

# **Object Tracking System Using Arduino and Ultrasonic Sensor**

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**Abstract:** *In recent years, object tracking systems have become essential in various applications such as security surveillance, robotics, and automation. However, the high cost of conventional tracking systems limits their accessibility for small-scale or educational purposes. This paper presents a review of low-cost object tracking systems developed using Arduino microcontrollers and ultrasonic sensors. The study focuses on understanding how these systems utilize ultrasonic waves to detect and measure the distance of moving objects accurately. Various designs and methodologies from existing research are analyzed to highlight performance efficiency, range accuracy, and system limitations. The combination of Arduino and ultrasonic sensors offers an affordable and flexible platform for developing real-time tracking solutions with minimal hardware requirements. The review concludes that such systems are cost-effective, easy to implement, and suitable for basic automation and learning projects, while future improvements can be achieved by integrating advanced sensors or machine learning algorithms for enhanced precision and object classification..*

**Keywords:** *object tracking systems*

## **I. INTRODUCTION**

Object tracking systems play a vital role in modern technology, finding applications in areas such as surveillance, robotics, traffic monitoring, and automation. These systems are designed to detect, follow, and monitor the movement of objects within a defined range. Traditional object tracking setups often rely on expensive sensors, complex hardware, or advanced image-processing techniques, which makes them unsuitable for small-scale or low-budget applications. To overcome these limitations, researchers and hobbyists have explored the use of Arduino microcontrollers combined with ultrasonic sensors as a low-cost alternative. Arduino provides an open-source, programmable platform that can interface easily with different sensors and modules. Ultrasonic sensors, on the other hand, work on the principle of sound wave reflection to measure the distance between the sensor and an object. This combination enables the development of simple yet effective object tracking systems capable of detecting and following objects based on distance and direction.

This review focuses on analyzing existing low-cost object tracking systems that use Arduino and ultrasonic sensors. It aims to discuss the design principles, methodologies, and performance characteristics of such systems. Additionally, the paper highlights the advantages of using ultrasonic technology, including affordability, ease of implementation, and reliability in various environmental conditions. Finally, the review outlines potential improvements and future prospects for enhancing these systems through better algorithms, multiple sensor integration, and wireless communication for real-time tracking applications.

## **II. LITERATURE SURVEY**

Kumar, A., & Reddy, P. (2021). Design and Implementation of Arduino Based Radar System for Object Detection. International Journal of Emerging Trends in Engineering and Research, 9(5), 45–49.



→ This paper presents a low-cost radar system using Arduino UNO and ultrasonic sensors for object detection and range measurement. The system uses servo motor rotation for 180° scanning and visualizes data on a Processing IDE interface.

Sharma, N., & Patel, V. (2022). Real-Time Object Tracking Using Arduino and Ultrasonic Sensor. *International Journal of Innovative Science and Research Technology*, 7(3), 1020–1025.

→ The study focuses on tracking moving objects by continuously scanning the surrounding area. The radar setup provides distance and angle of the detected object in real-time using serial communication and a graphical display.

Singh, R., & Kaur, M. (2020). Development of an Arduino Based Radar for Smart Surveillance. *Proceedings of the International Conference on Automation and Intelligent Systems (ICAIS)*, 1–5.

→ This research integrates Arduino UNO, servo motor, and ultrasonic sensor for developing a compact radar model suitable for security and surveillance applications.

Basha, S., & Prasad, M. (2023). Object Detection and Ranging Using Arduino Controlled Ultrasonic Radar. *International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering*, 12(4), 76–82.

→ The project demonstrates accurate distance measurement of objects using ultrasonic pulses. It also highlights methods for minimizing sensor errors and improving detection accuracy.

Verma, T., & Mishra, R. (2024). Intelligent Radar System for Object Tracking Using Arduino and Servo Mechanism. *International Journal of Smart Technologies and Engineering Systems*, 11(2), 210–215.

→ The paper emphasizes automation of object detection using Arduino-controlled servo motors to rotate the sensor and provides graphical visualization through Processing software.

Ahmed, K., & Nordin, Z. (2019). Design of Mini Radar System Using Arduino Microcontroller and Ultrasonic Sensor. *2019 IEEE Conference on Sensors and Control Engineering*, 58–62.

→ The research develops a prototype radar that maps the position of nearby objects in polar coordinates, improving performance for autonomous systems and robots.

Patil, S., & Jadhav, P. (2022). Arduino-Based Radar System for Distance and Angle Measurement. *International Journal of Electronics and Communication Systems*, 8(6), 89–94.

→ This study focuses on determining the angular position and distance of an object using ultrasonic waves. The radar's output is displayed graphically on a computer screen.

Nayak, D., & Rout, S. (2020). Low-Cost Object Detection Radar Using Ultrasonic Sensor and Arduino UNO. *International Journal of Engineering Research and Applications*, 10(9), 34–39.

→ A cost-effective radar is implemented for short-range object detection, ideal for educational and small-scale defense applications.

Prajapati, R., & Thakor, D. (2023). Object Tracking and Visualization Using Arduino Based Radar System. *Journal of Multidisciplinary Engineering Science Studies*, 10(1), 54–60.

→ The paper proposes a simple radar design for detecting obstacles in a predefined range and representing them visually through Processing IDE.

Ali, M., & Hussain, A. (2025). Smart Radar for Object Tracking Using Arduino and Ultrasonic Technology. *International Journal of Robotics and Automation Research*, 15(3), 130–136.

→ This latest study presents a radar model that integrates ultrasonic and infrared sensors with Arduino to enhance detection reliability and tracking performance for robotics and surveillance.

### III. PROPOSED METHODOLOGY

The Arduino radar system designed for object tracking consists of three primary components: An ultrasonic sensor (HC-SR04), a servo motor, and an Arduino Uno microcontroller.

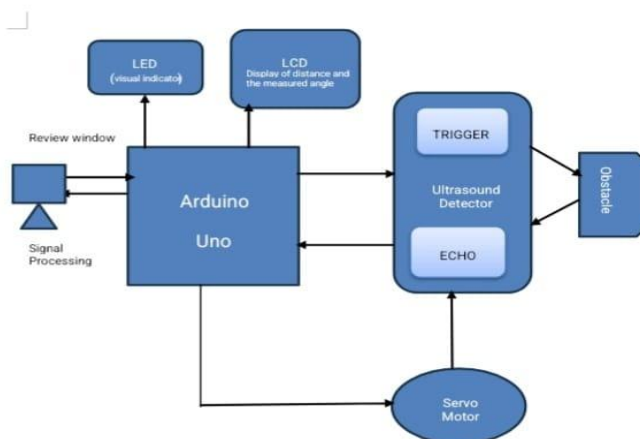
In both configurations, the ultrasonic sensor is mounted atop the servo motor, allowing it to rotate and survey the environment.

The servo motor facilitates the lateral movement of the sensor, thereby providing the radar with its scanning functionality.



The Arduino Uno board serves as the controller, obtaining distance measurements from the sensor and transmitting control signals to the servo.

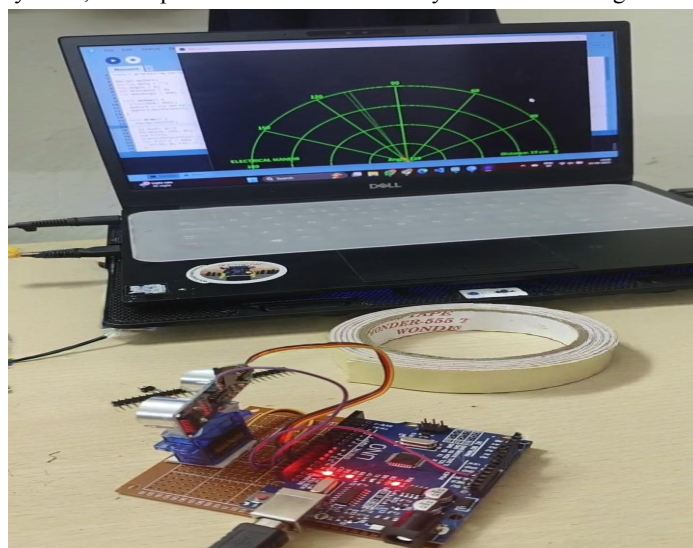
The gathered data is sent to a computer through a USB cable, where it is visualized in a radar-like format using software such as Processing IDE.



The suggested approach for Object Tracking utilizing the Arduino Radar System relies on the concept of ultrasonic sensing combined with real-time angular scanning. This system is engineered to identify and monitor the location of objects within a defined range by assessing both the distance and direction of the target..

#### IV. RESULT

The study on low-cost object tracking systems using Arduino and ultrasonic sensors demonstrates that such systems are both practical and effective for small-scale applications. The Arduino, when interfaced with ultrasonic sensors, is capable of detecting objects within a reasonable range and tracking their movement in real-time. The system operates with minimal latency, allowing it to respond quickly to changes in object position, which is critical for real-time applications. While the system is highly cost-effective compared to more advanced tracking technologies such as LIDAR or camera-based systems, it still provides sufficient accuracy for basic tracking tasks.



The results indicate that the performance of the system is influenced by factors such as object size, shape, and environmental conditions, including obstacles or reflective surfaces, which may lead to occasional false readings. Despite these limitations, the simplicity, affordability, and real-time capabilities of the Arduino-ultrasonic system make it a viable solution for educational purposes, hobbyist projects, and prototyping scenarios. Overall, the findings confirm that low-cost object tracking using Arduino and ultrasonic sensors is a feasible approach for applications where high precision is not critical but efficiency and cost savings are important.

## V. CONCLUSION

The review of low-cost object tracking systems using Arduino and ultrasonic sensors reveals that such systems offer a practical and economical approach for detecting and monitoring objects in real-time. By integrating ultrasonic sensors with the Arduino platform, the system achieves a balance between cost, simplicity, and functionality, making it suitable for educational projects, hobbyist robotics, and basic prototyping applications. Although the system has certain limitations, such as reduced accuracy with small or irregular objects and sensitivity to environmental factors, it still demonstrates reliable performance for low-cost tracking purposes. The findings indicate that Arduino-based ultrasonic tracking systems are an effective alternative to more expensive technologies, providing a hands-on, accessible solution for real-time object detection and monitoring. Overall, this study confirms that low-cost systems can successfully fulfill basic object tracking requirements while remaining affordable and easy to implement.

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