A Project report on

AIRCRAFT RADAR SYSTEM

Submitted in partial fulfillment of the award of the

BACHELOR OF SCIENCE

IN

AERONAUTICS

(AVIONICS)

By

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BONAFIDE CERTIFICATE

This is to certify that project report titled **"AIRCRAFT RADAR SYSTM"**, is a bonafide record of work carried out by **Mr.Chaitanya Badekar** during the final semester from **February 2021** to **May 2021** under my guidance, in partial fulfillment of the requirements for the award of **Bachelor of Science** in **Aeronautics (Avionics).**

Prof. Dr. M Suresh Kumar **Project Guide**

Principal **Prof Dr. M Suresh kumar**

DECLARATION

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

Mr.Chaitanya Badekar
2018-A-006

Place: NAVI MUMBAI

Date: 07/06/2021

PROJECT RECORD BOOK

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Semester:

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Table Of Content

1. ACKNOWLEDGEMENT

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I respect and thank **Prof Dr. M Suresh kumar**, for providing me an opportunity to do the project work in Wingsss college of aviation technology and giving us all support and guidance, which made me complete the project duty. I am extremely thankful to him for providing such a nice support and guidance, although he had busy schedule.

I owe my deep gratitude to our project guide **Prof Dr. M Suresh kumar**, who took keen interest on our project works and guided us all along, till the completion of our project work by providing all the necessary information for developing a good system

I would not forget to remember for their encouragement and more over for their timely support and guidance till the completion of our project work.

Mr.Chaitanya Badekar
Date: 07 / 06 / 2021 .

2. ABSTRACT

This paper is about Radar System controlled via Arduino. This RADAR 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 has 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. These systems controlled through Arduino. Arduino UNO board is sufficed to control ultrasonic sensor and also to interface the sensor and display device. While researching, we leaked about existing navigation and obstacle detection innovations and different systems where ultrasonic sensors are used efficiently. Main application of this RADAR system comes into different field of navigation, positioning, object identification, mapping, spying or tracking and different applications. These less investment systems are also suitable for indoor applications.

KEYWORDS:

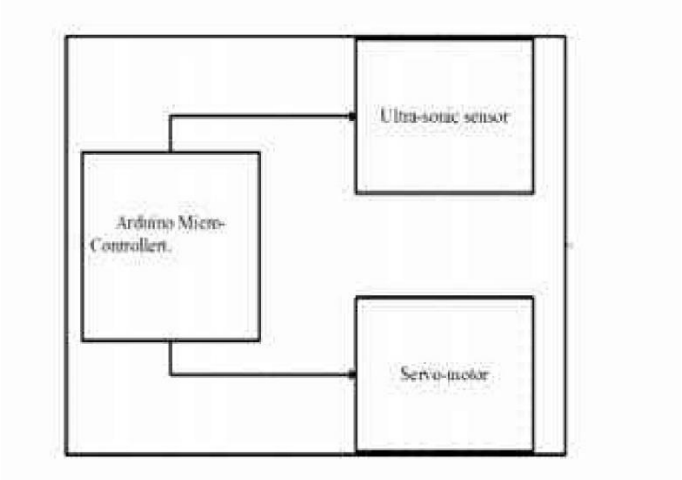
Arduino, ultra-sonic, radar, positioning, surveillance, obstacle detection.

3.INTRODUCTION

RADAR system is an object detection or tracking system which uses radio waves to decide or get the range, height, heading, or speed of items or objects. Radar frameworks or system arrive in an assortment of sizes and have distinctive performance particulars. Some radars are utilized for aviation authority at air terminals and others are utilized for long range observation and vacationing frameworks [1]. There are some ways to show radar working data. There are also some modified radar systems which have advance etymology of handling the systems. These modified systems are used at higher levels to get or extract the helpful or important data [2]. Our proposed system's working principle is linked by the following components which are is ultra- sonic sensor connected to the microcontroller (we have chosen Arduino) digital input and output pins. Then we have servo atrophic is also commented to digital output and input pins. Our both main components ultra- sonic sensor and servo motor am connected simultaneously, so that when our servo motor orates fiom0 degree to 180 degrees from extreme right to extreme left the odor will rotate nearby its axis [3]. We utilize Computer screen to dedicate the data (Distance and angle) though software called "processing development environment".

4.System Overview

Figure 1. System hardware description



The above figure represents a brief overview of this radar system. Here, as it is shown the controller, we are using is Arduino, with the input Ultrasonic sensor and the output is the servo motor which rotates 180 degrees. The micro controller controls all the operations of this system from rotation of the motors to the obstacle detection of the ultrasonic and representation of them result on the screen.

System Block Diagram:

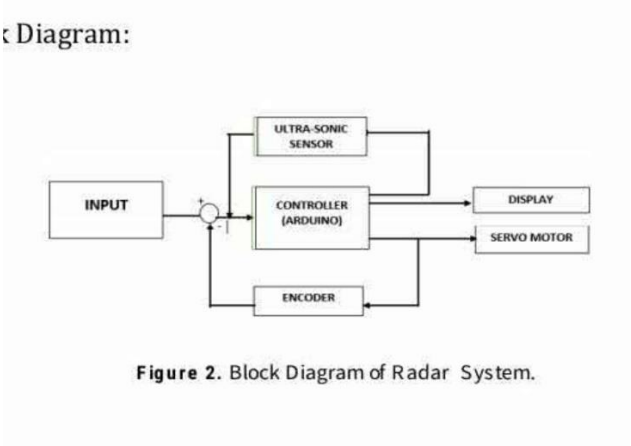
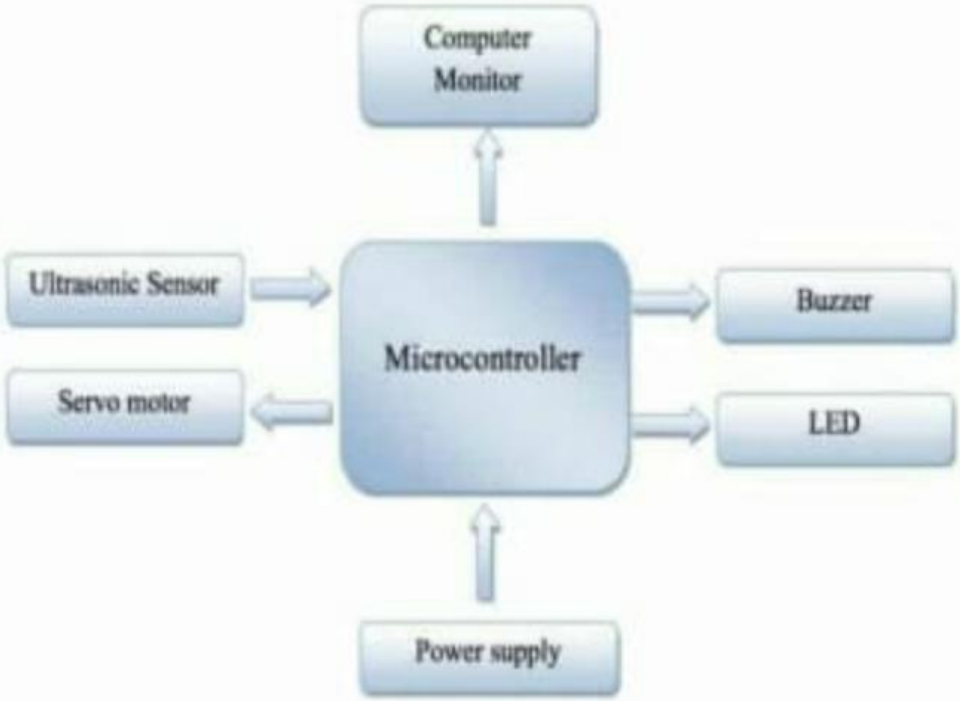


Figure 2. Block Diagram of Radar System.

Here, it can be seen how the work flow in this radar system. The sensor is going to sense the obstacle and determine the angle of incident and its distance from the radar. The servo motor is constantly rotating to and fro, hence making the sensor move. The data obtained is encoded and fed to the processing IDE which represents it on the screen. The results are displayed further in this paper. All these operations are done by Arduino microcontroller from the rotation of the servo, data collection from the sensor, feeding the data to encoder to transferring it to the display.

Block Diagram



6. Component and Tools Required

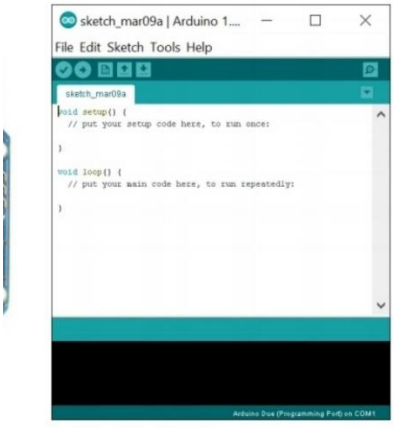
2-1Arduino Board UNO Model:

Arduino is a hardware and software company, project, and user community that designs and manufactures computer open-source hardware, open-source software, and microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices.

The project is based on microcontroller board designs. The board provides sets of digital and analog Input/output (1/0) pins that can interface to various expansion boards (termed shields) and other circuits Fig (2-1). The boards feature serial communication interfaces, including Universal Serial Bus (USB) on UNO model, for loading programs from personal computers [3].

For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board Fig (2-2).

Fig(2-1).Arduino UNO



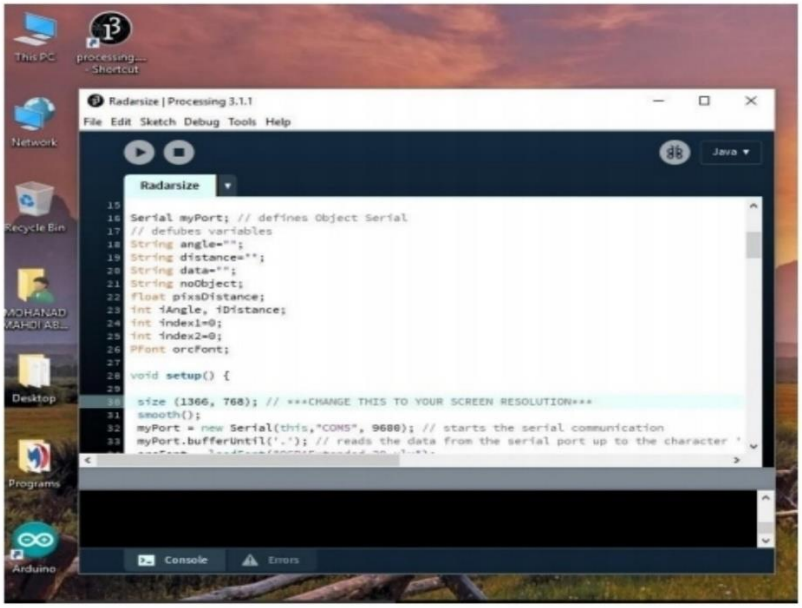
Fig(2-2). IDE Software.

Processing.

Processing is an open-source computer programming language and integrated development environment (IDE) built for the electronic arts, new media art, and visual design communities with the purpose of teaching the fundamentals of computer programming in a visual context Fig (3).

❖ Specifications

- Free to download and open source
- Interactive programs with 2D, 3D or PDF output
- OpenGL integration for accelerated 2D and 3D
- For GNU/Linux, Mac OS X, and Windows
- Over 100 libraries extend the core software
- Well documented, with many books available



Fig(3). Software and processing

2-2 Ultrasonic sensors HC-SR04:

Ultrasonic ranging module HC-SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm The modules include ultrasonic transmitters, receiver, and control circuit, within measuring angle 15 degrees Fig (4). [4-1]

❖ The basic principle of work. Fig (4-2).

(1) Using IO trigger for at least 10us high-level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

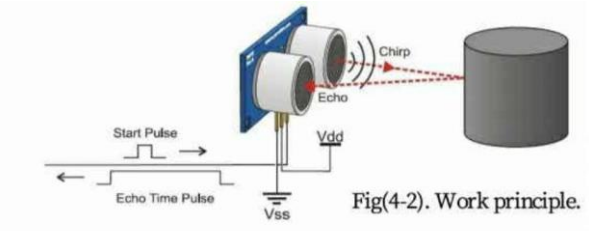
(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time X velocity of sound (340M/S)/2.

❖ Wire connecting directly as following:

- 5V Supply
- Trigger Pulse Input
- Echo Pulse Output
- OV Ground

Fig(4-1). Ultrasonic. HC-SR04



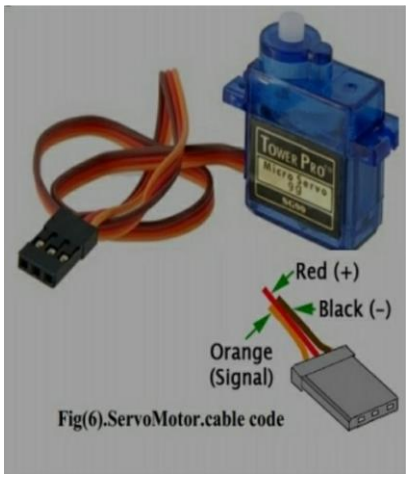
Fig(4-2). Work principle.

2-3 Servo Motor tower pro micro servo 9g:

Tiny and lightweight with high output power. The servo can rotate approximately 180 degrees (90 in each direction), and works just like the standard kinds but smaller Fig (5). You can use any servo code, hardware or library to control these servos.[5]

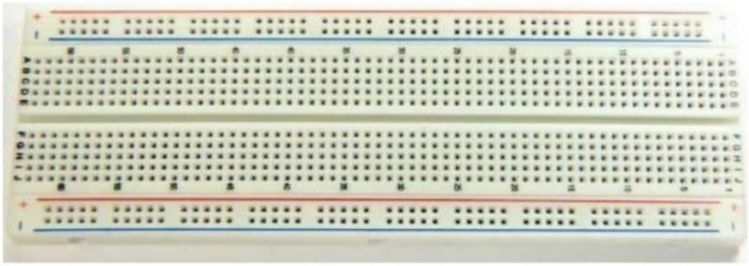
- ❖ Specifications

- Weight: 9 g
- Dimension: 22.2 x 11.8 x 31 mm approx.
- Stall torque: 1.8 kg f cm
- Operating speed: 0.1 s/60-degree Operating voltage: 4.8 V (~5V)
- Temperature range: 0 °C -55 °C



Fig(6).ServoMotor.cable code

A breadboard is a construction base for prototyping of electronics. Originally it was literally a bread board, a polished piece of wood used for slicing bread. In the 1970s the solderless breadboard (AKA plug board, a terminal array board) became available and nowadays the term" breadboard" is commonly used to refer to these. "Breadboard is also a synonym for "prototype".[6] Fig (7)


Fig(7).Breadboard

1- Work procedure:

❖ Components needed for this project

• Arduino Board UNO Model.

• Processing software.

• Ultrasonic sensor HC-SR04.

• Servo Motor tower pro micro servo 9g.

• Breadboard and Jump Wires.

1-1 Circuit Diagram

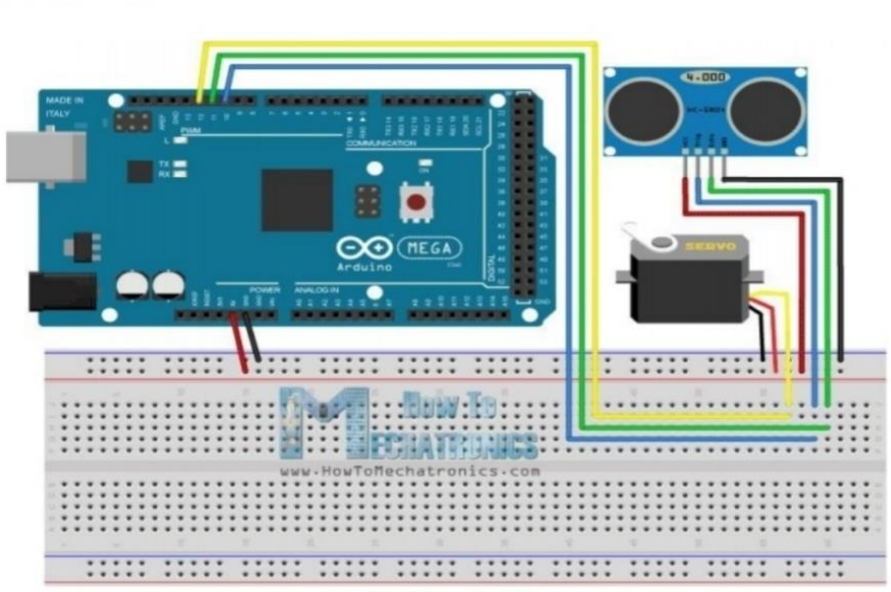
We connected the Ultrasonic Sensor HC-SR04 to the pins number 10 and 11 on the Arduino Board.

TrigPin = 10.

▪ EchoPin = 11.

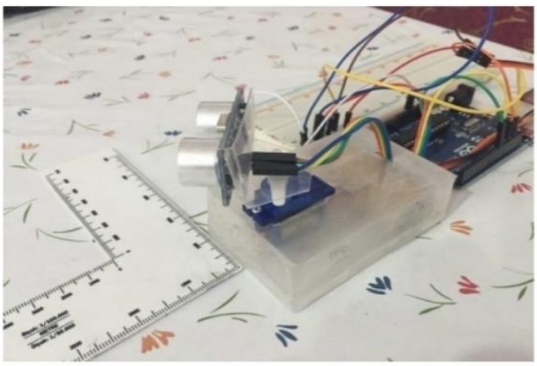
And the servo motor to the pin number 12 on the Arduino Board. Fig (8) shows circuit structure for the project.[7].

▪ MyServo = 13.



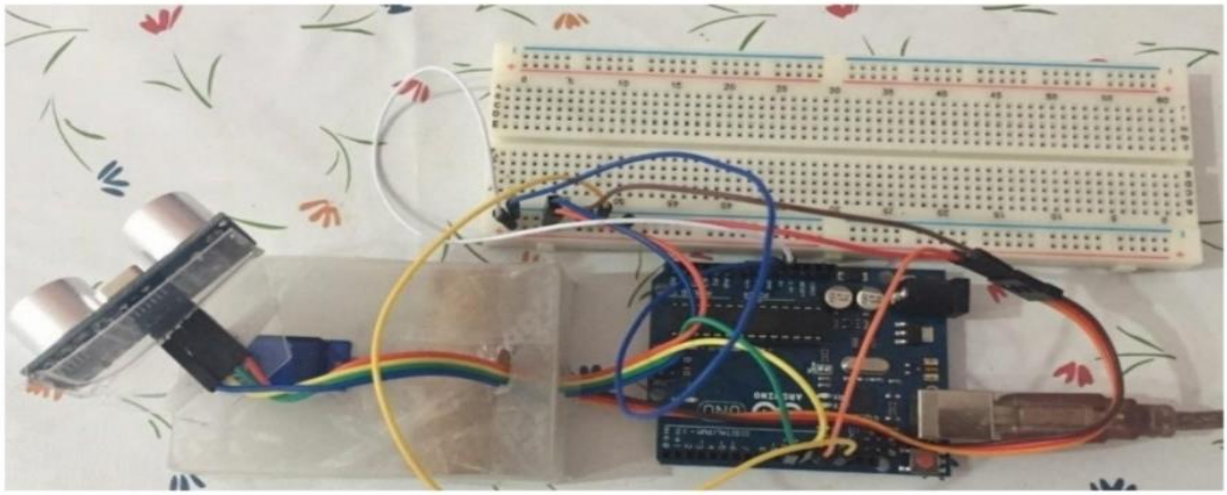
Fig(8). Circuit Diagram

- We made a base form plastic box for servo motor and ultrasonic that allows servo motor to move within 180°. Fig(9) shows the ultrasonic base of our project



Fig(9).Ultrasonic Base

- Here's the final appearance of the project:



Fig(10).Final appearance

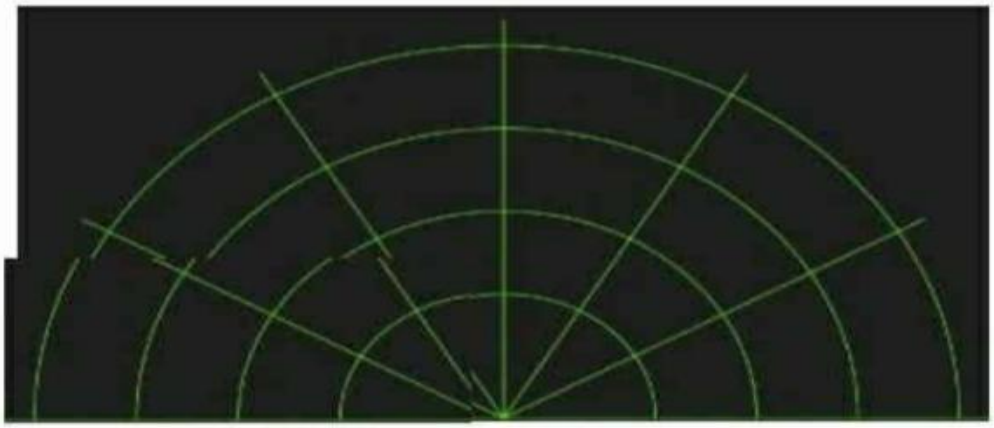
1-2 Write and upload sketch to Arduino

We wrote a sketch in IDE, for this project we need to include some libraries. We use (Serial.h) built-in library for transfer data through the serial port with processing software. Therefore, we add the last library for servo

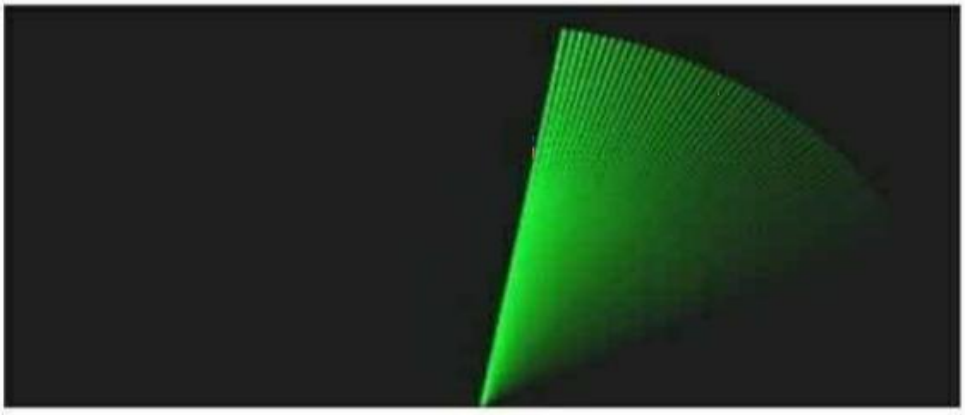
1-3 Write and upload sketch to Processing

- The values for the angle and the distance measured by the sensor will be read from the Arduino board by the Processing IDE using the Serial Event() function which reads the data from the Serial Port. These values will be used for drawing the lines, the detected objects and some texts.

- For drawing the radar display we make this function drawRadar() which consist of arc() and line() functions Fig(13).

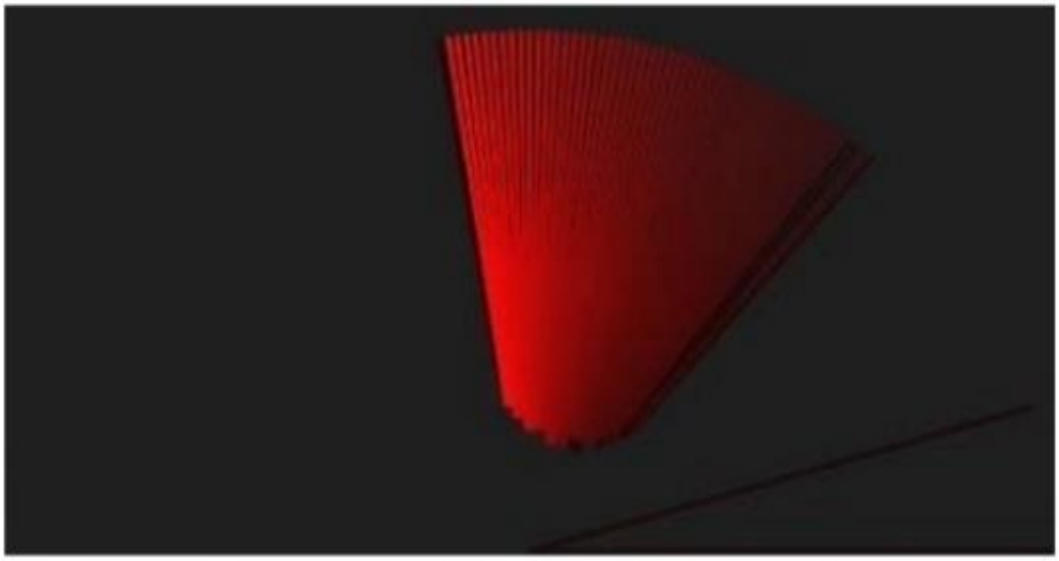


Fig(13). The radar workspace



Fig(14). Radar lines

- For drawing the moving lines we make this function drawLine(). Its center of rotation is set with the translate() function and using the line()) function in which the iAngle variable is used to redraw the line for each degree. Fig (14)



Fig(15). Radar detected lines

- For drawing the detected objects we made the drawObject() function. It receives the distance from the ultrasonic sensor, transforms it into pixels. Then, using the angle detected by the sensor it draws the object on the radar screen Fig (15).

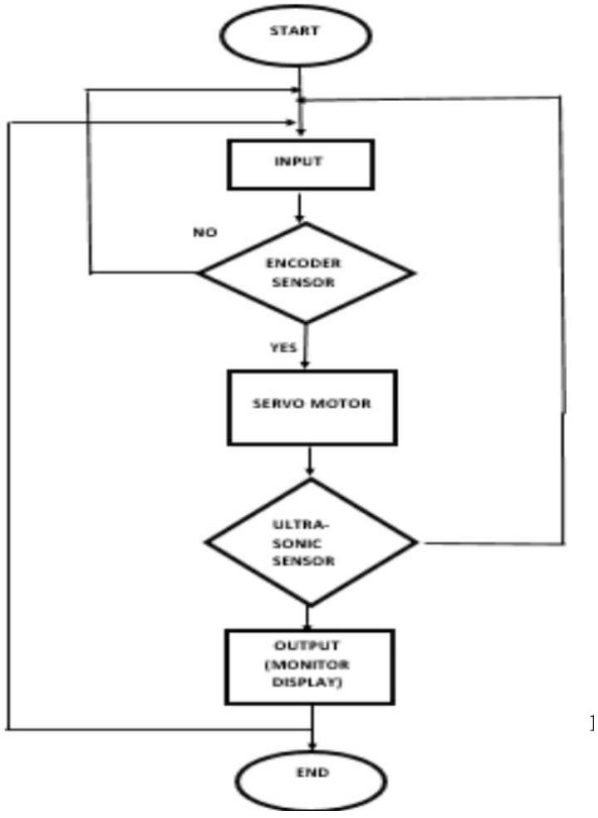
- To illustrate the text on the screen, we make the drawText() function that draws texts on some particular locations. All of these functions are called in the main draw() function which is repeated in each iteration to draw the screen details.

7.METHODOLOGY

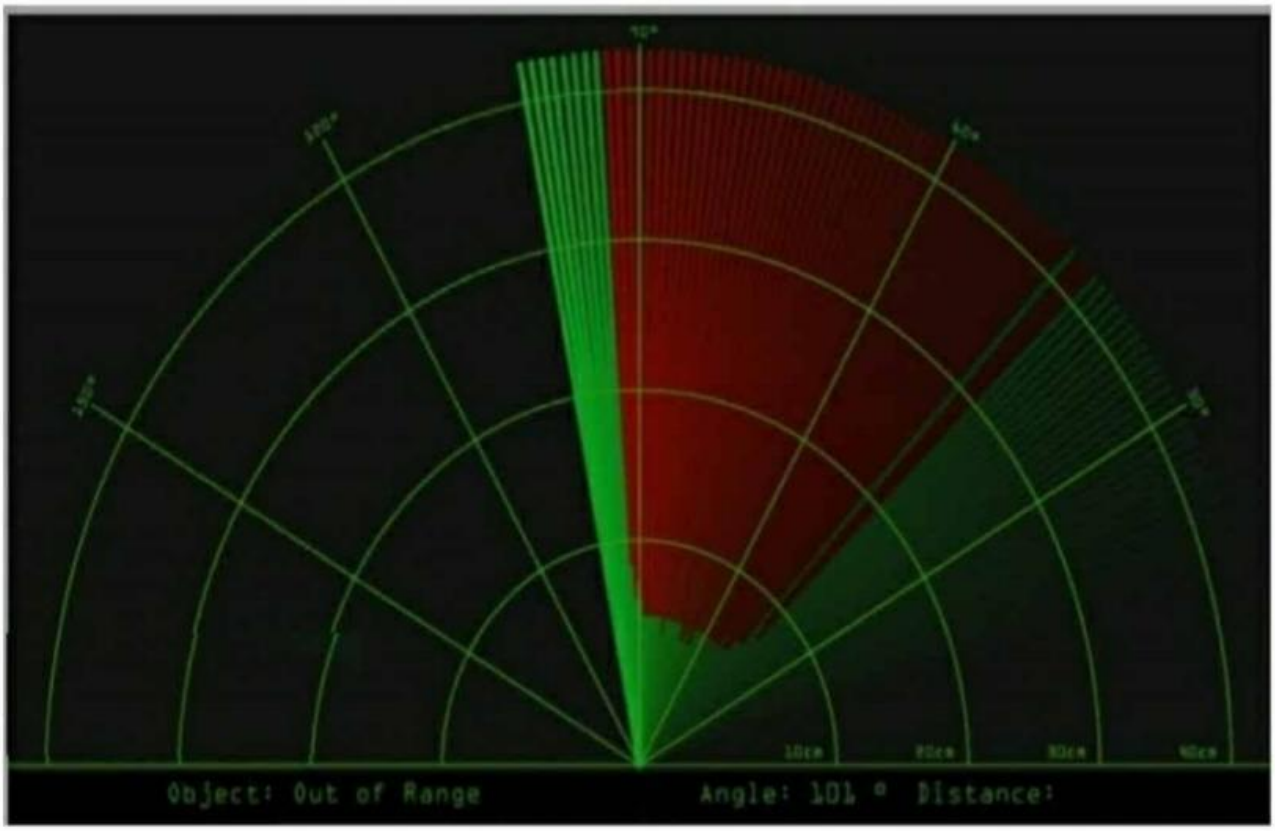
In order to testify the working of this system, after its designing, construction and programming we placed few objects in front of the ultrasonic sensor. As the motor started to rotate, our monitor started to display the output through processing IDE. Hence, when the sensor crossed over the object it showed a red segment with the distance and angle where the object is paced. The first object was placed at the distance of 30.5cm measured through a ruler and the system measured the distance at 32cm. While the second object was placed at a distance of 20 cm and the system measured it as 21cm. Hence the calculated efficiency turned out to be 95%.

8. WORKING:

The basic objective of our design is to ascertain the distance position and speed of the obstacle set at some distance from the sensor. Ultrasonic sensor sends the ultrasonic wave in various ways by rotating with help of servo motors. This wave goes in air and gets reflected back subsequent to striking some object. This wave is again detected by the sensor and its qualities is analyzed and output is shown in screen indicating parameters, for example, distance and position of object. Arduino IDE is utilized to compose code and transfer coding in Arduino and causes us to detect position or angle of servo motor and it is communicated through the serial port alongside the covered distance of the nearest object in its way. Output of all of this working is shown in the software called processing, it will display the input/output and the range of the object [4]. Implementations of the sensors are done in such a way that ultra-sonic sensor is attached on top of the servo motor because it have to detect the object and its distance. Arduino (micro-controller) will control the ultra-sonic sensor and servo motor and also powered will be given to both of them through micro-controller [3].



The above flow chart explains the working and the decision flow of this framework. As it can be seen the system starts with an input i.e. when the ultrasonic sensor detects an object, or does not detects any object, at any condition the encoder feeds the information in the controller while the servo keeps constantly rotating. As soon as any obstacle/objet is detected by the ultrasonic sensor the data is immediately processed by the controller and is fed to the IDE which shows it on the display screen. Here the process ends with an estimated distance of the object from the system with the angle at which it is placed.



9.APPLICATION

This Radar System have various applications for security purposes and it is mainly used for mapping.

- APPLCATION IN AIR FORCE:

It is used in airplanes or aircraft machines which have implemented radar system in it to detect the objects that comes in a way. It is also used to calculate height readings.

- APPLICATION IN MARINE:

This radar system also used in ships or marine. It is implemented on big ships to calculate the distance of other boats or ships, with the help of this sea accidents can also be reduced by not colliding. It can also be implemented on ports to see the distance of other ships and to monitor or control the ship movements.

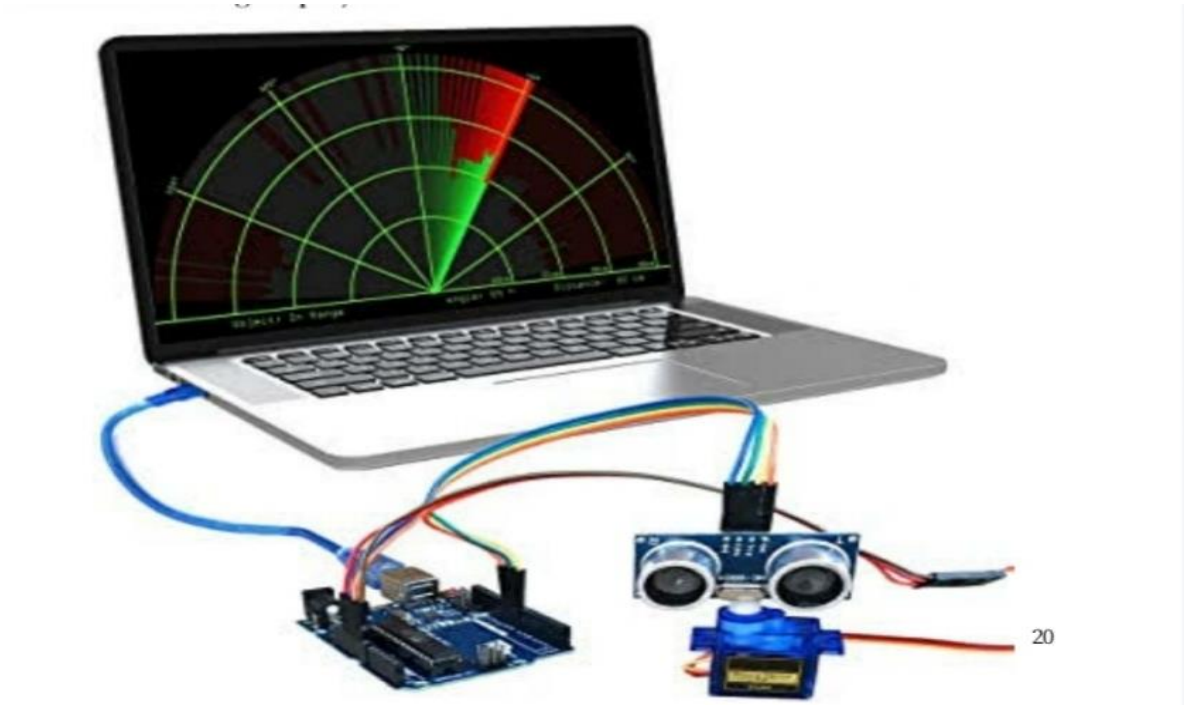
- APPLICATON IN METEROLOGY:

Meteorologists also uses radar systems to track or monitor the wind. It has been become an important equipment for climate testing. For example to detect tornados, storms.

Discussion and result

In this research paper we have mentioned that our system is designed consisting following components such as, a servo- motor, an ultra-sonic sensor and a micro-controller (Arduino). System's objective is to track the distance and angle of the object and to represent this information graphically, means: its output should be in graphical form which will be represented through processing software. We can have an idea of an efficiency of this radar by testing objects at different levels and observe how faster or smoothly it detects an object that it finds in a way and gives us an expected range of the obstacle [3].

Following figure show the results of the monitor screen of our design when the sensor rotates through the area and detects obstacle in the way. The red area indicates the presence of obstacle and below the angle of incident and distance is being displayed.



11. Conclusion

Radar is normally used to determine velocity, range, and position of an object. In this technical project, we read the distance and angles of detected objects in order to convert these data into visual information. The performance of our project is so good. It works smoothly to detect objects within the designed range. The screen shows the information clearly with enough delay for the user to read it. This project could be helpful for object avoidance/ detection applications. This project could easily be extended and could be used in any systems may need it.

12.References

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by:Praveen Tamhankar (06d07007),Piyush Mittal (06d07035), Ashutosh Singh (06d07034) Guide: Prof. Jayanta Mukhergee.

[3] https://en.wikipedia.org/wiki/Arduino

[4] http://www.elecfreaks.com/estore/

[5] Servo motor datasheet.

[6] https://en.wikipedia.org/wiki/Breadboard.

[7] http://howtomechatronics.com/projects/arduino-radar-project/