VISVESVARAYA TECHNOLOGICAL UNIVERSITY

BELAGAVI-590 018, KARNATAKA

Arka Educational & Cultural Trust (Regd.)

JAIN INSTITUTE OF TECHNOLOGY

DAVANGERE-577003, KARNATAKA

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

PRE-FINAL YEAR BE. (2023 – 2024)

A MINI PROJECT SYNOPSIS ON

" ARDUINO BASED ULTRASONIC RADAR SYSTEM "

UNDER THE GUIDANCE OF

Mrs. Rajeshwari H M

Assistant Professor,

Dept of ECE, JIT,

Davangere

MINI PROJECT ASSOCIATES

Ms. Akshatha H	**4JD21EC004**
Ms. Chandrika N S	**4JD21EC012**
Ms. Priya P H	**4JD21EC034**
Ms. Ruchitha C	**4JD21EC040**

VISVESVARAYA TECHNOLOGICAL UNIVERSITY
BELAGAVI – 590018

ARKA Educational and Cultural Trust®

JAIN INSTITUTE OF TECHNOLOGY

DAVANAGERE–577003, KARNATAKA

DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

CERTIFICATE

This is to certify that the Mini Project synopsis entitled **"ARDUINO BASED ULTRASONIC RADAR SYSTEM"** carried out by **Akshatha H (4JD21EC004), Chandrika N S (4JD21EC012), Priya P H (4JD21EC034), Ruchitha C (4JD21EC040)** are bonafied students of **Bachelor of Engineering in Electronics and Communication** of the **Visvesvaraya Technological University, Belagavi** during the year 2023-2024.

It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the synopsis report deposited in the departmental library. The mini project synopsis report has been approved as it satisfies the academic requirements in respect of mini-project work prescribed for the Bachelor of Engineering degree.

Mrs. Rajeshwari H M Mini Project Guide, Dept. of ECE, JIT, Davangere	Mrs. Deepthi G B Mini Project Co-ordinator Dept. of ECE, JIT, Davangere
Dr. Santosh Herur Associate Professor & Head, JIT, Davangere	Dr. Ganesh D B Principal JIT, Davangere

TABLE OF CONTENTS

ABSTRACT

Radar is an object detection system which uses radio waves to determine the range, altitude, direction, or speed of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain. The radar dish or antenna transmits pulses of radio waves or micro waves which bounce off any object in their path. The object returns a tiny part of the wave's energy to a dish or antenna which is usually located at the same site as the transmitter.

The modern uses of radar are highly diverse, including air traffic control, radar astronomy, air defence 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 a ultrasonic sensor, the sensor released the waves which we want to measure the distance of a object. The microcontrollers of the Arduino board can be programmed using C or C++ & Java languages. When a code is written in Arduino 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.

CHAPTER 1

INTRODUCTION

RADAR stands for Radio-Detection and Ranging. It uses radio waves to locate and locate objects by determining their range, altitudes, directions, or speeds. RADAR systems come in different sizes and have different performance requirements. Some radars are used to control aircraft at airports. Others are used for long-range surveillance and early warning systems. A radar system is the core of a rocket guidance system. There are small, portable radars that can be operated by a single person, and there are large radars that take up multiple rooms. Radar technology was developed by several countries before during the Second World War.

The term "radar" was first used by the United States Navy in 1940, but not the actual development of the technology. Modern applications of radar range from air traffic control and radar to astronomy, air defence antimissile and anti-missile systems. Marine radars are used to locate ships and points of interest. Airborne radar systems are used to detect aircraft collisions. Surveillance and metering systems are used for maritime surveillance. Space surveillance systems are used to monitor the Earth from space. Meteorological radars are used for meteorological monitoring. Precipitation radar, altimetry, and flight control systems are used.

The purpose of this project is to demonstrate the use of ultrasonic sensor via connected with the Arduino UNO board. The signal from the sensor which is then sent to the laptop creates a signal on the laptop that indicates that there is an obstacle before the sensor. It also determines the range and the angle at which it recognizes the obstacle. Because, when electronic components are used to create any circuit, there are some issues that need to be solved in order for the circuit to work as expected. There are some issues that we have encountered in this project.

1.1 PROBLEM STATEMENT

When the airplanes were invented so there is need of an instrument that could detect their location and time. So, there is need of a system that could detect the aircrafts in air. So, to overcome this problem the scientists invented the **"Radar System",** and our whole defence system, air-traffic, airport system is based on it.

1.2 OBJECTIVE

The objective of the project is to detect the obstacle using Ultrasonic Sensor, Arduino UNO Board and MATLAB or Processing coding as a platform to display the result.

To prevent or reduce the accidents and useful for security and protection.

Detection of objects come in the range of 2 to 3 meters and give signal to the observer about the object.

1.3 MOTIVATION

Creating an Arduino-based ultrasonic radar project can be motivated by several factors:

1. Educational Value: It offers a practical, hands-on way to learn about electronics, programming, and sensor integration. It can be a great project for students and hobbyists to understand the basics of ultrasonic sensors, servos, and microcontroller programming.

2. Skill Development: Building such a project enhances problem-solving skills, coding abilities, and knowledge of interfacing various components. It can also help in learning about signal processing and real-time data visualization.

3. Cost-Effectiveness: Using an Arduino and ultrasonic sensors is relatively inexpensive compared to commercial radar systems. This makes it accessible for personal projects, educational purposes, or low budget research.

4. Customization and Flexibility: With Arduino, the project can be easily customized and expanded. integrated

5. Prototype Development: This project can serve as a prototype for more complex systems. It can be a stepping stone for developing more advanced radar or detection systems for security, robotics, or automotive applications.

CHAPTER 2
LITERATURE SURVEY

1. **Anuj Dutt in, has presented the principle of Arduino Based Radar System (2014).**
   Radar is an object detection system which uses radio waves to determine the range, altitude, direction, speed of the objects. This projects aims at making a Radar that is efficient, cheaper & reflects all possible techniques that a radar consists of.
2. **Y B Gandole in [2011], has explained the simulation and data processing in ultrasonic measurements.**
   In this paper the system for simulation & processing in graphical user interface implementation is presented. The received signal from the simulation is compared to that of an actual measurement in the time domain.
3. **Naman Gupta, Ambuj Kumar Agarwal, has presented Arduino object radar (2018).**
   A object Radar is a device that is used to measure the distance from the object to the device which is used for the purposes of surveying, determining focus in photography or getting the information about the location & angle of the object.
4. **Akshaya U Kulkarni; Amit M Potdar; Suresh Hegde; Vishwanath P Baligar has presented RADAR based object detector using Ultrasonic sensor (2020).**
   This paper provides a method in which the ultrasonic sensor (HC-SR04) acts as a RADAR. The HC-SR04 is connected to servo motor (SG90) for the movement purpose. The range of ultrasonic wave is 20KHz but there the HC-SR04 range is 3m-4m as it is smaller in terms of project.
5. **P Divya, N Bhavana, M George has presented Arduino based obstacle detecting system (2020).**
   The main aim of this paper was detecting both movable and immovable obstacles which are present in particular range by using processing IDE software.

CHAPTER 3

METHODOLOGY

In order to testify the working of this system, after its designing, construction and programming we placed few objects in front of the ultrasonic sensor. As the motor started to rotate, our monitor started to display the output through processing IDE. Hence, when the sensor crossed over the object it showed a red segment with the distance and angle where the object is paced. The first object was placed at the distance of 30.5cm measured through a ruler and the system measured the distance at 32cm.While the second object was placed at a distance of 20 cm and the system measured it as 21cm. Hence the calculated efficiency turned out to be 95%.

System Overview:

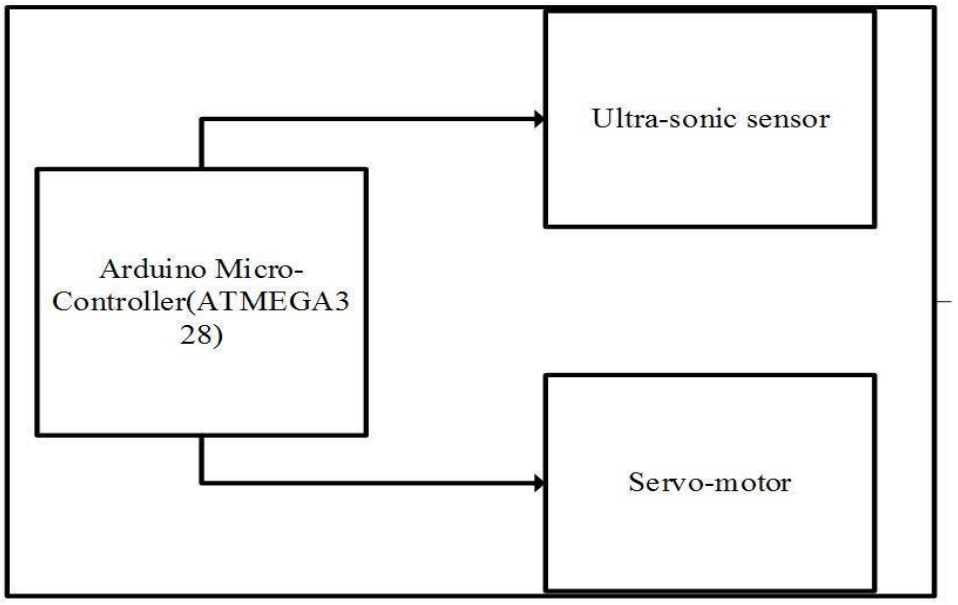

Figure 1: System hardware description

The above figure represents a brief overview of this radar system. Here, as it is shown the controller we are using is Arduino, with the input Ultrasonic sensor and the output is the servo motor which rotates 180 degrees. The microcontroller controls all the operations of this system, from rotation of the motors to the obstacle detection of the ultrasonic and representation of the result on the screen.

Block Diagram:

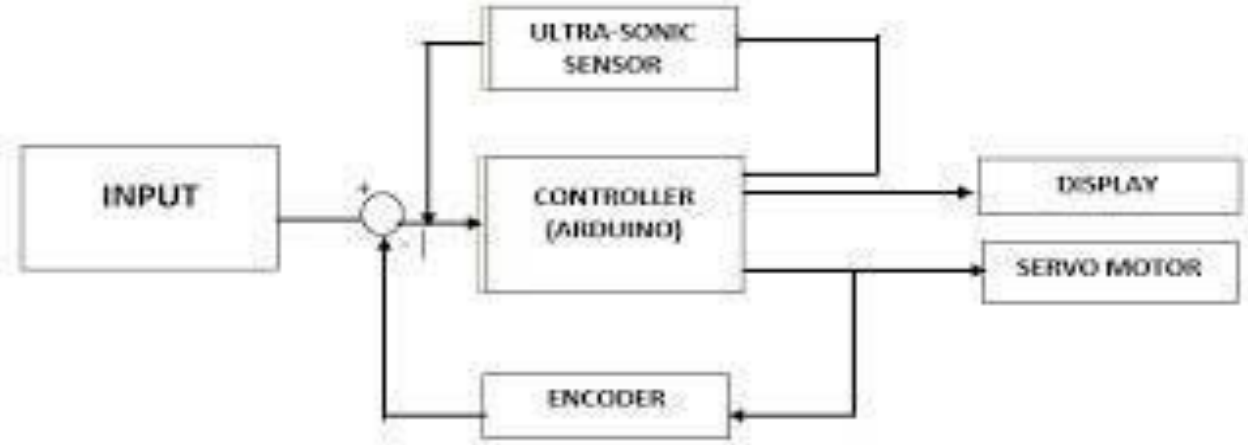

Figure 2: Block Diagram of Radar System

The sensor is going to sense the obstacle and determine the angle of incident and its distance from the radar. The servo motor is constantly rotating to and from, hence making the sensor move. The data obtained is encoded and fed to the processing IDE which represents it on the screen. The results are displayed further in this paper. All these operations are done by Arduino microcontroller from the rotation of the servo, data collection from the sensor, feeding the data to encoder to transferring it to the display. The basic objective of our design is to ascertain the distance position and speed of the obstacle set at some distance from the sensor. Ultrasonic sensor sends the ultrasonic wave in various ways by rotating with help of servo motors. This wave goes in air and gets reflected back subsequent to striking some object. This wave is again detected by the sensor and its qualities is analysed and output is shown in screen indicating parameters, for example, distance and position of object. Arduino IDE is utilized to compose code and transfer coding in Arduino and causes us to detect position or angle of servo motor and it is communicated through the serial port alongside the covered distance of the nearest object t in its way. Output of all of this working is shown in the software Arduino based radar system DOI: http://dx.doi.org/10.17993/3ctecno.2019.specialissue.14 162 called processing, it will display the input/output and the range of the object [4]. Implementations of the sensors are done in such a way that ultra-sonic sensor is attached on top of the servo motor because it has to detect the object and its distance.

Arduino (microcontroller) will control the ultra-sonic sensor and servo motor and also powered will be given to b both of them through micro-controller.

CHAPTER 4

HARDWARE AND SOFTWARE REQUIREMENTS

4.1 HARDWARE REQUIREMENTS

4.1.1 ARDUINO UNO

Arduino Uno is a microcontroller board based on the AT Mega 328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 Analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller. “Uno” means one in Italian and was chosen to mark the release of Arduino Software (IDE)1.0. The Uno board version 1.0 of Arduino Software (IDE) were the reference version of Arduino, now evolved to newer releases. The Uno board is the first in series of USB Arduino boards.

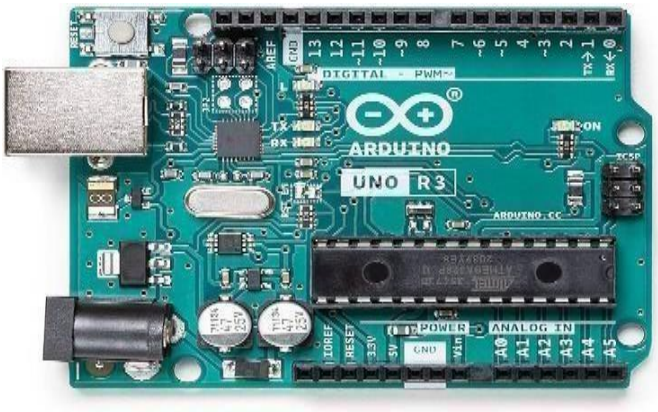

Figure 3: Arduino UNO

4.1.2 ULTRASONIC SENSOR

The ultrasonic sensor consists of transmitter, receiver and transceiver. The transmitter converts electrical signal into soundwaves. The receiver converts the soundwaves into electrical signal again. The transceiver performs both the receiver and transmitter operations. It also has crystal oscillators in it. It will perform the stabilization operation in the ultrasonic sensor.

Figure 4: Ultrasonic Radar

4.1.3 SERVO MOTOR

A servo motor is a type of rotary actuator that allows for precise control of angular position. It consists of a motor coupled with a sensor for position feedback, usually through a potentiometer. Servo motors are widely used in various applications where precise control of angular position, velocity, and acceleration is required, such as in robotics, CNC machinery, and industrial automation.

Figure 5: Servo motor

4.1.4 JUMPER WIRE

The jump wires are also known as jumper wire used to connect devices. Without soldering we can make an easier connection with devices. These are available as a set of wire that has the pin on both sides. These wires are used as making their one end connecting to the corresponding device and another end to the breadboard.

Figure 6: Jumper wires

4.1.5 BREADBOARD

Breadboards are one of the most fundamental pieces when learning how to build circuits. In this tutorial, you will learn a little bit about what breadboards are, why they are called breadboards, and how to use one. Once you are done you should have a basic understanding of how breadboards work and be able to build a basic circuit on a breadboard.

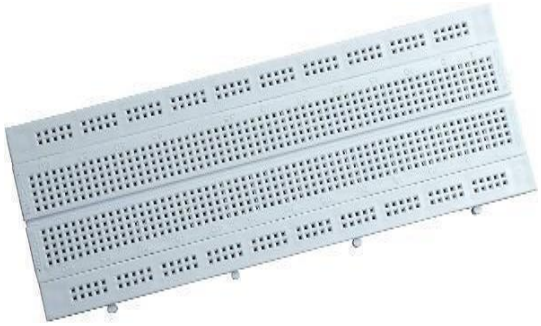

Figure 7: Bread board

4.2 SOFTWARE REQUIREMENTS

4.2.1 ARDUINO IDE

The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. This software can be used with any Arduino board. Arduino is the computer hardware and software device. Arduino UNO ATmega328 offers UART TTL-serial communication, and itis accessible on digital pins like TX (1) and RX (0). The software of an Arduino has a serial monitor that permits easy data. There are two LEDs on the board like receiver and transmitter which will blink whenever data is being broadcasted through the USB. The boards feature serial communications interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. The microcontrollers are mainly programmed using a dialect of features from the programming languages C and C++.

4.2.2 PROCESSING IDE

Processing is a free graphics library and integrated development environment (IDE) built for the electronic arts, new media art, and visual design communities with the purpose of teaching nonprogrammers the fundamentals of computer programming in a visual context.

CHAPTER 5

ADVANTAGES, DISADVANTAGES & APPLICATIONS

ADVANTAGES:

1.It is cost effective.

2.It has low power consumption.

3.Real time processing.

4.Highly customizable.

DISADVANTAGES:

1.Limited range.

2.Variable accuracy.

3.Low resolution.

4. Slow detection speed.

APPLICATIONS:

1.In speed detection of mobile objects.

2.In various military operations such as to guide automatic weapons.

3.For Navigation, Ship Security, Remote Sensing, Space(satellite).

4.Detect and Tracks the Target & even control the weapons.

CHAPTER 6

EXPECTED OUTCOMES

Radar is used to find velocity, long range and position of the object. Advantage of radar is that it provides superior penetration capability through any type of weather condition.

Range of the object detection for the current project is between 2 to 3 meters.

To increase the range of object detection, Radar can be made more improved which is known as “Lidar. Lidar is advanced type of Radar which uses visible light from laser.

REFERENCES

1. Anuj Dutt in, has presented the principle of Arduino Based RADAR System.
2. Y. B. Gandole in [20], has explained the simulation and data processing in ultrasonic measurements.
3. Naman Gupta, Ambuj Kumar Agarwal, has presented Arduino object radar (2018).
4. Akshaya U Kulkarni; Amit M Potdar; Suresh Hegde; Vishwanath P Baligar has presented RADAR based object detector using Ultrasonic sensor (2020).
5. P Divya, N Bhavana, M George has presented Arduino based obstacle detecting system (2020).