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Radar System Using Arduino Uno

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Abstract: *Radar technology is widely used for detecting objects and measuring their distance. This project presents a simple radar system developed using Arduino Uno, an Ultrasonic sensor, and a servo motor. The ultrasonic sensor sends sound waves toward an object, and the reflected waves return to the sensor. By calculating the time taken for the echo signal to return, the system determines the distance of the object. The server motor is used to rotates the sensor to scan a specific area, and allowing detection of objects at different angles. The collected data is displayed on the computer screen using Arduino IDE and processing software. The project is useful for understanding the working principle of radar system and for applications such as obstacle detection.*

Keywords: *Radar technology*

I. INTRODUCTION

Radar stands for radio detection. It is a technology used to detect the distance, speed and direction of objects using electromagnetic or sound waves. Radar systems are commonly used in military, weather forecasting and navigation system in this project a simple radar system is made using an Arduino Uno microcontroller and an ultrasonic sensor. The ultrasonic sensor sends sound waves and receives the reflected signals from nearby objects and this is how distance and angle are measured the server motor rotates the sensor to detect different directions the detected objects position are displayed on a radar like interface on the computer screen this project helps students to understand the basic concept of radar and embedded systems.

II. COMPONENTS

Arduino Uno

Arduino Uno is a microcontroller board based on the ATmega328P. It control's the entire system and processes signals from the ultrasonic sensor. The Arduino board reads the data from sensors and send commands to other components to perform actions.

Ultrasonic Sensor (HC – SRO4)

The HC-SR04 ultrasonic sensor is a device used to measure the distance of an object by using ultrasonic sound waves. It works on the principle of echo and reflection of sound waves. In radar system project, the ultrasonic sensor is used to detect objects and measure how far they are from the sensor.

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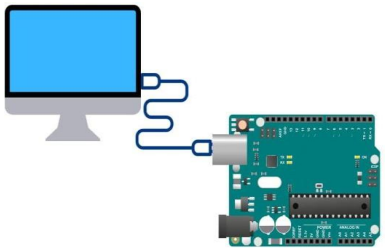
Servo Motor

A servo motor is a motor that is used to control the exact position or angle of rotation. Unlike normal motors that rotate continuously, a servo motor can move to a specific angle when it receives a signal from a controller. It is easy to control using a microcontroller. It provides accurate angle control.

Jumper Wires

Jumper wires are small connecting wires used in electronic circuits to join different components together. They are mainly used with breadboards and microcontroller boards because they make the circuit connections easy without soldering. This wires help in transferring electrical signals and power from one component to another.

Computer With Arduino IDE



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A computer with Arduino IDE is used to write the program and upload it to Arduino Uno. Arduino IDE is a software where we write the code required for the project. The Arduino IDE is easy to use and helps in writing, editing, and uploading the program to the Arduino board.

III. BASIC PRINCIPLE OF RADAR

The working principle of a radar system is based on the transmission and reflection of waves. In this project, an ultrasonic sensor is used to send high frequency sound waves toward an objects. When these waves strike an object, they are bounce back to the sensor in the form of an echo signal.

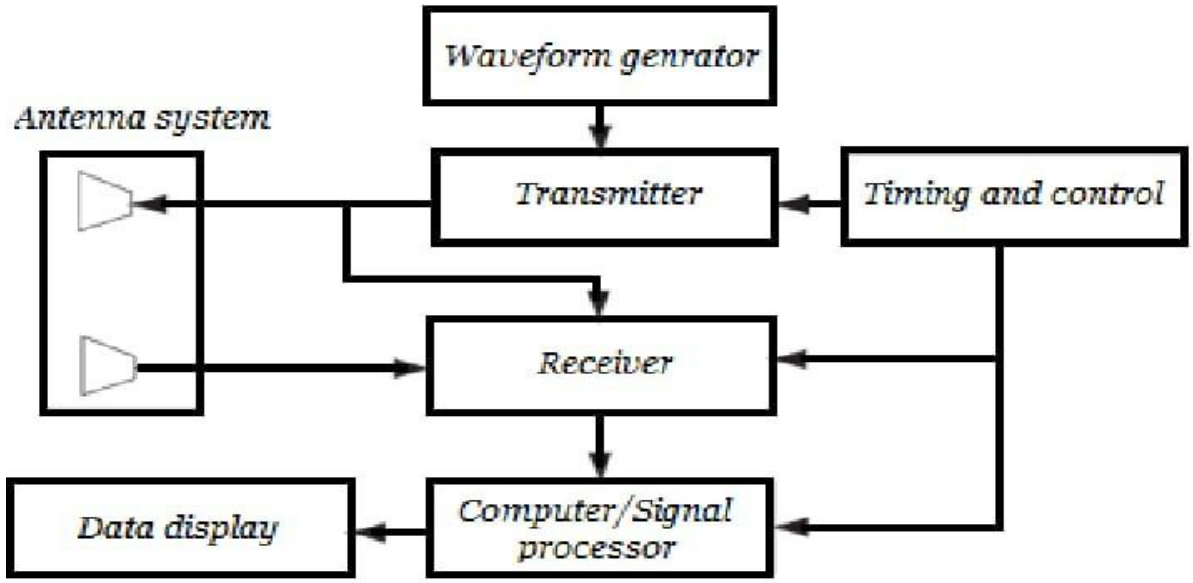
The system measures the time required for the echo to return to the sensor. By using this time value, the distance between the sensor and the object can be determined. In the Arduino radar system, a servo motor rotates the ultrasonic sensor to scan different direction. This helps in detecting objects present in various angles around

Radar Range Equation:

C = speed of light

T = time taken for signal to return

V. BLOCK DIAGRAM OF RADAR SYSTEM



1. Waveform Generator: The waveform generator produces the electrical signals required for the radar system. These signals are sent to the transmitter to create radio waves. It helps in generating pulses at specific frequency.
2. Transmitter: The transmitter converts the electrical signals into high-frequency radio waves. These radio waves are then sent to the antenna for transmission into the air. It provides the required power for the radar signal.
3. Timing and Control: The timing and control unit manages the operation of different radar components. It controls when the signal should be transmitted and when the receiver should start receiving signals.
4. Antenna System: The antenna system is used to transmit radio waves into space and also receive the reflected signals from the target. It acts as a medium between the radar system and the surrounded environment.
5. Receiver: The receiver collects the reflected signals that return from the target. It amplifies and processes these weak signals so that they can be analyzed by the system
6. Computer / Signal Processor: The computer or signal processor processes the received signals and calculates important information like distance and position of the object. It converts the signals into useful data.

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7. Data Display: The display unit presents the final result of the radar system after processing the signal. It helps the user see the location and movement of the target in a visual form.

V. CHALLENGES FACED DURING IMPLEMENTATION

While implementation difficulties were faced during the implementation developing the radar system project, some difficulties were faced during the process.

1. Sensor Accuracy: Sometimes the ultrasonic sensor did not give accurate distance readings, especially when the object was very small or placed at an angle.
2. Servo Motor Adjustment: Another challenge was setting the correct movement of the servo motor
3. Circuit Connections: During the project setup, loose connections of jumper wires on the breadboard sometimes caused the circuit to stop working.
4. Programming Errors: While writing the code in the Arduino IDE, small mistakes in the program caused the errors and the system did not work correctly until the code was corrected.
5. Power Supply Issues: At some points, the components did not receive proper power, which affected the working of the Arduino Uno and other modules.
6. This problems were solved by checking the circuit connections, correcting the program code, and properly adjusting the components.

VI. ADVANTAGES

1. Object Detection: The radar system can detect objects and measure the distance between the sensor and the object accurately.
2. Wide Area Scanning: With the help of the servo motor, the sensor can rotate and scan a wider area to detect objects in different directions.
3. Easy To Build: The radar system project is easy to design using simple components like Arduino Uno and the HC-SR04 Ultrasonic Sensor.
4. Low Cost: The components used in this projects are cheap and easily available, making it suitable for educational and beginner projects.
5. Useful For Learning: This project helps students understand the basic concept of radar systems, sensors, and microcontroller programming.

VII. CONCLUSION

The radar system project was successfully designed and implemented using components such as the Arduino Uno, HC-SR04 Ultrasonic Sensor, and a servo motor. The system was able to detect objects and measure the distance between the sensor and the object effectively.

Through this project, the basic working principle of radar and object detection was understood. It also helped in learning how sensors, microcontrollers, and programming work together in an electronic system.

This project is useful for understanding practical applications of radar technology and can be further improved for more advanced detection systems.

VIII. ACKNOWLEDGEMENT

I would like to thank my project guide and teachers for guiding us during the completion of this radar system project. Their support and suggestions helped me to understand the project better and complete it successfully.

I am also thankful to my college for providing the facilities and resources needed to carry out this project.

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