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A MINI PROJECT REPORT ON

SOUND NAVIGATION AND RANGING (SONAR) USING ULTRASONIC SENSOR

BY

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UNDER THE GUIDANCE OF

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IN PARTIAL FULFILLMENT OF

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DEPERTMENT OF ELECTRONICS & TELECOMMUNICATION ENGINEERING

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CERTIFICATE

This is to certify that the project entitled "Sound Navigation And Ranging (SONAR) Using Ultrasonic Sensor" submitted by

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is record of bonafide work carried out by them under my guidance, in partial fulfillment of requirement for the award of Final Year Engineering (Electronics & Telecommunication) of Savitribai Phule Pune University.

Date:

Place: Dr. D.Y.P.I.T., Pimpri, Pune-18

Prof.Dhanashree Kulkarni	**Dr. Bhavana Ambulkar**	**Dr. Pramod D. Patil**
Project Guide	**H.O.D.**	**Principal**

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Finally, we thank all teachers for their endless help to accomplish our task with great efficiency.

E&TC Engineering

CONTENT

Abstract

Sonar (Sound Navigation and Ranging) was covertly created by few countries during the reign of World War II. SONAR can be used to detect some moving object. It helps in the measurement of distance and angle from the observer.It works on the principle of Doppler shift. The designing of cheaper SONAR system for security purpose is the requirement of industry. In this research Paper, the designing and implementation of Arduino based SONAR system using ultrasonic sensor are presented. The device is able to detect the object, calculate its distance(up to 30cm) and can determine the elevation angle. It provides cheaper solution for security purposes.

SONAR System controlled via Arduino. This SONAR system consists of an ultra-sonic sensor and servo motor, these are the major components of the system. Basic working of the system is that it have to detect objects in its defined range. Ultra-sonic sensor is attached to the servo motor it rotates about 180 degree and gives visual representation on the software called processing IDE. Processing IDE gives graphical representation and it also gives angle or position of the object and distance of the object. This system is controlled through Arduino. Arduino UNO board is sufficed to control ultrasonic sensor and also to interface the sensor and display device. While researching, we learned about existing navigation and obstacle detection innovations and different systems where ultrasonic sensors are used efficiently. Main application of this SONAR system comes into different field of navigation, positioning, object identification, mapping, spying or tracking and different applications. These less investment system are also suitable for indoor applications.

Chapter I. Introduction and Literature Survey

1.1Introduction

Sound Navigation and Ranging (SONAR) is a Remote Sensing System with important military, scientific and commercial applications. Active SONAR transmits acoustic (i.e., sound) waves. These waves return echoes from certain features or targets that allow the determination of important properties and attributes of the target (i.e., shape, size, speed, distance, etc.). Because electromagnetic waves are strongly attenuated (diminished) in water, RADAR signals are mostly used for ground or atmospheric observations. Because SONAR signals easily penetrate water, they are ideal for navigation and measurement under water

Modern naval warfare makes extensive use of both passive and active sonar from water-borne vessels, aircraft and fixed installations. Although active sonar was used by surface craft in World War II, submarines avoided the use of active sonar due to the potential for revealing their presence and position to enemy forces. However, the advent of modern signal-processing enabled the use of passive sonar as a primary means for search and detection operations. In 1987 a division of Japanese company Toshiba reportedly sold machinery to the Soviet Union that allowed their submarine propeller blades to be milled so that they became radically quieter, making the newer generation of submarines more difficult to detect.

Sonar (Sound Navigation and Ranging) is a device which can be used for the detection of location of some moving objects. It utilizes ultrasonic waves to compute the angle of elevation, the distance, the speed of the moving objects and their bearing. Sonars are used by aviation authority for long range reconnaissance and early-cautioning purpose. Sonar is used for navigation and direction guidance in modern rockets. Ultrasonic sensor based Sonars are used for distinguishing the objects and separation of edge. The cutting edge employments of SONAR are profoundly various, including airport regulation, radar cosmology, frameworks including altimetry and air traffic control, guided rocket objective finding, sea reconnaissance, air-safeguard and antimissile, radars operating for marine activities like the observation of ships and boats and the exploration of historic points, from the hostility of flying machines to the crash frameworks, space surveillance and meeting frameworks, meteorological precipitation checking and ground-entering radar for geographical perceptions. Innovative SONAR frameworks are installed for analyzing and computing helpful data from high commotion altitudes and are associated with advanced sign preparing.

Army, Navy and the Air Force utilize the SONAR for obstacle detection. The SONAR is also used in self-stopping auto frameworks made by Mercedes, Benz, AUDI, FORD and many other companies. The SONARS will be used in future driverless autos made by Google like Prius and Lexus. The present research work can be used as a low cost solution in a motor bike, a typical auto, or whatever else. The practice of using Arduino provides flexibility for the above said modules. During old days (world wars), detecting, identifying, tracking the object was done manually which was difficult. Even for predicting the weather, it was difficult for a mere human. As the water bodies are huge and what lies beyond them isn't visible, it was difficult for humans to travel or explore. Therefore, to solve these and many problems, Radio Detection And Ranging (RADAR) was invented.

In military, its used to detect, identify the target or enemy or used to guide missiles. In aircraft related field, it can control air traffic by identifying the aircraft's position to guide it to land or fly even in bad weather safely. In remote sensing, it can be used to predict weather to take the necessary steps in case of natural disasters, to observe planetary positions in space, to track satellites, to guide ships in the water bodies or to discover objects lying beneath them. In ground traffic control, it is used by police officials to detect speed of the vehicle, to detect obstacles, etc. The RADAR consists of a transmitter which produces an electromagnetic signal which is radiated into space by an antenna. When this signal strikes any object, it gets reflected in many directions. This reflected or echo signal is received by the radar antenna which delivers it to the receiver, where it is processed to determine the geographical statistics of the object. The range is determined by the calculating the time taken by the signal to travel from the RADAR to the target and back. The target's location is measured in angle, from the direction of maximum amplitude echo signal, the antenna points to. To measure range and location of moving objects, Doppler Effect is used. Fig. 1 shows the working of RADAR

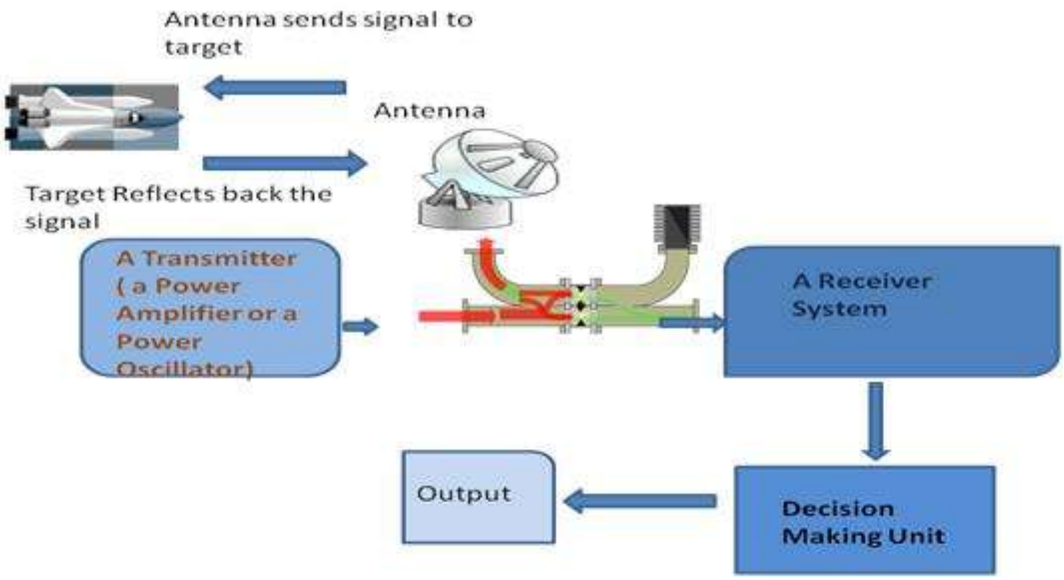


Fig. 1: RADAR System

RADAR can be used in weather condition to detect object, as it uses electromagnetic wave, it doesn't need a medium to travel through, it has long range, flexible, etc. But it is costly, not east to setup or handle, too close objects deviates the receiver, not target specific because of its wide range.

2.2 Literature Survey

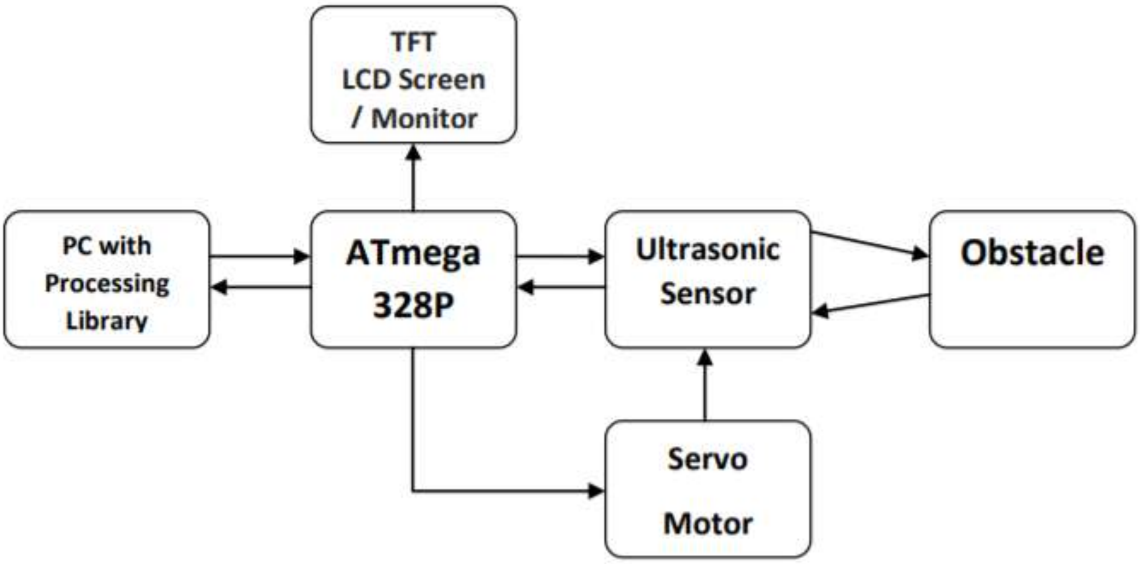
Sr no.	Name(Title of paper)	Method Used	Gap Identified
1	Smart SONAR System	Innovative methodology and solution that enables a SONAR system with a generic configuration to provide real-time updates to its user and hence cancelling out the extra time taken for the Communication	The system detects the object by using an ultrasonic sensor which is connected to an Arduino UNO and is rotated 180 degrees throughout by using a servo motor
2	RADAR based Object Detector using Ultrasonic Sensor	The software Arduino IDE is installed to program the code in C/C++. Another software used is the Processing IDE for creating the GUI in java language. The code is for running the devices to make the proposed work possible and to observe the output/results	Data was processed by the computer and Arduino Uno board.Object detection was done via the Ultrasonic sensor with servomotor attached to the boards and the distance and angel of object was detected
3	ARDUINO BASED RADAR SYSTEM	Navigation and obstacle detection innovations and different systems where ultrasonic sensors are used efficiently.	The linear measurement problem because of which distance measurement was not possible between some objects.
4	DESIGNING OF LOW COST ARDUINO BASED ULTRASONIC SONAR SYSTEM	The designing and implementation of Arduino based SONAR system using ultrasonic sensor	To present a SONAR which is cost effective and detect hurdle accurately. It provides cheaper solution for security purposes.

Chapter 2: System Specification and Block Schematic

Components Required:

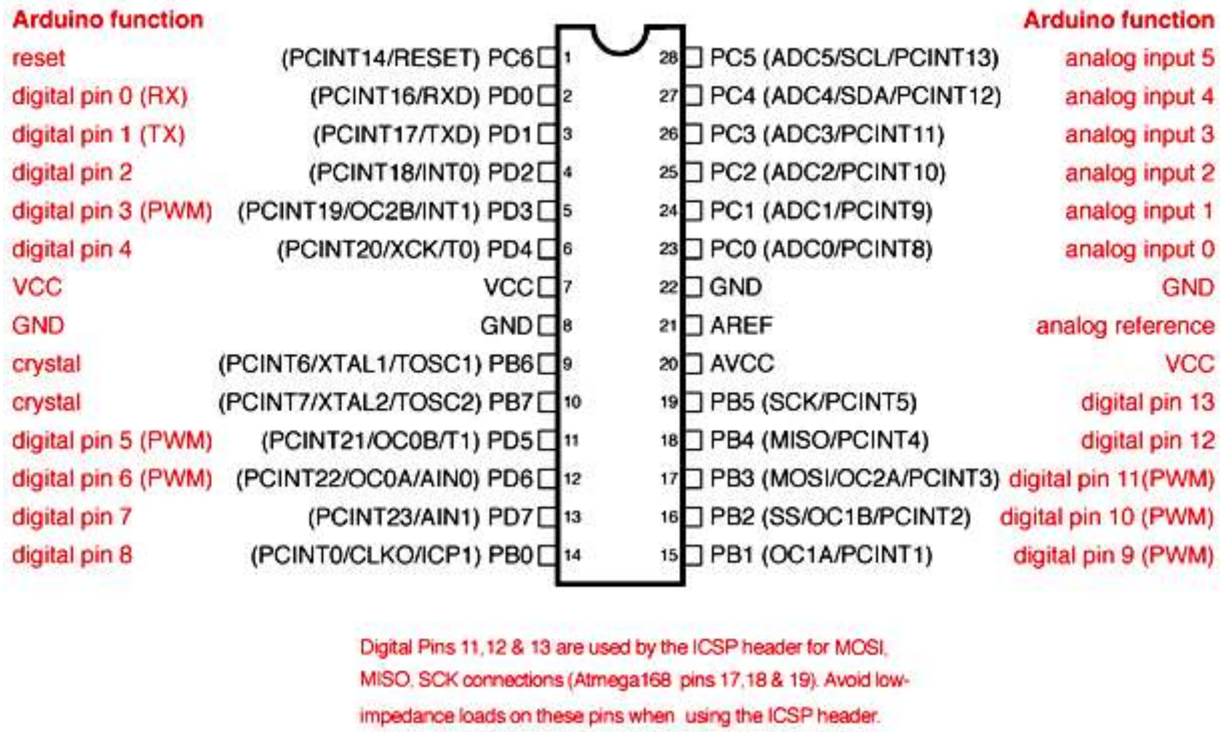
Arduino Uno R3
Ultrasonic Sensor
LCD Display 16×2
Cables and Connectors
Potentiometer

Block Diagram



Arduino Uno Board:

The **Arduino Uno** is a microcontroller board based on the ATmega328 (**datasheet**). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header, and a reset button.

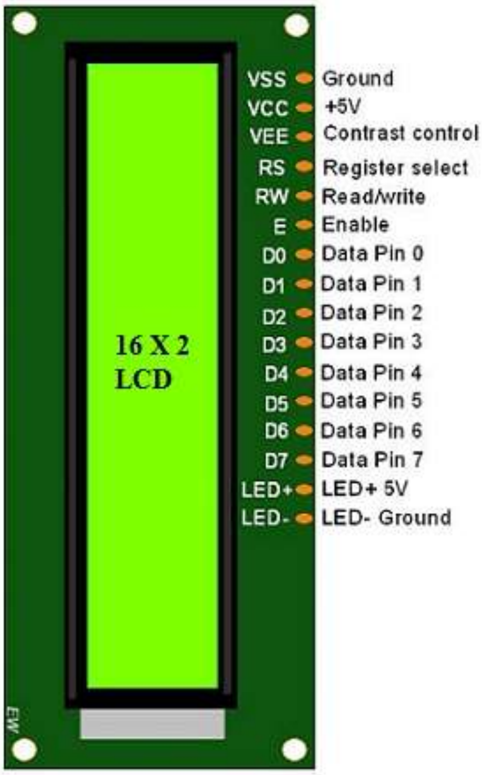


Arduino Uno R3 Specifications, The Arduino Uno R3 board includes the following specifications**.**

- It is an ATmega328P based Microcontroller.
- The Operating Voltage of the Arduino is 5V
- The recommended input voltage ranges from 7V to 12V
- The i/p voltage (limit) is 6V to 20V
- Digital input and output pins-14
- Digital input & output pins (PWM)-6
- Analog i/p pins are 6
- DC Current for each I/O Pin is 20 mA
- DC Current used for 3.3V Pin is 50 mA
- Flash Memory -32 KB, and 0.5 KB memory is used by the boot loader
- SRAM is 2 KB
- EEPROM is 1 KB
- The speed of the CLK is 16 MHz
- In Built LED
- Length and width of the Arduino are 68.6 mm X 53.4 mm
- The weight of the Arduino board is 25 g

Arduino UNO R3

LCD DISPLAY



Features of LCD16x2

The features of this LCD mainly include the following.

- The operating voltage of this LCD is 4.7V-5.3V
- It includes two rows where each row can produce 16-characters.
- The utilization of current is 1mA with no backlight
- Every character can be built with a 5×8 pixel box
- The alphanumeric LCDs alphabets & numbers
- Is display can work on two modes like 4-bit & 8-bit
- These are obtainable in Blue & Green Backlight
- It displays a few custom generated characters

Ultrasonic Sensor:

Ultrasonic Sensor - Working

As shown above the **HC-SR04 Ultrasonic (US) sensor** is a 4 pin module, whose pin names are Vcc, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor.

How to use the HC-SR04 Ultrasonic Sensor

HC-SR04 distance sensor is commonly used with both microcontroller and microprocessor platforms like Arduino, ARM, PIC, Raspberry Pie etc. The following guide is universally since it has to be followed irrespective of the type of computational device used.

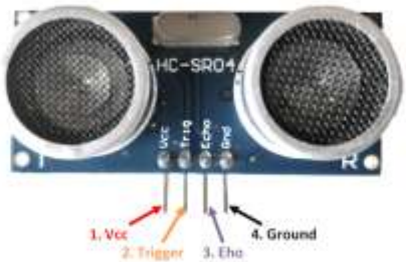
Power the Sensor using a regulated +5V through the Vcc ad Ground pins of the sensor. The current consumed by the sensor is less than 15mA and hence can be directly powered by the on board 5V pins (If available). The Trigger and the Echo pins are both I/O pins and hence they can be connected to I/O pins of the microcontroller. To start the measurement, the trigger pin has to be made high for 10uS and then turned off. This action will trigger an ultrasonic wave at frequency of 40Hz from the transmitter and the receiver will wait for the wave to return. Once the wave is returned after it getting reflected by any object the Echo pin goes high for a particular amount of time which will be equal to the time taken for the wave to return back to the sensor.

The amount of time during which the Echo pin stays high is measured by the MCU/MPU as it gives the information about the time taken for the wave to return back to the Sensor. Using this information the distance is measured as explained in the above heading.

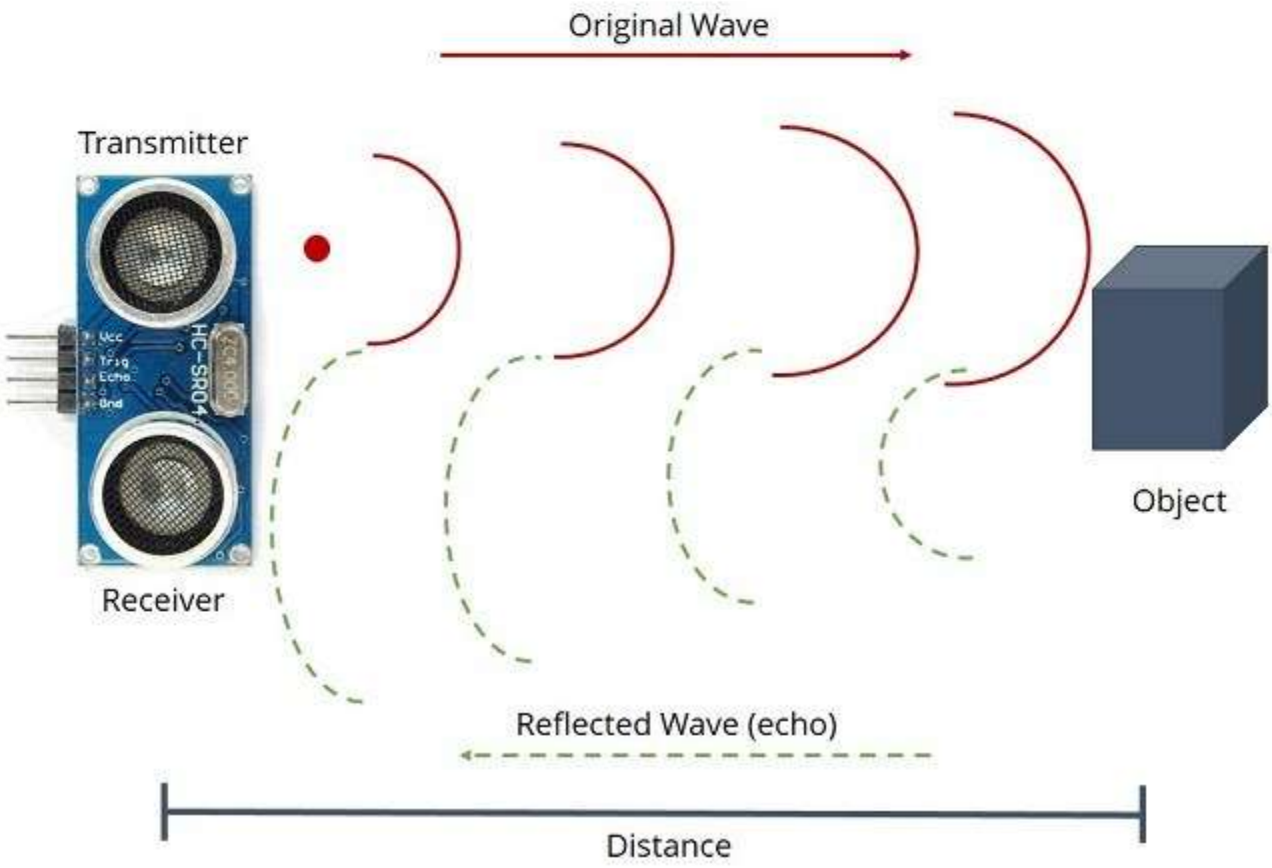
Applications

- Used to avoid and detect obstacles with robots like biped robot, obstacle avoider robot, path finding robot etc.
- Used to measure the distance within a wide range of 2cm to 400cm
- Can be used to map the objects surrounding the sensor by rotating it
- Depth of certain places like wells, pits etc can be measured since the waves can penetrate through water

Ultrasonic Sensor



Pin Diagram



Ultrasonic Sensor Pin Configuration

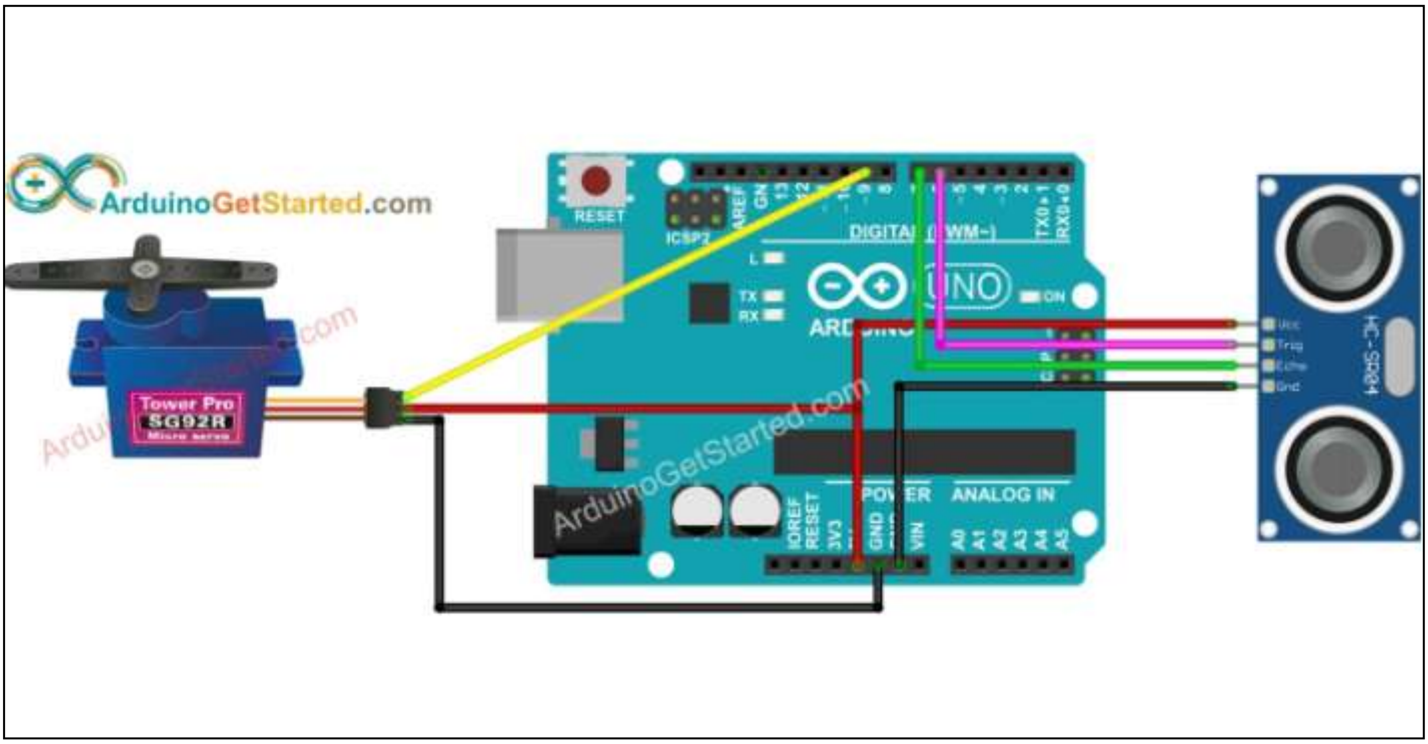
Pin Number	Pin Name	Description
1	Vcc	The Vcc pin powers the sensor, typically with +5V
2	Trigger	Trigger pin is an Input pin. This pin has to be kept high for 10us to initialize measurement by sending US wave.
3	Echo	Echo pin is an Output pin. This pin goes high for a period of time which will be equal to the time taken for the US wave to return back to the sensor.
4	Ground	This pin is connected to the Ground of the system.

Servo Motor

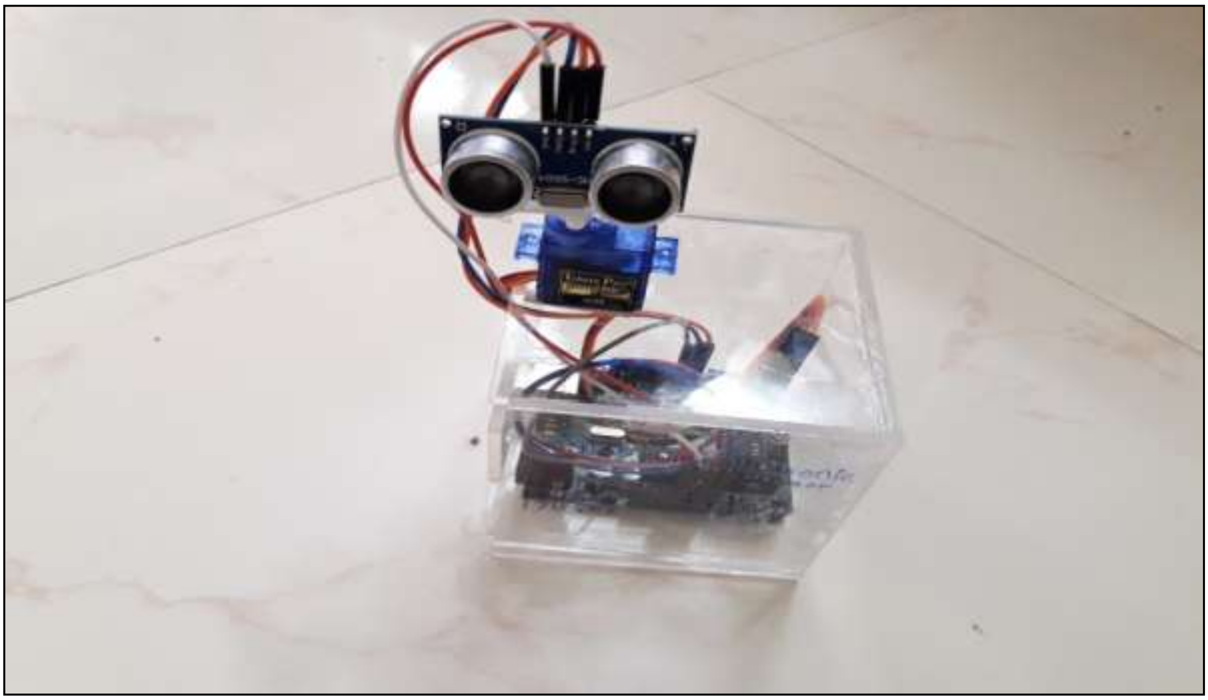
A servomotor allows the precise control of velocity, acceleration and angular position serving as a rotary actuator. For position and location feedback, a suitable motor is coupled to its sensor. A relatively sophisticated and well refined controller which is a module, designed specifically for use with the servomotors. To attain closed loop command with a standard open loop motor, it uses a particular servomechanism. Servomotors have a wide use in automation, robotics, and automatic machines manufacturing.

Servomotor

Chapter 3: Hardware Design / Technical Details



Project Photo



Chapter 4: Software Design

Processing is a flexible software sketchbook and a language to code within the contact of the visual arts. It's free to download and open source.

Libraries are used to extent "Processing" beyond graphics and images into audio, video and communication with other devices.

Serial – Send data between processing and external hardware through serial communication.

Produce for adding library select "Add library" → "Import library" from submenu.

When we send data to the console, the console is relatively slower. For real time monitoring of serial value, we rendered those values to the processing window using draw ( )

Important import for the processing code:

import processing.serial.*; // import library for serial communication

import java.awt.event.keyEvent; // import library for reading data from the serial port

import java.io.IoException; // for handling exception

Arduino IDE:

The Arduino integrated development environment (IDE) is a Java based cross-stage application. For the Processing programming dialect and the wiring ventures, it acquired from the IDE. For the purpose of familiarizing programming with specialists and amateur programmers, IDE is often intended. It integrates elements with a code editorial manager, for instance, sentence structure highlighting, support coordinating and programmed space. It is also equipped for organizing the projects and conveying them to the board with a solitary snap. A code, more likely a system, generated for Arduino is known as a "sketch". Arduino projects are generated and compiled in the most basic and simplest languages like C or C++. For making various I/O operations much simpler and reliable, the IDE accompanies a product called wiring from the first wiring project.

1.Setup() Run once at the start of the program
2. Loop()More than once until the board powers off

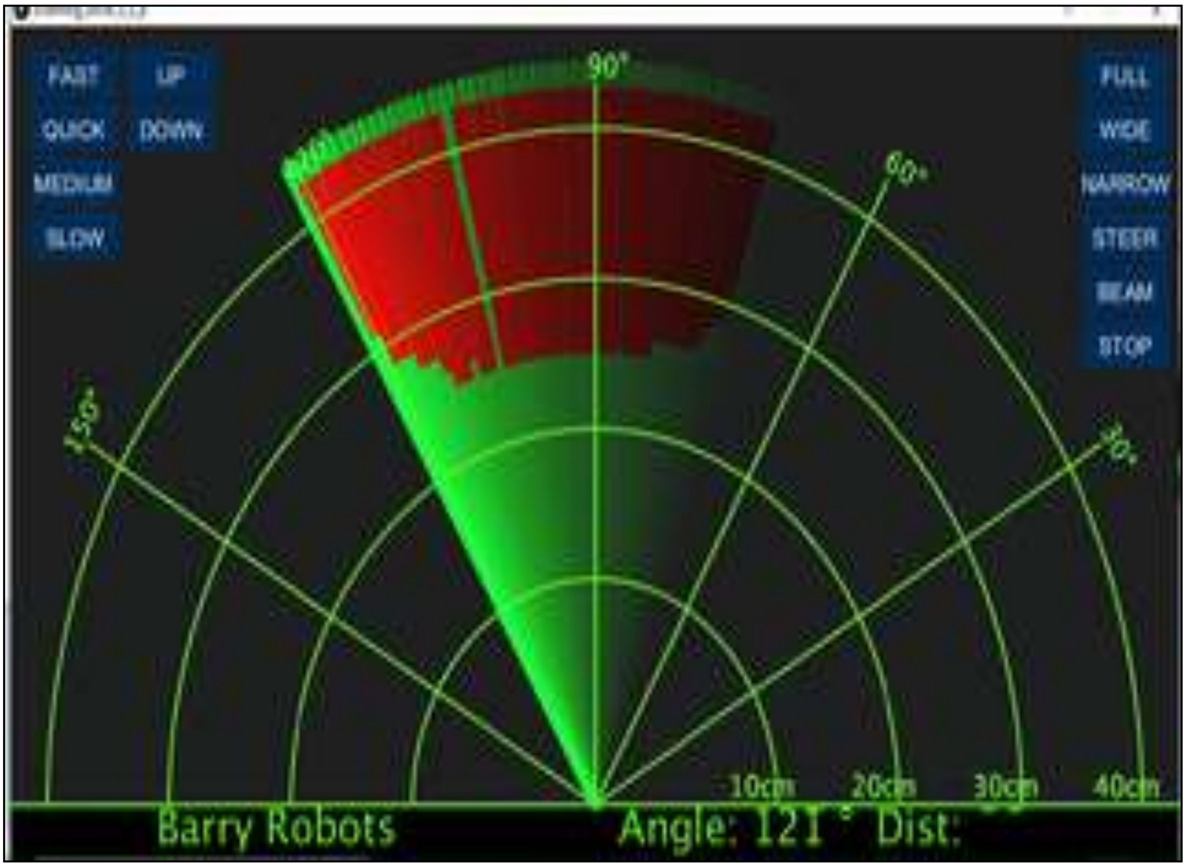
To select the board, open the software for Arduino IDE. Selection of board is:

1.Go to tools
2.Selection of board
3. Select the port at which Arduino board is selected

Compose the code in the space give and tap on aggregate. As soon as the order for code is confirmed, tick on transfer to allocate the description to the Arduino board.

Processing Software.

Processing software is an open source programming language. With the aim to educate the essentials of PC programming in a visual and graphical setting and to aid in launching the electronic sketchbooks, IDE operates for different visual alignment and configuration groups, electronic terminologies, new media craftsmanship. This undertaking was signed by the personnel of Esthetics at MIT Media Lab, Casey Reas and Benjamin Fry, in 2001. The dialect expands on the Java dialect, however utilizes a streamlined linguistic structure and represent programming model.

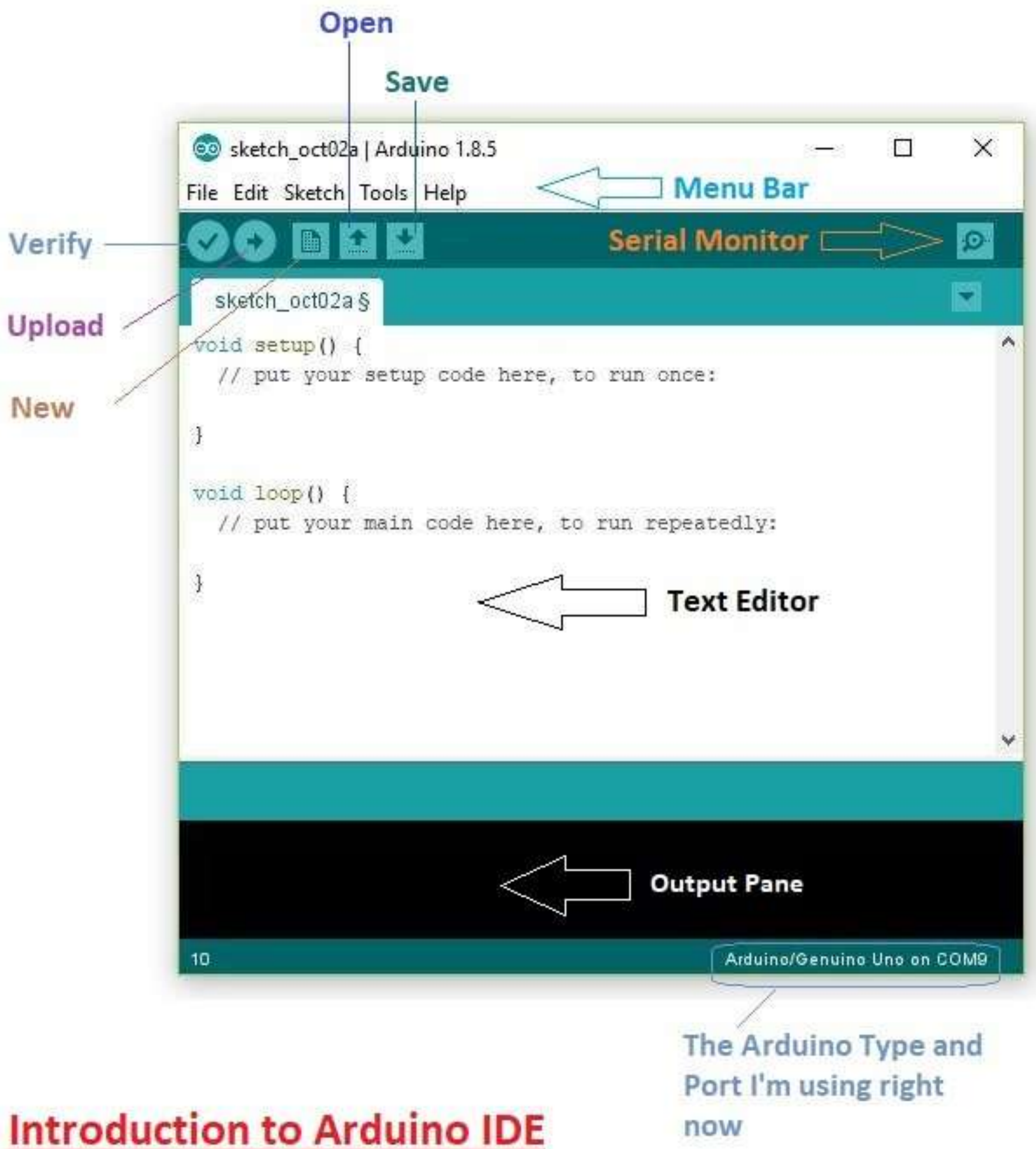


Communication between Arduino and Computer.

Another significant issue identified with the Arduino board was the correspondence between Arduino and PC. There was a communication between RS-232 and TTL circuits. Different strategies were adopted to manage this problem
1. Firstly, MAX-232 IC was utilized to communicate with the Arduino. Due to high voltage drop and jumble in the velocity, it was neglected to impart.
2.Next, AVR was used as USB to Serial converter in the Arduino board. This technique was failed and data transmission was not possible in our working.
3.Finally FTDI FT-232R chip was used for USB to Serial data transfer.

Programming the Arduino to show the result screen.

The main task was to show the results on SONAR screen. For this purpose, VB. NET was used to shape the SONAR screen. It was a difficult task to establish the interface with the Arduino information. This task was completed with the help of Processing programming (Version 2.0) [6]



Introduction to Arduino IDE

ARDUNIO CODING :-

```
#include <Servo.h>
#include<NewPing.h>
#include <LiquidCrystal.h>
#define TRIGGER_PIN 12 // Arduino pin tied to trigger pin on the ultrasonic sensor.
#define ECHO_PIN 11 // Arduino pin tied to echo pin on the ultrasonic sensor.
#define MAX_DISTANCE 100 // Maximum distance we want to ping for (in centimeters).
#define SERVO_PWM_PIN 10

// means -angle .. angle
#define ANGLE_BOUNDS 80
#define ANGLE_STEP 1

int angle = 0;

// direction of servo movement
// -1 = back, 1 = forward
int dir = 1;
String valstring ="";

Servo myservo;
LiquidCrystal lcd(2, 3, 4, 5, 6, 7);
NewPing sonar(TRIGGER_PIN, ECHO_PIN, MAX_DISTANCE);

void setup() {
Serial.begin(9600);
lcd.begin(16, 2);
myservo.attach(SERVO_PWM_PIN);
lcd.setCursor(0,0);
lcd.print("Pos:");
lcd.setCursor(0,1);
lcd.print("Dis:");
}

void loop() {
delay(50);
// we must renormalize to positive values, because angle is from -ANGLE_BOUNDS ..
ANGLE_BOUNDS
// and servo value must be positive
```

```
myservo.write(angle + ANGLE_BOUNDS);
valstring = String(angle + ANGLE_BOUNDS);
if (valstring.length() < 2)   {
   valstring = "00" + valstring;
   }
else if (valstring.length() < 3)  {
   valstring = "0" + valstring;
   }
lcd.setCursor(5,0);
lcd.print(valstring);
// read distance from sensor and send to serial
getDistanceAndSend2Serial(angle);
// calculate angle
if (angle >= ANGLE_BOUNDS || angle <= -ANGLE_BOUNDS) {
dir = -dir;
}
angle += (dir * ANGLE_STEP);
}

int getDistanceAndSend2Serial(int angle) {

int cm = sonar.ping_cm();
Serial.print(angle, DEC);
Serial.print(",");
Serial.println(cm, DEC);
valstring = String(cm);
if (valstring.length() < 2)   {
   valstring = "00" + valstring;
   }
else if (valstring.length() < 3)  {
   valstring = "0" + valstring;
   }
lcd.setCursor(5,1);
lcd.print(valstring);
}
```

[Type here]

PROCESSING SOFTWARE CODE:

```
Import processing.serial.*;
int SIDE_LENGTH = 1000;
int ANGLE_BOUNDS = 80;
int ANGLE_STEP = 2;
int HISTORY_SIZE = 10;
int POINTS_HISTORY_SIZE = 500;
int MAX_DISTANCE = 100;

int angle;
int distance;

int radius;
float x, y;
float leftAngleRad, rightAngleRad;

float[] historyX, historyY;
Point[] points;

int centerX, centerY;

String comPortString;
Serial myPort;

void setup() {
size(1000, 500, P2D);
noStroke();
//smooth();
rectMode(CENTER);

radius = SIDE_LENGTH / 2;
centerX = width / 2;
centerY = height;
angle = 0;
leftAngleRad = radians(-ANGLE_BOUNDS) - HALF_PI;
rightAngleRad = radians(ANGLE_BOUNDS) - HALF_PI;

historyX = new float[HISTORY_SIZE];
historyY = new float[HISTORY_SIZE];
points = new Point[POINTS_HISTORY_SIZE];
```

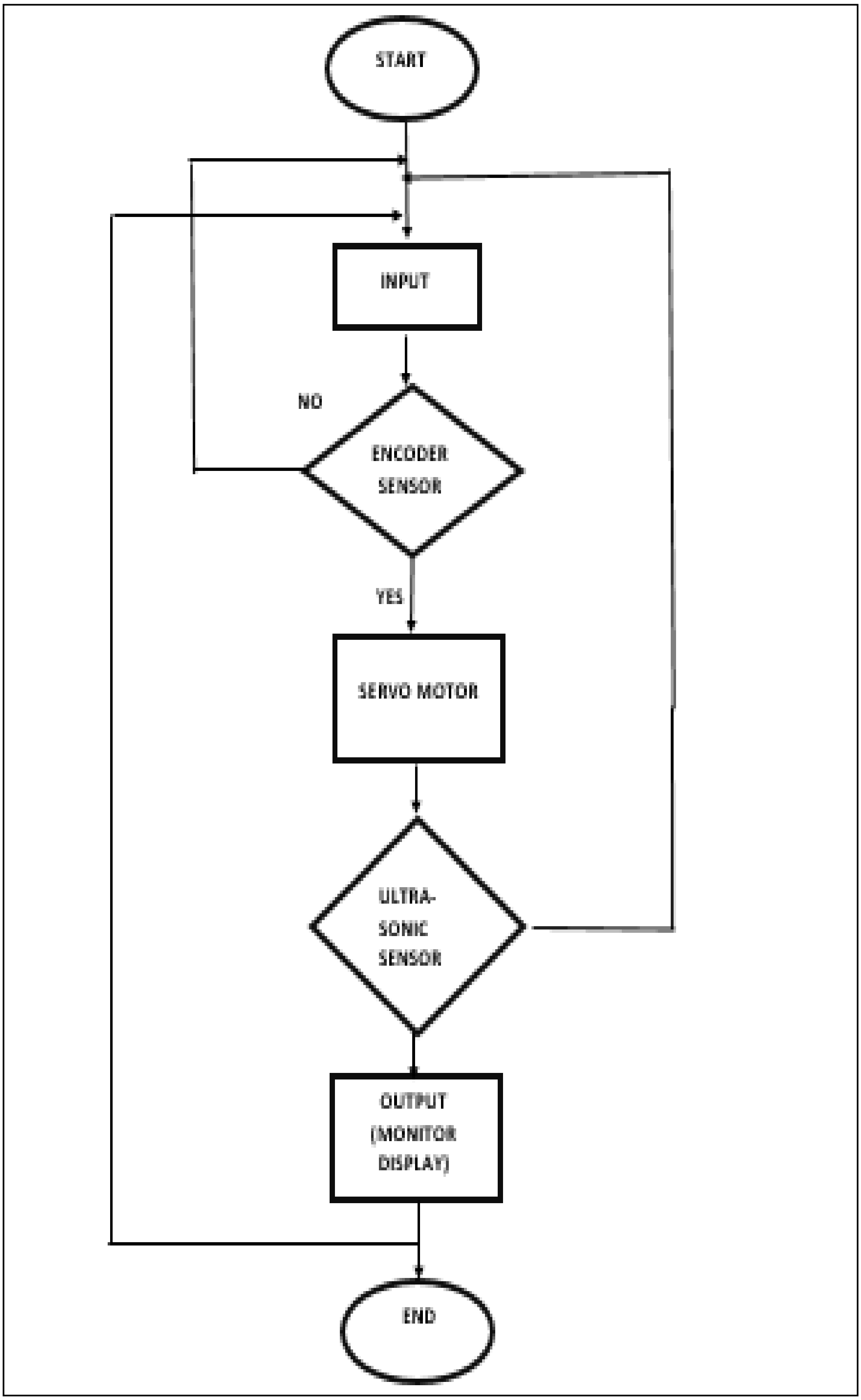
```
myPort = new Serial(this,"COM5", 9600);
myPort.bufferUntil('\n'); // Trigger a SerialEvent on new line
}


void draw() {

background(0);

drawRadar();

drawFoundObjects(angle, distance);
drawRadarLine(angle);
}

void drawRadarLine(int angle) {

float radian = radians(angle);
x = radius * sin(radian);
y = radius * cos(radian);


float px = centerX + x;
float py = centerY - y;

historyX[0] = px;
historyY[0] = py;
for (int i=0;i<HISTORY_SIZE;i++) {

stroke(50, 150, 50, 255 - (25*i));
line(centerX, centerY, historyX[i], historyY[i]);
}
shiftHistoryArray();
}

void drawFoundObjects(int angle, int distance) {


if (distance > 0) {
float radian = radians(angle);
x = distance * sin(radian);
```

```
y = distance * cos(radian);

int px = (int)(centerX + x);
int py = (int)(centerY - y);

points[0] = new Point(px, py);
}
else {
points[0] = new Point(0, 0);
}
for (int i=0;i<POINTS_HISTORY_SIZE;i++) {

Point point = points[i];
if (point != null) {

int x = point.x;
int y = point.y;

if (x==0 && y==0) continue;

int colorAlfa = (int)map(i, 0, POINTS_HISTORY_SIZE, 50, 0);
int size = (int)map(i, 0, POINTS_HISTORY_SIZE, 30, 5);

fill(50, 150, 50, colorAlfa);
noStroke();
ellipse(x, y, size, size);
}
}

shiftPointsArray();
}

void drawRadar() {
stroke(100);
noFill();

for (int i = 0; i <= (SIDE_LENGTH / 100); i++) {
arc(centerX, centerY, 100 * i, 100 * i, leftAngleRad, rightAngleRad);
}

for (int i = 0; i <= (ANGLE_BOUNDS*2/20); i++) {
float angle = -ANGLE_BOUNDS + i * 20;
```

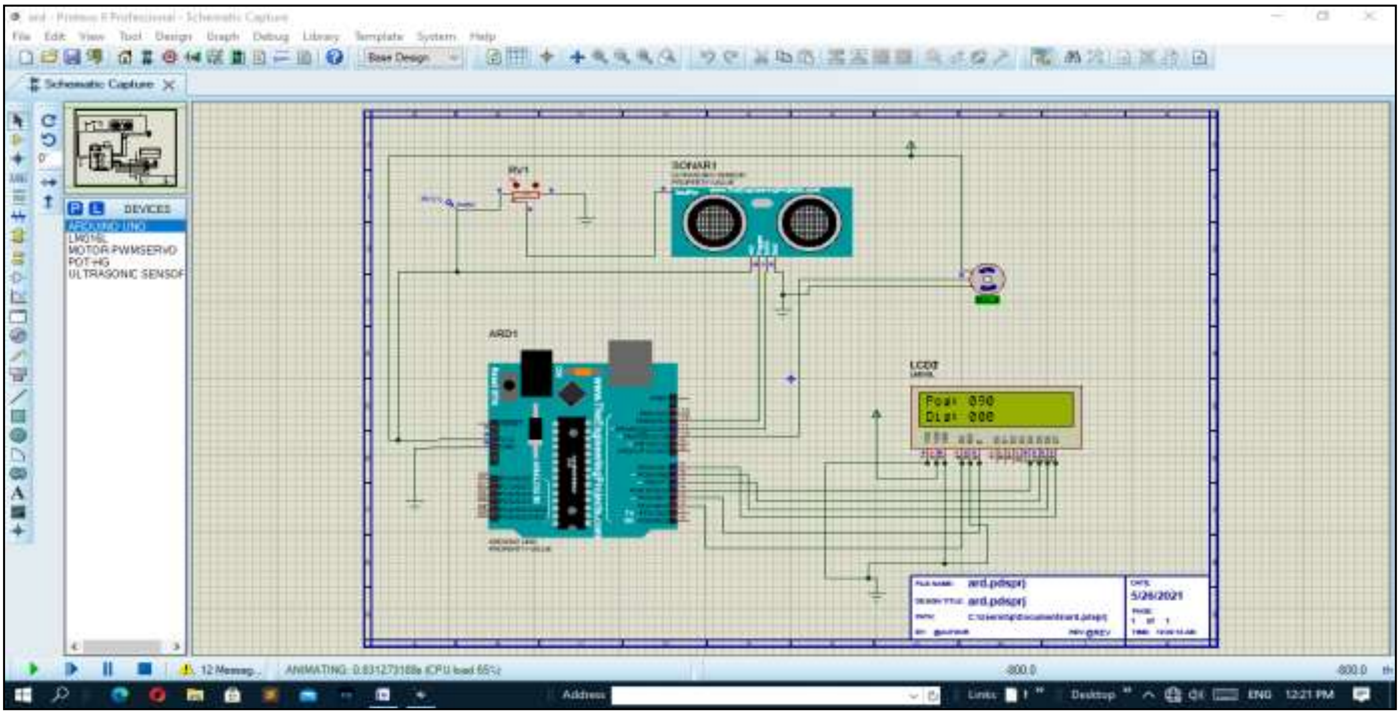
```
float radAngle = radians(angle);
line(centerX, centerY, centerX + radius*sin(radAngle), centerY - radius*cos(radAngle));
}
}

void shiftHistoryArray() {

for (int i = HISTORY_SIZE; i > 1; i--) {

historyX[i-1] = historyX[i-2];
historyY[i-1] = historyY[i-2];
}
}

void shiftPointsArray() {

for (int i = POINTS_HISTORY_SIZE; i > 1; i--) {

Point oldPoint = points[i-2];
if (oldPoint != null) {

Point point = new Point(oldPoint.x, oldPoint.y);
points[i-1] = point;
}
}
}

void serialEvent(Serial cPort) {

comPortString = cPort.readString();
if (comPortString != null) {

comPortString=trim(comPortString);
String[] values = split(comPortString, ',');
try {
angle = Integer.parseInt(values[0]);
distance = int(map(Integer.parseInt(values[1]), 1, MAX_DISTANCE, 1, radius));
} catch (Exception e) {}
}
}

class Point {
```

```
int x, y;

Point(int xPos, int yPos) {
x = xPos;
y = yPos;
}

int getX() {
return x;
}

int getY() {
return y;
}
}
```

Chapter 5: Setup and Testing Procedure



Chapter 6: Result and Analysis



Note:
1.As shown on LCD Display Servomotor Rotates from 0^{o} to 180^{o} but no Obstacle is detected i.e It is not Possible to show Obstacle on Proteus Software.
2.As a result Position of Servomotor is Displayed on LCD screen.

Chapter 7: Conclusion/Future Scope

SONAR system with a generic configuration to provide real-time updates to its user and hence cancelling out the extra time taken for the communication. The combination of Hardware and Software together governed with a comprehensive algorithm allows the SONAR system to switch between conventional system and smart system with the help of automation which ultimately adds in the ability to establish remote communication without any additional motors or actuators and also saving some room for other features. This also makes the SONAR capable of graphically representing any object within its range. Additionally, the Processing app-based range feature helps to map the environment around the system. Furthermore, this data visualization technique saves time on understanding the collected data effectively. So that, proper methods can be devised to ease down the
problems encountered.

Numerous advanced control methods gave designers to have more command over different advanced applications. In our paper, the recommended mapping method of whole system is assessed on small principles or scale . The field that we have chosen for our design “SONAR System” is a very vast field and future scope of this technology is very high. We have tremendous applications in which radar system 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 .

As we have designed a short range SONAR therefore our research was specified and limited. This system can only detect objects from 0 to 180 degrees only because the servo motor that we have used can rotate only to this range. So, due to this limitation our design cannot be applied to places or areas for obstacle detection on a larger scale. Usage of a 360 degrees rotating servo motor can make the system more efficient. We look forward to modify this system and enhance our research work by using a fully 360 degrees rotating servo and a higher ranged ultrasonic sensor. We can further add features to this system i.e. making it mobile, mounting an alarm system to it which turns on when obstacle is detected. Further modifications could be an obstacle avoiding robot with surveillance system.

References

[1] Yadav, E.P., Mittal, E.A. and Yadav, H., 2018, February. IoT: Challenges and Issues in Indian Perspective. In *2018 3rd International Conference On Internet of Things: Smart Innovation and Usages (IoT-SIU)* (pp. 1-5). IEEE.

[2] Li, S.A., Weng, C.W., Chen, Y.H., Lo, C.H., Yang, M.H.,Lin, Y.C., Hsieh, M.H. and Wong, C.C., 2012, November. Servo motor controller design for robotic manipulator.In *2012 International Symposium on Intelligent Signal Processing and Communications Systems* (pp. 254-257).IEEE.

[3] Patkar, A.R. and Tasgaonkar, P.P., 2016, April. Object recognition using horizontal array of ultrasonic sensors.In *2016 International Conference on Communication and Signal Processing (ICCSP)* (pp. 0983-0986). IEEE.

[4] Bystrov, A., Abbas, M., Hoare, E., Tran, T.Y., Clarke, N.,Gashinova, M. and Cherniakov, M., 2014, October.Remote road surface identification using radar and ultrasonic sensors. In *2014 11th European Radar Conference* (pp. 185-188). IEEE.

[5] Wobschall, D., Zeng, M. and Srinivasaraghavan, B.,2005, February. An ultrasonic/optical pulse sensor for precise distance measurements. In *2005 Sensors for Industry Conference* (pp. 31-34). IEEE.

[6] Hyun, E., Jin, Y.S., Ju, Y. and Lee, J.H., 2015,September. Development of short-range ground surveillance radar for moving target detection. In *2015 IEEE 5th Asia-Pacific Conference on Synthetic Aperture Radar (APSAR)* (pp. 692-695). IEEE.

[7] Shao, Y., Chen, P. and Cao, T., 2018, July. A Grid Projection Method Based on Ultrasonic Sensor for Parking Space Detection. In *IGARSS 2018-2018 IEEE International Geoscience and Remote Sensing Symposium* (pp. 3378-3381). IEEE.

[8] Paulet, M.V., Salceanu, A. and Neacsu, O.M., 2016,October. Ultrasonic radar. In *2016 International Conference and Exposition on Electrical and Power Engineering (EPE)* (pp. 551-554). IEEE.

[9] RADAR system, https://www.elprocus.com/wpcontent/uploads/2013/09/A-RADAR-System.jpg, 2013[Online; accessed 08-April-2019].

[10] Ultrasonic Sensor HC-SR04 System, https://randomnerdtutorials.com/complete-guide-forultrasonic-sensor-hc-sr04/, 2013. [Online; accessed 08-April-2019].

[11] C. Sturm and W. Wiesbeck, "Waveform Design and Signal Processing Aspects for Fusion of Wireless Communications and Radar Sensing",*Proceedings of the IEEE*, vol. 99, pp. 1236-1259, July 2011.

[12] A. Hassanien and S. A. Vorobyov, “Transmit/receive beamforming for MIMO radar with colocated antennas”, *Proc. IEEE Intl. Conf. Acoust.,Speech, and Signal Proc.*, Taipei, 2009.

[13] B. Friedlander, “On the relationship between MIMO and SIMO radars”,*IEEE Trans. Signal Processing*, pp. 394–398, Jan., 2009.

[14] J.-H. Kim, M. Younis, A. Moreira, and W. Wiesbeck, “A Novel OFDM Chirp Waveform Scheme for Use of Multiple Transmitters in SAR”,IEEE Geoscience and Remote Sensing Letters, vol. 10, no. 3, May 2013,pp. 568-572.

[15] Krieger, G., "MIMO-SAR: Opportunities and Pitfalls," Geoscience and Remote Sensing, IEEE Transactions on , vol.52, no.5, pp.2628,2645,May 2014

[16] International Research Journal of Engineering and Technology (IRJET)
e-ISSN: 2395-0056 p-ISSN: 2395-0072

[17] C. Sturm, Y. L. Sit, M. Braun, T. Zwick, “Spectrally Interleaved Multi-Carrier Signals for Radar Network Applications and MIMO-Radar“ *IET Radar, Sonar & Navigation*, 2013

[18] W. Wiesbeck, “Radar of the Future,” Proceedings of the 10th European Radar Conference, 9-11 Oct. 2013, Nuremberg, Germany, pp. 137-140.

[19] Y. Leen, C. Sturm, L. Reichhardt, T. Zwick, and W. Wiesbeck, “The OFDM joint radar-communication system: An overview,” in The Third International Conference on Advances in Satellite and Space Communications, 201 SPACOMM, 2011

Bill of Material/Component List

Component Name	Reference Number	Quantity	Price
Arduino Board	ATmega328p	1	360
LCD Display	LM016L	1	120
Ultrasonic Sensor	HC – SR04	1	100
Connecting Wires	Jumper Wires	15	150
Potentiometer	1k ohm A Pot potentiometer	1	50
TOTAL			780