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SONAR DETECTION & AUTOMATIC MISSILE LAUNCHING SYSTEM USING LDR

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Abstract - This project develops a prototype using sonar and object detection for aerial security. It identifies friendly and enemy flying objects via a laser detection technique. Sonar, by emitting sound waves and interpreting the echo, locates objects. It uses object detection for instant identification of aerial objects. The laser detection technique differentiates between friendly and enemy objects, enhancing threat detection accuracy. This advancement in aerial security technology has potential applications in defense, aviation, and space exploration sectors. It aims to provide reliable identification of potential aerial threats, thereby improving safety measures.

***Key Words*:** Sonar, LDR, Laser Detection, Missile Launcher

1.INTRODUCTION

The field of aerial security has seen significant advancements with the integration of various technologies[1]-[2]. One such development is the creation of a prototype that combines sonar technology, object detection, and a laser detection technique along with a Light Dependent Resistor (LDR)[1]-[2].

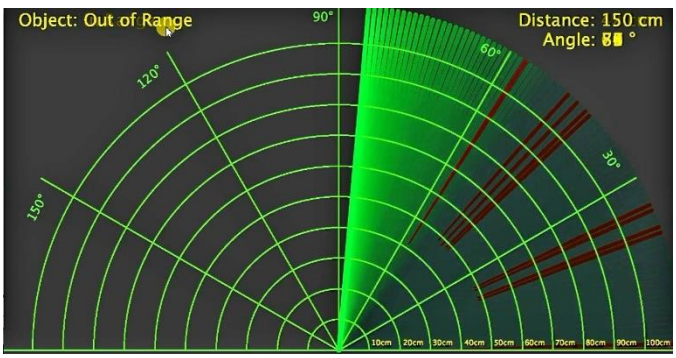


Fig.1 : Sonar Detection System

Sonar technology, known for its precision in detecting and locating objects through sound waves, has been widely used in various applications[1]. Coupled with object detection capabilities, it plays a crucial role in real-time identification of aerial objects[1]-[2].

However, a gap exists in accurately distinguishing between friendly and enemy flying objects[1]-[2]. This project aims to fill this gap by incorporating a sophisticated laser detection technique and LDR[1]-[2].This prototype proves beneficial in scenarios where an aircraft experiences communication failure yet requires entry into a country. In such cases, the aircraft can employ this manual technique, which involves projecting light of the correct intensity onto an LDR (Light Dependent Resistor), thereby preventing missiles from being launched at it. These tools are adept at differentiating between friendly and enemy flying objects, thereby enhancing the prototype's threat detection accuracy[1]-[2].

The experimental question that this study seeks to answer is: Can the integration of sonar technology, object detection, and a laser detection technique with LDR in a prototype enhance the accuracy and efficiency of aerial object identification? The approach taken to test this hypothesis involves the development and testing of the said prototype[1]-[2].

The successful implementation of this prototype could revolutionize the field of aerial security, with potential applications in defense, aviation, and space exploration[1]-[2]. It could provide a reliable solution for the swift and accurate identification of aerial objects, thereby significantly contributing to the overall field of study[1]-[2].

2. COMPONENTS REQUIRED FOR THE STUDY

The study was conducted using the following materials, all of which were procured from Haque Electronics:

I.Ultrasonic Sensor: An essential component for distance measurement and object detection.
II.Servo Motor: Used for precise control of angular or linear position, velocity, and acceleration.

III.Light Dependent Resistor (LDR): A component whose resistance changes with the intensity of light it is exposed to.
IV.Laser Module KY-008: A laser emitting module used for a variety of applications including distance measurement and object detection.
V.Breadboard: A device for constructing an electronic circuit without any soldering.
VI.Arduino Nano: A small, complete, and breadboard-friendly board based on the ATmega328P; it offers the same connectivity and specs of the UNO board in a smaller form factor.
VII.Spring for Launching Missile: A mechanical component used to store energy and subsequently release it to launch a missile.

3. OBJECT DETECTION :

In our prototype we have utilized ultrasonic sensor which is capable of detecting objects at various distance,we have limited it to detect within the range of 100cm.Ultrasonic sensors uses the principle of sound wave propagation and echo reflection. In our project, the Ultrasonic Sensor plays a pivotal role in object detection by emitting high-frequency sound waves that bounce off objects and return to the sensor. If an object is within the sensor's range, the echo of the sound wave is detected, indicating the presence of an object. The sensor measures the time it takes for the echo to return, known as the "time of flight". Given the speed of sound in air, the sensor calculates the distance to the object using this time of flight. We have configured the sensor to detect objects within a range of 100cm. In conjunction with the Light Dependent Resistor (LDR) and Laser Module KY-008, the Ultrasonic Sensor aids in identifying whether the detected object is a friend or foe. If an object is detected and the light intensity detected by the LDR matches the predefined 'friendly' intensity, the object is identified as a friend. Otherwise, it is identified as a foe.

Distance Calculation: Given the speed of sound in air (approximately 343 meters per second), the sensor can calculate the distance to the object using the formula,

$$\text{Distance} = \frac{Time\ of\ Flight \times Speed\ of\ Sound}{2}$$

[1]-[2].

The division by 2 is necessary because the sound wave has to travel to the object and back.

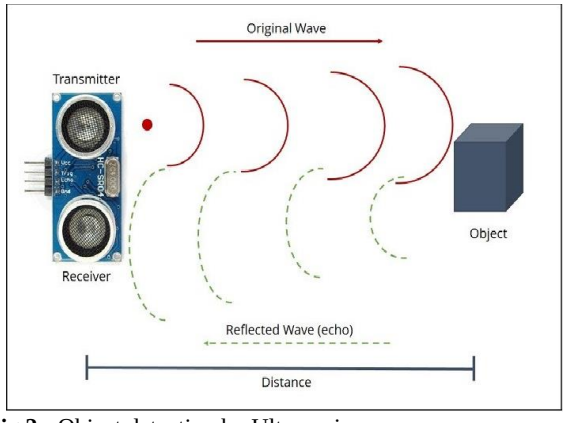
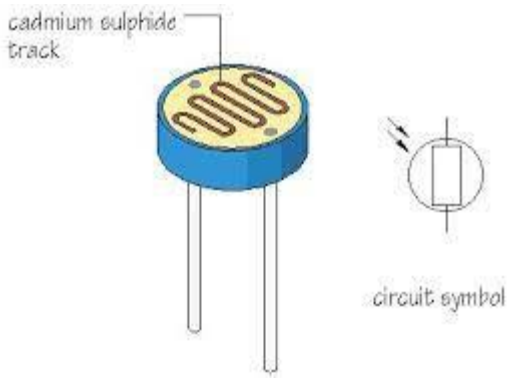


Fig.2 : Object detection by Ultrasonic sensor

4. CHECKING WHETHER THE FLYING OBJECT IS FRIEND OR FOE :

In our prototype, we've integrated a Light Dependent Resistor (LDR) to distinguish between friend and foe based on light intensity. The LDR, a resistor that alters its resistance based on the amount of light it receives, plays a pivotal role in our setup. It's used to detect the light intensity from an object. The system is programmed such that a 'friend' object is aware of the exact light intensity needed to be recognized as friendly. If the LDR detects a light intensity that matches this predefined 'friendly' intensity, the object is classified as a friend. Conversely, if the detected light intensity doesn't match, the object is deemed an enemy. The 'friend' object can adjust its light intensity based on the surrounding environment, ensuring the LDR detects a consistent light intensity regardless of environmental conditions. Furthermore, if the system identifies an object as a friend, it prevents the missile launcher from firing. This is accomplished by the 'friend' object emitting the correct light intensity, which is detected by the LDR, signaling the system to inhibit missile launch.

Fig.3 : LDR helps in identifying Friend or Foe object



5.LAUNCHING MECHANISM :

In our prototype, the spring and servo motor play a crucial role in the missile launching mechanism. The primary function of the spring is to store energy. When it's compressed or stretched from its equilibrium position, it stores potential energy. This stored potential energy is rapidly released when the spring is let go by the servo motor, propelling the missile forward. The force exerted by the spring on the missile results in it being launched at a high speed. Springs are mechanically simple and reliable components. They do not require any power supply and lack complex electronics that could potentially fail, adding to their reliability and simplicity.

6. RESULT

In our prototype, we have utilized two Arduino Nano to control all the operations of our missile launcher and object detection system. We have employed the Processing 4 application to monitor the readings from the ultrasonic sensor. Initially, the Arduino continuously commands the servo motor

to rotate from 0 to 180 degrees and vice versa. The ultrasonic sensor persistently searches for objects within a range of 100cm and provides the readings regarding the object's distance and angle to the Processing code. A Light Dependent Resistor (LDR) is mounted on top of the ultrasonic sensor. If the ultrasonic sensor detects an object and the LDR does not receive the correct light intensity required to prevent the missile from firing, another Arduino, which receives readings from the first Arduino via serial communication, triggers another servo motor. This servo motor, attached to the launching system via a rod mechanism, moves from 90 degrees to 0, which in turn triggers the missile to launch.

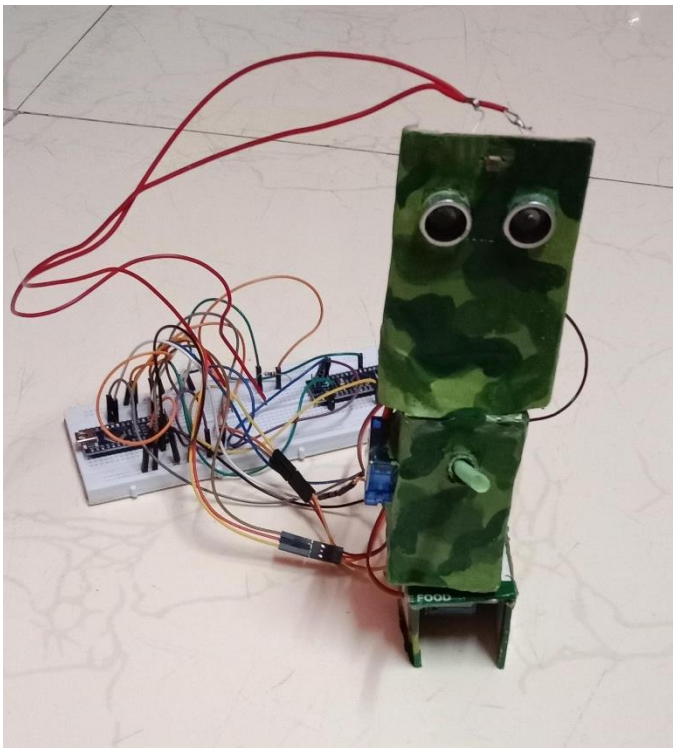


Fig.4 : Final Prototype

7. CONCLUSIONS

The convergence of sonar, laser detection, and ultrasonic sensor technologies represents a significant leap forward in object detection systems. Sonar's proven efficacy in underwater object detection, combined with the precision of laser detection for identifying aerial objects, and the added dimension of ultrasonic sensors, culminates in a detection system that is not only comprehensive but also marked by heightened accuracy and reliability. This integrated approach, as supported by diverse research findings, underscores the potential for a more sophisticated and fail-safe surveillance mechanism in both civilian and military applications.

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