

Location Based Radar Monitoring System

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Abstract--- This paper delves into a radar system driven by an Arduino, integrating both an ultrasonic sensor and a servo motor. The system's key components encompass the ultrasonic sensor and servo motor. Its optimal function is to detect objects within a defined range. Mounted on the servo motor, the ultrasonic sensors rotate 180 degrees, presenting visual representations on the Processing Integrated Development Environment (IDE). The IDE then showcases graphical depictions of detected objects, along with their respective angle, location, and distance. The operation of the system is overseen by an Arduino UNO board, proficiently managing the ultrasonic sensor and its interface with the display device. The radar system is primarily designed for navigation and positioning.

Keywords: Arduino, Ultra-sonic Sensor, Servo motor.

I.INTRODUCTION

Radio-Detection and Ranging is referred to as RADAR. It locates things by using radio waves to ascertain their range, elevations, orientations, or speeds. RADAR systems are available in various sizes and with varying performance specifications. At airports, some radars are used to control airplanes. Others are employed in early warning systems and long-range monitoring.

The essential component of a rocket guiding system is a radar system. There are big radars that occupy numerous rooms, as well as compact, portable radars that are controlled by one person. Many nations developed radar technology both before to and during World War II. The United States Navy coined the name "radar" in 1940, although the technology itself was not developed until later.

Radar is used in many modern applications, such as air traffic control, radar for astronomy, air defence,

and antimissile systems. Ships and other objects of interest are located using marine radars.

Systems for space surveillance are used to keep an eye on Earth from orbit. Meteorological radars are employed in the surveillance of the weather. Altimetry, precipitation radar, and flight control

II.RELATED WORK

S. Calcaterra and F. Benedetto states that, in order to develop sophisticated navigation systems for robots and those with disabilities, researchers and businesses have recently concentrated on developing new systems for mapping and exploring uncharted territory. Specifically, the most popular uses involve taking advantage of ultrasonic technology's benefits to explore uncharted and/or hazardous areas that are inaccessible to humans. The goal of this effort is to build a novel, low-cost technology called an ultrasonic radar system that uses ultrasonic sensors to map environments blindly. An Android-based device will subsequently display the information that has been collected[1].

In broader terms, Saini, M defines radar as an electrical system that utilizes electromagnetic radiation to detect the positions of both dynamic and static objects. Here, however, an ultrasonic signal is used by the radar system in place of electromagnetic impulses with the aid of an ultrasonic sensor. This project employs an Arduino Uno, an ultrasonic sensor, a servo motor, and software to develop an ultrasonic radar system capable of accurately locating objects within a short range. The ultrasonic radar can recognize objects up to 40 cm away, and it can rotate robotically in two directions: from 5 to 175 degrees and from 175 to 5 degrees. The Arduino IDE environment's written code, used by the Arduino Uno, controls the radar system over serial communication. The Arduino Uno interacts serially with display panel through Processing for enhanced

software and uses written code to operate the radar system within the Arduino IDE environment[2].

Mehta, S., & Tiwari, S proves that the use of radio detection and ranging in various settings. The detection of objects in various environments, ranging from military installations to commercial settings, is facilitated by the utilization of radar systems, which employ electromagnetic waves to detect various physical elements, including size, direction, speed, distance, and position, which can be stationary or moving. Radar system use has advanced significantly, particularly in the navigational domain. In this paper, we examine current navigational technologies and suggest a radar system built on an Arduino platform. Compared to other radar systems, it has the benefit that the kit uses less power and link the programmer to open-source code and a variety of Arduino programmers. The device comprises a servo motor, which rotates at a precise angle and speed, positioned above a standard ultrasonic sensor. Both the servo motor and the ultrasonic sensor are connected to the digital input/output pins of the Arduino board[3].

M. V. Paulet, A. Salena, and O. M. Neacsu propose the utilization of the HC-SR04 ultrasonic sensor, designed specifically for Arduino, to develop a radar system. The development of specialized libraries intended to link the sensor made for Arduino with the Microchip microcontroller PIC 18F is the originality this research adds. We have considered how temperature affects ultrasonography. The radar has the capability to measure distances ranging from 2 centimetres to 4 meters and display the distance of detected objects. The 180-degree angle is used to perform the object detection. A stepper motor is used by the motion sensor that monitors this angle. A radar screen browse is timed with the motor action to deliver data on an LCD display. The microcontroller's timers are programmed to establish synchronization. These clocks cause pauses at predetermined intervals, timed to coincide with finishing certain section of the image display[4].

The objective of this project, as described by M. D. Al-Haidar, is to develop a radar system utilizing an Arduino Uno, a servo motor (SG90), and an ultrasonic sensor (HC-SR04). This RADAR system can identify nearby objects and show details about their position and distance in the Processing software and Arduino IDE. The ultrasonic sensor determines the distance of objects from the radar system, facilitated by the servo motor's movement, allowing it to scan the surroundings effectively. Acting as the control unit, the Arduino Uno

orchestrates these operations seamlessly. In this study, an experimental design is utilized to test the radar system at different distances. The findings reveal that the developed radar system achieves a remarkable accuracy rate of 97.5% in detecting objects, particularly at distances up to approximately 30 cm. This radar system can be utilized as an efficient and productive substitute for other methods of object detection in specific situations by utilizing readily available and reasonably priced components[5].

Sekar S, explains this effort is in Favor of autonomous cars, which will benefit the next generation greatly. One such effort that clears the path for driverless car accidents is this one. This project utilizes a servo motor and radar-based ultrasonic sensors (HC-SR04) to detect obstacles at user-defined distances. Additionally, it enables sending SMS notifications to concerned individuals regarding object proximity, live video streaming via a connected camera, and remote monitoring via Wi-Fi connectivity between an Android device and the Arduino board. Beyond personal applications, such technology holds potential for critical sectors like defence systems and aids in navigation, particularly in low-light environments[6].

Manikandan, explains that a simple robot that can put out fires for a reasonable price can come in handy for battling house fires until assistance comes. Three components make up the produced robot: software, electronic interface circuits, and hardware. There are four battery-operated motors (BO motors) on the robot. This robotic firefighting apparatus has the ability to both detect and put out fires. It is possible to program these robots to roll into areas that are dangerous for people to be in. In the battle against flames, every moment counts, as even a brief delay can escalate small fires into uncontrollable infernos. Designed as a first-response unit, this robot swiftly extinguishes fires and maintains containment until further assistance arrives. To detect fires, it also has a fire flame sensor installed. It has a pump and a water tank installed. As a result, it sprays water to put out fires when it detects one. A servo motor is equipped with a water spraying nozzle to ensure maximum coverage. While there is much need for development, this might serve as a prototype for a full-fledged firefighting robot with victim rescue capabilities. This robot's primary purpose is to transform into an autonomous assistance vehicle that can find and put out fires. These robots allow for more precise and safe fire detection and rescue operations without putting fire personnel in perilous situations[7].

Prathap S emphasizes that simultaneous localization and mapping (SLAM) for robots is increasingly vital in the advancing realm of mobile robotics. Even though there are many different algorithms and approaches available for SLAM in mobile robots, there are still many challenges in this sector when it comes to mapping and multiple object detection. In this research, we offer a highly efficient and cost-effective approach to estimate the proposed solution involves mobile robots determining their position and navigating to create a map of the environment without prior location knowledge. Key components include an RGB-720p camera, motor drivers, an ultrasonic sensor, and a Raspberry Pi module for data extraction[8].

Lasya C proves that, the huge breakthroughs in automation are making human existence better and more advanced in every way. An automation system, comprising sensors, controllers, and actuators, collaborates to accomplish tasks with minimal human intervention, steadily supplanting traditional, manual methods. A home automation system will keep an eye on and/or control lighting, climate, entertainment systems, appliances, and other elements. Moreover, home security systems with features like alarms and authentication systems could be employed. The project's objective is to establish a home automation framework where diverse sensors and devices interact to activate each other, such as activating a smart siren upon motion detection by a laser. This integrated system harnesses a variety of sensory inputs and human expertise to accomplish tasks seamlessly and autonomously, eliminating the necessity for human involvement[9].

S. Vignesh explains the "Utilizing ultrasonic sensors, the Arduino-powered Parking Guidance System offers a clever and innovative solution for simplifying parking in busy urban areas." This research develops an economical and effective parking assistant system by utilizing the capabilities of ultrasonic sensors and the Arduino Uno microcontroller. This paper's main goal is to help drivers park their cars safely and accurately by giving them instant feedback on how far away their car is from nearby obstructions. Obstacles are detected using ultrasonic sensors, which also determine their distance from the vehicle and provide the driver with visual and aural cues. The ultrasonic sensor emits high-frequency sound waves, measuring the time it takes for these waves to bounce back after encountering an obstacle. The Arduino Uno uses this information to determine how far away the obstacle is, and it shows that distance on the selected output device. Because the

technology measures distances precisely, drivers can correctly determine how close obstructions are to them. With a visible display that provides drivers with instant feedback, parking is safer and more convenient. This parking aide can be affordably replaced with commercial parking aids thanks to its open-source Arduino programming and utilization of generally available components. Users of any skill level can derive value from the system's easily understandable and concise distance information, crafted with simplicity in mind. This Arduino Uno-powered Ultrasonic Sensor Parking Assistant provides a flexible and affordable answer to urban parking problems, improving driver safety and convenience and encouraging the learning of DIY electronics. Its potential uses go beyond private automobiles and include public and commercial parking lots, helping to build intelligent transportation systems and smart cities[10].

According to A. U. Kulkarni, detecting, recognizing, and manoeuvring around a target or object is straightforward when it is nearby or easily visible. However, this isn't always the case, particularly when the item is far away or obscured by a variety of circumstances, such as the time of day or night, the weather, etc. As a result, radio waves were used to create radio detection and ranging (RADAR), which measures an object's range, angle, or velocity. However, because of its vast range, oversensitivity, expense, and lack of target specificity, it takes a long time to detect. An straightforward, affordable, and efficient substitute is to employ an ultrasonic sensor, which uses sound waves for both ranging and detecting. As a result, this study offers a technique for using the Ultrasonic Sensor (HC-SR04) as RADAR. The Servo Motor (SG90) is attached to the HC-RS04 in order to facilitate rotation and movement. The SIM808 module is also utilized for SMS/message notification of object detection. The components are connected to both an Arduino Uno and a Raspberry Pi 3 for analysis to identify and alert objects. The HC-SR04 range is set to 3 to 4 meters due to the project's smaller scale compared to the typical ultrasonic wave range of 20 kHz. Benefits include usability in low-light conditions, minimal impact from dust, dirt, or high moisture environments, and independence from the colour or transparency of objects [11].

M. Arunkumar and E. Lokesh states, today's generation, robotics is rapidly expanding and fascinating. Globally, intelligent software-equipped robots are intelligent enough to manipulate their surroundings. Creating a robot that can avoid constraints is regarded as a crucial first step toward establishing personal vehicles. Transportation,

surveillance, and rescue operations are just a few of the many uses for these engines. There is an embedded ultrasonic sensor in the suggested prototype. The Arduino has a built-in Wi-Fi camera that streams live video for viewing on a variety of terminals, including PCs, tablets, and smartphones. Operating on an Arduino UNO board, the robotic automobile uses ultrasonic distance sensors to detect impediments. Robot capable of total autonomy that avoids collisions while exploring an unknown region[12].

H. Santhosh Nivas explains that, over the past few decades, there has been a significant expansion in urbanization. At the same time, there is a rise in the output of trash. The neglect of authorities and apathy among the public can lead to untreated odours from decaying waste persisting for extended periods, resulting in lasting issues. Horrible diseases could arise from this. This project utilizes a microcontroller-based platform, incorporating an Arduino Uno board. The Arduino Uno board interfaces with a servomotor, infrared sensor, and ultrasonic sensor to create a smart litter box. To determine the garbage can's level and the appropriate stopping point, two sensors are placed at its top and bottom, respectively: The smart litter box incorporates both an infrared sensor and an ultrasonic sensor for enhanced functionality. A particular height has been established for the threshold. When someone approaches the litter basket. This is the programming method for Arduino. As these intelligent bins gain widespread adoption, they have the potential to replace traditional trash cans, streamlining waste management and reducing the prevalence of unsightly trash heaps along roadsides. [13]

III.METHODOLOGY

Define Objectives: Clearly state what the radar monitoring system hopes to accomplish. Decide what you need to collect precise information about and what you want to monitor, such as air traffic, weather patterns, and maritime activities.

Conditions Evaluation: Determine the radar system's operational and technical needs. This covers factors including ambient conditions, update rate, resolution, detection range, and system integration.

Design of Radar Systems: Create the radar system architecture in accordance with the specified needs. This entails choosing the proper antenna arrangement, signal processing algorithms, data transmission techniques, and radar technologies

(such as pulsed, continuous-wave, and phased array radar).

Site Selection and Installation: Determine the best places to put radar systems in relation to environmental considerations, line of sight, and coverage needs. To guarantee optimum performance, install radar equipment in accordance with manufacturer instructions and industry requirements.

Testing and Calibration: To guarantee precise and dependable performance, calibrate the radar system. Undertake thorough testing to confirm system functionality in a range of scenarios, such as varying target kinds, interference levels, and weather.

Data Analysis and Processing: Create software and algorithms that process radar data in real time. If required, put algorithms for data fusion, tracking, categorization, and target identification into practice. Extract useful information from radar data analysis that is pertinent to the monitoring goals.

Integration with Decision Support Systems: To make data visualization, analysis, and decision-making easier, integrate the radar monitoring system with decision support systems or other operational platforms.

Verification & Validation: To make sure the radar system is accurate and dependable, validate it using simulations or real-world data. Make that the system satisfies the goals and performance requirements. The radar monitoring system should be put into use in operational settings. Operators and maintenance staff should get instruction on system operation, troubleshooting, and maintenance procedures.

Ongoing Monitoring and Maintenance: Create protocols for the radar system's continuous monitoring, upkeep, and performance assessment. Update firmware and software frequently to fix bugs and enhance functionality.

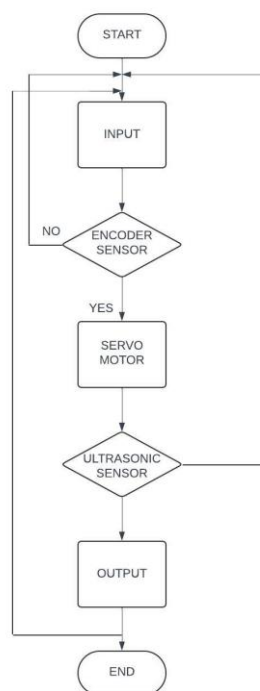
Record-keeping and Reporting: Record the radar monitoring system's design, implementation, methodology, and operating procedures. Make routine reports on the functionality of the system, problems you've encountered, and any suggestions you have for enhancements.

Reactions and Rework: To find places where the radar system needs to be improved and prospective upgrades, ask users and stakeholders for their opinions. Adjust the design and execution in response to suggestions and changing needs.

IV.WORKING MODEL

This project's goal is to determine an object's position and velocity once it has been placed at a specific distance from the sensor. To emit waves in both directions, an ultrasonic sensor utilizes a servo motor for rotation. This wave moves through the air and, when colliding with an object, is reflected back. Once more, the sensors will pick up on this wave, examine its properties, and produce a display on the screen that provides information about parameters like object position or distance. By feeding the servo motors into a serial port, we can find out where they are and how far away they are from the closest item in their path using code that is created and uploaded using the Arduino IDE. With the help of processing software, the sensor's output is shown on a display screen to generate its final result.

Figure 4.1: Flow of process



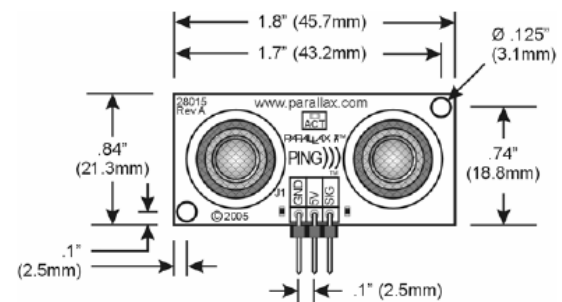
IMPLEMENTATION AND OUTCOMES

Hardware description

A) ultrasonic detection

An electronic device known as an ultrasonic sensor uses ultrasonic waves to determine an object's distance and then transforms the reflected sound into an electrical signal. Sound waves, or sounds that are audible to humans on their own, travel at a speed equal to that of sound. The two primary parts of ultrasonic sensors are a transmitter that can send sound through piezoelectric crystals and a receiver

that picks up sound after it has passed near or beyond the target.



B) Servomotor

A servomotor is an independent electronic device that moves machine parts with extreme precision and high efficiency. In actuality, the servo motor is a brushless DC motor with position feedback sensors. Consequently, it is possible to move the output shaft at a specific angle, location, and speed that is not feasible with a regular motor. However, the Closed Loop Motion Control System consists of more than just servo motors. PWM, or pulse with modulation, is used to operate servo motors. The control wires supply this power. A minimum pulse, maximal pulse, and repetition rate are all present. A servo motor can rotate ninety degrees in either direction from its neutral position.



C) Arduino Uno

The Arduino Uno, built around the ATmega328P microcontroller, is a versatile platform. The Arduino Uno features six analog inputs, a 16 MHz ceramic resonator, 14 digital input/output pins (with six offering PWM output capability), a USB port, a power jack, an ICSP header, and a reset button. The Uno arrives fully assembled with all necessary components to support the microcontroller; simply connect it to your computer via USB cable or power it using the included AC adapter or battery to get started. The Uno board, succeeding the Demilune

release, marks the ninth iteration in a series of USB-based Arduino boards.



D) Buzzer:

An electronic, mechanical, piezoelectric, or electromechanical audio signal device, like a buzzer or beeper. The primary role is to convert the audio signal to sound. Its power is produced by DC voltage and it can be utilized as an alarm controller, timer, printer, scanner, computer, etc. in general. Numerous designs can produce various noises, such as alarms, music, bells, and sirens.



V.CONCLUSION

In summary, the radar monitoring system is a reliable and essential instrument for a wide range of uses, such as air traffic control, weather forecasting, military defence, and marine navigation. Its dependability and importance in maintaining safety and security are shown by its capacity to precisely detect and track objects in any setting. We have examined the many benefits that radar technology provides during this investigation, including its broad coverage area, real-time data collecting, and flexibility in a variety of operational settings. These

characteristics improve situational awareness while also facilitating prompt decision-making, which reduces risks and maximizes operational effectiveness. It is imperative to recognize the limitations of the system, though, which include its vulnerability to interference, its poor resolution at long distances, and its sporadic signal loss brought on by atmospheric conditions. Improving the system's functionality and increasing its usefulness in next projects will depend critically on addressing these issues through continued research and development activities. It is essential that we keep funding the development of radar technology going forward in order to maximize its potential. We can do this by utilizing developments in machine learning algorithms, signal processing, and antenna design. By doing this, we can fully utilize radar monitoring systems to protect people and property in a variety of contexts and adapt to changing operating needs.

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