A

PROJECT REPORT
ON

RADAR SYSTEM
IN DEFENCE SECTOR

Submitted By:
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Aim:

This project aims to design and implement a radar system using an ultrasonic sensor, a motor, and an Arduino microcontroller. The system will measure distances to objects and rotate the ultrasonic sensor to scan a specified area. The measured distances will be displayed on an LCD screen, and the system will provide alerts when an object is detected within a certain range. This project demonstrates the principles of radar technology and provides a practical application for distance measurement and object detection.

introduction:

Radar systems are widely used in various applications, including automotive safety, robotics, and industrial automation. This project focuses on creating a simple radar system that utilizes an ultrasonic sensor to measure distances and a servo motor to rotate the sensor for scanning. The system will provide real-time feedback on detected distances and can be used for obstacle detection and tracking.

Objectives:

To design a radar system that can measure distances using an ultrasonic sensor.

- To rotate the ultrasonic sensor using a servo motor to scan a specified area.
- To display the measured distance on an LCD screen.
- To provide visual and audible alerts when an object is detected within a certain range.
- To understand the basic principles of radar technology and its applications.

Components Required:

1. Arduino Uno

Description: The Arduino Uno is a microcontroller board based on the ATmega328P. It is widely used in electronics projects due to its ease of use, versatility, and extensive community support.

Function in the Project:

- Acts as the central processing unit (CPU) of the radar system.
- Reads data from the ultrasonic sensor and controls the servo motor.
- Processes the distance measurements and displays them on the LCD.
- Activates the buzzer when an object is detected within a specified range.

2. Ultrasonic Sensor (HC-SR04)

Description: The HC-SR04 is an ultrasonic distance sensor that uses sound waves to measure distances. It consists of two main components: a transmitter that emits ultrasonic pulses and a receiver that detects the echoes of those pulses.

Function in the Project:

- Emits ultrasonic sound waves and measures the time it takes for the echo to return after bouncing off an object.
- Calculates the distance to the object using the formula: [\text{Distance} = \frac{\text{Time} \times \text{Speed of Sound}}{2}]
- Provides distance measurements to the Arduino for processing and display.

3. Servo Motor

Description: A servo motor is a type of motor that can be precisely controlled for position, speed, and acceleration. It typically consists of a motor, a feedback device (like a potentiometer), and control circuitry.

Function in the Project:

- Rotates the ultrasonic sensor to scan a specified area.
- The Arduino sends control signals to the servo to set its angle, allowing the sensor to sweep from 0 to 180 degrees.
- Enables the radar system to measure distances at different angles, enhancing its scanning capability.

4. LCD Display (16x2)

Description: A 16x2 LCD display is a common type of alphanumeric display that can show two lines of text, with each line containing up to 16 characters. It uses a controller (like the HD44780) to manage the display.

Function in the Project:

- Displays the measured distance in real-time, providing immediate feedback to the user.
- Enhances user interaction by showing relevant information about the radar system's operation.

5. Buzzer

Description: A buzzer is an audio signaling device that produces sound when an electrical signal is applied. It can be either active (producing sound when powered) or passive (requiring a specific frequency to produce sound).

Function in the Project:

- Provides an audible alert when an object is detected within a specified distance threshold.
- Alerts the user to potential obstacles, enhancing safety and awareness.

6. Resistors

Description: Resistors are passive electrical components that limit the flow of electric current in a circuit. They are used to control voltage and current levels.

Function in the Project:

- Used in the LCD circuit to set the appropriate voltage levels for the display.
- May also be used to limit current to the buzzer or other components.

7. Breadboard and Jumper Wires

Description: A breadboard is a reusable platform for prototyping electronic circuits without soldering. Jumper wires are used to make connections between components on the breadboard.

Function in the Project:

- Facilitate the assembly of the circuit for testing and prototyping.
- Allow for easy modifications and adjustments during the development phase.

8. Power Supply

Description: A power supply provides the necessary electrical power to the Arduino and other components in the circuit.

Function in the Project:

- Supplies power to the Arduino and sensors, ensuring they operate correctly.
- Can be a battery, USB power, or an external AC-DC adapter, depending on the project requirements.

Connections:

1. **Arduino Uno**
    - **Power Supply**: Connect the Arduino to a power source (USB or external power supply).
2. **Ultrasonic Sensor (HC-SR04)**
    - **VCC**: Connect to the 5V pin on the Arduino.
    - **GND**: Connect to the GND pin on the Arduino.

- **TRIG**: Connect to a digital pin on the Arduino (e.g., D2).
- **ECHO**: Connect to another digital pin on the Arduino (e.g., D3).

3. **Servo Motor**
    - **VCC**: Connect to the 5V pin on the Arduino (or an external power supply if the servo requires more current).
    - **GND**: Connect to the GND pin on the Arduino.
    - **Signal**: Connect to a digital pin on the Arduino (e.g., D9).
4. **LCD Display (16x2)**
    - **VSS**: Connect to the GND pin on the Arduino.
    - **VDD**: Connect to the 5V pin on the Arduino.
    - **V0**: Connect to the middle pin of a potentiometer (for contrast adjustment), with the other two pins connected to 5V and GND.
    - **RS**: Connect to a digital pin on the Arduino (e.g., D4).
    - **RW**: Connect to the GND pin on the Arduino.
    - **E**: Connect to a digital pin on the Arduino (e.g., D5).
    - **D4**: Connect to a digital pin on the Arduino (e.g., D6).
    - **D5**: Connect to a digital pin on the Arduino (e.g., D7).
    - **D6**: Connect to a digital pin on the Arduino (e.g., D8).
    - **D7**: Connect to a digital pin on the Arduino (e.g., D9).
5. **Buzzer**
    - **Positive (+)**: Connect to a digital pin on the Arduino (e.g., D10).
    - **Negative (-)**: Connect to the GND pin on the Arduino.

Program:

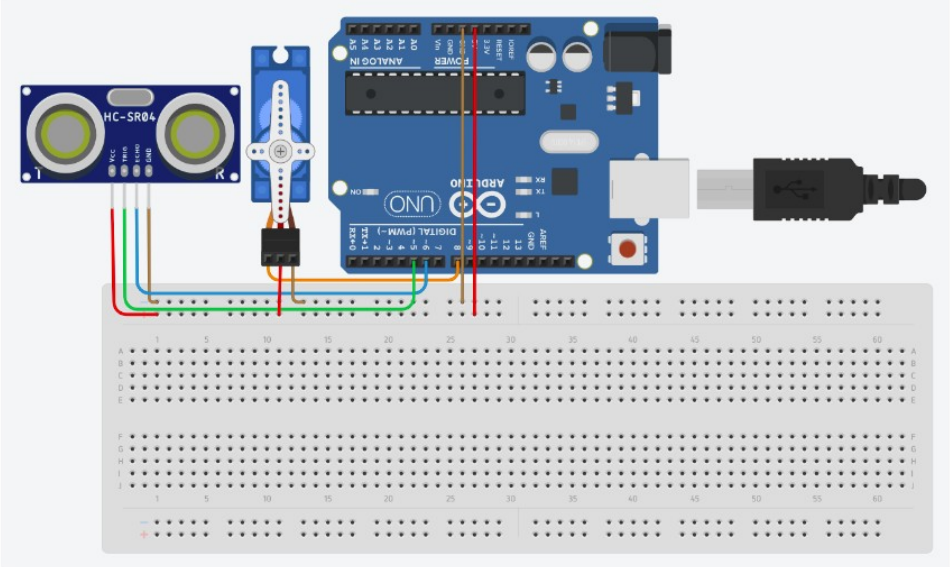
```
#include <LiquidCrystal.h>

#include <Servo.h>
```

```
// Initialize the LCD
LiquidCrystal lcd(4, 5, 6, 7, 8, 9);
Servo myServo; // Create a Servo object

// Pin Definitions
const int trigPin = 2 ; // Trigger pin for ultrasonic sensor
const int echoPin = 3; // Echo pin for ultrasonic sensor
const int buzzerPin = 10; // Buzzer pin
const int servoPin = 9; // Servo pin

// Distance threshold (in cm)
const int distanceThreshold = 20; // Alert if an object is within 20 cm

void setup() {
    // Initialize the LCD
    lcd.begin(16, 2);
    myServo.attach(servoPin); // Attach the servo to the specified pin
    pinMode(trigPin, OUTPUT);
    pinMode(echoPin, INPUT);
    pinMode(buzzerPin, OUTPUT);
    Serial.begin(9600);
}

void loop() {
```

```
    for (int angle = 0; angle <= 180; angle += 10) { // Sweep from 0 to 180 degrees
        myServo.write(angle); // Set the servo position
        delay(500); // Wait for the servo to reach the position

        // Clear the trigger
        digitalWrite(trigPin, LOW);
        delayMicroseconds(2);

        // Set the trigger high for 10 microseconds
        digitalWrite(trigPin, HIGH);
        delayMicroseconds(10);
        digitalWrite(trigPin, LOW);

        // Read the echo pin
        long duration = pulseIn(echoPin, HIGH);

        // Calculate the distance
        int distance = duration * 0.0343 / 2; // Convert to cm

        // Display the distance on the LCD
        lcd.clear();
        lcd.print("Distance: ");
        lcd.print(distance);
```

```
        lcd.print(" cm");


        // Check if the distance is below the threshold
        if (distance < distanceThreshold) {
            digitalWrite(buzzerPin, HIGH); // Activate buzzer
        } else {
            digitalWrite(buzzerPin, LOW); // Deactivate buzzer
        }


        delay(500); // Wait before the next measurement
    }
}
```

SCHEMATIC:



Applications

- **Industrial Equipment**: Safeguarding industrial machinery from electrical faults that could lead to equipment failure or safety hazards.
- **Renewable Energy Systems**: Protecting solar inverters and battery systems from overvoltage and overcurrent conditions.

Future scope:

The project has significant potential for future enhancements, including:

- **Increased Range and Accuracy**: Exploring more advanced sensors or multiple sensor configurations to improve detection capabilities.
- **Wireless Communication**: Implementing wireless modules for remote monitoring and control, allowing users to access data from a distance.
- **Data Logging and Analysis**: Adding data logging capabilities to record measurements over time for analysis and pattern recognition.
- **Integration with Other Technologies**: Combining the radar system with other sensors (e.g., infrared, LIDAR) to create a more comprehensive detection system.

Conclusion:

In summary, this radar system project not only showcases the practical application of ultrasonic technology but also opens the door to further innovations in distance measurement and object detection. It serves as a stepping stone for more complex projects in robotics, automation, and smart systems, contributing to the ongoing development of intelligent technologies.