360 Degree Ultra Sonic Radar for Defence Application with Automatic Shooting and Monitoring

Mr. E. Prabhakar[1], G. Saiteja[2], E. Vikram[3], G. Akahay[4]
[1]*Assisstant professor, Dept of ECE, TKR College of Engineering and Technology.*
[2,3,4] *Student, Dept of ECE, TKR College of Engineering and Technology.*

***Abstract*—This project is about Ultrasonic Radar System controlled via ESP32 and ESP32 CAM. This RADAR system**
consists of two ultra-sonic sensor, servo motor, ESP32 CAM controller With IOT interface. 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 each on either side covering 360-degree field View and gives visual representation on the software called processing IDE based on Java programming.
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 ESP32 and the ESP32 CAM is a IOT based micro controller with built in Camera Module with send the live streaming to a local IOT Server and this system also includes an automatic Laser shooting mechanism
ESP32 board is sufficed to control two ultrasonic sensors 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 RADAR system comes into different field of navigation, positioning, object identification, mapping, spying or tracking, shooting and different applications. These less investment systems are also suitable for indoor applications

I . INTRODUCTION

We are aware that everything emits sound waves simply by existing and causing the air to flow around it at its inherent frequency. Humans are unable to hear these frequencies. Ultra-sonic waves are defined as waves with a frequency range of 20,000 Hz and above. An ultrasonic sensor can detect these waves, providing us with a variety of information.

A transducer, which transforms sound energy into electrical energy and electrical energy into sound energy, is typically found in ultrasonic detectors. They are employed in surveillance systems, collision avoidance systems, and object position and orientation measurements, among other applications. Because ultrasonic technology enables non-contact measurements, it alleviates issues like linear measurement problems by making it simple to measure things like an object's distance from another and its speed. come into contact with any object.

We can learn about an object's distance, position, speed, and other characteristics by examining its reflected wave properties. The hardware device uses an Arduino and processing software to recognize items based on a variety of factors. Range finding is one of the most popular uses for ultrasonic sensors. Sonar, often known as radar, is a device that directs ultrasonic sound in a certain direction. If an item is in its path, the sound impacts it and is reflected back, allowing us to calculate the object's distance after calculating how long it takes. Bats actually employ this technique.Ultrasonic RADAR is a technique that uses sound waves to map or locate objects in the surrounding environment. Radar is a long-range object detection system.

II.EXISTING SYSTEM AND PROPOSED SYSTEM

Existing system:

This device can identify objects exclusively within a range of 0 to 360 degrees. used cameras to display obstacle in the system not enabled auto shooting (fast threat response)and not integrated with IOT platform.

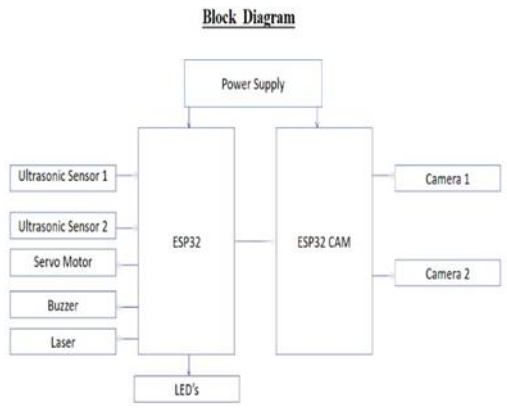
Proposed sytem:

This project will identify the object by transmitting the sound waves through ultrasonic sensor which covers approximately 360degree and whenever the object is sensed, it reflects back the echo signal. This signal detection will be displayed on the LED screen through graphical user interface through processing IDE and simultaneously it fires the laser. And live streams the video directly on to the mobile using Web server and Alerts through IOT platform.

III.METHODOLOGY

This project, called "360 Degree Ultrasonic Radar for Defense with Automatic Shooting and Monitoring," combines several advanced technologies to enable real-time surveillance and threat response. The radar can scan all directions continuously, covering a full 360 degrees. It uses ultrasonic waves to find objects or intruders nearby. These sensors send sound waves that hit objects and bounce back. By measuring the time it takes for the sound to return, the system determines how far away things are. An onboard computer processes this information instantly. It analyzes the surroundings, identifies possible threats, and tracks their movement and position. The wide scanning range gives a complete view of the area, helping to monitor all sides effectively.

Block Diagram



For automatic firing and response, the system includes an AI-based targeting tool that can spot and engage threats on its own. When the radar detects a target, it sends data to the control system. This system then calculates the best path for the weapon. It adjusts and aims the weapon to hit the target accurately and quickly. The process includes automatic aim, targeting, and firing, with little or no human help. The system is designed to respond fast to dangers. It keeps working by constantly checking and updating the radar and weapons. This helps it adjust to changing conditions on the field. The setup reduces mistakes and makes the defense more reliable.

IV.IMPLIMENTATION

Implementing a 360-degree ultrasonic radar for defense applications involves deploying a network of ultrasonic sensors arranged in a circular or spherical configuration to provide continuous, omnidirectional coverage. These sensors emit highfrequency sound waves to detect objects based on the time it takes for the sound waves to reflect back. The sensor data is processed to track moving targets, measure distances, and assess the position and speed of potential threats. The system integrates sensor fusion techniques, combining data from ultrasonic sensors with other technologies like radar or infrared to improve detection range and accuracy, especially in complex environments. Advanced algorithms, including machine learning, are employed for object classification and threat assessment.

System circuit design:

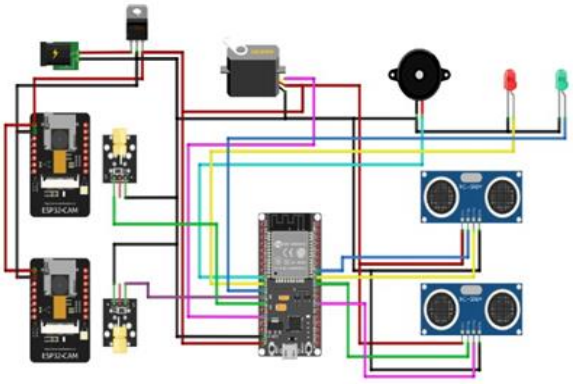


Fig1. Schematic diagram

Once a threat is detected, the system autonomously controls a shooting mechanism (e.g., a machine gun or missile launcher) to engage the target. The weapon system uses the target's position, velocity, and trajectory data to accurately aim and fire. An AIdriven decision-making process ensures that the weapon is fired only when the target meets predefined threat

criteria, allowing for efficient and precise engagement. The system also provides realtime monitoring via a control interface, allowing operators to oversee the radar data, target identification, and firing decisions while maintaining the option for manual override. Additionally, the system is designed to operate under diverse environmental conditions, relying on robust power and communication systems for uninterrupted operation in defense scenarios.

Circuit implimentation:

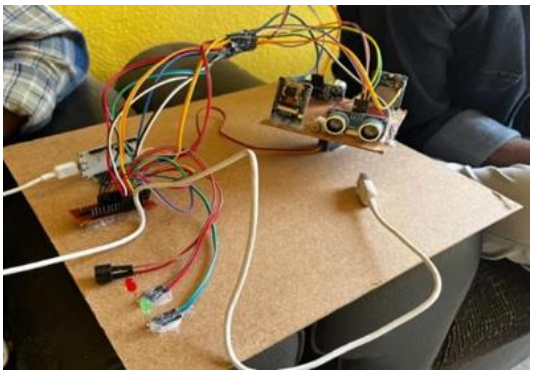


Fig 2. Circuit diagram

A Combinstion of Hardware and advanced software is needed to process and manage the data from the radar and control the system.

Hardware description:

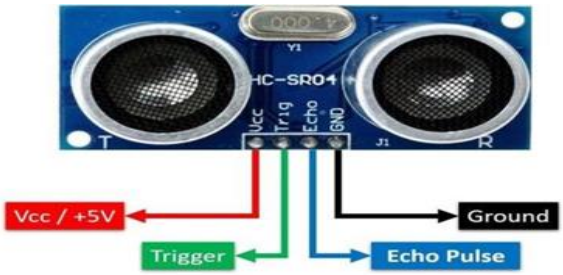
ESP32

ESP32 is a low-cost System on Chip (SoC) Microcontroller from Espressif Systems ; the developers of the famous ESP8266 SoC. It is a successor to ESP8266 SoC and comes in both single-core and dual-core variations of the Tensilica's 32-bit Xtensa LX6 Microprocessor with integrated Wi-Fi and Bluetooth.

ESP32 CAM

ESP32-CAM is a advance development board with WiFi camera. It allows creating IP camera projects for video streaming with different resolutions. ESP32-CAM has built in PCB antenna. ESP32CAM- module is having WIFI/Bluetooth.

Ultrasonic Sensor



Ultrasonic sensors are based on the measured propagation time of the ultrasonic signal. They emit high-frequency sound waves which reflect on an object. The objects to be detected may be solid, liquid, granular or in powder form. Ultrasonic transducers operate at frequencies in the range of 30–500 kHz for air-coupled applications. As the ultrasonic frequency increases, the rate of attenuation increases. Thus, low-frequency sensors (30– 80 kHz) are more effective for long range, while high-frequency sensors are more effective for short range. Distance = speed x time/ 2

LED's

A light-emitting diode (LED) is a semiconductor light source that emits light when current flows through it. Electrons in the semiconductor recombine with electron holes, releasing energy in the form of photons. The color of the light (corresponding to the energy of the photons) is determined by the energy required for electrons to cross the band gap of the semiconductor.

White light is obtained by using multiple semiconductors or a layer of light-emitting phosphor on the semiconductor device.

Buzzer

a piezo buzzer works by applying an alternating voltage to the piezoelectric ceramic material. The introduction of such an input signal causes the piezoceramic to vibrate rapidly, resulting in the generation of sound waves.

Servo Motor

A servo motor is a type of motor that can rotate with great precision. Normally this type of motor consists of a control circuit that provides feedback on the current position of the motor shaft, this feedback allows the servo motors to rotate with great precision. If you want to rotate an object at some specific angles or distance, then you use a servo motor.

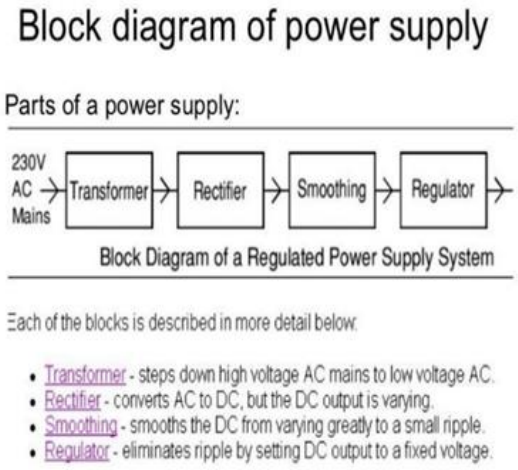
Laser

Laser diode modules produce a laser beam when current flows through the diode. The term "laser" is actually an acronym that means "light amplification
by stimulated emission of radiation"

Power Supply

It is an electrical device that supplies electric power to an electric load.

The primary function of a power supply is to convert electric current from a source to the correct voltage, current and frequency to power the load.



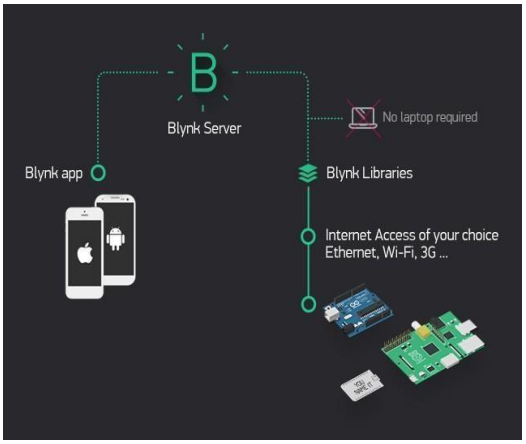
Soft ware description:

Blynk IOT

Blynk is a Server and APP Service providing Platform.
It provides High Security Service and Server for
IOT applications

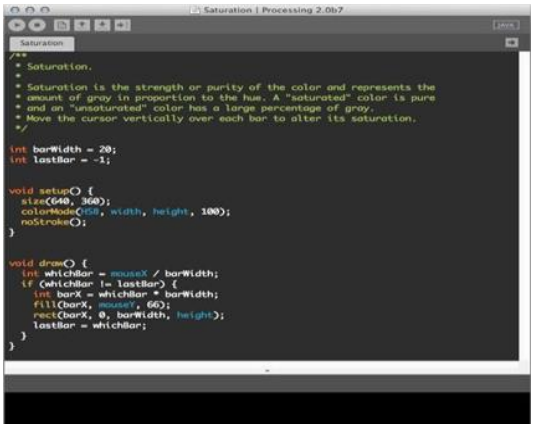
This is easy to use and supports all advance Micro controllers

Soft ware description:
Blynk IOT
Blynk is a Server and APP Service providing Platform.
It provides High Security Service and Server for
IOT applications
This is easy to use and supports all advance Micro controllers



Processing IDE

Processing describes itself as “a flexible software sketchbook and a language for learning how to code within the context of the visual arts”. It's based loosely on Java, but it ships with its own development environment and code editor (the Processing “sketchbook”) and its syntax is notquite-Java.



V. RESULTS

ULTRASONIC SENSOR OUTPUT

Ultrasonic sensor outputs are based on a simple idea called Trigger and Echo. The sensor’s transmitter sends out pulses of sound waves. When an object is nearby, these waves hit it and bounce back. By measuring the time it takes for the echo to return, we can find the distance to the object. The formula used is Distance equals (speed times time) divided by 2. This calculation accounts for the sound traveling to the object and back.We can also tell where the object is and at what angle it views on a computer screen. This is done with the help of the Processing IDE, which displays the position and angle information.

Fig. 360degree sketch radar

The position and angle of the object are indicated on the laptop screen with the help of Processing IDE

ESP32 CAM OUTPUT

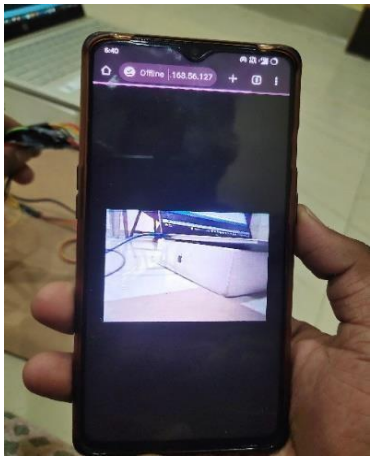
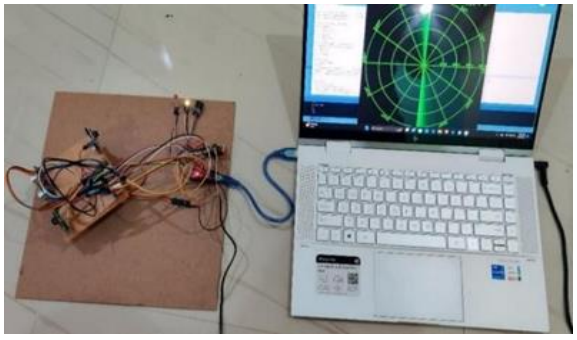


Fig2. ESP32 CAM live streaming ESP32 Cam is an IoT-based microcontroller

LED OUTPUT



with a built-in Camera module t hat sends live streaming to a local IoT server.

Fig.3 Green led on (safe state)

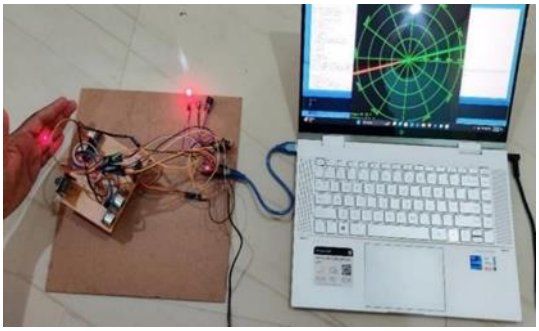


Fig.1Red led on (Danger)

VI. ADVANTAGES

Extended surveillance
Improved threat response speed
Less human error and personnals risk

VII. FUTURE SCOPE

Military missions like to control automatic weapons by using these technologies like AI and ML algorithms to empower automated response to threats. Integration with drones can further increase the system's ability to perform aerial as well as underwater surveillance and reconnaissance

VIII.CONCLUSION

Fundamental functioning of the system is that it should detect objects within its given range. Ultrasonic sensor is fixed to the servo motor it will turn around 180 degree both on either side sweeping 360-degree field View and provides visual representation on software known as processing IDE based upon Java programming. Processing IDE provides graphical output and it also provides angle or position of object and object distance. It is controlled by ESP32 and ESP32 CAM is a IOT based micro controller having inbuilt Camera Module to send the real time streaming to local IOT Server and this system also has an automatic Laser shooting mechanism. ESP32 board is adequate to handle two ultrasonic sensors and even to connect the sensor and display device. While studying, we came to know about the already available navigation and obstacle detection technology and various systems where ultrasonic sensors are efficiently utilized. Major application of this RADAR system enters various sector of navigation, positioning, object recognition, mapping, spying or tracking, firing and various applications. The employment of ultrasonic sonar sensors in conjunction with IoT technology has the potential to provid advantages for defense use cases like surveillance, reconnaissance, and border protection.

The suggested project is a cost-effective initiative that utilizes off-the-shelf hardware and software modules, and it can be afforded by defense forces to deploy.

REFERENCES

[1] G. Bhor, P. Bhandari, R. Ghodekar and S. Deshmukh, "Mini Radar," International Journal of Technical Research and Applications, pp. 68-71, 2016.

[2] D. B. Kadam, Y. B. Patil, K. V. Chougale and. S. S. Perdeshi, "Arduino Based Moving Radar System," International Journal of Innovative Studies in Sciences and Engineering Technology (IJISSET), vol. 3, no. 4, pp. 23-27, 2017.

[3] T. P. Rajan, K. K. Jithin, K. S. Hareesh, C. A. Habeeburahman and. A. Jithin, "Range Detection based on Ultrasonic Principle," International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, vol. 3, no. 2, pp. 7638-7643, 2014.

[4] P. S. Abhay, S. K. Akhilesh, P. Amrit and Kriti, "A Review on Ultrasonic Radar Sensor for Security system," Journal of Emerging Technologies and Innovative Research (JETIR), pp. 137-140, 2016.

[5] P. P. Arun, M. A. Sudhakar, P. MeghaSunil and S. S. Balaji, "Ultrasonic Distance Meter," SVERIAN Scientific, pp. 1-4, 2015.

[6] O. V. Amondi, "Collision Avoidance System," The University of Nairobi, 2009.

[7] Shamsul A., Tajrian M., “Design of an Ultrasonic Distance Meter”, International Journal of Scientific & Engineering Research, pp. 1- 10, March 2013.

[8] U. Papa, G. D. Core, “Design of sonar sensor model for safelanding of an UAV”, Proc. IEEE Metrol. Aerosp., pp. 346-350, Jun. 2015.

[9] Abbay P., Akhilesh S., Amrit P., and Prof Kriti, “A Review onUltrasonic Radar Sensor for

Security system", Journal ofEmerging Technologies and Innovative Research (JETIR), April 2016.

[10] Babu Varghese, "Collision Avoidance System in HeavyTraffic & Blind spot Assist Using Ultrasonic Sensor",International Journal of Computer Science and EngineeringCommunications-IJCSEC. Vol. 2, Isuue 1, February, 2014ISSN: 2347-8586.