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Research Article

Enemy ship detector with anti-ship rifle with ultrasonic sensor

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ABSTRACT

This article describes the design and application of enemy ships equipped with sensors. Ultrasonic waves emitted from the radar model by the ultrasonic sensor travel through free space, scanning the surrounding space. When an enemy ship or boat is detected, the rotating radar mechanism locks onto the unknown craft and begins firing until the ships disappear from range. Registered vessels have a transmission link with the Master Control Unit, allowing them to be identified and navigated openly at sea. This is the primary goal of this work, and the design of the entire mechanism over work is for demonstration purposes. When the system is turned on, a motor positioned above the ultrasonic sensor begins to spin, detecting enemy ships within a range of approximately two feet. Narrow scope, as it is a prototype module. Using a simulated weapon that works in conjunction with a radar mechanism that points in the direction of ultrasonic waves, when the system detects an unauthorized vessel, it produces a machine gun sound with flashing LEDs. When the system detects the permitted vessel, the green LED will illuminate, and the vessel's details will be displayed on the LCD screen. A red LED also illuminates when a rogue vessel is detected. The fully operational device sits atop a 15-inch-tall metal tower framework, designed to mimic operational offshore towers for radar systems. The rotational mechanism is capable of traversing the range from 0 to 300 degrees, its speed limited by limit switches. The core processor is equipped with an 89C52 microcontroller chip, while the LCD displays whether the shipment is authorized. Upon detection of an authorized vessel in the infrared range, data transmission occurs, delivering the details via the Vessel Detail LCD.

Keywords: *Enemy ship detector, ultrasonic sensor, radar mechanism, 89C52 microcontroller, automatic targeting system, vessel identification, IoT-based defence system, maritime surveillance*

1. Introduction

The word "radar" comes from the phrase "radio detection and ranging". As an object detection technology, radar uses microwaves to measure the distance, height, direction, and speed of objects within a radius of approximately 160 miles. This functional prototype demonstrates that concept by detecting the orientation of unknown vessels and boats. However, existing radar systems are often too sophisticated, complex, long-range, and expensive [1], and are mainly used by defence sectors such as the Air Force, Navy, and Army. Recognizing this gap in accessible technology, we embarked on a mission to develop an economical base model radar. Our primary objective is to assist the Navy in detecting unauthorized vessels within its operational area [2].

Typically, radar antennas emit radio waves, or microwaves, which bounce off objects in their path, making it easier to identify objects within radar range. Radar, as an electromagnetic sensor, operates by sending out these waves into open space. When some waves encounter obstacles, they are reflected; the returned waves are then captured, received, and amplified by the radar device, indicating the presence of objects along the transmission path. Modern radar systems have become highly sophisticated and are used in diverse applications, including air traffic control, air defence, astronomical studies, missile interception, and space observation networks [3-4]. Building on these principles, this effort introduces the use of short-range ultrasonic sensors as an updated approach. Here, ultrasonic sensors function as proximity sensors, measuring the proximity of a target or object. The focus is not on distance measurement, but on demonstrating features such as direction finding, vessel recognition, distinguishing between authorized and unauthorized vessels, and simulating fire against unidentified vessels [5].

When the system is turned on, the ultrasonic sensor connected to the motor starts rotating and detects enemy ships within a range of approximately 60 cm. However, as this is a prototype module, it is limited in scope. With the help of simulated weapons based on ultrasound and radar mechanisms, if the system detects a single ship, it will emit the sound of a machine gun and an LED indicator. When the system detects a specific container, the green LED indicator will light up, and the details will be displayed on the LCD. If the system detects an invalid container, the red LED will light up [6-7]. The entire mechanism of the system is mounted on a 15-inch-tall metal tower structure designed to replicate marine towers used in radar systems. The rotary mechanism will move from 0 to 300 degrees, and its movement is limited by limit switches. The central processor is equipped with an 89C52 microcontroller chip, while the LCD is used to display whether the shipment is in authorization status. Information is broadcast and transmitted when the licensed vessel is in infrared range. The received ship information is displayed on the LCD screen. Stream machine gun sounds through speakers with a voice recording and playback chip. H-bridge ICs are used to drive DC motors [8]. Ultrasonic sensors generate ultrasonic waves to detect objects and convert the waves reflected by the container into electrical signals. These sound waves travel at speeds beyond human hearing. The system consists of two primary components: a transmitter connected to an amplifier and a receiver. The transmitter uses piezoelectric crystals to emit sound, while the receiver picks up the signals bouncing off the target. To determine the distance to an object, the sensor calculates the time that the signal takes from transmission by the transmitter to reflection from the target and back to the receiver. No regions found here. These sensors are mainly used in self-parking technology and automotive anti-collision safety systems. It is also used in robotic obstacle detection systems, manufacturing engineering, etc.

2. Literature Survey

Further development and research efforts in the radar field have been very successful and have led to decisive changes in data processing. Ultimately, researchers working with radar can design, create, refine, and develop user interfaces to successfully meet the intended performance criteria required in a variety of environments. Radar serves as a technology for detecting objects, employing electromagnetic waves to assess the range, elevation, orientation, or velocity of both mobile and stationary entities, including aircraft, vessels, vehicles, atmospheric patterns, and topography. It uses ultrasonic waves instead of electromagnetic waves, and is called ultrasonic radar.

Christian proposed that the Doppler Effect is the apparent change in frequency or pitch as the perception of sound changes as it either approaches or recedes from the listener, or as the listener themselves moves closer to or farther away from the source [1]. Milenko S. Andrik, Boban, P. Bond "Zurik and Bojan M. Zurnich suggested that the database is described by radar returns from various targets. The database is available for public download. This article, Spectral analysis performed in [2], is used to extract very basic information that can be used for classification. Alexander Angelor, Andrew Robertson, Raderick Murray-Smith, FrancesOFio[3], in the article, presented results for classification problems in the context of automotive radar using various neural network architectures [3]. Papa and G. Delocré proposed the design of a sonar sensor model for safe UAV landing. This article shows how to use an ultrasonic sensor model to create a three-dimensional (3D) virtual map to help you land your UAV quadcopter safely. By analyzing the reflected sound waves generated from the sonar sensors, we succeeded in creating an aircraft designed to allow the UAV to land safely. Inexpensive sensors provide relatively accurate distance values when angle uncertainty and mirror reflections are ignored [4]. S.BharambeR, Thakker, H.Patil K, and M.Bhurchandi proposed to replace the eyes of the visually impaired with an android navigator. The aim is to develop an inexpensive technology to replace the eyes of the blind. As a first step towards achieving this goal, we decided to develop a navigation system for the visually impaired [5]. Rekleitis designed a partial filtering tutorial for locating mobile robots. Navigation is one of the most challenging skills a mobile robot requires. Successful navigation requires success in its four components of navigation. Robots must interpret sensors to obtain meaningful data. Localization – The robot needs to determine its location within the environment. Insight – The robot must decide how to act to achieve its goal, and motion control – the robot must adjust motor power to achieve the desired trajectory [6].

3. Proposed Architecture

The process begins with a vessel data transfer card. This board is intended to be installed on a ship and is equipped with a microcontroller 89C2051. The chip is a small 20-pin device, so it occupies very little space. Therefore, the communication card has a compact design and fits in a small toy ship. Controllers used on ships generate digital information proportional to the ship's information. This chip comes pre-programmed to consistently generate identical information. The regulator creates digital data, which is then modulated at a frequency of 38 kHz. This modulation is essential because raw data from the controller cannot be transmitted directly; instead, it is stored at that particular frequency. The timer chip generates the oscillator carrier frequency needed for this process. The digital data is combined with this frequency to form a modulated waveform that is transmitted via an infrared LED. Basically, the controller's digital information is transmitted using an IR LED. The LM555 timer plays a role in the modulation process and ensures that the infrared signal remains detectable even in the presence of potential interference. The modulation technique allows distinct flashing of the IR light source at the selected frequency, regardless of other frequencies. When the trigger signal is received, the timer IC (LM555) generates pulses. In this setup, the microcontroller provides a trigger pulse, which then affects the reset pin of the timer IC. The specific values of the resistor and capacitor components externally connected to the timer IC determine its behaviour.

The duration of the pulse is dictated by the LM555 timer IC. The timer IC is set up in an a stable configuration, ensuring a consistent 38 kHz output, irrespective of the trigger pulse, contingent upon the chosen resistor and capacitor values employed for the IR signal transmission.

Moving to the central processing unit, containing the 89C51 microcontroller chip, a 40-pin component designed to handle a variety of tasks. These tasks include detecting the signal intercepted from the ultrasonic sounder, encoding the authorized ship data, displaying this data on the LCD screen, driving the movement of the motorized radar using a special motor and a suitable driver IC, and determining the order of the motor determined by the limit switch. , a light indicator to distinguish between familiar and unfamiliar objects, and actuation of a sound chip via relay for the sound of a gun, among other functions. A detailed description of these basic functions can be found in the following chapters.

The operational scope of the central processing unit hinges on the assembly language program tailored for the controller chip. This program imbues the device with the capability to activate the voice channel through a relay mechanism, thereby projecting the resonating discharge of a gunshot from the speaker. The chosen voice record cum playback chip is the APR33A3, boasting a total of 8 voice channels, each individually recordable and repayable. The controller chip facilitates the selection of a desired channel for playback.

An integral facet of this project involves generating the gunshot sound when unauthorized ship detection occurs. To achieve an authentic gunshot audio, the project employs a high-fidelity sound recording strategy. The APR33A3 chip, with its 8 distinct channels, lends itself to this purpose. Although originally intended for diverse voice or sound recordings, the chip's application here focuses on amplifying the gunshot sound. Any of the available channels can be designated to replay the pre-recorded gunshot sound, ensuring a prolonged, superior-quality audio output. A block diagram of the proposed system is shown in Figure. 1.

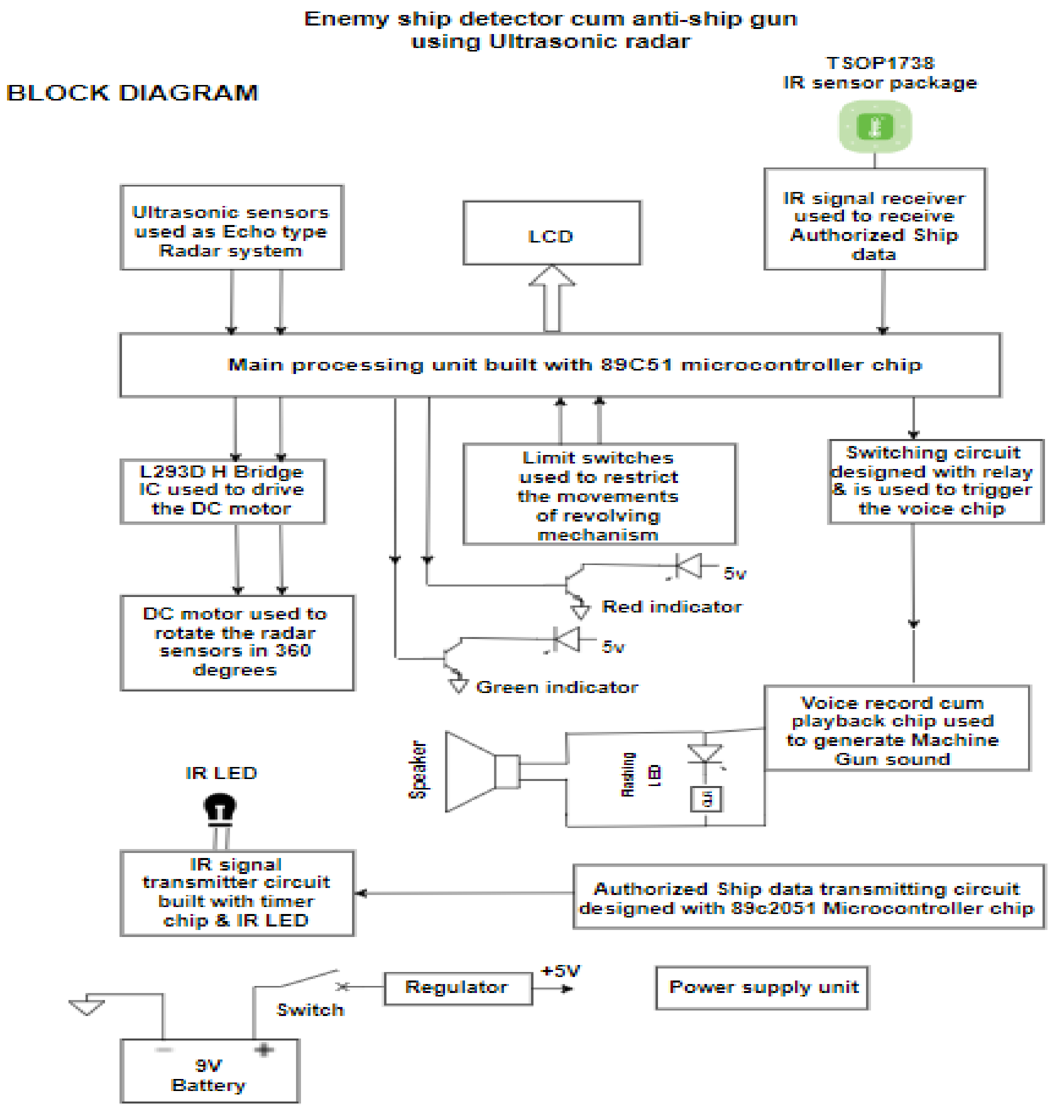

Figure 1: Block diagram of the proposed model.

Around the world, ultrasonic sensors are utilized in both indoor and outdoor settings, even under the most trying circumstances. Our ultrasonic sensors are composed of piezoelectric crystals, which transform electrical energy into acoustic energy and acoustic energy into electrical energy by using high frequency sound waves to produce a resonant frequency. After reaching the target and reflecting off of it, the sound wave returns to the transducer. There are other techniques to create these targets, including using circular patterns. However, the sensor's performance may be impacted by a few factors, including temperature fluctuations, the impact surface's texture, and the target surface's tilt.

3.1 Introduction to Infrared Sensors

The main use of infrared (IR) sensors in automation and security systems are object detection and proximity sensing. An infrared light-emitting diode (IR LED) and an infrared detector make up their two primary parts. The circuit produces logic high or low pulses when an item interrupts the continuous light that the infrared LED emits and is recognized by the sensor. Object counting, rotation detection, and obstacle sensing are made possible by this technique. Depending on ambient light, the design can function well within a range of 1 to 10 centimetres, making it appropriate for a variety of electronic applications. But because of its higher power consumption, it is not as suitable for long-term, energy-efficient use. This is shown in Figure.2.

Figure 2: Ultrasonic sensor

Infrared sensors offer a number of applications and advantages, especially they are widely used in various security systems, where proximity detection is a central theme. Another significant application involves counting objects, including counting rotations in a moving entity. In the context of proximity detection, a typical package consists of two basic components: an infrared light emitting diode (IR LED) and an infrared light/signal detector (IR sensor). The IR LED remains in a constant ON state and emits a continuous stream of light that the sensor diligently detects. By connecting these sensors to a trigger circuit, logic high/low pulses can be generated in response to interruptions caused by various objects. This circuit design has proven to be suitable for a large number of applications. However, it should be noted that while this circuit design is versatile, it comes at the cost of higher power consumption and is not optimized for extended ranges. As it stands, the effective range of the design ranges from 1 to 10 cm, depending on the prevailing ambient light conditions.

3.2 Detection of Objects using IR Light

The proposed solution eliminates special components such as photodiodes, phototransistors or special IR receiver integrated circuits (ICs). Instead, it relies on standard components such as a pair of IR illuminators, an operational amplifier (Op amp), a transistor, and two resistors. As the name suggests, the standard IR LED is used for detection, so this circuit is very complex and accessible even to hobbyist electronics enthusiasts. In a practical demonstration of the concept, we used two main illuminators strategically placed next to each other to efficiently capture the reflected IR light, as shown in the schematic.

This method determines the reflected IR light using a direct approach using a second IR LED to capture the IR light emitted by another similar LED. This phenomenon is a characteristic electrical property of light-emitting diodes (LEDs), which manifests itself as a voltage difference across the LED terminals when exposed to light. As shown in the diagram below, an infrared signal emitted by an LED hits an object and is then reflected, and a second infrared LED then detects this reflected signal. The magnitude of the signal depends on the current flowing through the infrared LED, which is compared to the radiation power measured in milliwatts. The range achieved is closely related to the signal strength.

3.3 Remote Control Application

The remote-control functions as an electronic device used to control the machine from a distance. Often shortened to "remote" or "controller". In addition, various nicknames correspond to it, including the informal term "clicker". These remote controls mostly fall into the category of consumer IR devices that allow remote commands to be transmitted to televisions and other consumer electronics such as stereo systems and DVD players. These remote-control devices usually take the form of compact handheld wireless units equipped with a series of buttons that allow you to adjust a number of settings such as TV channels, track numbers and volume levels. In current practice, many devices delegate most of the functional controls to the remote control, so that the controlled device itself has only a few basic primary controls. Communication between most of these remote controls and their respective devices is via infrared (IR) signals, while a select few use radio signals. These remote controls typically use small AAA or AA batteries to power their operations.

4. Results and Analysis

In this project, the role of the ultrasonic sensor is crucial in the detection and determination of objects. Due to its prototype nature, the developed radar system module is basic, yet it has a significant limitation: the inability to distinguish different objects located at appreciable distances. The prototype of proposed structure is shown in figure.3.

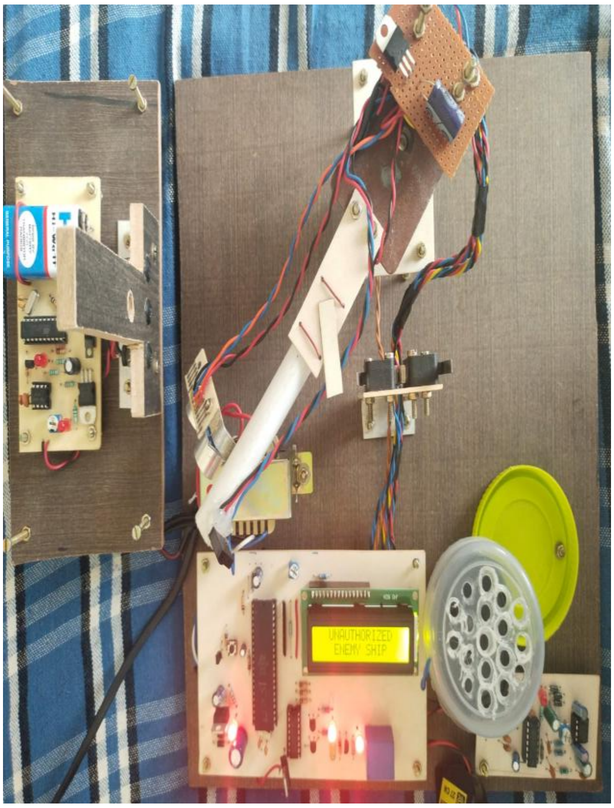

Figure.3: Output of the project

From the previous description, it is clear that when an authorized ship is detected by the system, the green LED lights up, accompanied by the display of relevant ship information on the LCD screen. On the contrary, in case of unauthorized ship detection, the system will start lighting up the red LED.

5. Conclusion

The focus of this project is the use of an ultrasonic sensor, which facilitates the detection and localization of objects. However, due to its prototype nature, the radar system module remains rudimentary and is characterized by a significant limitation - the inability to distinguish various objects at long distances. In addition, the operating range of the sensor is limited. To overcome these problems, the integration of an image processing system in conjunction with long-range sensors is proving to be a viable solution. An ultrasonic sensor works by sending electromagnetic energy towards designated targets, often aircraft, ships or vehicles, and then analysing the echoes returned from these objects. Although it excels at determining the presence, position and speed of these targets, more advanced radar systems can even extract information about their size and shape.

During this effort, we successfully constructed a system capable of generating outgoing signals via RADAR and effectively simulating return signals for objects located at specific distances. Our system has demonstrated the ability to detect nearby objects, which is a key achievement. The focus of our efforts revolved around the detection and recognition of ships, which produced positive results in this regard. In conclusion, the performance of the entire system was found to be either good or satisfactory, culminating in a commendable result.

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None.

Conflict of Interest

The authors declare no conflict of interest in this publication.

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