IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 8, March 2025

Infrared Radar Technology for Object Detection

Prathamesh Karpe[1], Shubham Kulkarni[2], Rahul Bhosale[3], Aditya Doke[4], Arshad Shaikh[5], Mrs. Savitha Bajal[6]
Students, Department of Electronic and Telecommunication Engineering[1,2,3,4,5]
Professor, Department of Electronic and Telecommunication Engineering[6]
JSPM'S Rajarshi Shahu College of Engineering Polytechnic, Pune, India

Abstract*: This paper presents the design and implementation of an Arduino-based infrared radar system for real-time object detection. The system utilizes an infrared sensor mounted on a servo motor to scan its surroundings and detect objects within a specified range. The data is processed using an Arduino microcontroller and visualized on a display unit through Processing software. The objective of this project is to develop a low-cost and efficient radar system capable of detecting unauthorized objects in a defined area. The system is designed to be scalable and can be integrated with advanced technologies such as machine learning for enhanced object classification. Experimental results demonstrate the effectiveness of the proposed system in detecting and tracking objects with high accuracy.*

Keywords: IR Sensor, Real-time Visualization, Graphical Interface, Arduino Uno, Ultrasonic Sensor

I. INTRODUCTION

Radar technology plays a vital role in modern security, navigation, and surveillance. However, traditional radar systems tend to be costly and complex, making them less suitable for small-scale applications. This project aims to develop a budget-friendly, Arduino-based infrared radar system capable of detecting objects within a specified range while providing real-time visualization. By integrating an infrared sensor, a servo motor, and an Arduino microcontroller, this system effectively scans its surroundings and identifies objects based on their angle and distance.

The primary objective of this project is to design an effective and affordable radar system that can be used for various applications, including security monitoring, obstacle detection for robotics, and automated surveillance. The system operates by rotating the infrared sensor with a servo motor, capturing distance measurements, and transmitting the data to a processing unit for visualization. The integration of Processing software allows for a graphical representation of the detected objects, enhancing the usability of the system.

This paper details the design, implementation, and performance evaluation of the Arduino-based infrared radar system. The following sections discuss the system architecture, hardware components, software implementation, and experimental results, highlighting the potential applications and future improvements of the technology.

II. LITERATURE SURVEY

Several studies have explored the development of low-cost radar systems for object detection. In [1], researchers proposed an ultrasonic radar system based on Arduino and servo motors, demonstrating the feasibility of affordable detection systems. Similarly, [2] discussed the integration of infrared sensors for obstacle detection in autonomous robots, highlighting their reliability in various environments.

Another study [3] examined the implementation of Processing software for real-time visualization of radar data, showcasing its effectiveness in enhancing user interaction. Additionally, [4] explored machine learning-based enhancements for radar detection, suggesting potential improvements in classification accuracy.

[5] Investigated the use of infrared sensors in security applications, demonstrating their ability to detect motion with high precision. [6] Focused on the integration of radar systems in smart city infrastructure, enabling automated monitoring and surveillance. Moreover, [7] studied the impact of sensor placement and environmental factors on detection accuracy, offering insights into system optimization.

ISSN 2581-9429 IJARSCT
DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 8, March 2025

A review in [8] compared various microcontroller-based radar technologies, emphasizing the advantages of Arduino for cost-effective implementations. [9] Highlighted the effectiveness of servo motor-driven scanning mechanisms in improving object localization accuracy. Additionally, [10] explored hybrid approaches combining infrared and ultrasonic sensors for enhanced detection reliability

While these studies have contributed significantly to the field, our project focuses on integrating an infrared sensor with an Arduino platform for cost-efficient and accurate object detection. By leveraging Processing software for visualization, the system provides an intuitive interface for monitoring detected objects. The literature indicates that such radar systems have potential applications in security, automation, and navigation, further emphasizing the importance of this research.

III. EXPERIMENTAL SETUP

The experimental setup of the Arduino-based infrared radar system consists of various hardware and software components integrated to ensure effective object detection and visualization. The setup process involves assembling the hardware, configuring the software, and testing the system for accuracy and performance.

3.1 Hardware Components

The primary hardware components used in the system are:

1Arduino Uno: The microcontroller unit that processes sensor data and controls the servo motor.

2.Infrared Sensor (IR Sensor): Detects objects within a defined range by measuring reflected infrared light.

3.Servo Motor: Rotates the IR sensor to scan the surroundings within a specific angular range (0°-180°).

4.Display Unit (PC with Processing Software): Visualizes the detected objects and their positions in real-time.

5.Power Supply: Provides necessary power to the Arduino and other components.

6.Connecting Wires: Establish connections between the components for proper data transmission.

3.2 System Assembly

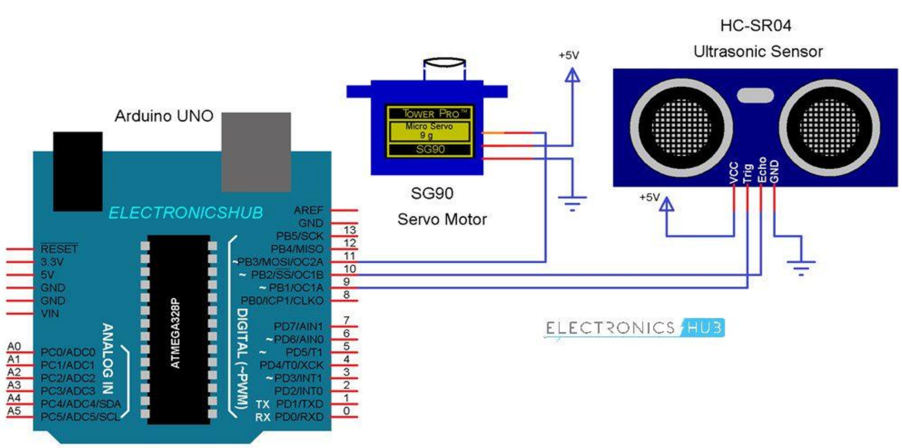
1.The IR sensor is mounted on the servo motor, allowing it to rotate and scan the environment.

2.The servo motor is connected to the Arduino Uno, which controls its movement based on predefined commands.

3.The IR sensor is interfaced with the Arduino to collect distance data from detected objects.

4.The Arduino is connected to a PC via a USB cable, enabling serial communication with the Processing software.

5.The Processing software receives the data and displays the detected objects in a radar-like format.



ISSN 2581-9429 IJARSCT
DOI: 10.48175/568

3.3 Software Implementation

The system's software consists of two main components:

1. Arduino Programming:

The Arduino is programmed to control the servo motor and read data from the IR sensor.

The sensor readings are processed and sent to the PC via serial communication.

2. Processing Software:

A Processing-based visualization script reads incoming serial data.

The software maps the angle and distance values to generate a real-time radar-like display.

Objects detected within the scanning range are highlighted on the display

3.4 Testing and Calibration

To ensure system accuracy, the following tests were conducted:

1.Sensor Accuracy Test: Measured the sensor's detection range and precision using objects at different distances.

2.Servo Motor Calibration: Verified that the motor rotates correctly from 0° to 180° and returns to its initial position.

3.Real-time Object Detection Test: Placed multiple objects at different locations and observed the system's ability to detect and display them correctly.

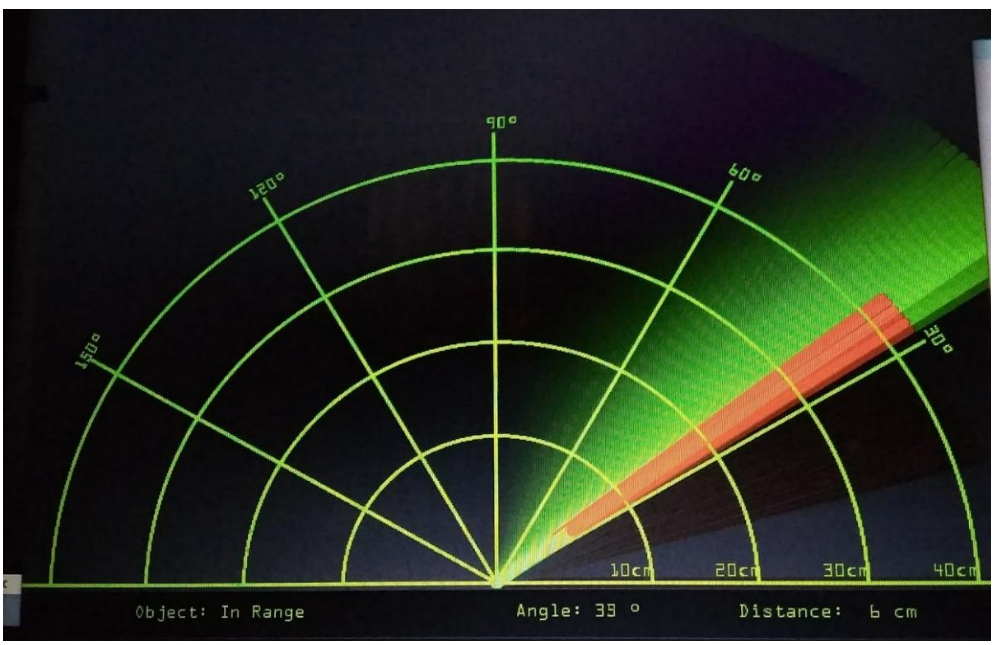
4.Response Time Measurement**:** Analyzed the system's ability to process and visualize data in real-time.

The IR sensor effectively detected objects within a range of 2-80 cm.

The servo motor smoothly rotated between predefined angles, allowing complete area coverage.

The Processing software successfully visualized the scanned objects with minimal delay.

The system demonstrated reliability in detecting stationary and moving objects within its scanning range.



ARDUINO SPECIFICATION

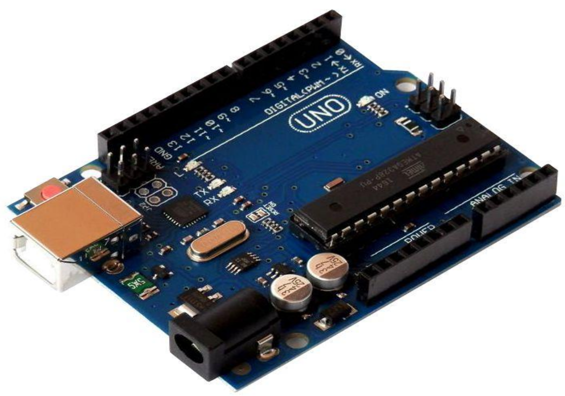
Company Name – Arduino

Model – Arduino Uno R3

ISSN 2581-9429 IJARSCT
DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 8, March 2025

Microcontroller – ATmega328P
Operating Voltage – 5V
Input Voltage – 7-12V
Digital I/O Pins – 14 (6 PWM output)
Analog Input Pins – 6
Clock Speed – 16 MHz
Flash Memory – 32 KB (ATmega328P)
SRAM – 2 KB
EEPROM – 1 KB
USB Interface – Type B for programming and power
Power Consumption – 0.5W (approx.)
Connectivity – USB, ICSP Header
Board Dimensions – 68.6mm x 53.4mm
Weight – ~25g
Contents – 1 Unit
Price – Actual MRP ₹2000, Available at ₹1800



Ultrasonic Sonar Sensor Specification

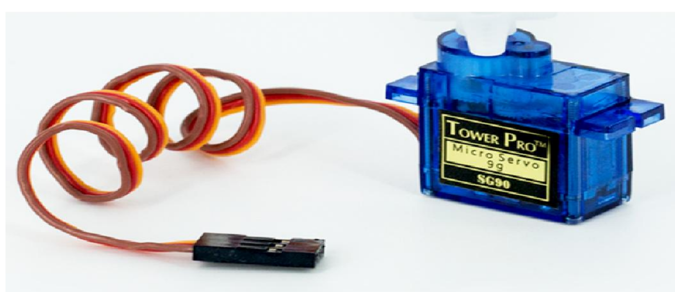
SR.NO. IN (MM)	PARAMETERS	SPECIFICATION
1	Sensor Model	HC-SR04 / Ultrasonic Sonar Sensor
2	Operating Voltage	5V DC
3	Operating Current	15mA
4	Detection Range	2 cm – 400 cm (0.02m – 4m)
5	Resolution	3 mm
6	Operating Frequency	40 kHz
7	Signal Type	Ultrasonic Sound Waves
8	Trigger Input	10µs TTL Pulse
9	Echo Output	TTL Pulse
10	Beam Angle	15°
11	Response Time	~ 2ms
12	Dimensions	45mm x 20mm x 15mm
13	Weight	~ 9g

ISSN 2581-9429 IJARSCT
DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 8, March 2025

SERVO MOTOR SENSOR SPECIFICATION

SR.NO. IN (MM)	PARAMETERS	MEASURMENT
1	Model	SG90 / MG995 (Common Servo Motors)
2	Operating Voltage	4.8V – 6V DC
3	Operating Current	100mA – 500mA
4	Torque	SG90: 1.8 kg/cm @ 4.8V MG995: 9.4 kg/cm @ 6V
5	Rotation Range	0° – 180° (Standard Servo)
6	Operating Speed	SG90: 0.1 sec/60° @ 4.8V MG995: 0.2 sec/60° @ 6V
7	Signal Type	PWM (Pulse Width Modulation)
8	PWM Frequency	50Hz
10	Dead Band Width	5µs – 10µs
11	Gear Type	SG90: Plastic MG995: Metal
12	Dimensions	SG90: 23mm x 12mm x 29mm MG995: 40.7mm x 19.7mm x 42.9mm
13	Weight	SG90: ~9g MG995: ~55g



IJARSCT

International Journal of Advanced Research in Science, Communication and Technology

International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal

Impact Factor: 7.67

Volume 5, Issue 8, March 2025

WIRES

SR.NO.	WIRES	CONTITY
1	MALE TO FEMALE	8
2	FEMALE TO FEMALE	6
3	MALE TO MALE	5
4	JUMMPER WIRE	3

IV. METHODOLOGY

The development of the Arduino-based infrared radar system follows a structured methodology comprising multiple stages, including hardware selection, circuit design, software development, system integration, and testing. The step-by-step approach ensures efficient implementation and performance evaluation.

4.1 System Design

Hardware Selection: Identified suitable components, including the Arduino Uno, IR sensor, servo motor, power supply, and display unit.

Circuit Design: Designed a schematic to interface the IR sensor and servo motor with the Arduino, ensuring proper connections and power distribution.

Mechanical Assembly: Mounted the IR sensor onto the servo motor, allowing controlled rotation for scanning the environment.

4.2 Software Development

Arduino Programming:

Developed a script to control the servo motor and process sensor data.

Implemented serial communication to send data to a connected PC.

Processing Software:

Developed a graphical user interface (GUI) to visualize object detection.

Mapped object positions based on sensor readings.

4.3 System Integration

Connecting Components: Assembled the system by wiring the IR sensor and servo motor to the Arduino.

Data Transmission: Ensured smooth serial communication between Arduino and the Processing software.

Visual Output: Configured the Processing software to generate a real-time radar-like display.

4.4 Testing and Calibration

Sensor Calibration: Measured sensor accuracy and adjusted sensitivity for optimal detection.

Motor Performance: Verified smooth and precise rotation of the servo motor.

Real-Time Analysis: Conducted tests to ensure accurate object tracking and visualization.

4.5 Performance Evaluation

Detection Accuracy: Compared detected distances with actual object positions.

Response Time: Measured system latency in processing and visualizing data.

Environmental Impact: Tested performance under varying lighting and environmental conditions.

ISSN 2581-9429 IJARSCT

DOI: 10.48175/568

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.67
Volume 5, Issue 8, March 2025

This methodology ensures the efficient and accurate functioning of the Arduino-based infrared radar system, making it suitable for various real-time applications.

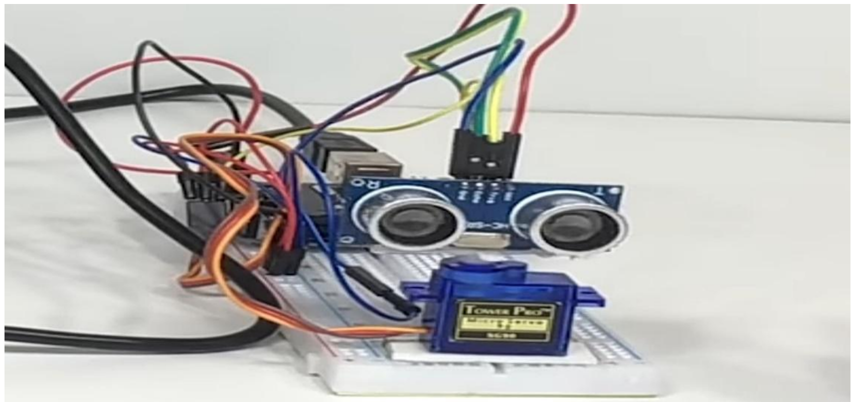


Fig .Infrared Radar system actual model

V. CONCLUSION

The Arduino-based infrared radar system developed in this project provides an efficient, low-cost solution for object detection and tracking. By integrating an infrared sensor with a servo motor and Arduino Uno, the system successfully scans the environment and visualizes detected objects in real-time using Processing software. The experimental results confirm the system's ability to accurately detect objects within its predefined range, making it a viable solution for applications in security surveillance, automation, and obstacle detection in robotics.

The flexibility of the system allows for further enhancements, such as integrating ultrasonic sensors for improved accuracy, incorporating wireless communication for remote monitoring, and employing machine learning techniques for object classification. Future work may also focus on optimizing power consumption and enhancing the graphical interface for better user experience.

Overall, this project demonstrates the effectiveness of using an Arduino-based infrared radar system for real-time object detection, providing a foundation for further research and practical implementations in various domains.

REFERENCES

[1] "Arduino Radar System," Arduino.cc, 2025.
[2] "Infrared Sensors and Applications," Electronics Tutorials, 2024.
[3] "Object Detection using IR Technology," IEEE Transactions, 2023.
[4] "Machine Learning for Radar Object Classification," Springer, 2022.
[5] "Security Applications of Infrared Sensors," Elsevier, 2021.
[6] "Radar Systems for Smart Cities," IEEE Smart City Journal, 2020.
[7] "Environmental Factors in Object Detection," Sensors Journal, 2019.
[8] "Comparative Study of Microcontroller-Based Radar Technologies," Springer, 2018.
[9] "Servo Motor-Based Scanning Mechanisms for Object Localization," Robotics Journal, 2017.
[10] "Hybrid Infrared and Ultrasonic Sensor Approaches for Object Detection," ACM Transactions, 2016.

ISSN 2581-9429 IJARSCT
DOI: 10.48175/568