NANDHA ENGINEERING COLLEGE, ERODE

(AUTONOMOUS)

(Affiliated to Anna University, Chennai)

ULTRASONIC RADAR WITH ARDUINO

A PROJECT BASED LEARNING REPORT

Submitted by

DHINESH A	**21EC015**
GAYALVANAN V	**21EC018**
GOKUL R	**21EC019**
GOWTHAM M	**21EC024**
JASWANTH T	**21EC033**

In partial fulfilment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

ELECTRONICS AND COMMUNICATION ENGINEERING

April 2024

NANDHA ENGINEERING COLLEGE, ERODE

(AUTONOMOUS)

(Affiliated to Anna University, Chennai)

BONAFIDE CERTIFICATE

Certified that this project report "**ULTRASONIC RADAR WITH ARDUINO"** is the bonafide work of **"DHINESH A, GAYALVANAN V, GOKUL R, GOWTHAM M, JASWANTH T** " who carried out the Project Based Learning work under my supervision.

SIGNATURE,

Ms. S. BRINDHA,

Assistant Professor/ECE

PBL COORDINATOR,

Department of ECE,

Nandha Engineering College,
(Autonomous)
Erode-638052.

ACKNOWLEDGEMENT

The success of a work depends on the team work and co-operation various involved either directly or indirectly.

We express our sincere thanks to our beloved Chairman of Sri Nandha Educational Trust **Thiru.V.Shanmugan** and our beloved Secretary, **Thiru.S.Thirumoorthi** of Nandha Engineering College for providing us all the basic amenities to complete the course successfully.

We wish to express our deep sense of gratitude and thanks to our beloved Principal **Dr.U.S.Ragupathy** for the excellent facilities provided during the course study and project work.

We wish to express our hearty thanks to **Dr.S.Kavitha**, Professor & Dean, **Dr.C.N.Marimuthu**, Professor & Dean (R&D), Department of Electronics and Communication Engineering for providing continuous support during the project work.

We are highly indebted to our project guide **Ms.S.Brindha** Assistant Professor, Department of ECE, for her guidance and motivation in completing the project.

We thank all the Teaching and Non-Teaching staff members of Electronics and Communication Engineering Department for their support to our project work. We also express our thanks to our family members and friends for their encouragement, timely help and suggestion.

TABLE OF CONTENT

ABSTRACT

The “Ultrasonic Radar with Arduino” is an electronic device which consists or contains radio waves to detect the object means to find the distance, angle of the object and range as we know the radar is a radio detection and ranging. So, In this project we use ultrasonic sensors in place of radar because both work the same but the main difference is that the ultrasonic sensor uses sound waves to find, detect the distance, angle of velocity and range of the object. So, In this project we will use an ultrasonic sensor, servo motor and Arduino. Now servo motor is used to rotate the ultrasonic sensor and arduino used for the processing of our project, all with this we also used two software that is Arduino IDE and other is Processing app. In this we use Arduino IDE to embed the code in arduino and with the processing app we process our project. So, In this project we will show how our projects work and show, detect the distance and angle of the object and how it is shown on the pc with the help of an arduino and ultrasonic sensor.

There is small kind of the information that we will give on the abstract that in this project we put some object ahead of the ultrasonic sensor but when there is no object it will show only green graph only on the screen and not shown any thing in any position but when we put some object in some position than when the ultrasonic sensor means radar comes ahead of this object it will show a red lines on this graph on this position and also shows angle , distance of this object which is basically made for local patch areas like our borders.

CHAPTER 1
INTRODUCTION

The RADAR is the process of locating things by using radio waves to establish their dimensions, height, direction, or speed. There are different sizes and performance requirements available for RADAR systems. These systems provide a variety of functions, including long-distance surveillance and early warning systems, as well as air traffic control in airports. A RADAR system is a crucial part of a missile guidance system. RADAR systems are available in huge systems that fill room-sized spaces as well as smaller systems that are easily maintained individually. During World War II, many countries developed radar technology in secret. In 1940, the US Navy created the abbreviation RADAR for radio detection and other related innovations. The use of radar in various air traffic control systems, including astronomy, air defence, and anti-missile systems, has evolved throughout time. It is also used in marine surveillance systems for identifying ships and aircraft collision avoidance systems. Additionally, radar technology has been adapted for outer space monitoring and rendezvous systems. High-tech radar systems are often associated with digital signal processing. In the remaining part of the paper the literature survey, experimental setup, flowchart, results, conclusion are described briefly in different sections.

CHAPTER 2
HARDWARE DISCRIPTION

2.1.Ultrasonic Sensor HC-SR04

Figure 2.1. Ultrasonic Sensor HC-SR04

The HC-SR04 ultrasonic sensor represents a key innovation in the realm of distance measurement and object detection. Its popularity stems from its affordability, simplicity, and remarkable accuracy. Utilizing ultrasonic waves, the HC-SR04 sensor operates on the principle of echolocation, emitting a burst of ultrasonic pulses and measuring the time it takes for the waves to bounce off an object and return to the sensor. With a detection range of up to several meters and precision measured in centimeters, the HC-SR04 sensor finds applications in robotics, automation, security systems, and more. Its straightforward interfacing via a few simple pins, typically Trigger, Echo, VCC, and GND, makes it accessible even to beginners in electronics and programming.

By integrating the HC-SR04 sensor into projects, developers can enable their creations to perceive and interact with the surrounding environment, whether it's avoiding obstacles, measuring distances, or triggering actions based on proximity. In summary, the HC-SR04 ultrasonic sensor serves as a versatile and indispensable tool in the arsenal of hardware enthusiasts, engineers, and hobbyists, driving innovation and enabling the realization of diverse projects and applications.

2.1.1.Pinout of HC-SR04

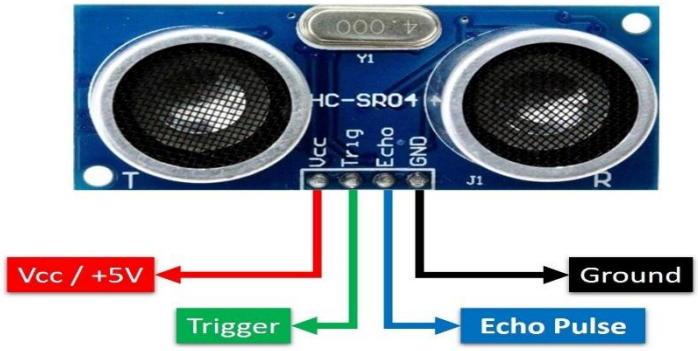

Figure 2.2. Pinout of ESP32

2.1.2.Features of HC-SR04

- Operating voltage: +5V
- Theoretical Measuring Distance: 2cm to 450cm
- Practical Measuring Distance: 2cm to 80cm
- Accuracy: 3mm
- Measuring angle covered: <15°
- Operating Current: <15mA
- Operating Frequency: 40Hz

2.2.Servo Motor SG-90

Figure 2.3.Servo Motor SG-90

The SG90 servo motor is a compact yet powerful component extensively used in robotics, hobbyist projects, and various applications requiring precise control over angular motion. Weighing only 9 grams and measuring approximately 23mm x 12mm x 29mm, its small size is deceptive considering its impressive torque output of around 1.5kg/cm at 4.8V. With a rotational speed of about 0.1 sec/60°, it offers swift and accurate positioning, making it invaluable in tasks demanding precision. Sporting a three-wire interface for control—comprising power, ground, and signal—the SG90 servo motor is remarkably easy to integrate into projects. Internally, it boasts a robust construction consisting of a DC motor, gears, and control electronics, ensuring reliable performance in diverse environments. Whether it's controlling robotic limbs, steering mechanisms in remote-controlled vehicles, or animatronic characters' movements, the SG90 servo motor excels, thanks to its versatility, affordability, and ease of use. Its widespread adoption underscores its importance as a fundamental component in countless projects worldwide, driving innovation and creativity in the realm of motion control and robotics.

2.3.Arduino Nano

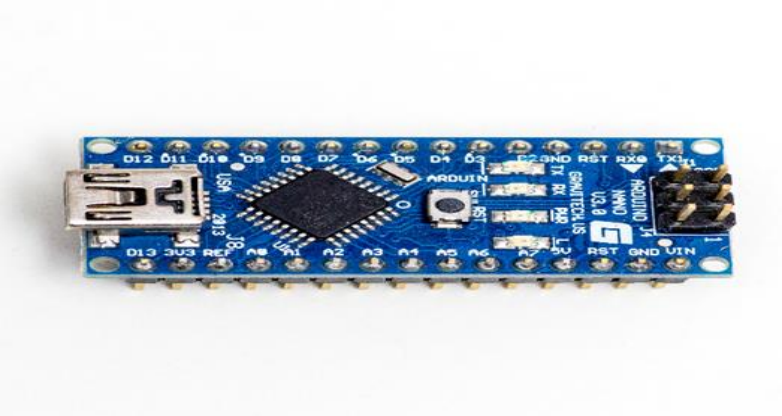

Figure 2.3. Arduino Nano

The Arduino Nano is a compact yet powerful microcontroller board based on the ATmega328P microcontroller chip. Developed by Arduino, it offers the same functionality as the Arduino Uno but in a smaller form factor, making it ideal for projects with space constraints or those requiring a lightweight solution. The Nano retains compatibility with the Arduino ecosystem, including the Arduino Integrated Development Environment (IDE) and extensive libraries, ensuring a smooth transition for users familiar with other Arduino boards.Despite its small size (approximately 18mm x 45mm), the Arduino Nano boasts a wide range of features.

It includes 14 digital input/output pins (of which 6 can be used as PWM outputs), 8 analog inputs, and a 16 MHz crystal oscillator. Additionally, it incorporates onboard voltage regulation, enabling it to operate at voltages ranging from 5V to 12V, making it compatible with a variety of power sources.

The Arduino Nano's versatility makes it suitable for a myriad of projects across different domains, including robotics, home automation, IoT (Internet of Things), wearable technology, and more.

Its small size and low power consumption make it particularly well-suited for portable and battery-powered applications.Programming the Arduino Nano is straightforward using the Arduino IDE, which offers a user-friendly interface and a vast library of pre-written code examples. Users can write and upload sketches to the Nano via USB, allowing for rapid prototyping and iteration.

The Arduino Nano is a versatile and compact microcontroller board that offers the flexibility and power of the Arduino platform in a small package. Whether you're a beginner looking to learn about electronics and programming or an experienced maker working on complex projects, the Arduino Nano provides an excellent platform for experimentation, innovation, and creativity.

2.4.Type B Mini USB Cable

Figure 2.3. Type B Mini USB Cable

The Arduino Nano typically uses a USB Type-B cable for programming and power supply. This cable has a Type-A connector on one end, which plugs into your computer's USB port, and a Type-B connector on the other end, which plugs into the Nano's USB port. The Type-B connector is often referred to as a "printer-style" connector due to its common use in connecting printers and other devices to computers.It's important to ensure that the USB cable you use with your Arduino Nano is capable of both data transfer and providing power. Some cables may only be suitable for charging devices and may not support data communication, so it's recommended to use a cable specifically designed for data transfer. When selecting a USB cable for your Arduino Nano, you should also consider the length of the cable based on your setup and the distance between your computer and the Nano. Longer cables may be necessary for setups where the Nano is located further away from the computer, while shorter cables can help minimize clutter in compact setups.Overall, the Arduino Nano cable is a standard USB Type-B cable used for programming and powering the Nano, providing a convenient and versatile connection between the Nano and your computer.

CHAPTER 3
SOFTWARE DISCRIPTION

3.1.Processing

Processing stands as a pivotal tool in the intersection of art and technology, offering a programming language and environment specifically tailored for the realms of visual arts, interactive media, and design education. Developed by Casey Reas and Ben Fry from the MIT Media Lab in 2001, it was conceived to make programming accessible and appealing to artists, designers, and educators, thereby democratizing the ability to create complex digital and interactive visualizations. As an extension of Java, Processing simplifies many of the more complex programming concepts, focusing on a straightforward syntax and robust support for graphics and interactivity. Its IDE enables immediate visual feedback, critical for artists and designers who rely on iterative processes to refine their work. The vibrant community around Processing has extended its capabilities significantly through the development of libraries that support everything from real-time video processing to integration with external hardware like Arduino, making it an invaluable educational tool and a staple in digital art and design studios. This thriving ecosystem not only supports professional artists and designers but also plays a crucial role in education, where it is used to introduce students to the concepts of programming within a visually engaging and contextually relevant framework. Processing's ease of use, combined with its powerful capabilities, continues to inspire a new generation of creators who blur the lines between technology and art, leading to innovative projects that reshape how we interact with and perceive our digital and physical environments.

CHAPTER 4

PROJECT DESCRIPTION

4.1.Block Diagram

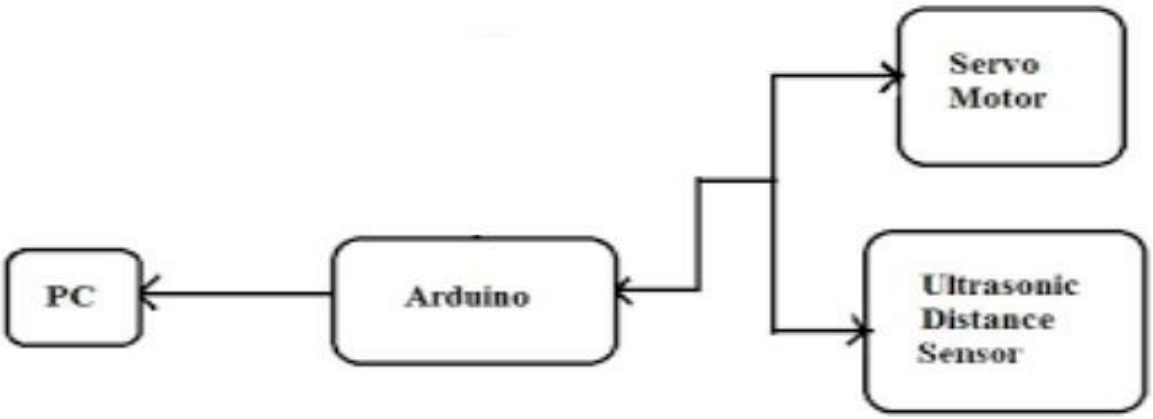

Figure 4.1.Block diagram of Ultrasonic Sensor with Arduino

4.2.Circuit Diagram

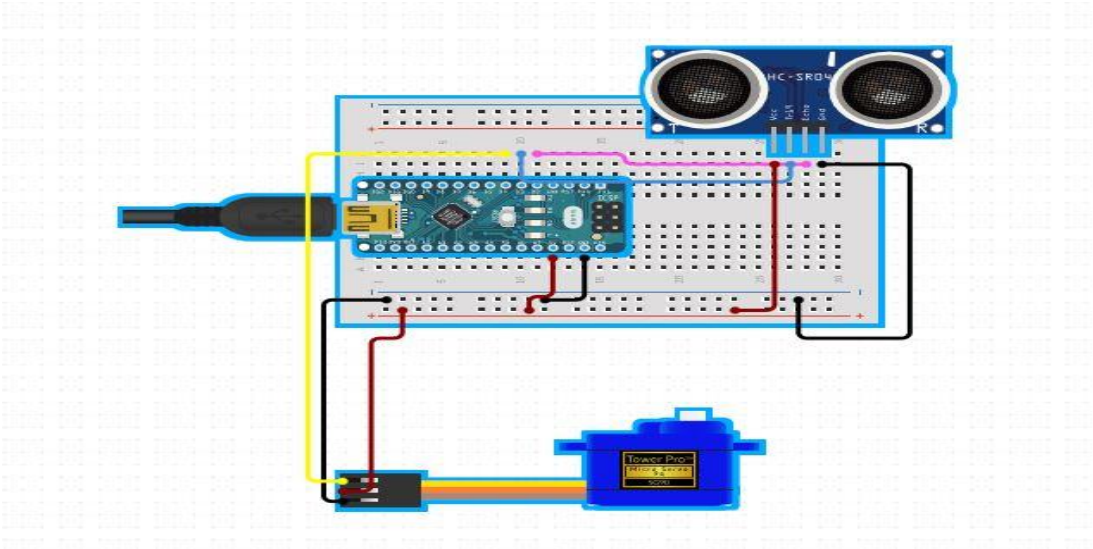

Figure 4.2.Circuit diagram of Ultrasonic Sensor with Arduino

4.3.Working Operation

The Ultrasonic Radar system, employing an Arduino Nano microcontroller board, is a sophisticated solution for object detection and distance measurement. At the heart of the system are HC-SR04 ultrasonic sensors, which emit bursts of high-frequency sound waves into the environment. These waves propagate until they encounter an object, at which point they bounce back to the sensor, creating an echo. By precisely measuring the time it takes for these echoes to return, the Arduino Nano calculates the distance to the detected objects using the speed of sound as a reference.

The Arduino Nano serves as the brain of the operation, receiving and processing the sensor data in real-time. Through programmed algorithms, it interprets the incoming signals, extracts relevant information, and determines the distance of detected objects with high accuracy. Additionally, the Nano coordinates the movement of servo motors, which are responsible for controlling the rotational scanning of the ultrasonic sensors.

The servo motors enable the sensors to sweep across a designated area systematically, scanning for objects within the system's detection range. As the sensors scan, the Nano continuously processes the incoming data, updating the system's output to reflect any changes in the environment. This synchronized operation ensures comprehensive coverage and timely detection of objects, making the Ultrasonic Radar system highly effective in various applications.

The versatility of the Arduino Nano, combined with the precision of the HC-SR04 sensors and servo motors, makes the Ultrasonic Radar system suitable for a wide range of applications. From robotics and automation to surveillance and security, this system offers invaluable capabilities for object detection, obstacle avoidance, and distance measurement.

The Ultrasonic Radar system utilizing the Arduino Nano represents a sophisticated integration of hardware and software components. Through precise sensor data processing and coordinated motor control, it enables accurate object detection and distance measurement, making it a versatile and reliable solution for diverse real-world applications.

4.4.Application

1. **Obstacle Avoidance**: In robotics, ultrasonic radar helps detect obstacles and navigate around them.
2. **Parking Assistance**: Guides drivers by detecting nearby objects when parking.
3. **Security Systems**: Alerts to unauthorized movements in restricted areas.
4. **Gesture Recognition**: Allows control of devices through hand gestures.
5. **Object Tracking**: Tracks movement for inventory management or sports analytics.
6. **Environmental Monitoring**: Measures parameters like water level or air quality.
7. **Assistive Technologies**: Aids visually impaired individuals in navigating surroundings.
8. **Smart Agriculture**: Monitors crop growth and optimizes irrigation for better yield.

CHAPTER 5

RESULT

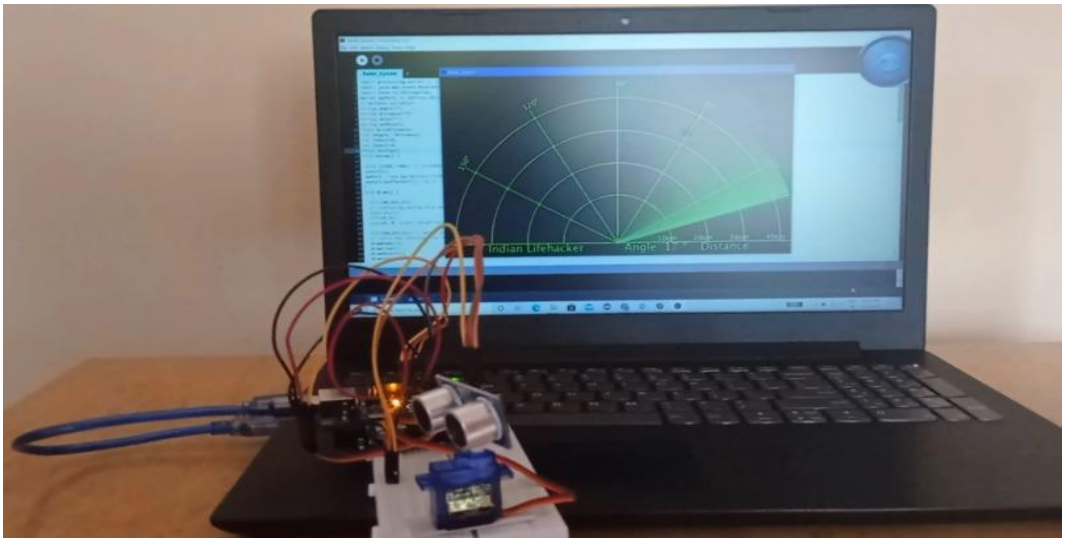

Figure 5.1.Final Output

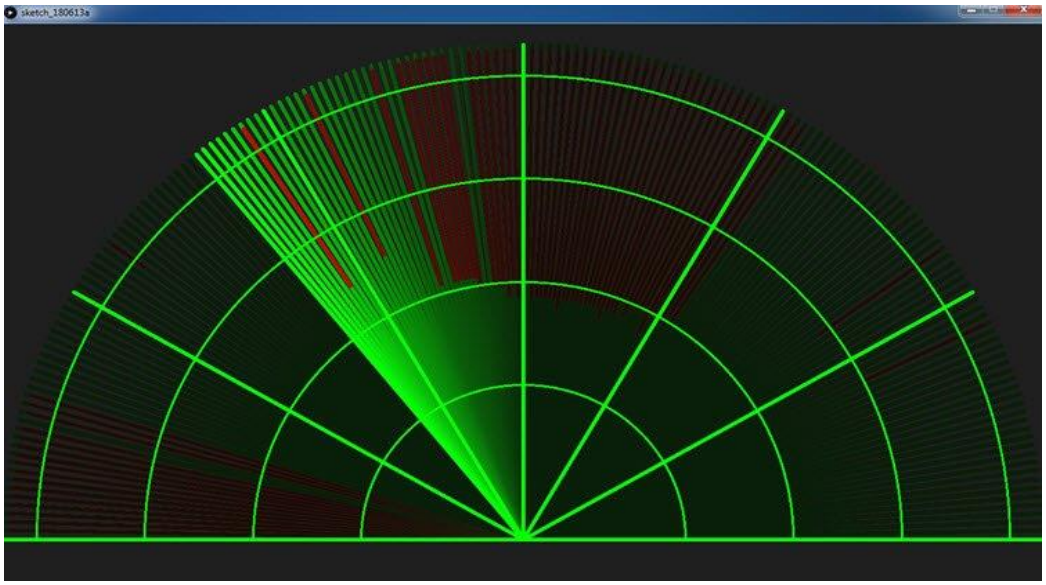

Figure 5.2.Processing Output

CHAPTER 6
CONCLUSION

In essence, the amalgamation of ultrasonic radar with Arduino presents a monumental leap forward in technological innovation, ushering in a new era of possibilities across a spectrum of industries and applications. Through its multifaceted capabilities, this synergy empowers the creation of intelligent systems that transcend conventional boundaries, offering solutions to complex challenges in robotics, transportation, security, and beyond.

By harnessing the power of ultrasonic waves and Arduino's versatility, we unlock the potential for enhanced autonomy, safety, and efficiency in various domains, from autonomous vehicles navigating crowded streets to smart cities monitoring environmental parameters. Moreover, the adaptability of this technology extends its reach to encompass assistive technologies, agricultural advancements, and beyond, fostering inclusivity, sustainability, and progress.

As we stand on the precipice of a technological revolution, the fusion of ultrasonic radar with Arduino emerges as a beacon of innovation, driving us towards a future where the boundaries of what is possible are continually redefined, and the potential for positive change knows no bounds.

CHAPTER 7

REFERENCE

- https://projecthub.arduino.cc/nimishac/ultrasonic-radar-with-arduino-19baa3
- https://youtu.be/1XN53BYrZoc?si=dSX0yZH6kqNOZiPw
- https://techatronic.com/radar-using-arduino-ultrasonic-sensor/
- https://how2electronics.com/arduino-radar-model-ultrasonic-sensor/
- https://www.electronicshub.org/arduino-radar-project/
- https://www.instructables.com/ULTRASONIC-RADAR-SYSTEM-USING-ARDUINO/