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Ultrasonic Radar Module Design Using Arduino

R. Ragavi[1*], A. Ramya[2], G. Sowndharya[3] & S. Sunmathy[4]

[1-4]*Department of Electronics and Communication Engineering, E.G.S. Pillay Engineering College, Nagapattinam, Tamilnadu-611002, India. Corresponding Author (R. Ragavi) Email: e20ecr058@egspec.org**

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ABSTRACT

Radar is a technique that detects and collects data about things using radio waves or microwaves. It is able to ascertain these objects' range (distance), height, direction, and speed. There are several uses for this technology across numerous industries. Rather of using broadcast and receive antennas to send out sound wave pulses, our radar technology uses ultrasonic sensors. These waves move through the atmosphere until they come into contact with an obstruction. A tiny amount of their energy is reflected back to the system when they come into touch with an item, and the system also records the reflected waves. While the waves are being captured, they contain important information about the object, like its direction, speed, or distance; by analyzing the received waves, the radar system can extract useful information about the object being detected. In recent times, digital signal processing has been incorporated into radar systems, allowing them to extract information even in noisy environments and achieve accurate results even in the presence of interference or other disturbances. Arduino boards, on the other hand, are multipurpose microcontrollers that can be programmed using the Arduino UNO IDE software. We may develop code in languages like C and C++ using this program. We may upload our code to the Arduino board by using a USB connection to link it to the computer. Applications for Arduino boards are numerous. They can be used, for instance, to projects that employ ultrasonic sensors to gauge an object's distance. The microcontrollers on the board may be configured to decipher the sensor's values and carry out different tasks in response to the information obtained.

Keywords: Arduino; Radar; Sensors; Microcontroller; Ultrasonic sensors.

1. Introduction

A technology called radar uses waves to identify objects and determine their location, height, direction, or speed. Ultrasonic radar is the application of ultrasonic waves in place of electromagnetic waves [1], [2]. Similar to radar, ultrasonic sensors function by listening for wave echoes. Radar information can be shown via LEDs, LCD displays, or sound alerts. In this work, we used an ultrasonic sensor to create basic radar. It measures angles between 15 and 165 degrees and distances between 3 and 40 cm without touching [3]-[5]. A tiny motor drives the sensors and specialized software displays the data on a PC screen [6]-[8].

This work aims to build a functional ultrasonic radar system that can keep an eye on a specific area. Since its inception, ultrasonic sensing technology has been used in a variety of applications, such as proximity detection in robots, home security systems, distance and tank level monitoring, and manufacturing lines. Numerous applications have made it feasible to fix technical issues more quickly and affordably without sacrificing stability, quality, or safety [9], [10].

2. Literature Review

Radar research and development have been incredibly successful, and they have significantly altered computers. In due course, the researchers working on radar will be able to create, develop, and enhance security and user interfaces, as well as be able to meet the specified performance requirements in various environments [11]-[14]. An ultrasonic radar is an object detection system that uses ultrasonic waves in place of electromagnetic waves to determine the location, velocity, direction, and altitude of both moving and stationary objects, including cars, ships, airplanes, weather formations, and terrain [15]. Ultrasonic Sensors are the primary parts of any ultrasonic radar.

Similar to radar or sonar, ultrasonic sensors assess a target's characteristics by deciphering the echoes of radio or sound waves. In order to measure the presence of any obstacles in front of the sensor and to ascertain the range and angle at which the obstacle is detected by the sensor, this project uses an ultrasonic sensor that is connected to a raspberry pi board. The signal from the sensor is then provided to a laptop screen [16], [17]. The apparent shift in frequency or pitch that occurs as a sound source travels toward or away from the listener, or when the listener moves toward or away from the sound source, was first described as the Christian Doppler effect in 1842. The work published in 2010 by Milenko et al., describes the database of radar echoes from different targets. The public can obtain the database. This research uses spectrum analysis to obtain fundamental information that may be applied to categorization [18], [19].

3. Proposed Model

A radar module is a tool used for surveying, focusing shots, and precisely targeting weapons. It estimates the distance between the target and the observer. In this survey study, we create basic radar employing an ultrasonic sensor. This radar measures a range of non-contact distances from 3 to 40 cm and an angle range of 15 to 165.A tiny servo motor is used to regulate the sensor's movement. Processing Development Environment" program will utilize data from the sensor to display the outcome on a PC screen.

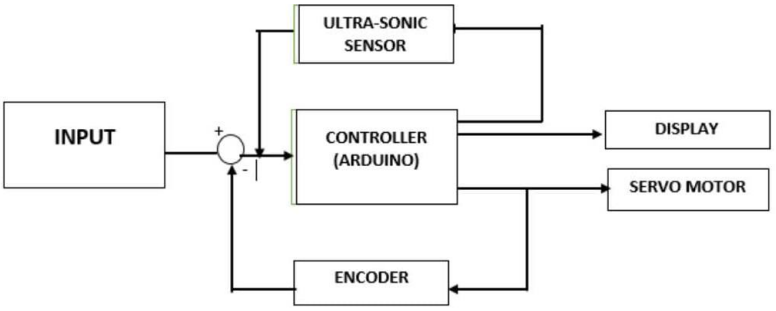

Figure 1. Block diagram of the proposed system

3.1. Flowchart Description

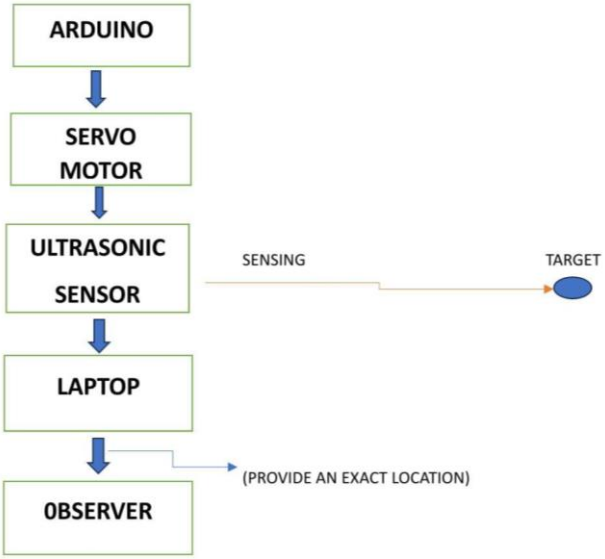

Figure 2. Flowchart

3.2. Circuit Connection

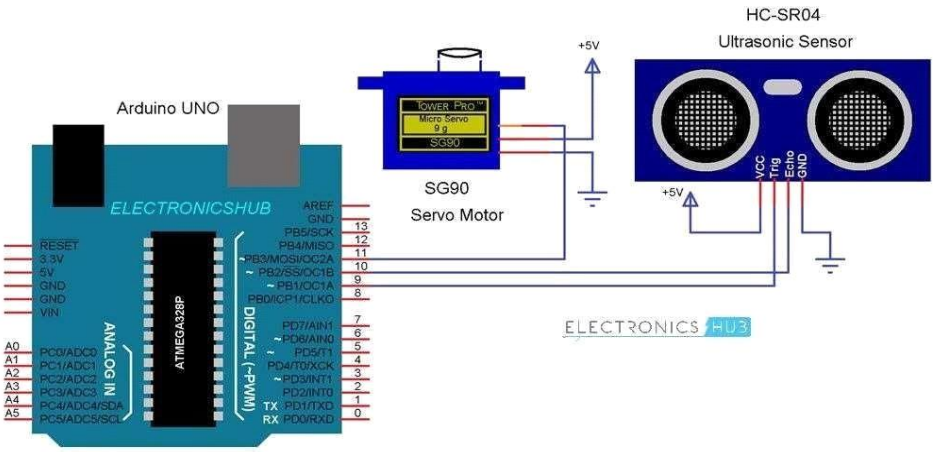

Figure 3. Circuit connection

4. Results and Discussions

Our radar system uses the object's echolocation, and it was built with an Arduino microcontroller. An open source electronics platform built on user-friendly hardware and software is called Arduino. Ultrasonic sensors are among the inputs that Arduino boards can read. A proximity sensor that detects an object's distance is called an ultrasonic sensor. By sending out ultrasonic waves and receiving back reflected waves, it detects the item and turns them into an electrical signal. The speed of these sound waves surpasses the audible sound speed for humans. The transmitter and the receiver are its two major parts. A piezoelectric crystal is used by the transmitter to produce sound, which is then perceived by the receiver after it has traveled to and from the target. is a transducer that transmits signals about objects; it uses an Arduino to communicate data with the user and estimate an object's distance.A servo motor is being used here. A separate servo mechanism may be used to drive the servo motor, which is a basic DC motor, to rotate at a particular angle. This motor will only turn in the desired increments before stopping. A conventional electric motor starts and stops based on the power input; this is not the case with a servo motor. The signal will determine how the servo motor operates. It is utilized in our project to detect objects at a 180-degree angle. These parts are joined to create an Arduino-based Ultasonic radar module design.

4.1. Stimulated Output

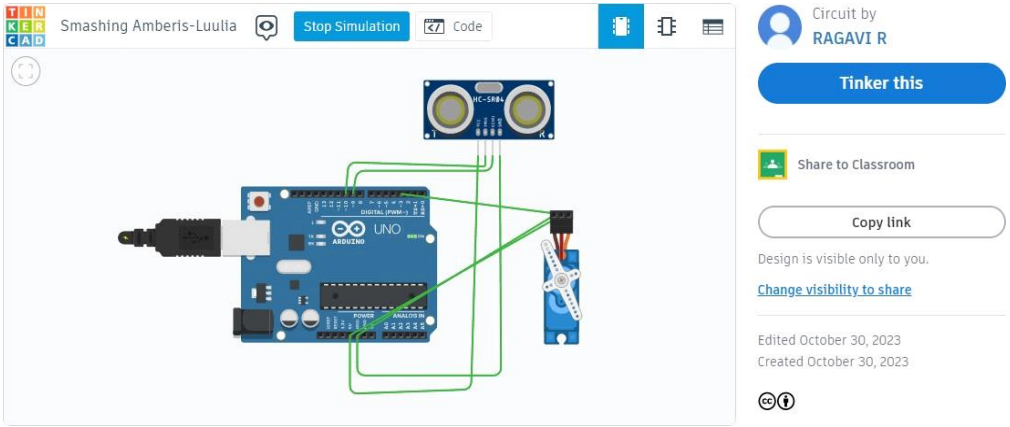

Figure 4a. Tinkercad stimulated output at 80 degree

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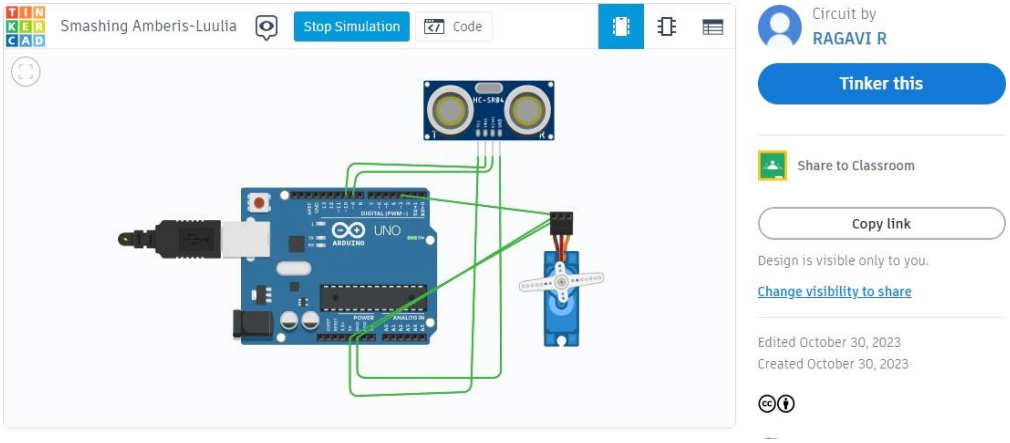

Figure 4b. Tinkercad stimulated output at 180 degree

4.2. Hardware Output

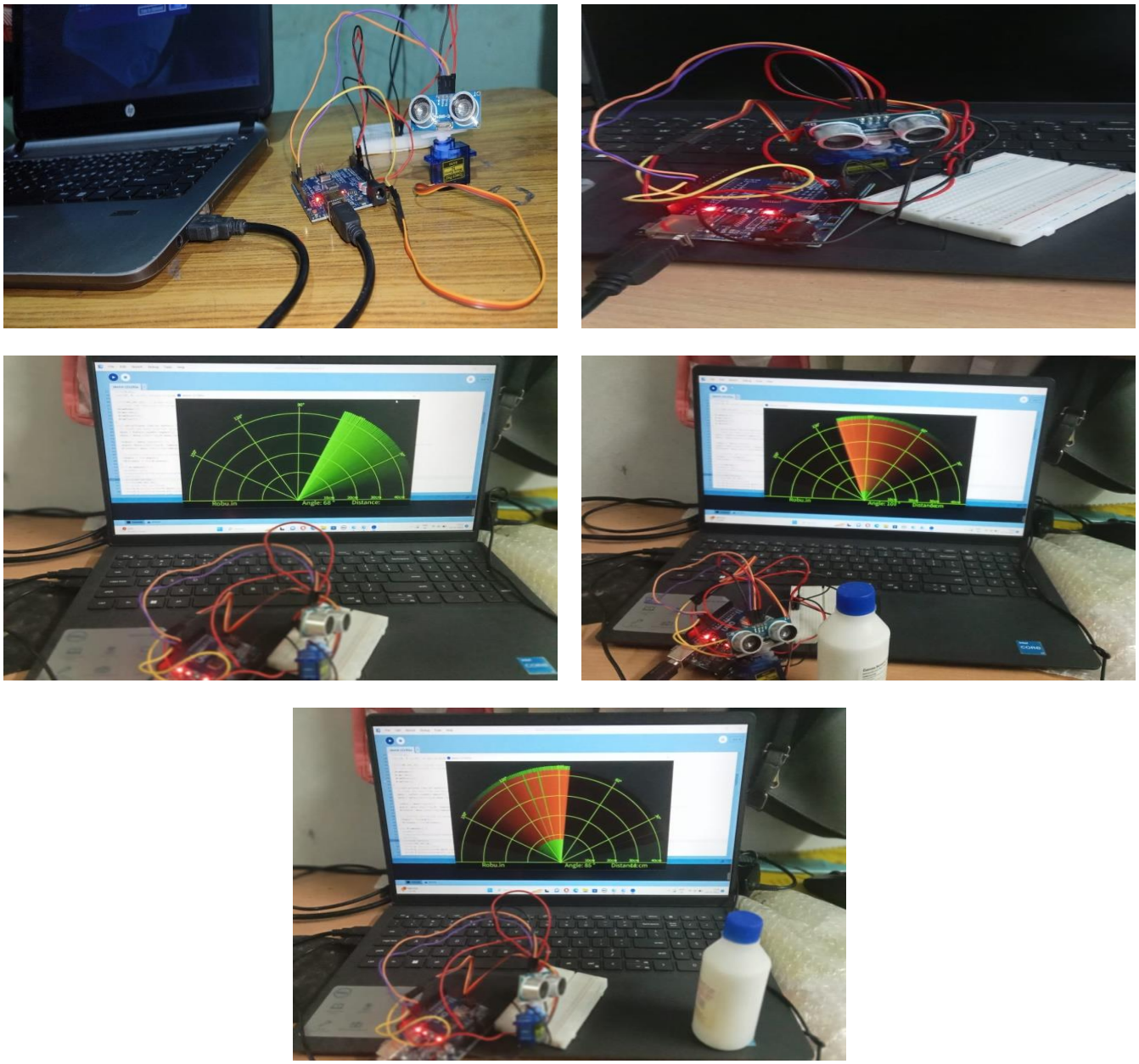

Figure 5. Outputs of the proposed system

5. Conclusion

Make a radar module with an Arduino and an ultrasonic sensor. By generating ultrasonic waves and timing their return after colliding with an item, the ultrasonic sensor calculates its wave length. You may find the position and existence of items within the sensor's range by estimating the distance based on the time taken. You may analyze this data, show it on a screen, or visualize it in a number of inventive ways using the Arduino. Testing the system can be used to carry out the findings. The code for this project is implemented using references to a number of articles. The analysis of each of these articles will form the basis of the outcome. Radar is an electromagnetic system that uses electromagnetic waves to detect targets and occasionally identify them. It works by sending out electromagnetic signals, picking up echoes from targets inside its coverage area, and deriving other information from the echo signals, such as the target's position. This project aims to build a functional ultrasonic radar system that can keep an eye on a specific area. Industries can make advantage of this system.

Declarations

Source of Funding

This study has not received any funds from any organization.

Conflict of Interest

The authors declare that they have no conflict of interest.

Consent for Publication

The authors declare that they consented to the publication of this study.

Authors' Contribution

All the authors took part in literature review, research, and manuscript writing equally.

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