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A STUDY AND IMPLEMENTATION OF ULTRASONIC RADAR DEFENCE SYSTEM

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Abstract: A range-measuring device is used to measure the distance and angle at which the target object is located from the observational unit. The purpose of this project is to determine the position of the object and aim the target accurately. In this project, we make a prototype radar system with the help of an ultrasonic sensor which is capable to measure a distance of 3 cm to 50cm as the targeting range, with angles ranging between 0 and 180 degrees. The ultrasonic sensor is mounted on a servomotor which creates a range by the rotation of the servo motor. The information gathered is sent to a microcontroller where the information is sent to other servomotors for the aiming and firing operations. The information from the microcontroller is sent to a PC screen where software is used to illustrate the results.

Keywords: Radar System, Microcontroller, Ultrasonic Sensor, Servo Motor

I. INTRODUCTION

An Ultrasonic Radar defence system uses ultrasound waves, which are used to determine the distance, altitude, and direction of objects. Ultrasound is waves with frequencies higher than the audible limit of human hearing. The Radar system transmits ultrasound waves that travel a particular distance until it hits an object in its path and gets reflected to the receiver, this helps in locating the exact position of the object. An ultrasonic sensor primarily consists of the transmitter and the receiver which captures the sound waves after it has travelled to and from the object. The sensor monitors the elapsed time between the sound emission from the transmitter and its contact with the receiver to calculate the separation between the obstruction and the sensor. When required, ultrasonic sensors may provide readings that are even more exact and are typically within 1% of the requisite accuracy. Proximity sensors are the primary use for ultrasonic sensors. They may be found in vehicle technology for self-parking and anti-collision safety. Ultrasonic sensors are used in both industrial technologies and robot obstacle detection systems. Compared to infrared (IR) sensors, ultrasonic sensors are less likely to be affected by smoke, gas, and other particles in the air, when used for proximity sensing, even though heat can still affect the physical parts.

In the modern world, Radar system comes in a variety of features and specifications, where some are used for long-range defence surveillance and others are used for alert systems. The radar system is the key component for the missile launching and guidance system. The Radar systems were developed before and during World War II. They were primitively used only for detection and ranging. Recent years have seen an increase in the use of radar systems for a spectrum of purposes, such as air defence, antimissile systems, radar astronomy, air traffic control, marine radars that can be utilised to locate submarines and ships, aircraft anti-collision systems, ocean monitoring systems, extra-terrestrial surveillance systems, meteorological climate and weather monitoring, guided missile target locating systems, altimetry and flight control systems, and ground-penetrating radar for geological investigation. Modern radar systems can glean relevant information from noisy environments.

II. LITERATURE REVIEW

Various scholars have disagreed on where radar fits into the greater scheme of science and technology. A sound source moving either toward or away from the listener, or the listener moving either toward or away from the sound source, causes an apparent shift in frequency or pitch, which was first described in 1842 as the Christian Doppler effect. The United States developed this technology in the Rad Lab at MIT, which was shut down at the end of 1945, and it is now used by the Army, Navy, and Air Force. The Cambridge Research Centre (CRC), located at Hansom Field, Massachusetts, was the focus of American radar research. MIT established the Lincoln Laboratory in 1951 to do cooperative research with the CRC. In a report published in 2010, Milenko S. Andri'c, Boban, P. Bondzuli'c, and Bojan M. Zrnic described a dataset of radar echoes from diverse targets. To get extremely basic data that might be used for categorization, a spectrum analysis was carried out. In research published in 2012, Francesco Fio and Alexander Angelov provided solutions for categorization issues in the area of automotive radar by utilising several neural network architectures.

III. SYSTEM DEVELOPMENT METHOD

Methodology of Model Development:
The required hardware components for this project are, Arduino UNO, Ultrasonic Sensor, Servomotors, Buzzer, LEDs, Pushbutton, Connecting Wires, and Bread Board. The microcontroller is connected to one ultrasonic sensor, three servomotors, a buzzer, and LEDs as shown in figure 1. First, the ultrasonic sensor is mounted on a servo motor to rotate at the desired angle, to create a range for the ultrasonic sensor to sense external objects. The ultrasonic sensor and servo motor are mounted on a higher platform to detect objects at a higher altitude with ease. A turret is created for firing the missile on the external object. This Turret is mounted on another servomotor where it turns to the angle according to the detected angle of the servo motor of the ultrasonic sensor. The angle of the servomotor and turret must be equal to ensure the accurate firing of the missile. As this is a prototype of a conventional turret, just an elastic band is used for the firing mechanism which is controlled by a servomotor and pushbutton for enabling the firing of the missile. Meanwhile, for a visual warning, the Arduino triggers a signal to the LEDs to light up and for an auditory trigger, the buzzer creates a sound that is used as an alert system.

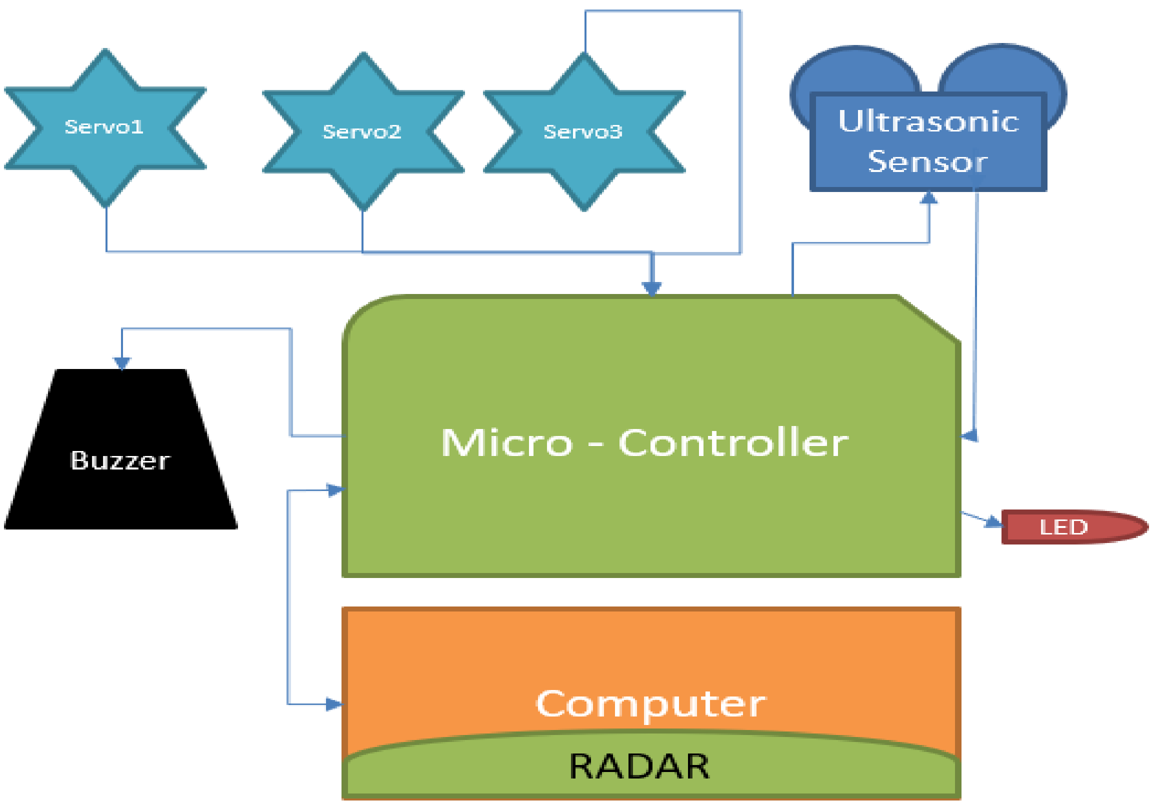

Fig 1 Block Diagram

Working of Hardware:

The ultrasonic sensor scans for objects within its range for detection with the help of a servo motor. Here, in the setup, our ultrasonic sensor's proximity is set as 20 cm and the angle of detection is set as 120 degrees. When an object is detected in the range of the ultrasonic sensor, the distance, and angle at which the object is detected are recorded and transmitted to the turret's servo motor and the PC via serial ports. The turret's servo motor turns to the angle at which the object is detected. Meanwhile when an object is detected the buzzer rings and LEDs light up which makes up the alert system for the user. The serial ports from the microcontroller to the PC send the angle and distance at which the object is detected. This is plotted on the screen which mimics the actual radar system. If the target needs to be eliminated, a push button is used to fire the missile on the target with the help of a servo motor as shown in figure 2. Our project can also be converted to an automatic firing radar system by removing the push button. In this case when an object comes within range of the ultrasonic sensor the turret eliminates the object without the acknowledgment of the user as shown in figure 3.

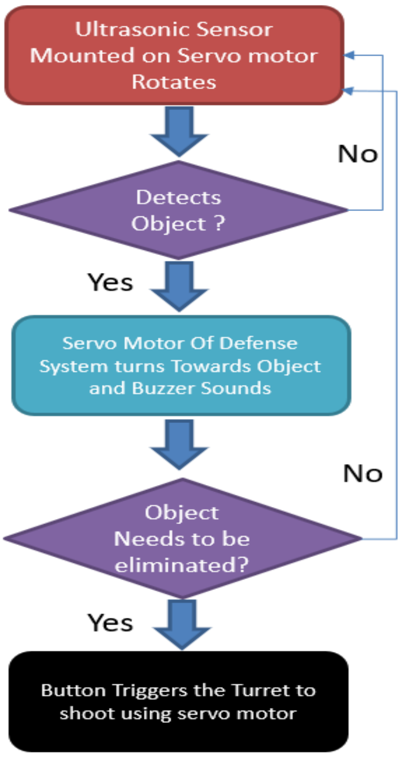

Fig 2 Working Flow Chart for manual fire

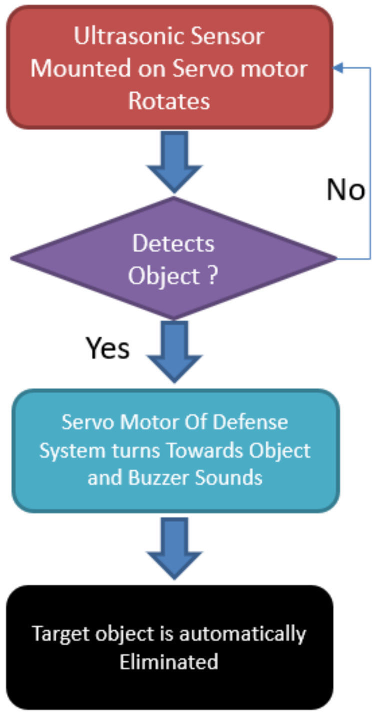

Fig 3 Working Flow Chart for automatic fire

Overview of Software:

The Arduino IDE and Processing are the two programs used to code this project. The open-source Arduino IDE software is primarily used for writing code and building it into any Arduino module. It is the official Arduino software that makes code compilation so simple that even a layperson with no prior expertise can pick it up and use it right away. It operates on the Java Platform, which is easily accessible for operating systems like Windows, MAC, and Linux. This platform has inbuilt tools, functions and commands that are essential for debugging, modifying, and compiling the code in the environment. Both C++ and C are supported in this environment. Additionally, as an open-source tool, Processing offers a comprehensive programming environment and a free visual library. Java is the coding language used by Processing, although it has been further simplified by the addition of accessible methods and procedures. Additionally, a GUI interface is offered for simple compilation and execution. When you combine Processing with the Arduino IDE, you can make a visual or graphical representation of how the code is run in the IDE.

Terminologies and Methodologies Implemented:

The void function consists of an important function that measures the distance with the use of an ultrasonic sensor. The speed of the ultrasonic is 0.034 m/s multiplied by the duration and the whole value is divided by two because the distance traveled by the wave is twice the original distance due to the reflection of the wave. Another major part of the code consists of an IF-Else statement which is used for the turning of the servo motor at an angle of 180 degrees from the initial point. The input for the servo-motors is the distance measured by the ultrasonic sensor. If the distance measured by the sensor is less than the threshold value the servomotor rotates and scans for objects in its range. The angle of detection of the servo motor that mounts the ultrasonic sensor is assigned to the turret's servo motor to aim the target object. The Arduino is interfaced with Processing software, where the function Serial. Print () is used to transfer the distance read by the ultrasonic sensor to Processing software via a USB cable. Processing software is used for the graphical representation of the radar. There are pre-defined functions in the software such as void drawLine(), and void drawObject() used to outline the radar as shown in figure 4. The real-time input is fed in by Port = new Serial(), where the ports are defined by the user. The whole code processing is done in the Java platform.

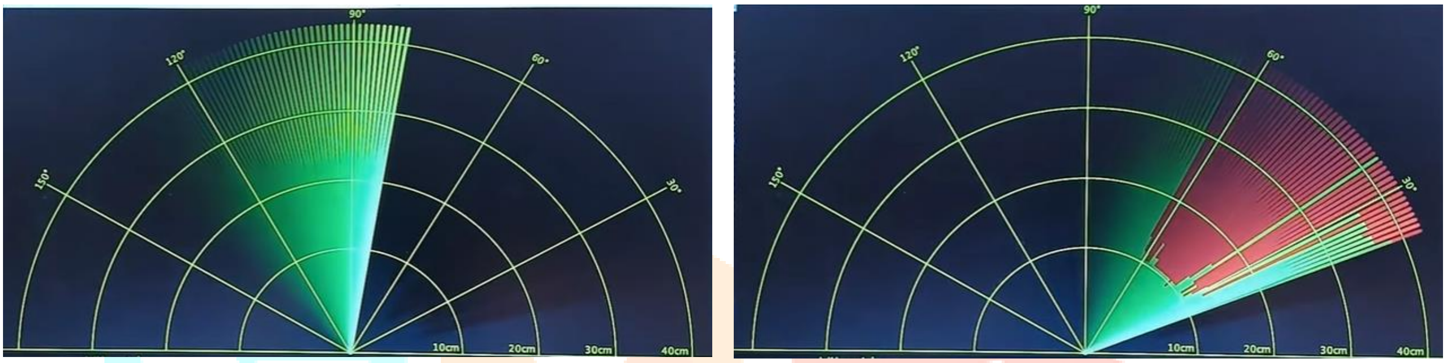

Fig 4 Working of Radar

Execution of Model:

An ultrasonic sensor is mounted on a servo motor, which enables it to create an angular range for detection as the servo motor rotates. A prototype of a turret is mounted on another servo motor (as shown in figure 5) to create an automatic aiming system to eliminate the target. First, the ultrasonic sensor scans at a proximity of 20 cm with an angle of 120 degrees as shown in figure 6. The ultrasonic Sensor detects an object which has entered the proximity zone, the turret targets the object and the distance and angle of detection are shown on the computer screen as shown in figure 7. To eliminate the object a push button is triggered as shown in figure 8.

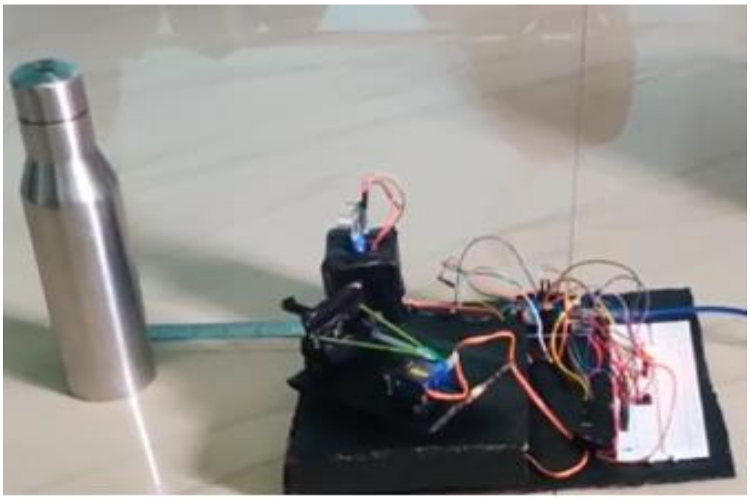

Fig 5 Turret Targeting Object Detected

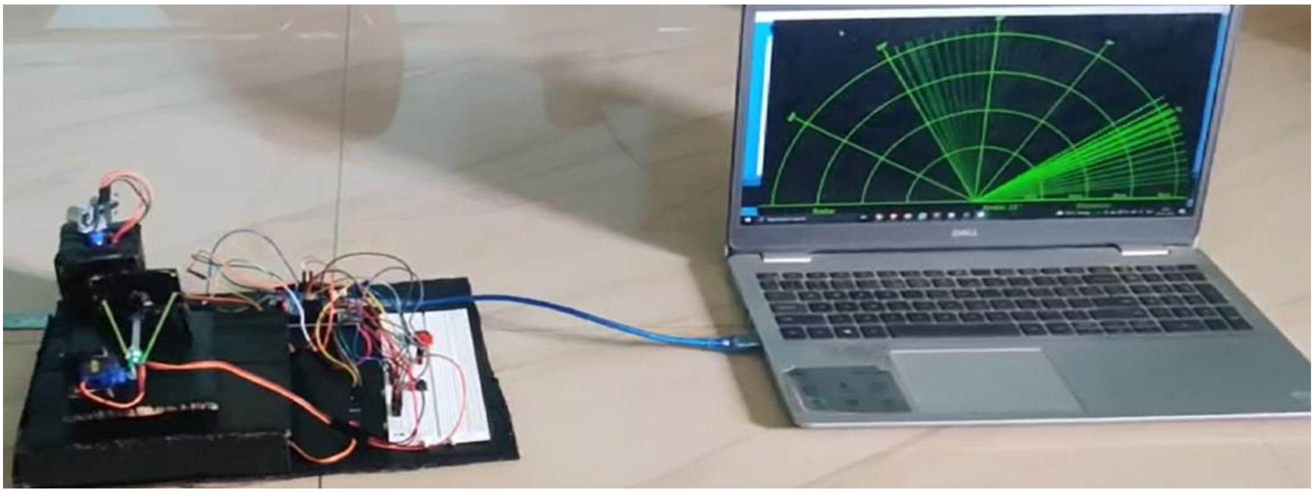

Fig 6 Ultrasonic sensor mounted on the tower scans the surrounding region for the presence of a target object.

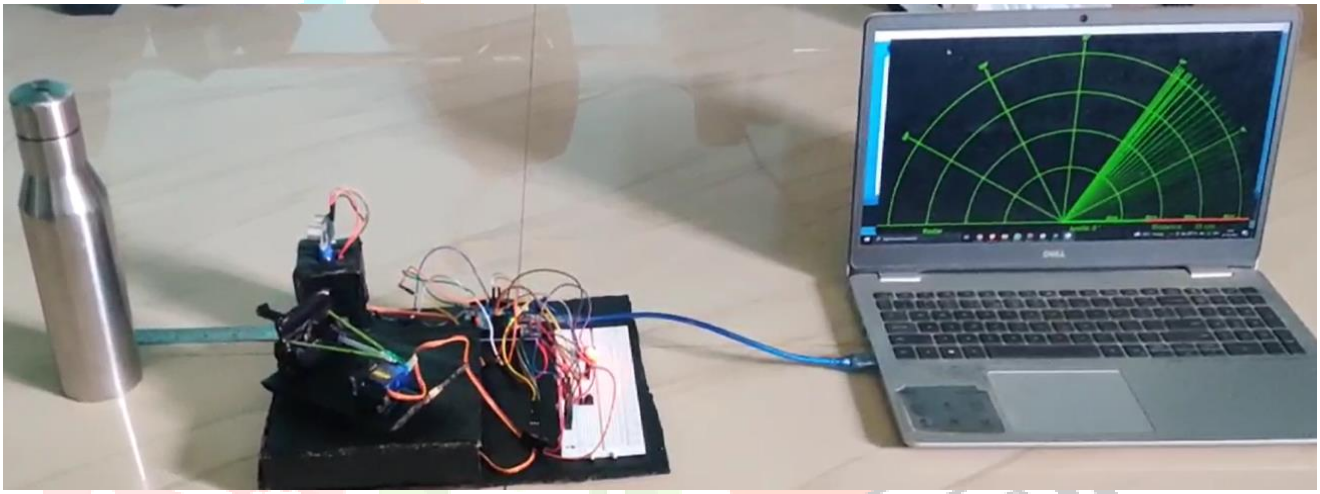

Fig 7 Ultrasonic sensor detects the object

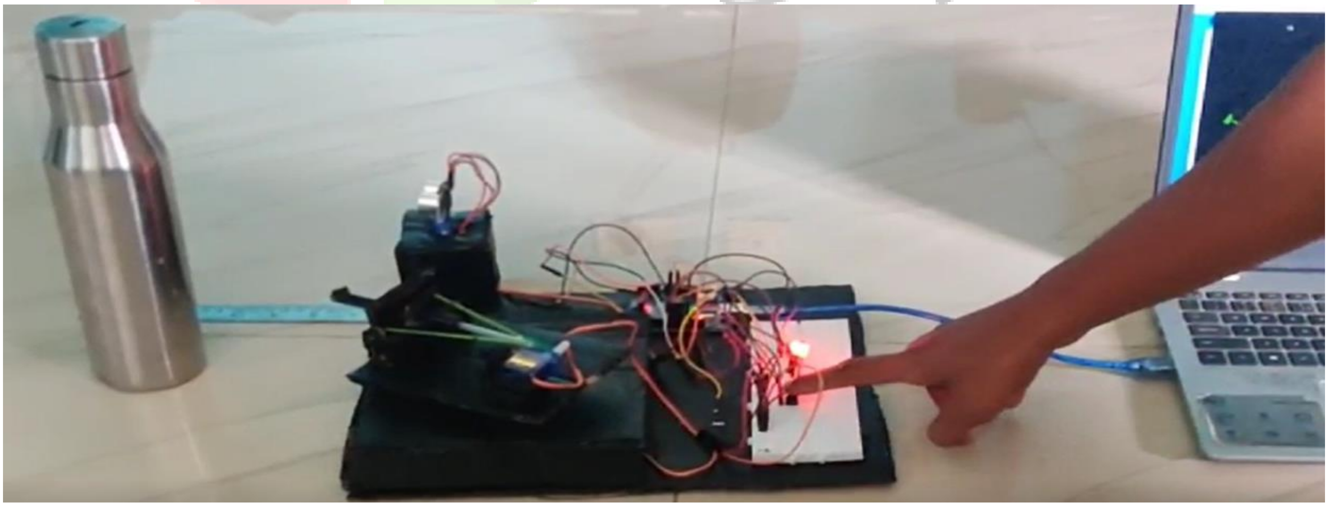

Fig 8 A push button is triggered to eliminate the Target

IV. APPLICATIONS

While observing the technology employed by the military, whether it be the Army, Navy, or Air Force, the concept of an ultrasonic radar first came to us. Aerial Force In aviation, airplanes are outfitted with radar equipment that provides accurate altitude measurements, displays weather information, and warns of aircraft or other impediments in or near their route. The anti-aircraft defence system's primary function is to detect unauthorized flights in surveillance zones or other areas where they are not permitted.

V. CONCLUSION

In order to measure the existence of any obstructions in front of the sensor as well as to determine the sensor's range and angle of detection, this project employs an ultrasonic sensor that is linked to an Arduino UNO board. The data from the sensor is then transmitted to a laptop screen. The motor will revolve from 0 to 180 degrees for object detection within a 50-meter range. The motor will halt for a time when the object is located within the range, and a graph that is shown on the screen will indicate a red line that denotes the object has been detected. The objectives of this project were met, and it was effectively completed.

VI. REFERENCES

(1). CH. Kushwant Kumar, D.Jetty Mariyam, ARDUINO RADAR FOR OBJECT DETECTION\by Koneru Lakshmaiah Education Foundation\published in April 2020.

(2) P.Vinay Varadan, S.Subba Rao, K.Nagaarjuna, D. Sai Venkat, Aslam Shaik \MICRO CONTROLLER BASED RADAR SYSTEM FOR OBJECT DETECTION\by Koneru Lakshmaiah Education Foundation\published in April 2019

(3) Werner Wiesbeck, Leen Sit\ publisher-IEEE\The future of radar systems\by Institute for High Frequency Technology and Electronics (IHE), Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany\published in October 2014 International Radar Conference.

(4) Atanas Dimitrov, Dimitar Minchev\ Publisher-IEEE\Ultrasonic sensor explorer\by Burgas Free University, Burgas, Burgas, BG\ Published in 2016 International Symposium on Electrical Apparatus and Technologies (SIELA)

(5) Antonio Tedeschi\publisher-IEEE \Ultrasonic Radar System - Arduino and Virtual Reality for a Light-Free Mapping of Indoor Environments\by University of Roma Tre, Rome, Italy\Published in 26 May 2017

(6) Marius Valerian Paulet, Andrei Salceanu, Oana Maria Neacsu\publisher-IEEE\ by International Conference and Exposition on Electrical and Power Engineering (EPE)\ Published in 2016.

(7) Akshaya U Kulkarni, Amit M Potdar, Suresh Hegde, Vishwanath P Baligar\publisher-IEEE\by KLE Technological University, Hubli, India\ Published in International Conference on Advances in Information Technology (ICAIT)\published in 2019.

(8) A. Carullo , M. Parvis \publisher- IEEE Sensors Journal \by Polytechnic of Turin, Turin, Italy\ Published in August 2001

(9) E. Hyun, Y.S. Jin, Y. Ju and J.H. Lee\Development of short-range ground surveillance radar for moving target detection\published in 2015 September IEEE 5th Asia-Pacific Conference on Synthetic Aperture Radar (APSAR).

(10).V. Paulet, A. Salceanu and O.M. Neacsu,\Ultrasonic radar\published in 2016 october\ published at: International Conference and Exposition on Electrical and Power Engineering (EPE)

(11) A.Balleri, K. Woodbridge,and K. Chetty\Frequency-agile non-coherent ultrasound radar for collection of micro-Doppler signatures\publisher-IEEE RadarCon(RADAR)\published by Kansas City

(12) S. Haykin\ Radar signal processing\ by McMaster University, Hamilton, ONT\ Published in April 1985.

(13) M. I. Skolnik \Introduction to Radar Systems\McGraw-Hill, 1980.

(14) G. V. Trunk, "Radar signal processing", Adv. Electron., vol. 45, pp. 203-252, 1978.