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OBJECT DETECTION RADAR SYSTEM

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ABSTRACT

Object detection plays an important role in many safety and monitoring applications where knowing the presence and position of nearby objects is necessary. This project presents an Object Detection Radar System developed using simple electronic components and a microcontroller platform. The system is designed to scan the surrounding area, detect objects within a fixed range, and display their position in a radar-like format on a computer screen. An ultrasonic sensor mounted on a servo motor is used to continuously rotate and measure distances at different angles, while an Arduino board processes the received data and controls the overall operation. In addition to visual detection, the system also includes an audio alert feature using a buzzer. When any object is detected within a predefined distance limit, the buzzer is activated to provide an immediate warning. This helps in improving awareness and response time, especially in situations where continuous visual monitoring is not possible. The project focuses on building a low-cost, easy-to-understand, and reliable system that demonstrates the basic working principle of radar scanning using commonly available hardware and simple programming techniques. The results show that such a system can effectively detect nearby objects and indicate their approximate direction and distance in real time.

KEYWORDS: Object Detection, Radar System, Arduino Uno, Ultrasonic Sensor, Servo Motor, Buzzer Alert, Distance Measurement, Real-Time Monitoring.

INTRODUCTION

object detection has become a very important part of many modern technology-based systems mainly in fields related to safety automation and intelligent monitoring the ability to identify nearby objects and understand their position helps reduce risks and improves decision making in real-time environments while advanced radar systems are widely used in fields such as aviation and defense they are often complex expensive and not suitable for small-scale practical studies or educational purposes this research work shows the design and implementations of a simple and low cost object detection radar system clearly describes basic working idea of object detection with simple electronic parts the system is made using an arduino board an ultrasonic sensor and a servo detection system motor unit to perform continuous scanning and distance measurement at different angles the detected information is processed and shown on a computer in a radar-like visual format making the result easy to understand and study in addition to visual display the system also includes an sound alert system using a buzzer to indicate the presence of objects within a defined distance range this feature improves practical use by giving instant feedback even when the display is not being closely observed through this research an effort is made to explore how simple hardware and efficient programming methods can be used together to build a dependable object detection system the study aims to contribute toward understanding low- cost and their possible uses in real-world monitoring and safety-oriented environments

i. Background of the Object Detection Radar System

Object detection has become an important area of study due to its wide use in safety systems, automation, and monitoring applications. In traditional environments such as aviation, military surveillance, and weather analysis, radar systems are used to detect and track objects over large distances. Although these systems are highly effective, they depend on complex hardware, advanced signal processing, and high implementation costs, which makes them unsuitable for small-scale projects and academic research work.

With the availability of low-cost microcontrollers and compact sensors, it is now possible to understand and demonstrate the basic concept of radar-based detection in a simplified way. Ultrasonic sensors provide an easy method to measure distance by using sound waves, while servo motors allow controlled movement for scanning different directions. When combined with microcontrollers like Arduino, these components help in building practical models that can perform real-time object detection without complex infrastructure.

This research work is developed in this background, focusing on learning and

experimentation rather than large- scale deployment. The Object Detection Radar System is designed to study how distance measurement, angle- based scanning, and visual representation can work together in a single system. By adding features such as radar visualization and audio alerts, the project reflects the basic behavior of real detection systems in a simple and understandable form. The background of this study supports the need for affordable and educational object detection models that can be used for learning, demonstration, and basic safety applications.

ii. Purpose of the Research

The main purpose of this research is to examine how a basic radar-based object detection system can be developed using simple and affordable electronic components. This study aims to understand how distance sensing, angle- based scanning, and real-time output can work together in a practical setup. The research also focuses on analyzing the use of microcontrollers and sensors to detect objects and present their location through visual and sound-based indications. Another goal of this work is to create an easy-to-follow experimental model that supports learning and technical understanding of object detection concepts. Overall, the research is intended to provide practical insight into simplified detection systems that can be applied in educational and basic monitoring environments.

iii. Objectives of the System

1) To develop a simple and effective object detection radar system using basic electronic components.
2) To detect nearby objects and calculate their distance using ultrasonic sensing techniques.
3) To scan the surrounding area by rotating the sensor and identifying object direction.
4) To display the detected object position on a computer screen in a radar-like visual form.
5) To provide an audio alert when an object is detected within a predefined distance range.
6) To help in understanding the practical working of real-time detection and monitoring systems.
7) To create a low-cost model suitable for learning, research, and basic safety applications.

METHODOLOGY

The Object Detection Radar System is developed by following a clear and practical method to ensure proper scanning and accurate detection of objects. First, all hardware components such as the Arduino Uno, ultrasonic sensor, servo motor, and buzzer are assembled and connected carefully. The Arduino acts as the main control unit and manages the movement of

the servo motor, sensor readings, and alert activation.

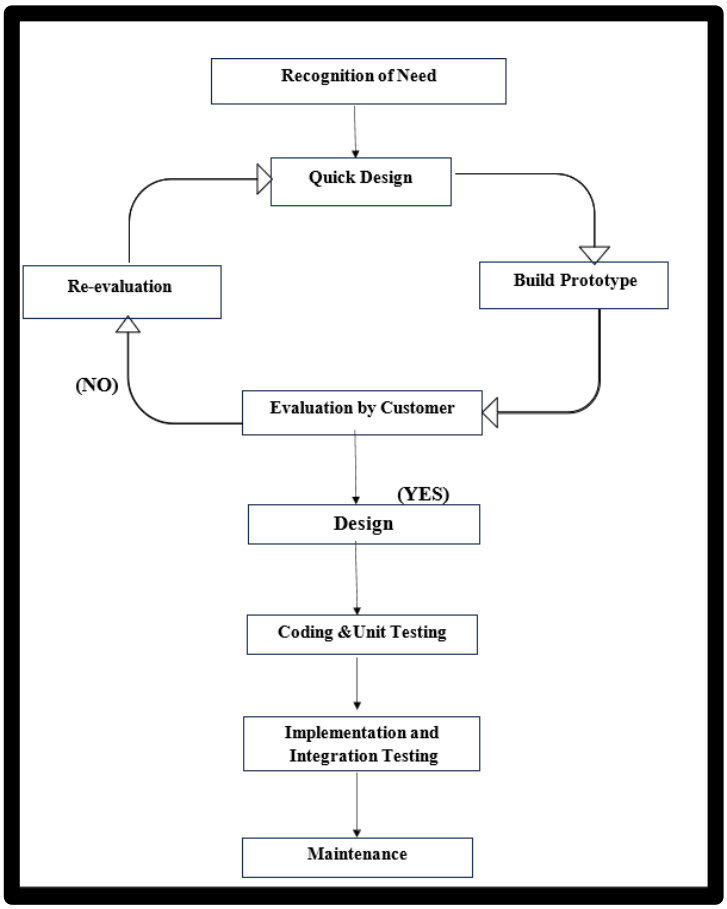
The servo motor is programmed to rotate slowly so that the ultrasonic sensor can scan the surrounding area at different angles. During this movement, the sensor continuously measures the distance of nearby objects by sending and receiving sound waves. This distance data is processed by the Arduino in real time and combined with the angle information of the servo motor.

The processed data is then sent to a computer system, where a C-based program displays the detected objects in a radar-like visual format. This visual representation helps in clearly understanding the position and distance of objects. When any object is detected within a predefined safety range, the buzzer produces an alert sound to warn the user.

To ensure reliable working, the system is tested with objects placed at different distances and directions. Adjustments are made in the program to improve accuracy and smooth scanning. This methodology focuses on combining hardware control, real-time sensing, visualization, and alert mechanisms into a single working model that is suitable for research, learning, and basic safety monitoring applications.

To ensure dependable system performance, the ultrasonic sensor is adjusted carefully so that it provides stable distance readings during operation. The movement of the servo motor is fine-tuned to cover the scanning area smoothly without sudden jumps or missed angles. Distance values are processed continuously so the system can respond instantly to changes in object position. Data communication between the Arduino and the computer is maintained steadily to avoid delays in visualization. The radar display is aligned with sensor input to reflect accurate object position. A fixed alert limit is defined so that the buzzer responds immediately when an object enters the warning range. Repeated testing is carried out to confirm that the system works consistently under different conditions.

overall, the methodology ensures smooth coordination between hardware and software components for accurate object detection and visualization. The systematic approach makes the project reliable, easy to understand, and suitable for practical research applications.



TECHNOLOGY

This project uses simple electronic and programming technologies to build an object detection radar system. The main part of the system is the Arduino Uno board, which works like the brain of the project. It controls all connected components and decides how the system should work based on the input it receives. The ultrasonic sensor is used to find nearby objects by sending sound signals and checking how long they take to return.

To scan the area properly, the ultrasonic sensor is fixed on a servo motor. The servo motor moves the sensor slowly from one side to another, which helps the system check objects in different directions. A buzzer is added to the system to give a sound alert whenever an object comes close to the set distance limit. For programming, Arduino IDE is used to write and upload the code into the Arduino board. A separate program written in C language is used on the computer to show the detected objects in a radar-like display. All these technologies work together to make the system simple, effective, and easy to understand for learning and research purposes.

FUNCTIONS AND FEATURES

The Object Detection Radar System works by continuously scanning the surrounding area with the help of an ultrasonic sensor mounted on a servo motor. As the servo rotates, the sensor checks for obstacles at different angles and calculates their distance using sound wave reflection. This scanning approach allows the system to cover a wider area and detect objects more effectively. The microcontroller controls this entire process and ensures that the sensor readings are collected smoothly and without interruption.

Once the distance and angle data are captured, the information is transferred to a computer system for visualization. A radar-style display is generated, which represents detected objects clearly on the screen. This visual format helps users easily understand the location and movement of objects in real time. Continuous updates in the display ensure accurate representation of the surroundings during operation.

To improve safety and responsiveness, the system includes an alert feature using a buzzer. When an object comes within a defined detection range, the buzzer activates immediately to warn the user. This feature makes the system useful for monitoring and basic safety applications. Overall, the system is simple to operate, reliable in performance, and suitable for educational demonstrations, research experiments, and introductory-level detection systems

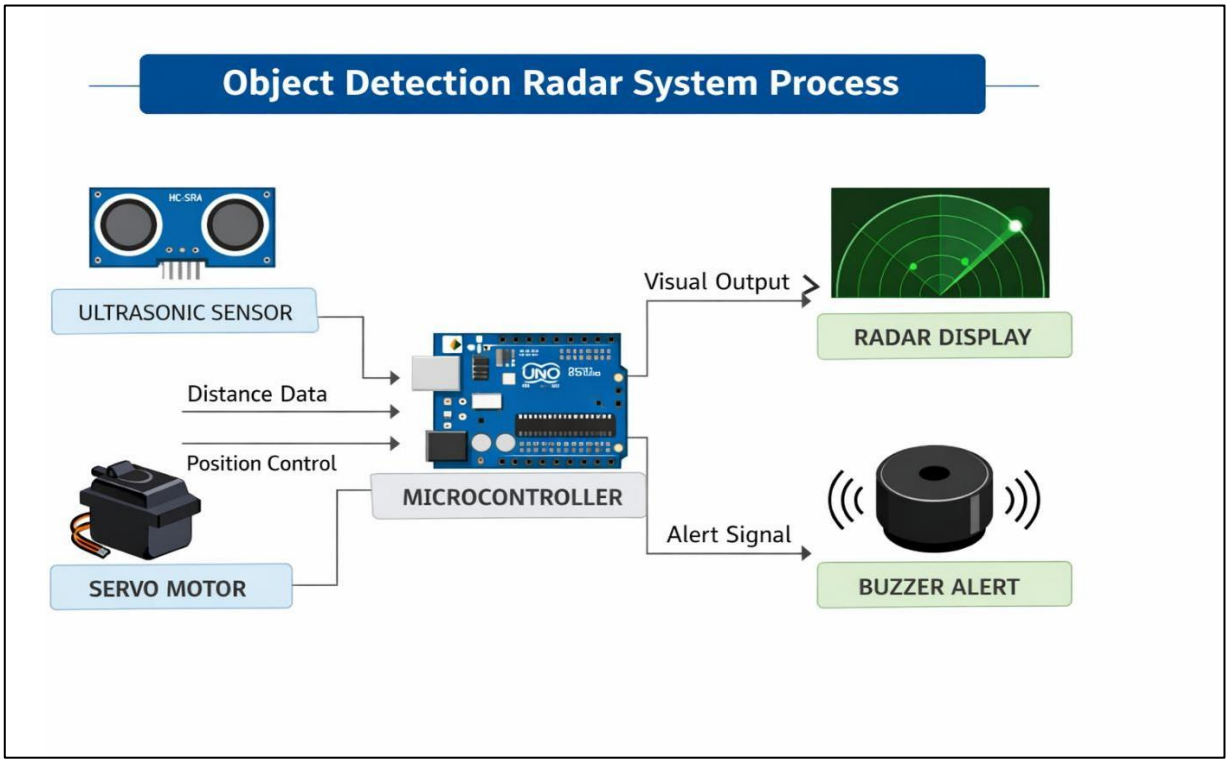
RESULTS AND ANALYSIS

The Object Detection Radar System was tested under different conditions to evaluate its performance and reliability. The system was able to detect objects placed at various distances and angles within the scanning range. The ultrasonic sensor provided consistent distance measurements, while the servo motor ensured smooth rotational movement, allowing effective area coverage. The radar-style visualization displayed object position clearly, helping in easy interpretation of the results.

During analysis, it was observed that the accuracy of detection slightly varied depending on the surface and size of the object. Flat and solid objects were detected more accurately compared to uneven surfaces. However, the overall response time of the system remained quick, and the display updated without noticeable delay. The buzzer alert function performed as expected by activating whenever an object entered the predefined detection limit.

The system demonstrated stable performance during continuous operation, with no major errors or interruptions. Minor fluctuations in readings were addressed through repeated testing and adjustment of threshold values. The final results confirm that the developed system effectively meets the project objectives and provides a practical, low-cost solution for

basic object detection and monitoring applications.



CONCLUSION

This project successfully shows how an object detection system can be created using simple and low-cost parts. An ultrasonic sensor fixed on a rotating servo motor checks the surrounding area and finds objects by calculating their distance from different directions. The information is displayed in a radar-style view, which helps in easily identifying where an object is located. A buzzer is added to give a quick sound alert whenever something comes close to the system.

While testing the setup, the system worked properly and gave correct distance values most of the time. The scanning movement was smooth and continuous. Small changes in readings were noticed because of environmental conditions, but they did not disturb the overall working of the system. This project clearly meets its purpose and helps in understanding how sensors and embedded systems work together. It can also be used as a starting point for developing basic safety and monitoring systems in the future.

FUTURE SCOPE

The Object Detection Radar System has good potential for further improvement and real-world use. In the future, the accuracy of object detection can be increased by using more advanced sensors and improving the scanning speed of the servo motor. This will help the system detect objects more clearly, even at longer distances or in different environmental conditions.

The alert mechanism can also be enhanced by adding visual indicators such as LEDs or by sending notifications to a mobile device. Wireless communication modules can be included so that the detected data can be monitored remotely without direct connection to the system. The radar display can be improved to show clearer visuals and better object movement tracking.

With these improvements, the system can be applied in areas like security monitoring, obstacle detection in vehicles, and basic automation systems. Further research and development can make the project more reliable, efficient, and suitable for practical applications.

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