensor and its characteristics are analyzed and output is displayed on the screen showing parameters such as distance and position of object.

So, for the simulation of the modules, I used Tinkercad. For this project I have used a Solderless Breadboard wired to the Arduino UNO, Servo Motor (GS – 9025MG), Ultrasonic Sensor (HC – SR04) using the Male to Male Jumper Wires and Male to Female Jumper Wires. The Resistors (100R), LED (GREEN), LED (RED) are connected in series. Now when we run the simulation on Tinkercad by generating the code. The purpose of this simulation is to show the working of the system in real time before making the connections on the hardware. So, we know that the system works perfectly fine once we have assembled the hardware along with the modules.

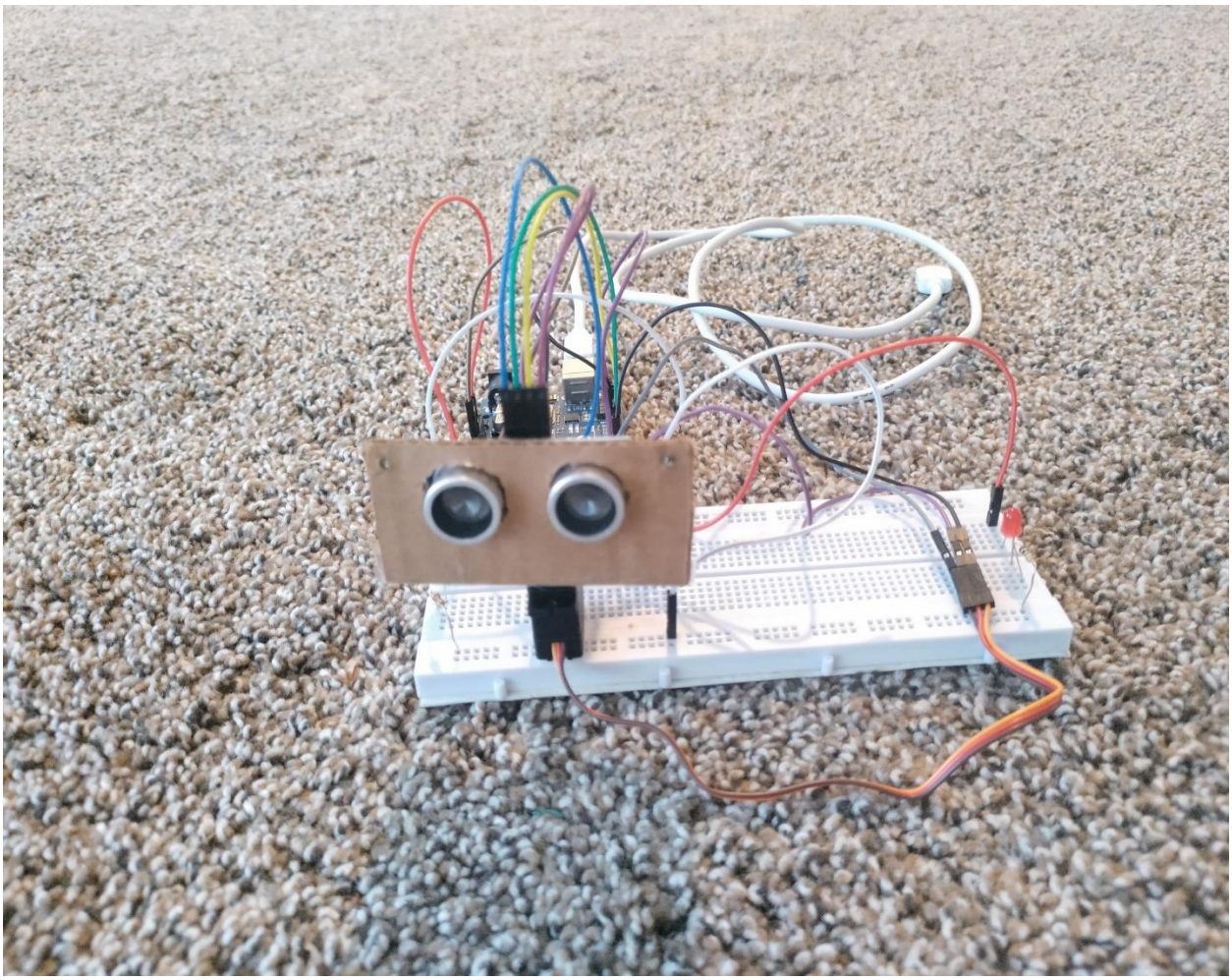
We need to upload the code on the Arduino Uno using an Arduino IDE. So, once we have fired up the IDE. Select new sketch, and then select tools and under that section go to board, and then select the board that you would be working on. After that, you need to verify/compile the code and once that step is done, and you don't see any errors then you can upload/burn the code onto the selected board. So, before running the program, let me give you an overview of the code and its working principle. For the Ultrasonic Sensor I have used two pins. Pin 6 is used for echo and pin 7 is used for trigger. I have used two LED's as well. Pin 8 is for the LED (GREEN) and pin 9 is for the LED (RED). Then you need to initialize the distance and degree variable. In the void setup you need to initialize the serial baud rate. So, I have given my baud rate as 9600 and also, we need to make sure that the same baud rate is used in the MATLAB code as well. Pin 2 is used for the servo meter. Then I initialized the echo pin as my input and the trigger, the LED (GREEN) and the LED (RED) pins as my output. I have given a delay of 100 milliseconds. Then it goes into a void loop. In void loop I ran the for loop first in which the servo motor rotates from 1 degree to 180 degrees. I have given 80 milliseconds delay. That is because when it shifts 1 degree there will be a delay of 80 milliseconds. After 80 milliseconds. After 80 milliseconds the data function gets called and the location of the data from the Ultrasonic Sensor reads the distance. After reading the distance it gets printed on the serial. The value goes up by +1. The for loop keeps running till it reaches 180 degrees. The same happens in the next step. But the values come down by -1. So, when the degree variable is equal to 1 here then based on that condition the for loop breaks and then returns to the first for loop. Next in data function, I have given 40 kilowatts in the trigger pin for transmission. Then we read the time in the echo pin. So, I have used a formula to read the time variable in centimeters. Then we make the distance variable equal. If the distance variable

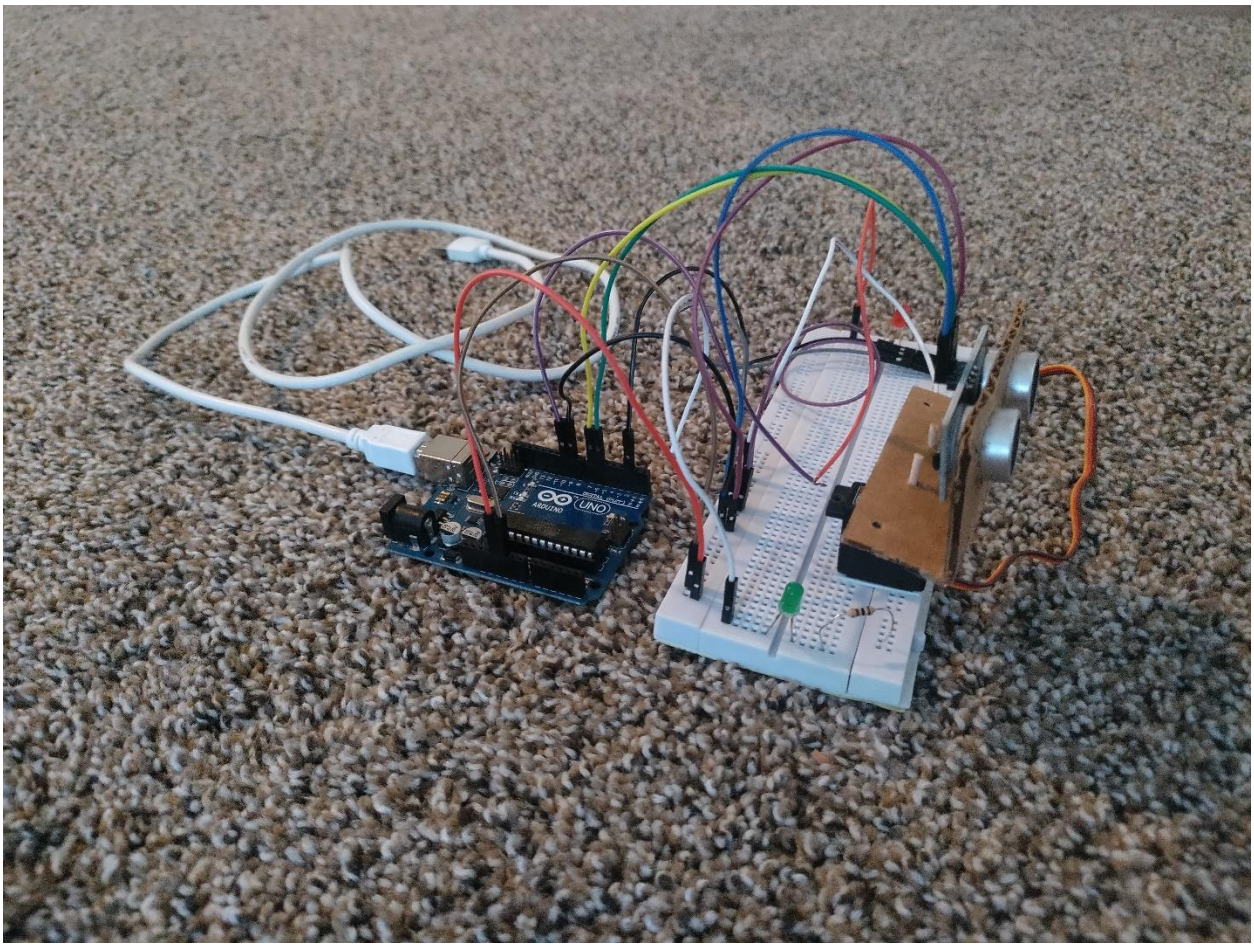
is more than 100 centimeters, then we have to keep the condition of the distance variable equal to 100 centimeters itself. The code I've given MATLAB for the Radar Display Simulation, I have given the maximum limit as 100 centimeters. So, if the distance value crosses above 100 centimeters it shows an error in the code. In order to overcome this problem, I have given a check condition, so when the value goes over 100 centimeters then it will become equal to 100 centimeters. Furthermore, I have given another check condition, so when the distance value is more than 50 centimeters then the LED (GREEN) turns on and the LED(RED) turns off and if the distance value drops below 50 centimeters, then the LED(RED) turns on and the LED(GREEN) turns off. After this the degree and distance variable get printed on the serial. Then the Servo Motor moves/rotates from 180 degrees to 0 degrees then again from 0 degrees to 180 degrees.

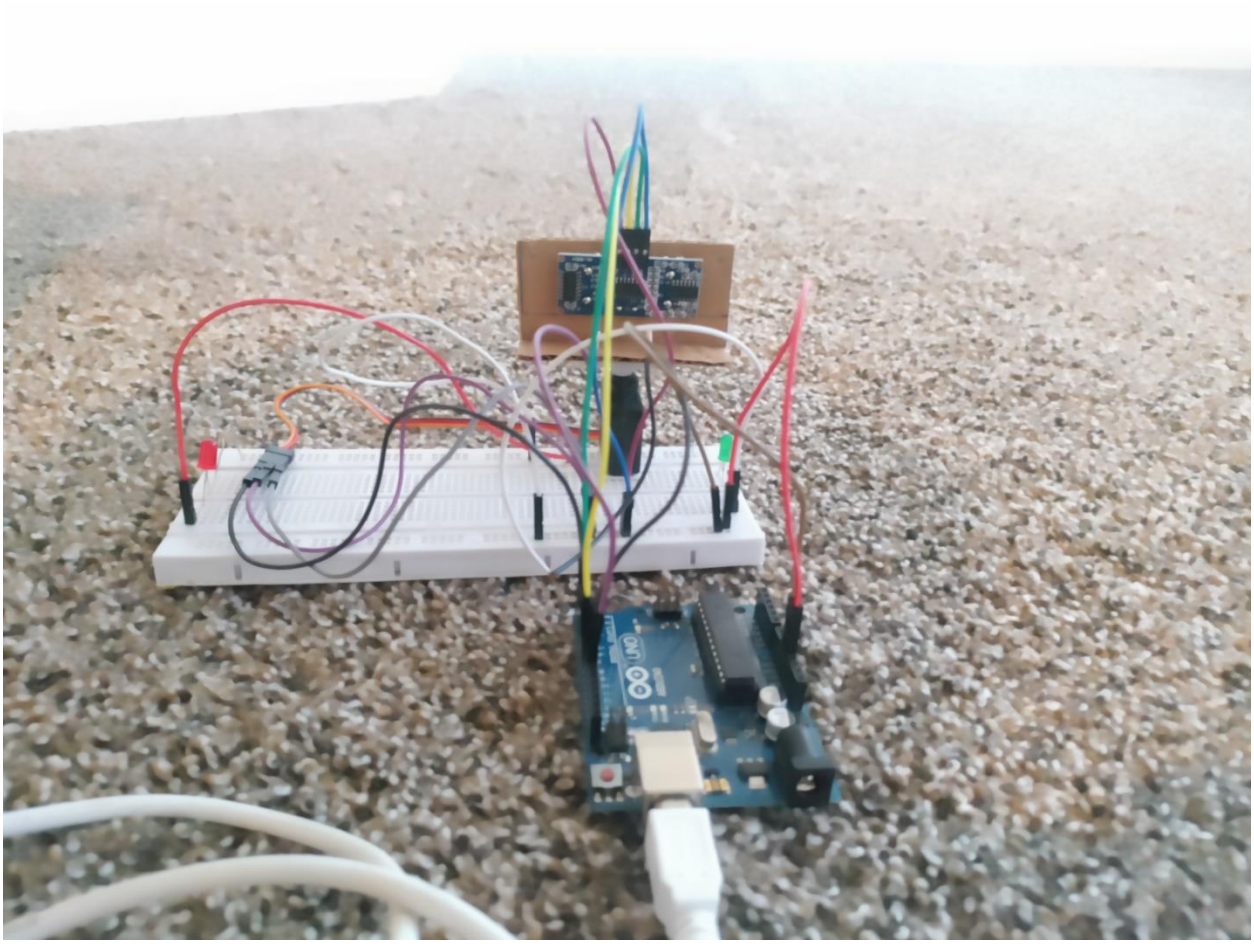
After burning the code into the Arduino Uno, Open MATLAB and run the MATLAB Radar Display Simulation code. Then MATLAB and Arduino IDE get linked. The Arduino Uno board sends the signal to the Servo Motor to rotate from and to the Ultrasonic Sensor to detect objects in its path. The output of sensor is displayed with the help of processing software to give final output in display screen. If the object is within the proximity of the Ultrasonic Sensor, then the LED(GREEN) turns on and if the object is away from the Ultrasonic Sensor, then the LED(RED) turns on. This is a continuous cycle. This can be used in various applications.

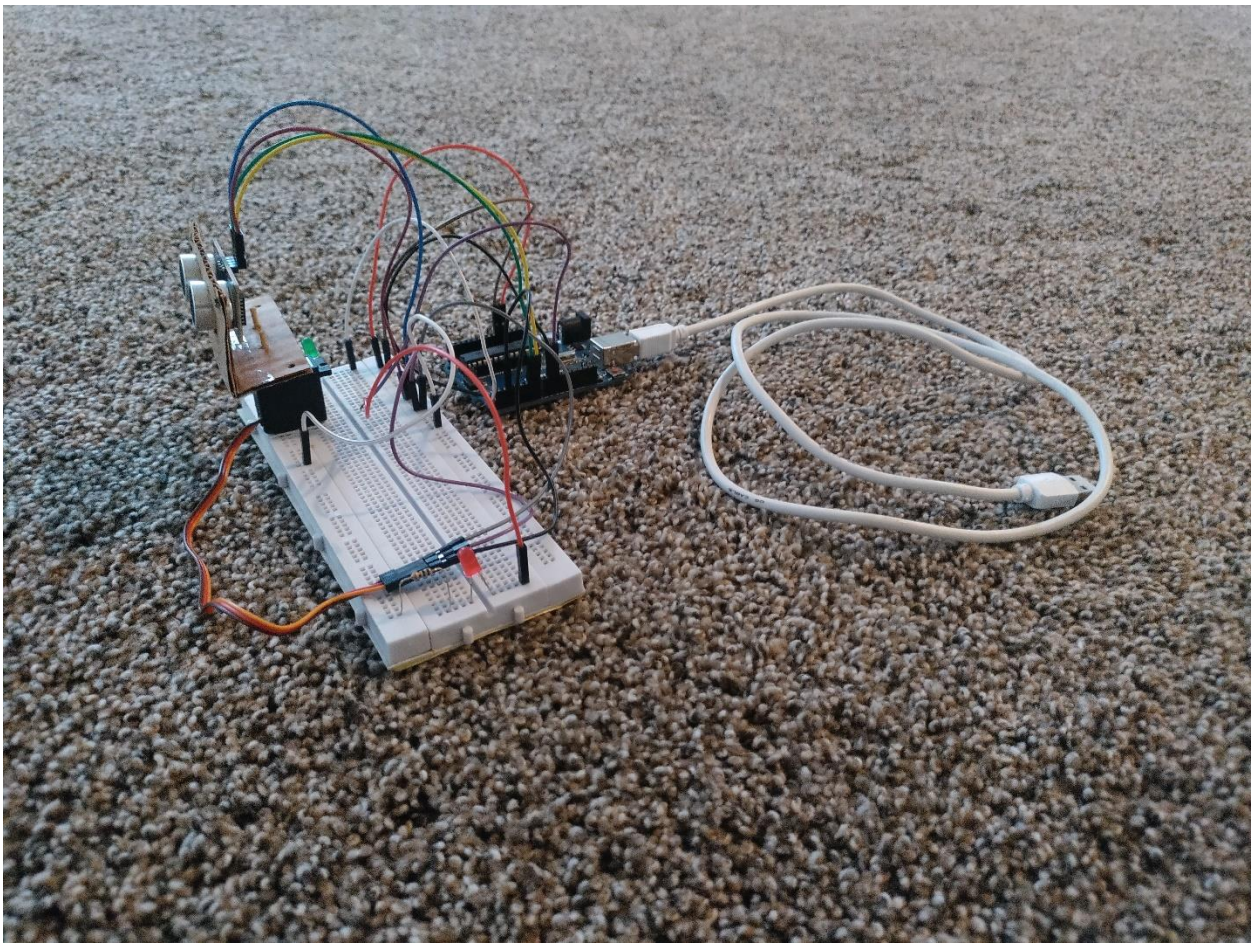
I have also designed the enclosers for the Servo Motor, Ultrasonic Sensor, and the Arduino Uno on Autodesk Inventor Professional.

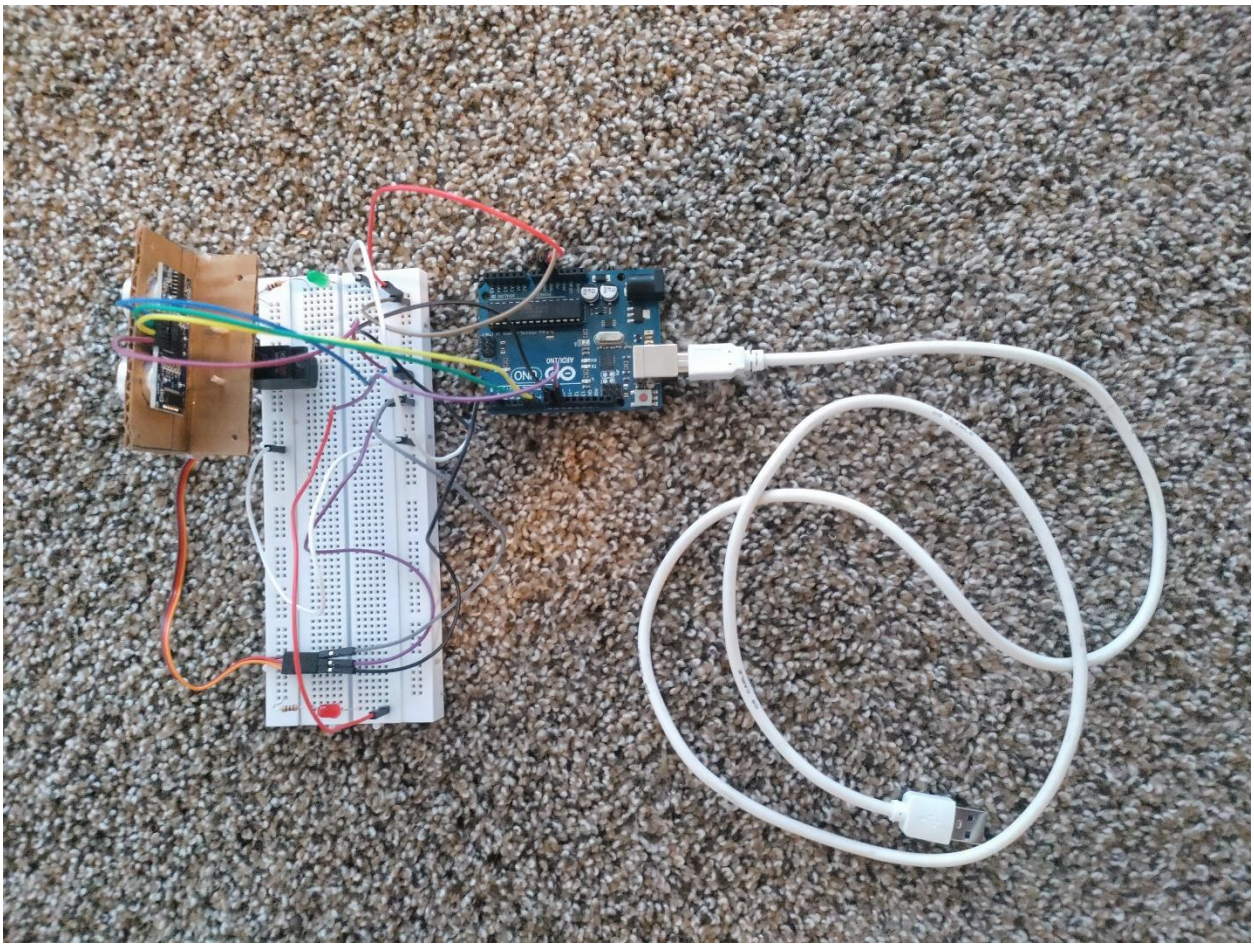
System Circuit Implementation on Breadboard.




ARDUINO
UNO







Arduino IDE Code.

```
#include <Servo.h>
Servo myservo;
#define echo 6
#define trigger 7
#define G_led 8
#define R_led 9
int distance;
int degree;
void setup() {
Serial.begin(9600);
myservo.attach(2);
pinMode(echo, INPUT );
pinMode(trigger, OUTPUT);
pinMode(R_led,OUTPUT);
pinMode(G_led,OUTPUT);
delay(100);
}
void loop() {
for(degree=1; degree<180; degree+=1){
myservo.write(degree);
delay(80);
data();
}
for(degree=180; degree>1; degree-=1){
myservo.write(degree);
delay(80);
data();
}
}
void data(){
digitalWrite(trigger, LOW);
delayMicroseconds(2);
digitalWrite(trigger, HIGH);
delayMicroseconds(10);
long time = pulseIn(echo, HIGH);
distance = time / 28.5 / 2;
if(distance>100){distance = 100;}
if(distance>50){
digitalWrite(G_led, HIGH);
```

```
digitalWrite(R_led, LOW);
}else{
digitalWrite(G_led, LOW);
digitalWrite(R_led, HIGH);
}
Serial.print(degree); Serial.print( " "); Serial.println(distance);
}
```

MATLAB Code for Radar Display Simulation.

```
clc;
clear all;

% Customize Graph

figure('units','normalized','outerposition',[0 0 1 1]);
whitebg('black');

% Draw Scale Data

th = linspace(0,pi,1000);
R = 10:10:100;
for i=1:length(R);
x = R(i)*cos(th);
y = R(i)*sin(th);
plot(x,y,'Color', [0.603922 , 0.803922 , 0.196078] ,'LineWidth',1);
hold on;
end

% Draw Axis Data

x0 = [0 100 0 0 0 0 ];  x1 = [0 100 86.60 50 -50 -86.60]; y0 = [0 0 0 0 0 0]; y1 = [100 0 50 86.60
86.60 50];
for i=1:length(x0);
hold on;
plot([x0(i),x1(i)],[y0(i),y1(i)] ,'Color', [0.603922 , 0.803922 , 0.196078],'LineWidth',2);
end

% Draw Sonar Default Data

for i=1:180
hold on;
[x, y] = pol2cart(i*0.0174532925, 100);
h(i) = plot([0,x],[0,y],'g','LineWidth',1);
end

% Define Serial Port

s1 = serial('COM11');
s1.BaudRate=9600;
fopen(s1);

% Draw Sonar Data
```

```
while(1)
data = fscanf(s1);
[th, r] = strtok(data);
th = real(str2num(th));
r = str2num(r);
set(h(th),'color','r');
[x0, y0] = pol2cart(th*0.0174532925, 100);
[x, y] = pol2cart(th*0.0174532925, r);
set(h(th),'XData',[x0,x]);
set(h(th),'YData',[y0,y]);
m = plot([0,x0],[0,y0],'r','LineWidth',3);
drawnow
delete(m);
end
```
