Arduino-based simple Radar System using Ultrasonic

A mini Project Report

By

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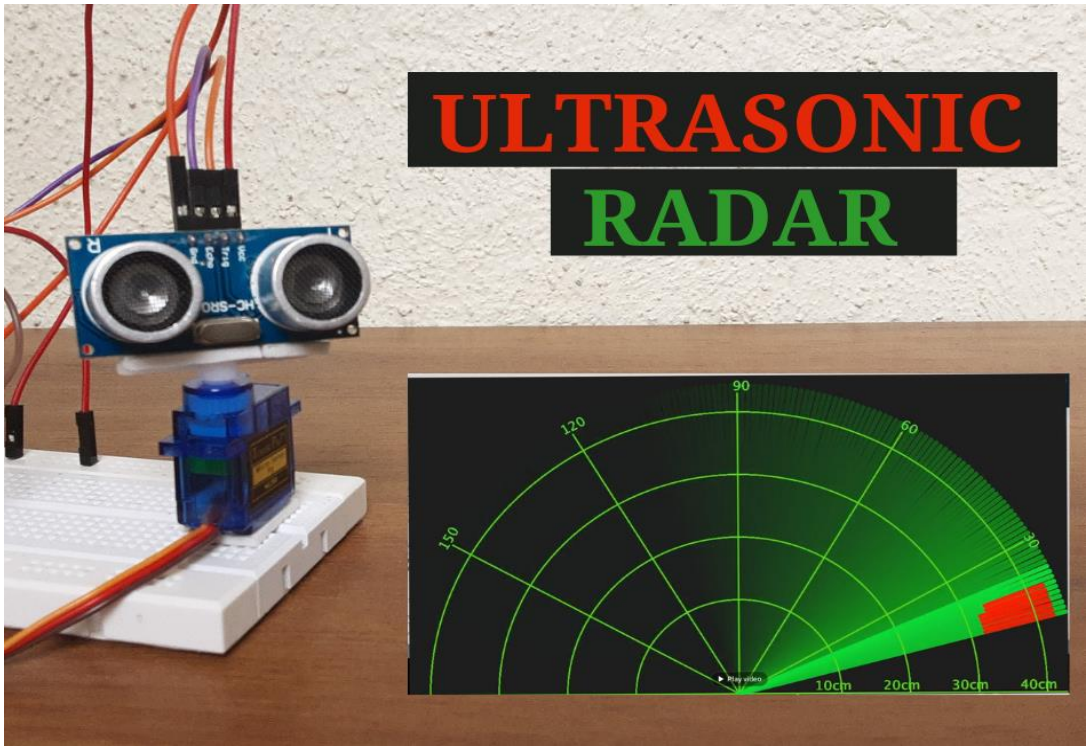

Scource Code : https://github.com/sattarabdul786/Ardunio-based-simple-Radar-System-using-Ultrasonic

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1. Project Description:

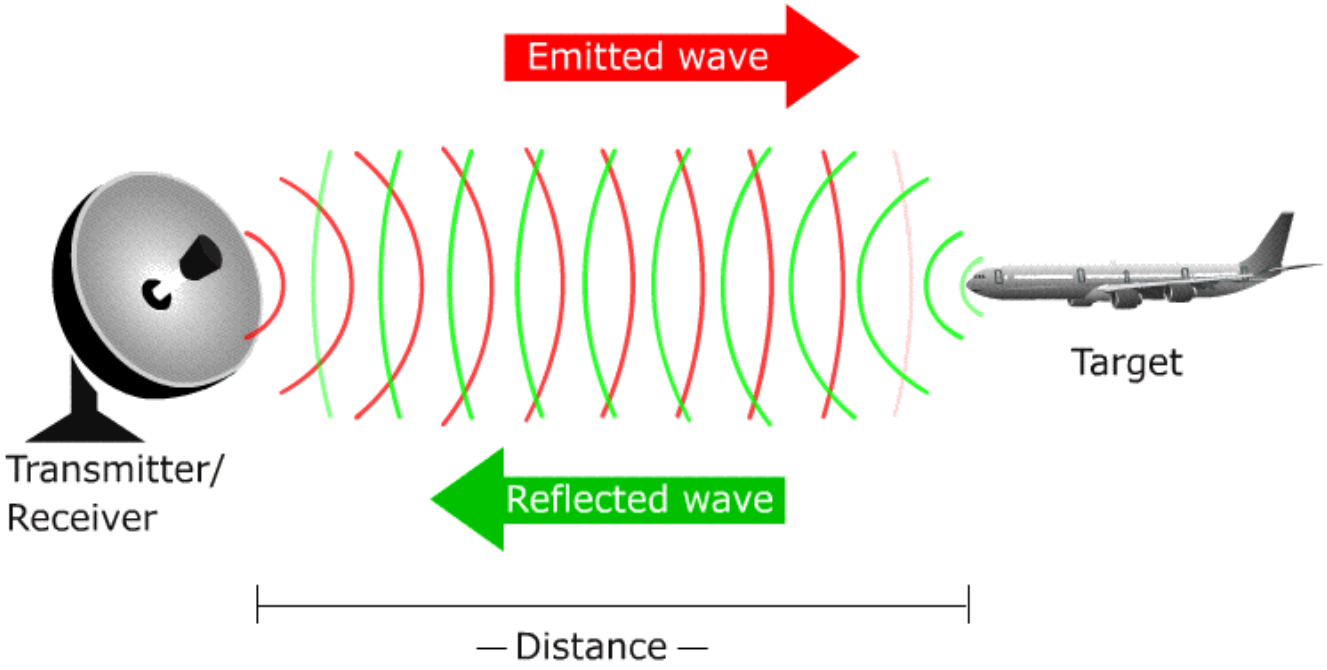
The "Arduino-based simple radar system using ultrasonic's" project involves creating a basic radar-like system using an Arduino microcontroller and ultrasonic sensors. The goal of this project is to detect the presence and approximate distance of objects within a certain range, simulating the functionality of a radar system but on a smaller and simpler scale.

2. Bill of Materials:

S.No	Component Name	Specification	Quantity	Purchase Link
1	Arduino Board	Arduino UNO	1	Amazon
2	Ultrasonic Sensor	HC- SR04	1	Amazon
3	LCD Display	16*2 Display	1	Amazon
4	Servo Motor	SG90	1	Amazon
5	Potentiometer	10 K	1	Amazon
6	Buzzer	5 V	1	Amazon
7	LED	5mm	2	Amazon
8	Connecting Wires	--	30	Amazon
9	Bread Board	--	1	Amazon

3. Radar Working Principle:

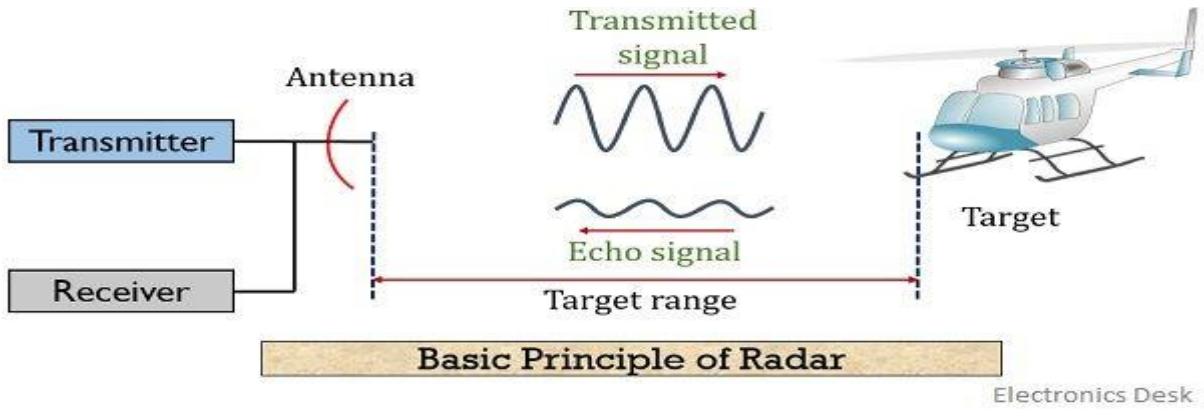
The word RADAR means Radio Detection and Ranging. Radar is an object detection system that uses microwaves to determine the range, altitude, direction, and speed of objects within about a 100-mile radius of their location.



3.1 Basic principle of operation:

A radar system operates in such a way that it radiates electromagnetic energy into space and detects various aspects related to objects by analyzing the echo generated when the radiated energy gets re-radiated by the object.

The figure below shows the basic principle of radar:



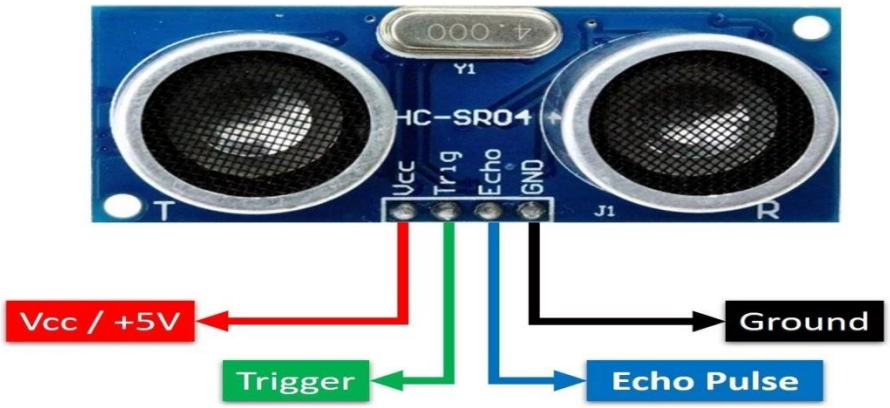
The electromagnetic signal is produced by the transmitter unit and radiated into space by the radar antenna. While the receiver extracts information from the signal received by the radar antenna.

We know that whenever an electromagnetic wave is transmitted by the system, it reflects or re-radiates some of its parts upon experiencing a variation in the conductivity of the medium. This variation in conductivity arises due to the presence of an object that is either stationary or moving. There by producing an echo.

The radar system receives the echo with the help of an antenna in order to analyze it and determine the location of the object.

4. 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 converting the reflected waves into an electrical signal. These sound waves travel faster than the speed of sound that humans can hear.



The principle of ultrasonic range finders is to measure the time it takes for the signal sent by a transmitter to propagate back to the receiver. As the name implies, an ultrasonic sensor operates at ultrasonic frequencies. Frequencies beyond our hearing range are known as ultrasonic frequencies." Those frequencies are above 20 kHz.

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

The formula for this calculation is:

D = ½ T x C

Where,

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

The microcontroller interprets the time signal into distance using the following functions:

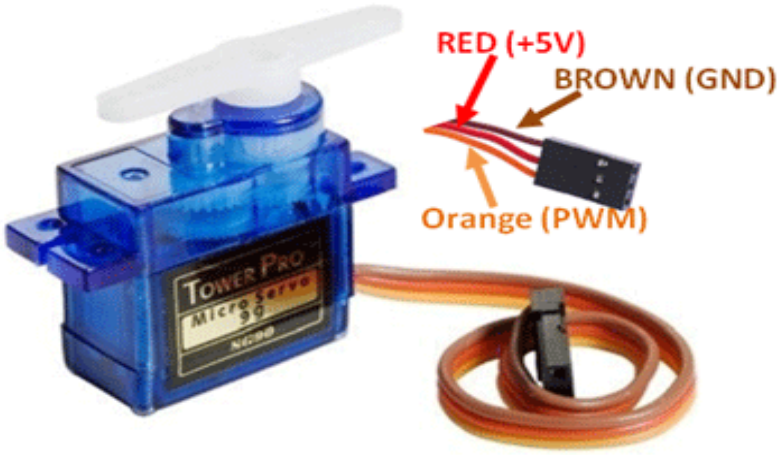
$$Distance\ (cm) = \frac{echo\ pulse\ width\ (uS)}{58}$$

$$Distance\ (inch) = \frac{echo\ pulse\ width\ (uS)}{148}$$

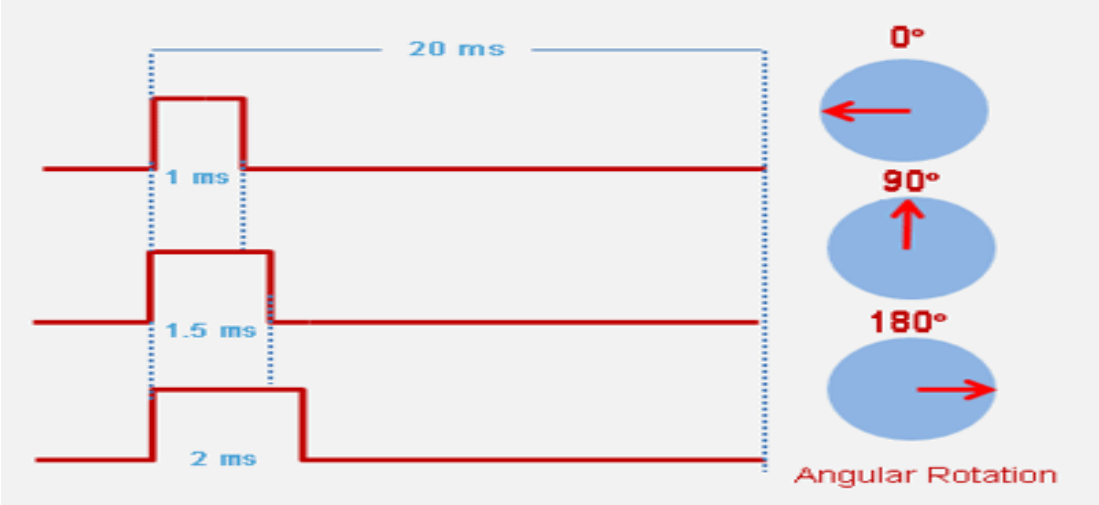
5. Servo Motor :

The servo motor is a simple DC motor that can be controlled for specific angular rotations with the help of additional servomechanisms. 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 speed and position.

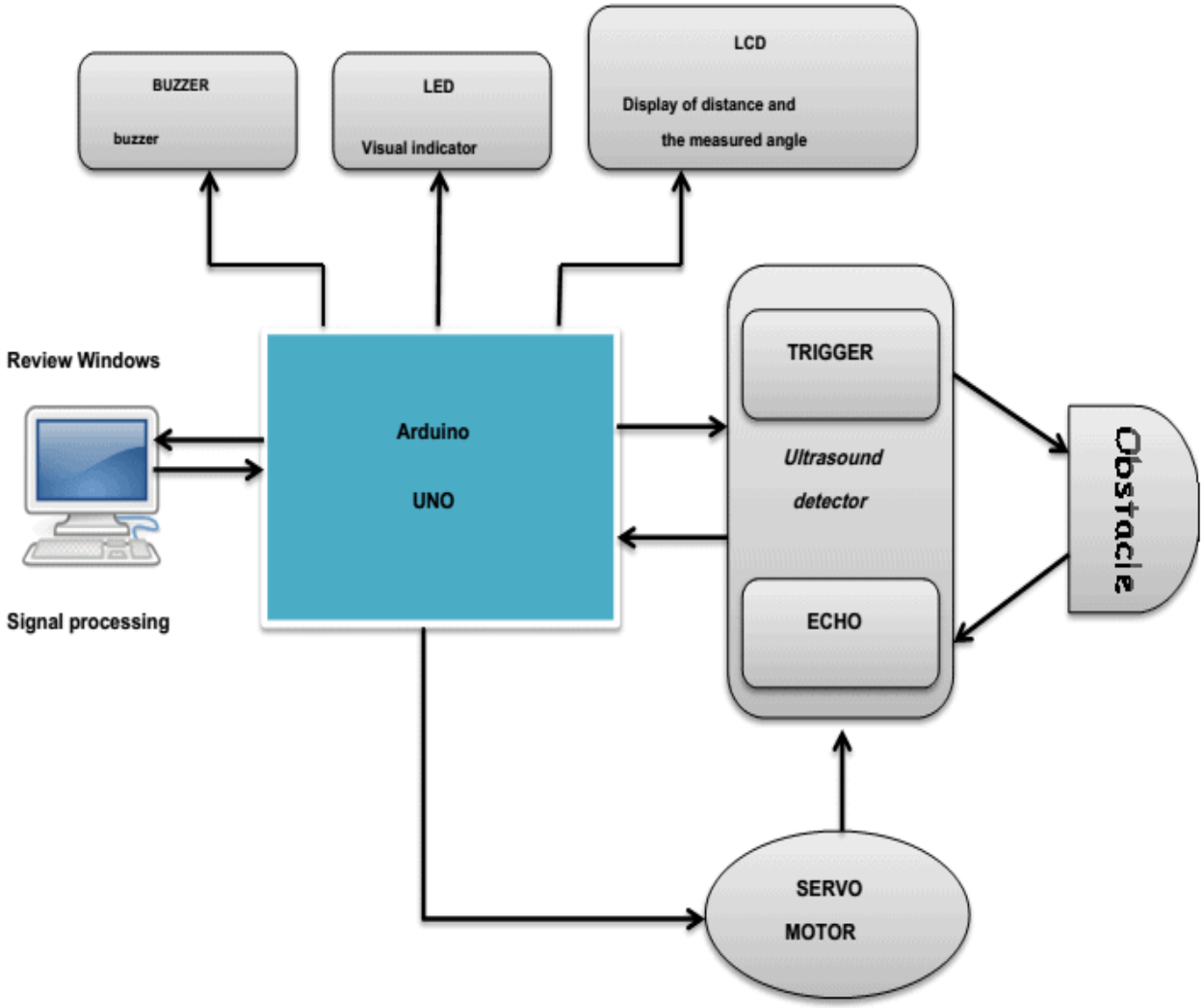
This closed-loop system includes a control circuit, servo motor, shaft, potentiometer, drive gears, amplifier, and either an encoder or resolver.



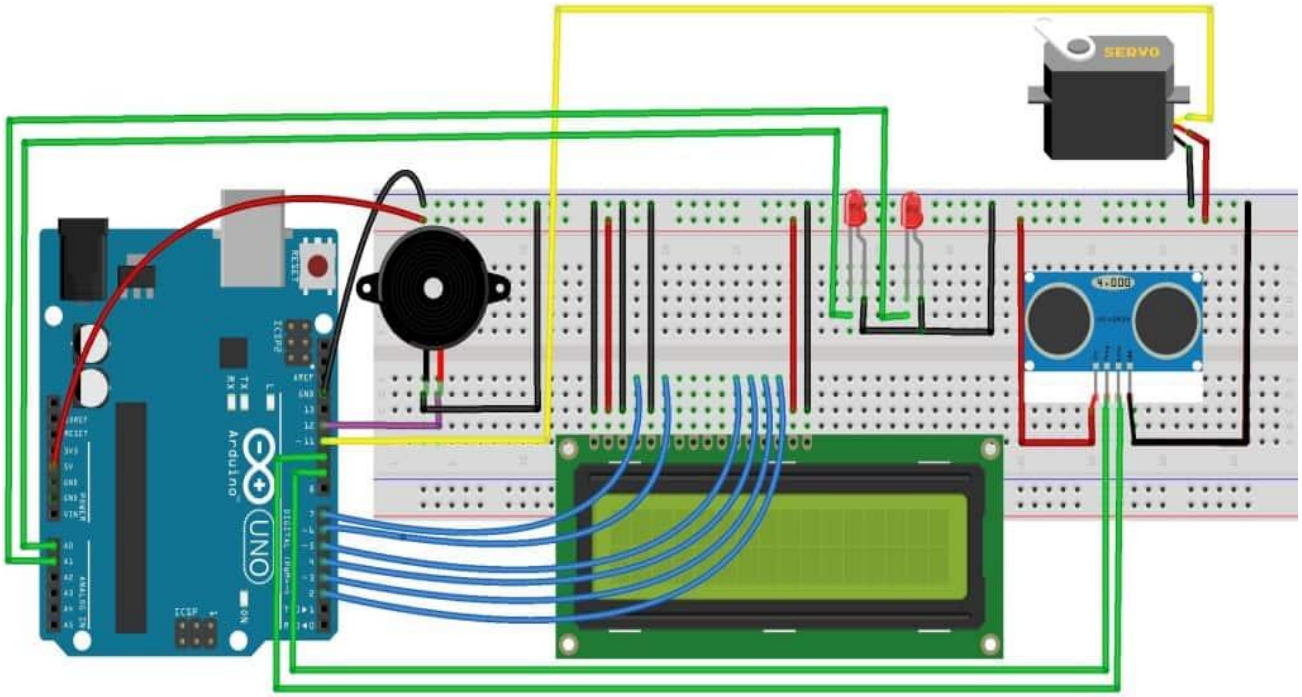
A servo motor works on the **PWM (pulse width modulation)** principle, which means its angle of rotation is controlled by the duration of the applied pulse to its control pin. Basically, a servo motor is made up of a DC motor, which is controlled by a variable resistor (potentiometer) and some gears.



6. Block Diagram :



7. Circuit Diagram :



8. Working :

The Arduino board sends a signal of +5V to the trig pin of the ultrasonic sensor HC-SR04, which triggers the sensor. Then it provides rotational action at the servo motor mechanically fitted along with the ultrasonic sensor HC-SR04 so that it can detect the moving objects and locate them within 180 degrees.

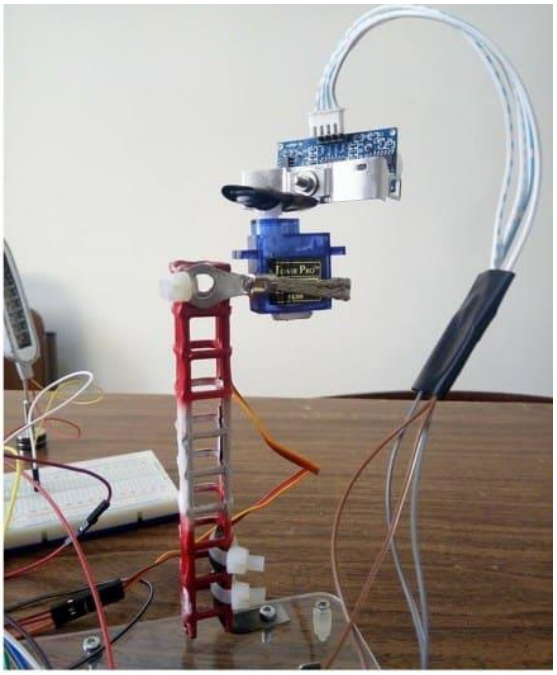
The Arduino sends a high pulse width of (10 S) on the trigger pin of the sensor to regenerate a series of ultrasonic waves that propagate through the air until they touch an obstacle and return in the opposite direction towards the sensor pin ECHO. The sensor detects the width of the pulse to calculate the distance.

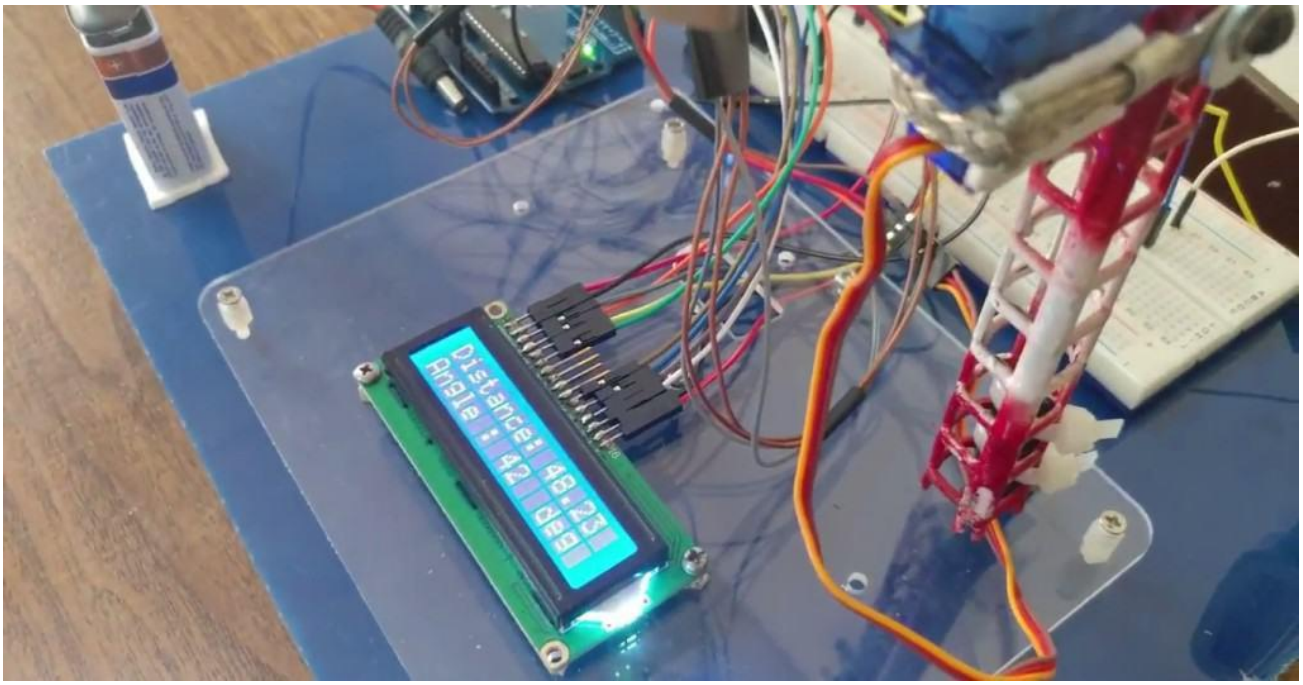
The signal on pin ECHO of the sensor remains at the HIGH position during transmission, thereby measuring the duration of the round trip of ultrasound and thus determining the distance.

The LCD display displays the calculated distance and the angle of rotation. The buzzer is an additional component; it rings when there is a detection (Tone 1 and Tone 2), along with LEDs. Both LEDs, along with the buzzer, determine the field where the object is located (near or distant).

9. Result :

9.1 Mechanical Arrangement :





9.2 Processing Sketch :

I have used the output display size as 1280×720 (assuming almost all computers now-a-days have a minimum resolution of 1366×768) and made calculation with respect to this resolution.