Design of an Arduino Based Radar System

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Abstract: **The range, altitude, direction, and speed of an item are all determined using RADAR, a radio wave-based object detecting technology. Radio waves or microwave pulses are emitted by radar dishes or antennas, which bounce off any object in their path. Arduino is a single-board microcontroller that aims to make electronics more accessible to individuals of all ages and backgrounds. An ultrasonic sensor and a servo motor are the most crucial components of this RADAR system. The system's main purpose is to detect things within a certain distance. The ultrasonic sensor is attached to the servo motor, which rotates 180 degrees and shows a graphical representation of the data on the Processing IDE program, as well as the angle or location of the data.**

Keywords: Arduino, Ultrasonic sensor, Radar, PIR Sensor, Obstacle detection.

1. INTRODUCTION

The range, altitude, direction, and speed of an object are all determined using RADAR, a radio-wave-based object detecting technology. Radar systems are available in a number of sizes and performance levels. At airports, radar systems are used to control air traffic, while others are utilised for long-range surveillance and early-warning systems. A radar system is at the heart of a missile directing system. Small portable radar systems, which can be maintained and managed by a single person, as well as big systems that take up many rooms, are available. Before and during World War II, several countries developed radar in secret. The United States Navy originated the term RADAR as an abbreviation for Radio Detection and Reconnaissance in 1940.

Radar, astronomy, air defence systems, antimissile systems, maritime radars to locate landmarks and other ships, aircraft anti-collision systems, ocean surveillance systems, outer space surveillance and rendezvous systems, meteorological precipitation monitoring; altimetry and flight control systems are some of the technologies used. In high-tech radar systems, digital signal processing is utilised to extract crucial information from very high noise levels.

2. THE STUDY'S OBJECTIVE

1 Create an ultrasonic RADAR.
2 To determine if an object is stationary or moving.
3 To determine the object's distance from the system.
4 To determine the angle at which the moving object is going.
5 To detect presence of living Organism using PIR Sensor.

3. REQUIRED COMPONENTS

ARDUINO UNO

Arduino Uno is a microcontroller board based on the ATmega328. On this board, you'll find 14 digital input/output pins, six analogue inputs, a 16MHz ceramic resonator, USB, a power connector, an ICSP header, and a reset button. It includes everything you need to get started with the microcontroller, including a USB cable for connecting it to your computer and a power source (AC-to-DC adapter or battery). The FTDI USB-to-serial driver chip is missing from the Uno, unlike earlier boards. Instead, a USB-to-serial converter, the Atmega16U2, is used.

ULTRASONIC SENSOR

Ultrasound is a type of sound that has frequencies that are higher than the human hearing limit. Ultrasonic sound waves are emitted, and the reflected sound is converted into an electrical signal. Ultrasonic waves travel quicker than audible sound waves.

when a pulse of at least 10 S is received by the Trigger pin (10 microseconds). The sensor responds by emitting an eight-pulse 40 kHz sound burst. The "ultrasonic signature" of the device is easily identifiable owing to an 8-pulse sequence that allows the receiver to distinguish the broadcast pattern from ambient ultrasonic noise. Eight ultrasonic pulses go away from the transmitter via the air. Meanwhile, the Echo pin is set to HIGH to begin the creation of the echo-back signal. If the pulses are not reflected back, the Echo signal will timeout and return low after 38 milliseconds (38 milliseconds). As a consequence, a pulse of 38 milliseconds shows that there is no blockage in the sensor's detecting range.

SERVO MOTOR

A servo motor is a rotary actuator or motor that enables for accurate positioning, acceleration, and velocity control. It essentially possesses abilities that a standard motor lacks. As a result, it employs a conventional motor in conjunction with a position feedback sensor. The servo motor is most typically utilised in high-tech industrial applications like as automation. It's a self-contained electrical device that efficiently and precisely rotates machine parts. This motor's output shaft can also be angled. Servo motors are commonly

found in consumer electronics, toys, automobiles, aeroplanes, and other machines.

PIR SENSOR

PIR sensors can detect animal/human movement within a certain range. A pyroelectric sensor detects differing levels of infrared light, which is what PIR is built of. The detector does not emit energy; instead, it passively absorbs it. The infrared radiation of the environment is detected. Focusing on the optical system causes the pyroelectric device to create a sudden electrical signal when infrared light from a human body particle with temperature is present.

Simply said, the first slot of the PIR sensor is intercepted when a human or animal approaches. As a result, there is a positive difference between the two bisects. The sensor creates a negative differential shift between the two bisects when a human departs the detecting zone.

BUZZER

A buzzer comes in the mechanical form of a small rectangular or cylindrical enclosure with an electrical connection for direct placement on a stiff printed circuit or a flexible electrical connection. The buzzer in this example has two little brackets. The decibel level of such a component is around 85 dB / cm.

LCD Display

This block's LCD panel connected to the microcontroller through an output connector. This is a 16-character, two-line LCD module that can show numbers, letters, and images. The display has two internal byte-wide registers, one for commands (RS=0) and the other for displayed characters (RS=1). It also has a user-programmable Ram region (the character RAM) that may be created using a dot matrix to generate any desired character.

ARDUINO IDE SOFTWARE

Based on the IDE for the Processing programming language, the Arduino integrated development environment (IDE) is a Java-based cross-platform tool for the Processing programming language and Wiring applications. It's intended for artists and other newbies who aren't familiar with software development to learn how to programme. It comes with a code editor that has syntax highlighting, brace matching, and automatic indentation, as well as the ability to construct and publish programmes to the board with a single click. For the Arduino platform, a "sketch" is a programme or code. C or C++ is used to write Arduino programmes. The Arduino IDE incorporates the "Wiring" software library from the original Wiring project, which simplifies many basic input/output functions.

PROCESSING SOFTWARE

Processing is an open-source programming language and integrated development environment for the electronic arts, new media art, and visual design communities (IDE). It was created as a basis for electronic sketchbooks and to teach computer programming concepts in a visual format. The project was founded in 2001 by Casey Reas and Benjamin Fry, both former members of the MIT Media Lab's Aesthetics and Computation Group. One of Processing's declared purposes is to provide immediate visual feedback to help nonprogrammers get started with programming. The language is similar to Java, but it features a simpler syntax and graphics programming models.

4. METHODOLOGY

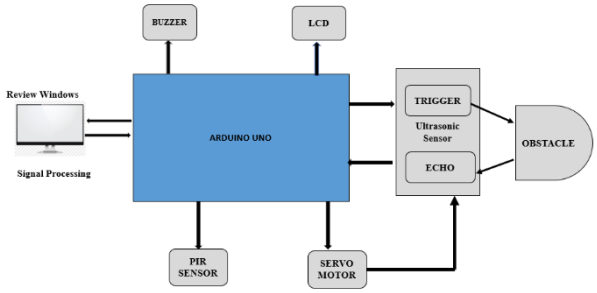


Fig 1: Block Diagram of Radar System

The suggested system design depicts how the model works with the necessary features. The ultrasonic sensor is mounted on a servomotor to cover the Radar's angle range. When an item stops a sensor that emits a large number of radio waves, the ultrasonic sensor returns as if it has located the object and records its distance and location. The Arduino controller is then used to send the data. An Arduino controller is just a board containing a set of digital input and output pins that may be used to connect hardware and software components. The signal is generated and shown on a monitor screen when the signals from the ultrasonic sensor are transferred to the Arduino board. The servomotor's position is specified via code on the Arduino.

5. EXPERIMENTAL SETUP

6. Ultrasonic sensor interfacing with Arduino

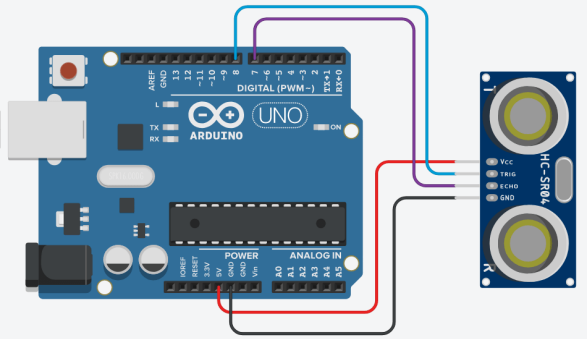


Fig 2: Ultrasonic sensor interfacing with Arduino
PIR sensor interfacing with Arduino

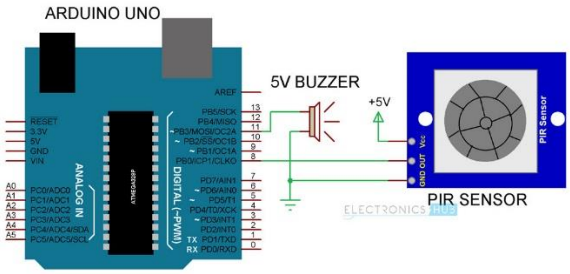


Fig 3: PIR sensor interfacing with Arduino
LCD interfacing with Arduino

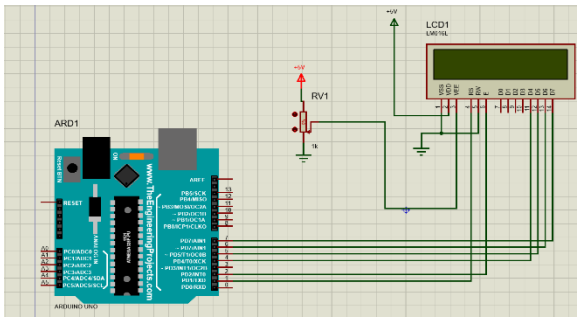


Fig 4: LCD interfacing with Arduino

Final setup

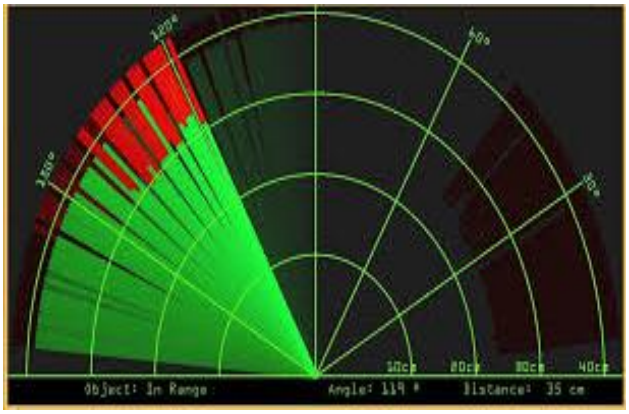
Fig 5: Final setup

7. RESULT ANALYSIS

Our system is made up of the following components, as stated in this study report: a servomotor, an ultrasonic sensor, and a microprocessor (Arduino). The system's purpose is to maintain track of distance and object orientation and display this information graphically. Its output should be in the form of a graph, which will be represented by processing software. Looking at the graph below, we can get an idea of how effective this radar is.

Observe how quickly or seamlessly it recognises different items at different levels an object that it discovers in some way and informs us about the obstacle's expected range.

The results of our design's monitor screen when the sensor rotates through the area and identifies an obstruction are shown in the following figure. The presence of an obstruction is indicated by the red region, and the angle of impact and distance are presented below.



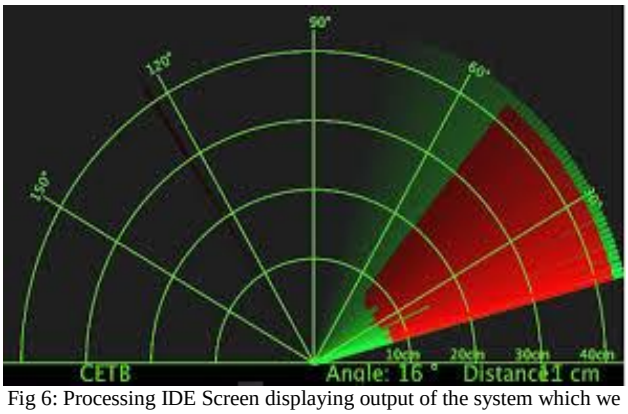


Fig 6: Processing IDE Screen displaying output of the system which we tested by placing objects.

8. CONCLUSION

In this study, we offer an improved method for quickly identifying objects. The features of the Arduino controller, as previously stated, provide an additional benefit in swiftly locating long-distance objects using C/C++ and showing them on the screen as a Radar function. This technology can be more effectively applied to future technologies.

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