

Radar System using Arduino and Ultrasonic Sensor

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ABSTRACT- The application of radio detection and ranging in different places, such as military installations and commercial use, is done with the help of a RADAR SYSTEM, which uses electromagnetic waves for the detection of different physical components, such as distance, speed, position, range, direction, size, etc., which can be either fixed or in motion. The use of radar systems has greatly advanced, especially in navigation. In this research, we study existing navigation technologies and propose an Arduino-based radar system. It has an advantage over other radar systems, as the kit reduces power consumption and connects to a wide range of Arduino boards and open-source code. The system consists of a basic ultrasonic sensor mounted on a servo motor that rotates to a specific angle and at a specific speed. This ultrasonic sensor is connected to Arduino digital input/output pins, and the servo motor is also connected to them.

KEYWORDS- Arduino, Ultrasonic sensor, Servo motor, Simulation,

INTRODUCTION: -

We know that everything produces a sound wave just by its existence and the flow of air around it, with its natural frequency. These frequencies are beyond the hearing range of humans. Waves with a frequency range of 20000Hz and thereabouts are called ultrasonic waves, and these waves can be detected by an ultrasonic sensor, which helps us gain various insights. An Ultrasonic detector usually has a transducer that converts sound energy to electrical energy and electrical energy back to sound energy. They are used for measuring object position and orientation, collision avoidance systems, surveillance systems, etc. Ultrasonic technology provides relief from linear measurement problems by allowing non-contact measurements; in this way, the distance between objects and their speed, etc., can be easily measured. The speed of travel of a sound wave depends upon the square root of the ratio between the medium's density and stiffness. Also, the speed of sound can be affected by natural environmental conditions, such as temperature. So basically, an ultrasonic sensor emits ultrasonic waves that travel through the air and are reflected when they strike an object. By studying the properties of reflected waves, we can learn about an object's distance, position, speed, etc. Processing and Arduino software are used with the hardware system to detect various object parameters. One of the most common applications of ultrasonic sensors is range finding. It is also called sonar, which is the same as radar, in which ultrasonic sound is directed in a particular direction. If there is any object in its path, it strikes it and is reflected; after calculating the time taken to return, we can determine the distance to the object. In real life, this method is used by bats.

DESIGN IMPLEMENTATION OF RADAR SYSTEM

The figure below shows the development life cycle of the Radar project, which includes component design and testing, component implementation, and the implementation of the entire system and its testing. These steps can be enumerated into the following stages

- a) Hardware System Design.
- b) Hardware Circuit Design.
- c) Hardware System implementation.
- d) Hardware unit testing.
- e) GUI System Design.
- f) GUI System Implementation
- g) GUI unit testing.

- h) Entire system integration.
- i) Entire system testing.



Figure 1: Block diagram of Arduino-based radar system.

a) Hardware system design for Arduino:

A hardware system consists of 3 components: an Arduino, a servo motor, and an ultrasonic sensor. An ultrasonic sensor is mounted on a servo motor, which helps it move and provides it with a turning mechanism. Both the ultrasonic sensor and the servo motor are controlled and powered by the Arduino. As shown in Figure 1 above, both the ultrasonic sensor and the servo motor are powered by the Arduino.

b) System circuit design:

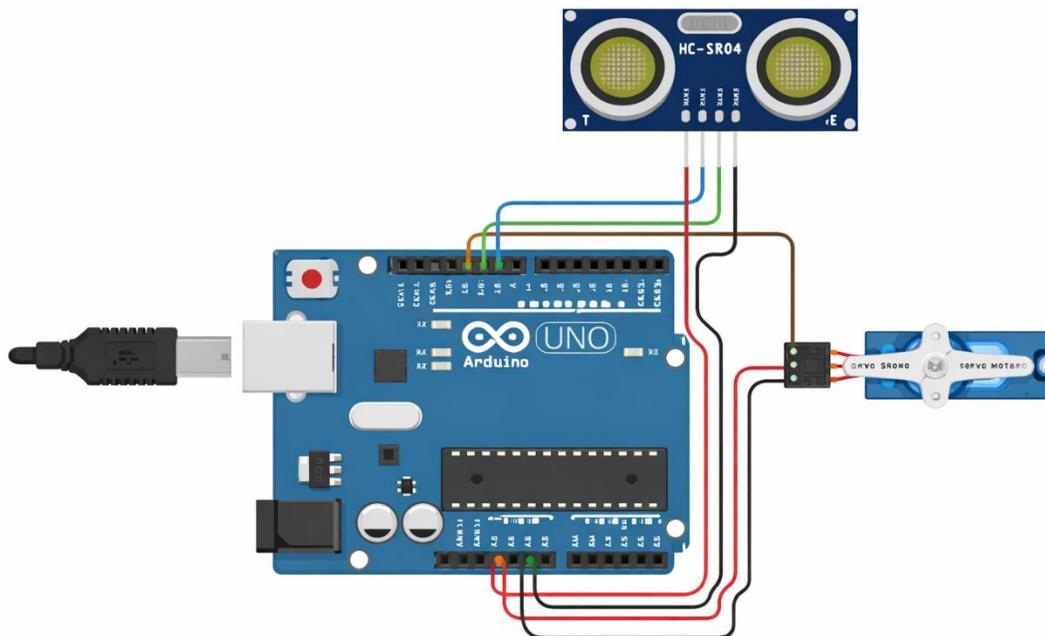


Figure 2: Arduino radar hardware setup diagram.

Figure 2 shows a hardware system designed in the Fritzing environment. It shows the connections between different electronic components. In the figure, the triggering pin of the ultrasonic sensor is connected to the Arduino's D8 pin, the servo motor's control line is connected to the Arduino's D6 pin, and the Arduino's D7 pin is connected to the ultrasonic sensor's echo pin.

The VCC pins of the servo motor and the ultrasonic sensor are connected to the Arduino's 5V pin. In contrast, the Arduino ground pin is connected to the ground pins of both the servo motor and the ultrasonic sensor.

c) System circuit implementation on a breadboard:

Figure 3 shows the complete hardware implementation. It can be seen that the ultrasonic servomotor is placed upon a servo motor. Arduino IDE was used to write code and upload it to the Arduino. The Arduino code reads the servo motor's position and calculates the distance to the nearest object in the path.

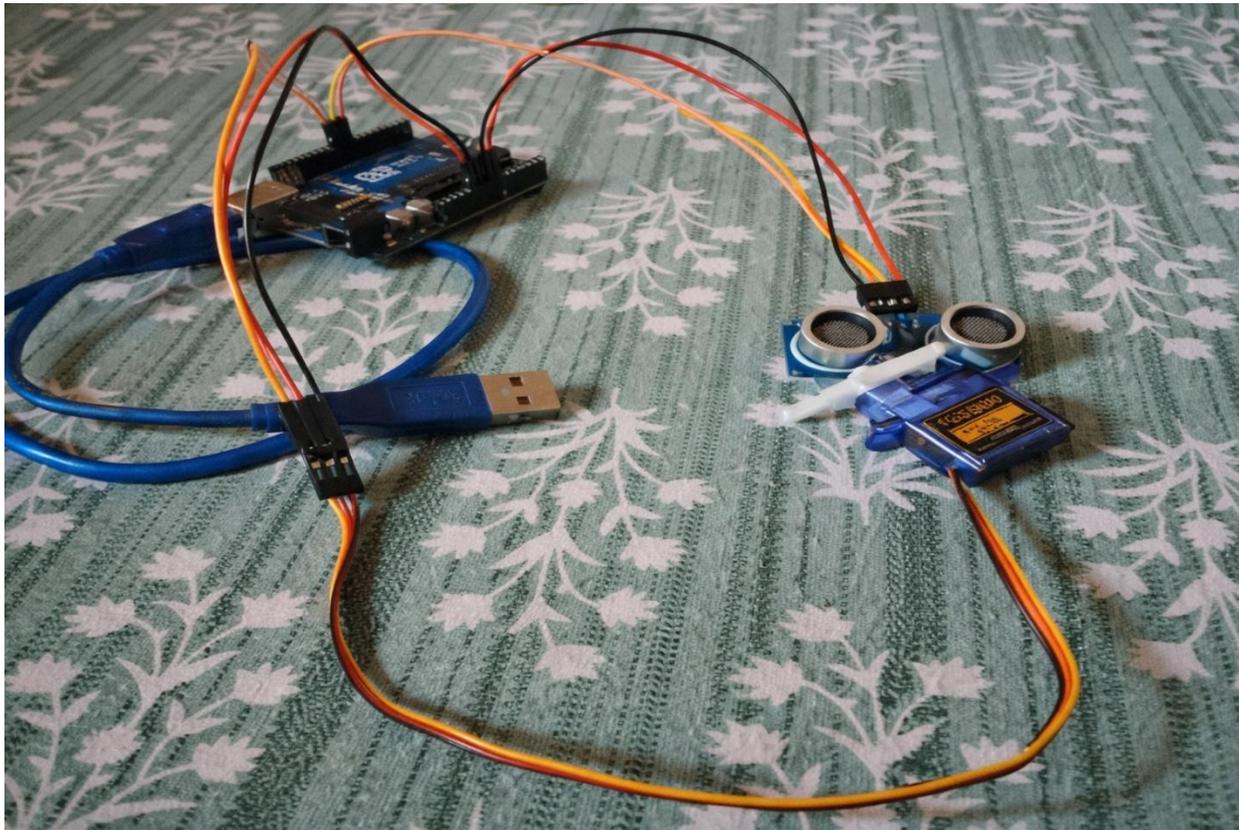


Figure 3. Hardware system implementation.

WORKING:

This project aims to calculate the object's distance, position, and speed at some distance from the sensor. An ultrasonic sensor sends an ultrasonic wave in different directions by rotating with a servo motor. This wave travels through the air and is reflected after striking an object. The sensor again senses this wave; its characteristics are analysed, and the output is displayed on the screen, showing parameters such as the object's distance and position. The Arduino IDE is used to write code and upload it to the Arduino, and it helps us sense the position of a servo motor and post it to the serial port along with the distance to the nearest object in its path. The sensor output is displayed in processing software, which produces the final output on the display screen.

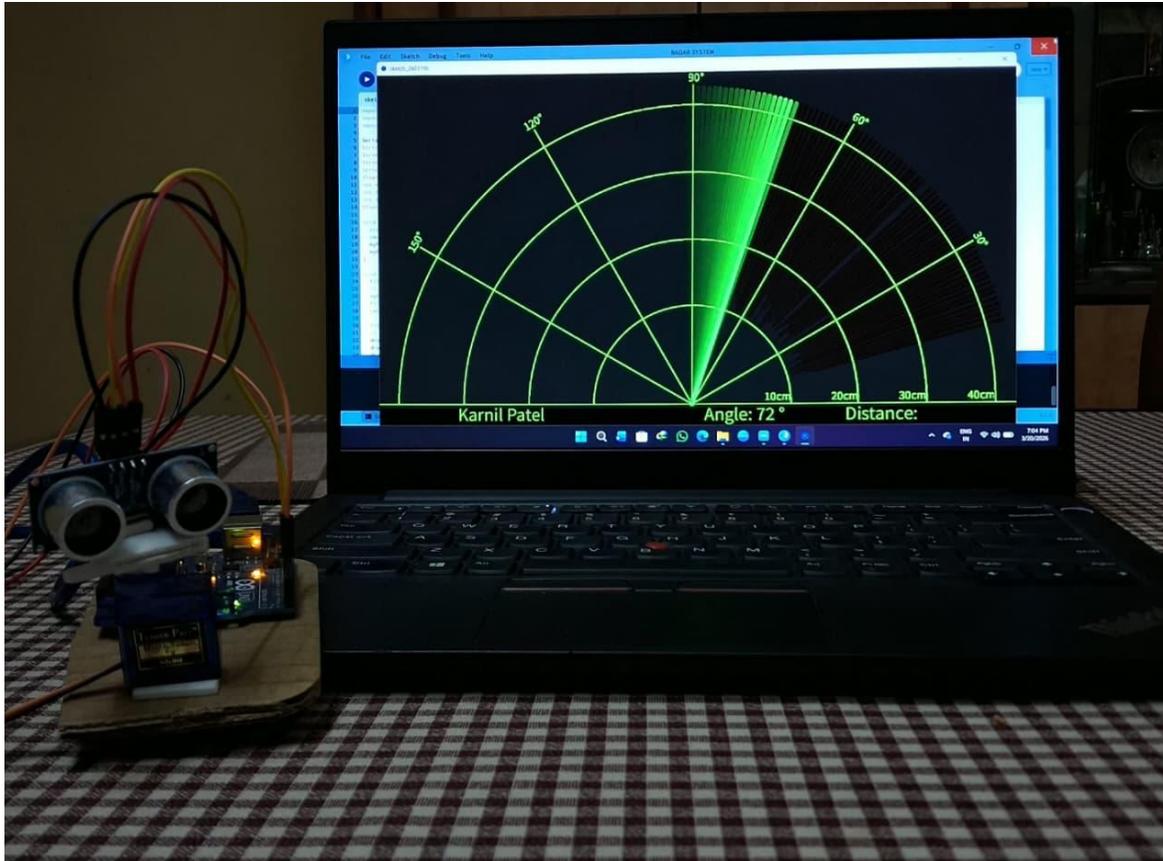


Figure 4: RADAR Output on Processing IDE

d) Hardware description:

Ultrasonic sensor

An ultrasonic sensor works similarly to sonar. It can measure the distance to an object by sending sound waves. Sound waves are sent at a specific frequency in a specific direction and listened for to come back. The time taken for the sound wave to return helps us determine the distance to the object.



Figure 5: Ultrasonic sensor and servo motor

Servo motor

A servomotor is a rotary actuator that allows for precise control of angular position, velocity, and acceleration. It consists of a suitable motor coupled to a position sensor. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a different class of motor based on a fundamental operating principle; they use a servomechanism to achieve closed-loop control with a generic open-loop motor. Servomotors are used in applications such as robotics, CNC machinery, or automated manufacturing.

Arduino

The Arduino is an open-source electronics platform based on easy-to-use hardware and software. The open-source Arduino software makes it easy to write code and upload it to the board. It runs on Windows, macOS, and Linux. The environment is written in Java and is based on Processing and other open-source software. This software can be used with any Arduino board. The Arduino IDE includes a code editor, a message area, a text console, and a toolbar with buttons for common functions. It connects to Arduino and Genuino hardware to upload programs and communicate with them. Programs written using Arduino software are called sketches.



Figure 6: Arduino Board

ADVANTAGES:

- Radar procurable value is very low
- Working and maintenance value is low
- Distance active resolution is high
- Radar's jam is troublesome
- It can work in any place
- NASA uses radio detection and ranging to map the world and alternative plants
- Activity gets updated in conclusion

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Conclusion

In this paper, a radar system was designed using an Arduino, a servomotor, and an ultrasonic sensor, which can detect the position and distance of obstacles in its path and convert this information into a visually representable form. This system can

be used in robotics for object detection and avoidance, or for intrusion detection in locations of various sizes. The system's range depends on the type of ultrasonic sensor used. We used an HC-SR04 sensor with a range of 2-40 cm.

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