

Radar System Using Arduino Uno and Ultrasonic Sensor

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Abstract — This project develops a low-cost Arduino-based radar system using an ultrasonic sensor and a servo motor to detect and scan objects within 0° – 180°. The sensor measures the distance of obstacle, and the servo motor rotates to cover a wide scanning area. The measured angle and distance data are transmitted via Bluetooth for real-time monitoring on a mobile device or computer. The system is simple, cost-effective, and easy to implement. It is suitable for obstacle detection, robotics, and basic security applications.

Keywords: Arduino Uno, Ultrasonic Sensor, Servo Motor, Bluetooth, Radar System, Obstacle Detection

I. INTRODUCTION

Radar systems are widely used in applications such as defense, aviation, navigation, and security to detect and track objects. Traditional radar systems use radio waves and are often complex and expensive. To demonstrate the basic concept of radar in a simple and cost-effective way, this project develops a radar system using Arduino Uno, an ultrasonic sensor, a servo motor, and an HC-05 Bluetooth module.

In this system, the ultrasonic sensor works by transmitting high-frequency sound waves and receiving their reflected signals from nearby objects. The time taken for the echo to return is used to calculate the distance. The servo motor rotates the sensor from 0° to 180°, enabling it to scan a wide area similar to a real radar system. The Arduino processes the angle and distance data and sends it wirelessly via Bluetooth for real-time monitoring and visualization on a mobile device or computer.

This project provides a practical understanding of embedded systems, sensor interfacing, and wireless communication. It is suitable for applications such as obstacle detection, robotics, smart vehicles, and basic security systems.

A. Objectives

- To design and develop a low-cost radar system using Arduino Uno.
- To measure the distance of objects using an ultrasonic sensor (HC-SR04).
- To rotate the sensor using a servo motor for wide-area scanning (0°–180°).
- To process angle and distance data using the Arduino microcontroller.
- To transmit data wirelessly using the HC-05 Bluetooth module.
- To display real-time object detection for monitoring purposes.
- To implement a simple system for obstacle detection and basic security applications.

B. Concept Overview

The concept of this project is to create a simple radar-like system using Arduino Uno, an ultrasonic sensor, a servo motor, and a Bluetooth module. The system works on the principle of ultrasonic wave reflection. The ultrasonic sensor sends high-frequency sound waves and receives the reflected signals from nearby objects. The time taken for the echo to return is used to calculate the distance of the object.

The servo motor rotates the ultrasonic sensor from 0° to 180°, allowing the system to scan a wide area similar to a real radar. The Arduino processes the distance and angle data and transmits the information via Bluetooth for real-time monitoring and visualization on a mobile device or computer. This project demonstrates the integration of sensors, actuators, microcontrollers, and wireless communication to build a practical obstacle detection and monitoring system.

II. BLOCK DIAGRAM

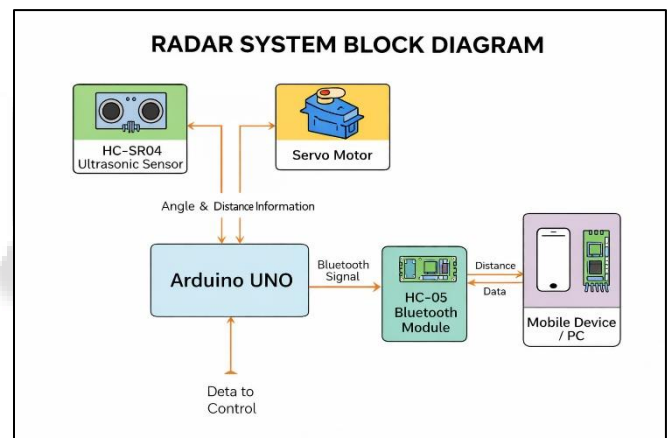


Fig. 1: Block Diagram

A. Block Diagram Explanation

- 1) *HC-SR04 Ultrasonic Sensor*
 - Sends ultrasonic waves and receives the reflected echo.
 - Measures the distance of objects based on echo time.
- 2) *Servo Motor*
 - Rotates the ultrasonic sensor from 0° to 180°.
 - Enables scanning of a wide area like a radar.
- 3) *Arduino UNO*
 - Acts as the main controller of the system.
 - Calculates distance using echo time.
 - Controls the servo motor rotation.
 - Processes angle and distance information.
- 4) *HC-05 Bluetooth Module*
 - Receives processed data from Arduino.
 - Transmits angle and distance data wirelessly.
- 5) *Mobile Device / PC*
 - Receives data via Bluetooth.
 - Displays object position and distance (radar view).

III. FLOW CHART

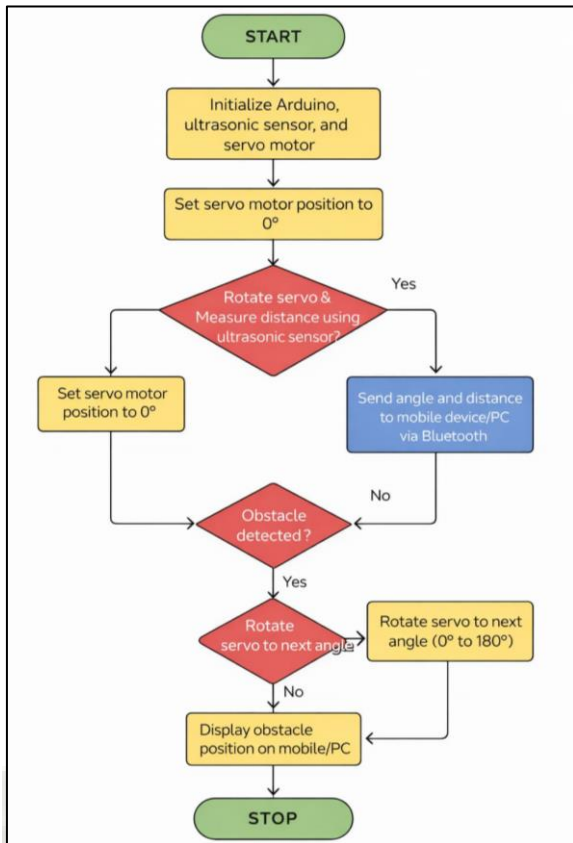


Fig. 2: Flow Chart

A. Working Principle

- 1) The system starts and initializes the Arduino, ultrasonic sensor, servo motor, and Bluetooth module.
- 2) The servo motor is set to the starting position (0°).
- 3) The servo begins rotating step-by-step from 0° to 180°.
- 4) At each angle, the ultrasonic sensor sends sound waves and measures the reflected echo time.
- 5) The Arduino calculates the distance of any object using the echo time.
- 6) The measured angle and distance data are sent to a mobile device or PC via Bluetooth.
- 7) The system checks whether an obstacle is detected within the set range.
- 8) If an obstacle is detected, its position (angle and distance) is displayed on the mobile/PC.
- 9) The servo continues rotating to scan the next angle.
- 10) This process repeats continuously to provide real-time radar-style object detection.

IV. ADVANTAGES

- 1) Low Cost: Uses affordable components like Arduino, ultrasonic sensor, and servo motor.
- 2) Simple Design: Easy to build, program, and understand for beginners.
- 3) Wireless Monitoring: Data can be viewed on a mobile or PC using Bluetooth.
- 4) Real-Time Detection: Provides continuous scanning and instant obstacle detection.
- 5) Low Power Consumption: Operates efficiently with minimal power requirement.

- 6) Easy to Upgrade: More sensors or features can be added easily.

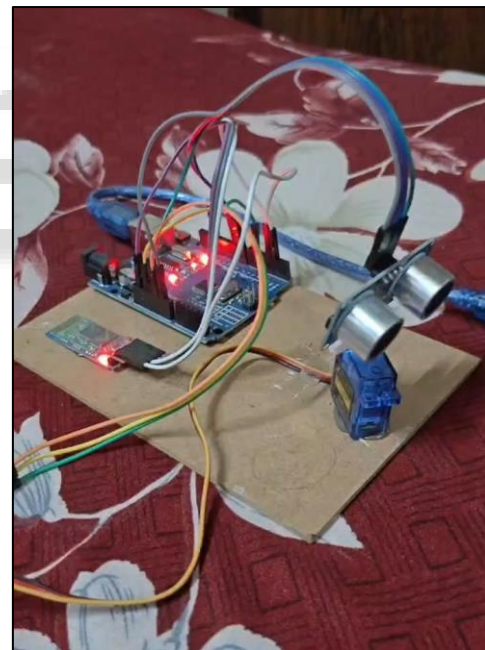
V. APPLICATIONS

- 1) Obstacle Detection Systems – Used in basic object detection and avoidance systems.
- 2) Security Monitoring – Detects movement in restricted areas.
- 3) Robotics – Helps robots sense and avoid obstacles.
- 4) Smart Parking Systems – Assists in detecting nearby vehicles or objects.
- 5) Educational Projects – Used for learning embedded systems and sensor interfacing.

VI. CONCLUSIONS

The Arduino-based radar system successfully demonstrates object detection using an ultrasonic sensor and servo motor. The system scans the surroundings, measures object distance, and transmits the data wirelessly via Bluetooth for real-time monitoring. It is a low-cost, simple, and effective solution for obstacle detection and basic security applications. This project also provides practical knowledge of embedded systems, sensor integration, and wireless communication.

VII. ACTUAL CIRCUIT



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