ISSN 2277-2685
IJESR/April-June. 2025/ Vol-15/Issue-2s/45-53
A.Soumya *et. al.,* / International Journal of Engineering & Science Research

Arduino RADAR using Ultrasonic Sensor for Detection and Range

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ABSTRACT

In this project, we have designed Arduino RADAR Model using Ultrasonic Sensor for Detection & Ranging. RADAR is an object detection system that uses radio waves to identify the range, altitude, direction, and speed of the objects. The radar antenna transmits radio wave pulses that bounce off any object in its path. The object returns a portion of the wave received by the receiver which is in line of sight with the transmitter. This Arduino RADAR project aims to achieve a radar system prototype based on an Arduino board, capable of detecting stationary and moving objects. Arduino is an open-source computer hardware, open-source software and microcontroller-based device building kit and interactive objects that can sense and control physical devices. Arduino designs and manufactures software, software and software.

The project is focused on the design of the microcontrollers. The board contains a combination of digital and analog input / output (I / O) pins, which can connect to specific expansion boards (termed shields). The plates have serial communication interfaces for loading programs from personal computers, including Universal Serial Bus (USB) in the UNO model. The Arduino provides the built-Indevelopment environment (IDE) for the programming of micro controlling system to allow code writing and uploading to the board. It runs on Mac OS Linux and windows. The code is written in Java, which is based on Open-source software and processing. You can use this program on any board.

The modern uses of radar are highly diverse, including air traffic control, radar astronomy, air-defense systems, antimissile systems; marine radar start 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; guided missile target locating systems; and ground-penetrating radar for geological observations. High tech radar systems are associated with digital signal processing and are capable of extracting useful information from very high noise levels. The Arduino based project requires an ultrasonic sensor, the sensor released the waves which we want to measure the distance of an object. The microcontrollers of the Arduino board can be programmed using C and C++ languages. When a code is written in Arduino UNO IDE software and connected to the board through a USB cable, Arduino boards have lot of applications in the present-day scenario, so we have decided to do a small project on them.

1-INTRODUCTION

Defining Arduino

An Arduino is actually a microcontroller-based kit which can be either used directly by purchasing from the vendor or can be made at home using the components, owing to its open-source hardware feature. It is basically used in communications and in controlling or operating many devices.

Arduino is an open-source electronics platform based on easy-to-use hardware and software.

Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

1. Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.
2. Arduino was born at the Ivrea Interaction Design Institute as an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IoT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is opensource, and it is growing through the contributions of users worldwide. We know everything produces sound wave just by existence and effect flow of air around them with their natural frequency. These frequencies are beyond hearing range of humans. Wave of frequency range of 20000hz and thereabouts are called ultra-sonic wave and these waves can be detected by an ultrasonic sensor which helps us to get various knowledge.

An Ultrasonic detector usually has a transducer which convert sound energy into electrical energy and electrical energy into sound energy. They are used for measuring object position and orientation, collision avoidance system, surveillance system etc. Ultrasonic technology provide relief from problem such as linear measurement problem, as it allows user to get non-contact measurements in this way distance between object and its speed can be easily measured.

2-LITERATURE SURVEY

Ensuring to encounter a segment of the papers as for utilization using, it was discovered thought is looked through a great deal and is a standard thought ahead of time. The uses are not simply beneficial and strong yet notwithstanding a monetarily feasible Arduino based radar framework. Not just this, here other helpful utilizations of ultrasonic sensors were noticed as well. This paper examines an observing framework which is intended to quantify the speed of waves and the stature of a waterway through an ultrasonic sensor utilizing a microcontroller (Arduino). If the stream can't oblige the volume of water, at that point it will lower with land and this wonder is called flood or flood. We can conquer issues by prior ID in the tallness of water and noticing speed. On the off chance that we recognize issues prior we can defeat this issue before it turns into an emergency. By testing the framework for example straightforward water level, it was seen that supersonic has a precision of. Be that as it may, when it is executed in the streams there are numerous blunders due to various kinds of water levels because of hefty waves and speed of water and furthermore because of drifting of weighty articles. Dissimilar to Previous testing results, the creator coordinated this examination on the adjustment. The test was finished. The Arduino was utilized as a regulator of utilization. For more

examination, data of profundity this framework will be shipped off the information base worker site to be checked consistently.

A savvy driver observing and vehicle control framework is presented in this examination. This innovation is made to stay away from mishaps by observing the driver's exercises. The essayist expresses a portion of the fundamental purposes behind mishaps today. These are liquor utilization by the driver, heedlessness, sluggishness or clinical disease. The different structure, engines, transfers, attempts and are seen. Ultrasonic is used to caution the driver if any vehicle gravitates toward his vehicle. It is seen by the help of sensors executed in the vehicle and the inconspicuous components are revived to the owner. This framework conquers all the variousviewpoints because of which different advancements intended for this reason have fizzled, making the framework more helpful, proficient and less expensive and less tedious. In this exploration paper creators have given data about the location of radio waves and following or going through a radar set which is worked from segments like an ultrasonic sensor, a servo engine and an Arduino.

The creator examined the direct estimation issue due to which distance estimation was unrealistic between certain items and was settled with the presentation of Ultrasonic distance measure. It permits us to take non-contact estimations. This radar framework can radically lessen power utilization. The writer says that this framework is an This paper represents a system for obstacle detection in a known

environment. This system works through an android based mobile camera. People who are Arduino based radar systems visually impaired, face difficulties in detecting obstacles and navigation while they walk. They use sticks for this problem nonetheless this manner or technique is not the right way of doing it. Object indicator or detector can overcome accidents or collision problems of people or the other way is they can do incredibly convenient radar framework, it can peruse or follow the distance and point of a hindrance and show it up on the screen. The ultrasonic was joined on top of the servo engine to recognize obstructions from option to left.

This paper speaks to a framework for snag location in a known climate. This framework works through an android based versatile camera. Individuals who are Arduino based radar frameworks outwardly hindered, face troubles in recognizing obstructions and route while they walk. They use sticks for this issue in any case this way or strategy isn't the correct method of doing it. Article pointer or finder can conquer mishaps or impact issues of individuals or the alternate way is they can do exact guide perusing. The calculation which is made for indoor planning. In the indoor climate all unmistakable floors are taken in thought and a solitary picture is kept or put away for particular floors. These pictures of the floor are taken as reference pictures. The creator makes reference to that this calculation is precise and works continuously. There are various strategies examined in this paper for hindrance location. For these kind of issues we can utilize the methodology of SONAR sensor and furthermore laser camera. In this paper presented a figure for distinguishing prevention in known condition with an android based adaptable camera which sweeps a picked area before the camera for hindrance area.

3-HARDWARE AND SOFTWARE REQUIREMENTS

In this chapter we will discuss Hardware and software requirements for Arduino RADAR using Ultrasonic Sensor for Detection and Range.

Hardware Requirements

The hardware components are interconnected, with appropriate wiring and connections established to

enable smooth communication and functionality within the system. Each component serves a specific purpose, collectively working together to create a comprehensive and secure system for vehicle authentication, safety, and monitoring. These components play a crucial role in the overall functionality of the system. The hardware components included are

- Arduino UNO
- HC-SR04 Ultrasonic sensor
- Tower Pro SG90 Servo Motor
- Connecting wires
- Jumper cables
- Power Supply
- USB Cable (for Arduino)

Arduino UNO

Arduino UNO is known as an open-source development board as it allows you to use this board to interact with real-world things by uploading programs on this board. There are many other microcontrollers like PIC microcontrollers, ST microcontrollers, Texas microcontrollers but Arduino is used mostly as it is inexpensive and can be used in various forms.it is based on ATMEL ATmega328p microcontroller.

It can interact with anything that is controlled by electricity in any way. It can also interact with motors, sensors, and electromagnets. In short, we can make devices that react and respond to the world by using this board. In short, we can say that Arduino is the brain of thousands of projects.

Arduino UNO is one of the famous microcontroller boards of the Arduino family and is developed by Arduino.cc. Basically Arduino.cc is an open-source platform and is mainly based upon AVR microcontroller Atmega328. It is one of the most economical boards of Arduino family and is widely used because of its small number of input-output pins and reduced size as compared to Arduino mega which is the big brother of Arduino UNO.

The word "uno" means "one" in Italian and was chosen to mark a major redesign of the Arduino hardware and software. The Uno board was the successor of the Duemilanove release and was the 9th version in a series of USB-based Arduino boards. Version 1.0 of the Arduino IDE for the Arduino Uno board has now evolved to newer releases. The ATmega328 on the board comes preprogrammed with a bootloader that allows uploading new code to it without the use of an external hardware programmer. While the Uno communicates using the original STK500 protocol,[1] it differs from all preceding boards in that it does not use a FTDI USB-to-UART serial chip. Instead, it uses the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

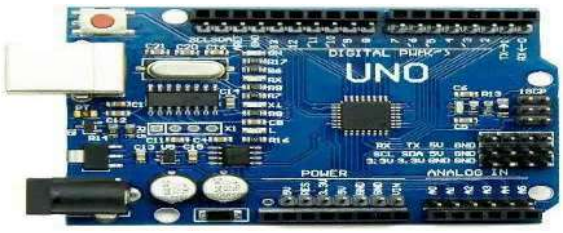

Fig 2.1 Arduino UNO

Software Requirements

We need to use two pieces of software to complete this Arduino radar project. One is the Arduino IDE, and the other is the processing IDE, Download both program from the below links.

- Arduino IDE 1.8.13
- Processing IDE

Arduino IDE

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Arduino IDE is an integrated development environment designed specifically for writing, compiling, and uploading code (sketches) to Arduino microcontroller boards. This version of the IDE has been popular due to its stability and ease of use. Here's a detailed description of the key features and functionalities of Arduino IDE 1.8.13

Fig 2.5 Arduino IDE

4-ARDUINO RADAR USING ULTRASONIC SENSOR FOR DETECTION AND RANGE

Existing System

These existing radar systems are widely used in various fields and have been developed by various organizations, including government agencies, military forces and private companies. These advanced technologies can enhance by capabilities of radar systems in various applications like weather forecasting and monitoring, air traffic control and navigation, health and medical imaging. Radar (Radio Detection and Ranging) systems are widely used across various sectors for detection, ranging, tracking, and navigation. These systems send out radio waves, and by analyzing the echoes that return after bouncing off objects, they can detect and measure the distance, speed, and position of objects. There are several existing types of radar systems, each with different uses and capabilities. Here's a breakdown of various existing radar systems.

Proposed System

The proposed radar system builds on existing radar technologies but introduces enhancements aimed at improving usability, portability, precision, and cost-effectiveness. This system is designed to detect objects and measure their distance using an ultrasonic sensor mounted on a servo motor, controlled by an Arduino microcontroller. This setup will allow for the real-time detection and visualization of objects in the surrounding area.

Block Diagram

A radar system using Arduino can be broken down into several functional blocks. Each block represents a key component of the system, and together they form the entire radar mechanism. Here we use an Arduino UNO microcontroller which is open source to implement an embedded

based system. ATMEGA 328 microcontroller sends 10 milliseconds pulse width to ultrasonic transmitter, echo back received by TX module of ultrasonic. After then receive 180 degrees signal. Microcontroller communication through with a band rate of 9600.This protocol works on ASCII values. So calculated distance transmitted from microcontroller. According to sensing different obstacles which are around
180 degree and 250 cm range, visible as a red spot.

The block diagram of the Arduino radar system shows how different components interact to create a functional radar system. Each block plays a specific role, with the Arduino acting as the central processor that gathers data from sensors, processes it, and sends alerts or visualizations through a display. This system can be used in applications like obstacle detection, parking assistance, or surveillance.

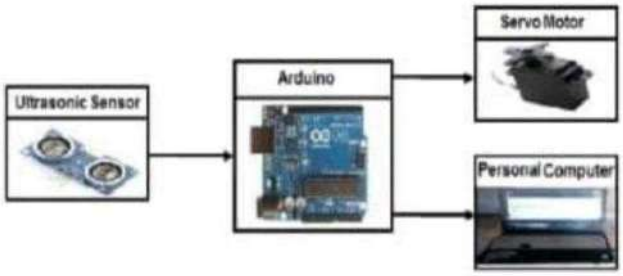

Fig 3.1 Block diagram

Methodology

To check the working of this undertaking, after its arranging, advancement and programming we put barely any articles before the ultrasonic sensor. As the ultrasonic radar moves with the help of a servo motor, our screen started to show the yield through getting ready IDE. From this time forward, when the sensor crosses across the object or article then in the pc screen it shows a red portion with the distance and point where the thing is placed. The essential thing was gotten at the distance of 30.5cm (about 1 ft) assessed through a ruler and the system assessed the distance at 32cm. While ensuring the article was set away of 20cm and the structured assessed it is 21cm. Subsequently the efficiency wound up being 95%. Here, as it is shown the controller, we are using is Arduino, with the data Ultrasonic sensor and the yield is the servo motor which turns 180 degrees. The microcontroller controls all the exercises of this system. The sensor will recognize the object distance and angle easily with the help of ultrasonic radar because as we know ultrasonic sensors are very sensitive and easily detect the deep objects. All these distance, range and angle can be shown on PC screen in which the Arduino is connected. This all working depends upon the two software's i.e. Arduino IDE and processing IDE applications help the project means ultrasonic radar. So, this is the working of the project.

5-Advantages, Disadvantages and Applications

Advantages

Cost-Effective

Affordability: Ultrasonic sensors are relatively inexpensive compared to other radar technologies, making them accessible for hobbyists and

educators.

1. Simplicity

   Ease of Use: The Arduino platform is user-friendly, with a large community and plenty of resources, making it easy to program and set up.

2. Real-Time Data Processing

   Immediate Feedback: Ultrasonic sensors provide real-time distance measurements, allowing for quick responses in applications like obstacle avoidance.

Disadvantages

1. Limited Range

   Short Detection Distance: Ultrasonic sensors typically have a maximum range of a few meters, which may not be sufficient for some applications.

2. Sensitivity to Environmental Factors

   Interference: Performance can be affected by environmental conditions such as temperature, humidity, and air pressure, leading to inaccurate readings.

3. Obstacle Limitations

   Material Dependency: Ultrasonic sensors may struggle to detect soft or absorbent materials (e.g., fabrics), which can lead to missed detections.

Applications

1. Obstacle Avoidance in Robotics

   Used in autonomous robots to detect and avoid obstacles, enabling safe navigation in various environments.

2. Parking Assistance Systems

   Helps vehicles detect distances to nearby objects when parking, providing audio or visual alerts to drivers.

3. Proximity Sensors

   Implemented in smart home devices to detect human presence, enabling automation such as turning on lights when someone enters a room.

6-RESULTS

- After uploading the code, the servo motors start running from 0 to 180 degrees and again back to 0 degrees. An ultrasonic sensor also rotates along with the servo as it is mounted on the motor.
- Now, open the processing application and paste the above code. In this code, update the COM port number where your Arduino board is connected.
- Now, run this processing code. If your code is right, then you will get a new window. This is the graphical representation of data from the ultrasonic sensor, which is represented on a radar- type display.
- If an ultrasonic sensor detects any object within its range, you can see the same in the graphical representation. The below gif shows the output of the Arduino radar project.

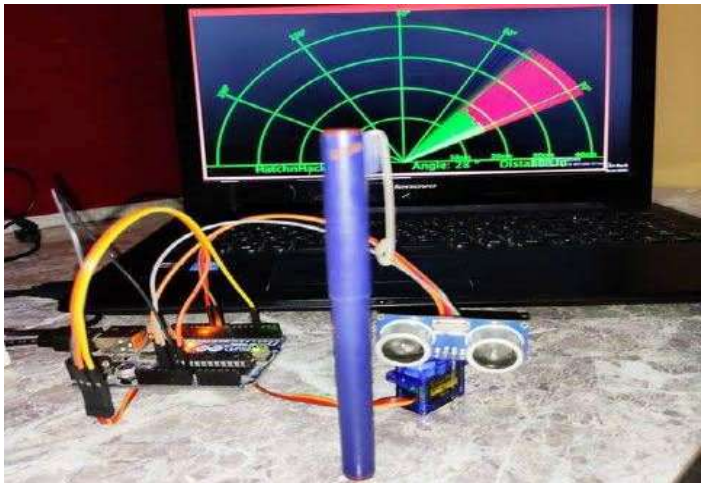

Fig 5.1 Practical Implementation

7-CONCLUSION

Various progressed control strategies offered fashioners to have more order over various progressed applications. In our paper, the suggested planning strategy for the entire framework is surveyed on little standards. We have decided that our plan "Radar System" is an extremely tremendous field and the future extent of this innovation is high. We have colossal frameworks that have been executed or utilized. There is a top of future extent of this plan due to its security limit. It very well may be utilized in numerous applications. This system can likewise be created or altered by the rising requirements and requests. As we have planned a short reach radar consequently our exploration was determined and restricted. This framework can just identify objects from 0 to 180 degrees simply because the servo engine that we have utilized can pivot just to this reach.

Along these lines, because of this constraint our plan can't be applied to spots or zones for deterrent location for a bigger scope. Utilization of 360 degrees pivoting servo engine can make the framework more productive. We anticipate changing this framework and upgrading our examination work by utilizing a completely 360 degrees pivoting servo and a higher went ultrasonic sensor. We can additionally add highlights to this framework for example making it portable, mounting an alert framework to it which turns on when a deterrent is recognized. Further changes could be an impediment evading robots with reconnaissance frameworks.

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[8] S. Murakami, Y. Nishia, T. Hori, H. Mizoguchi, Detecting Human Head Location Using a Simply Installed Ultrasonic Radar System, 1A23(1)-(2), September 2004. APPENDIX >> Main hardware's used in this project are Arduino, Ultrasonic Sensor and Servo Motor. >> This project is done by the Arduino IDE application. >> This project is done by the Processing IDE software