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# Radar system using Arduino and Ultrasonic sensor

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## 1. Abstract

In this paper, we are going to talk about Radar System controlled by an Arduino. This Radar System consists of an Ultra-sonic Sensor and servo motor. These are the main components of the system. The basic function of the system is to detect objects within its defined range. The Ultra-sonic Sensors are connected to the servo Motor. The servo motor rotates about 180 degrees and provides visual representation on the processing IDE. The processing IDE provides graphical representation and also gives the angle or position of object and the distance of object. This system is controlled by an Arduino UNO board. This board is sufficient to control the ultrasonic sensor and to interface the sensor with the display device. The main applications of this RADAR System are navigation, positioning and object identification, mapping and spying or tracking and various applications. These low-cost system is also suitable for indoor applications. RADAR is a type of object detection system that uses radio waves to measure the distance, height, direction, or speed of objects. A radar dish or antenna sends pulses of radio waves or microwaves that bounce off any object that passes through its path. RADAR is capable of seeing things far away before humans can see them with their own eyes. It acts as an early warning system as well as a tracking system. It is used as an object detection system which uses electromagnetic waves. It is controlled by Arduino and uses ultrasonic sound sensors. It uses a servomotor to continuously monitor a limited area. The goal of this project is to make a RADAR which is cost-effective and accurate. Because of its insensitivity, it is able to work in harsh conditions such as dirt, dust and rain. It constantly monitors a limited area and alerts the system if there are any obstacles in the way. If an object is very close to the sensor, it is alerted by buzzer and red LED. If it is at a short distance, the buzzer is turned on and the green LED is turned on, but if it is at a limited range, the system is off. Arduino is a one-board microcontroller that makes it easier to use electronics in multi-disciplinary projects. The goal of this project is to make a RADAR that's efficient, cost-effective, and reflects all the different techniques that a radar is made up of.

## 2. 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 and 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 defense, 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. Guided missile target locating (GMLT) systems are used to locate missiles. Ground Penetrating Radar (GPR) is used for geological observation .High tech radar systems use digital signal processing and are able to extract useful information from very high noise

## 3. Literature Review

After reading several papers on the implementation of RADAR with ultrasonic sensor, we found that the concept is very sought after all over the world and is a very popular concept that is still in development. These papers presented some very innovative ideas for accident prevention and driving safety. The techniques illustrated were of the highest quality and can make a big difference in the automotive industry. The technologies were not only effective and reliable, but also cost-effective. This paper discusses the main reasons for accidents and the easy ways to prevent them. The current system uses a microcontroller and an LCD display. We have used a variety of tools such as Arduino UNO, MATLAB, etc. Our main goal is to display the position of the obstacle as clearly as possible. The conclusion of this paper is that the concept of RADAR can easily be duplicated with ultrasonic sensor at small distances. The data transmission from the sensor to the display device is done using the Arduino UNO.

## 4. Problem statement

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.

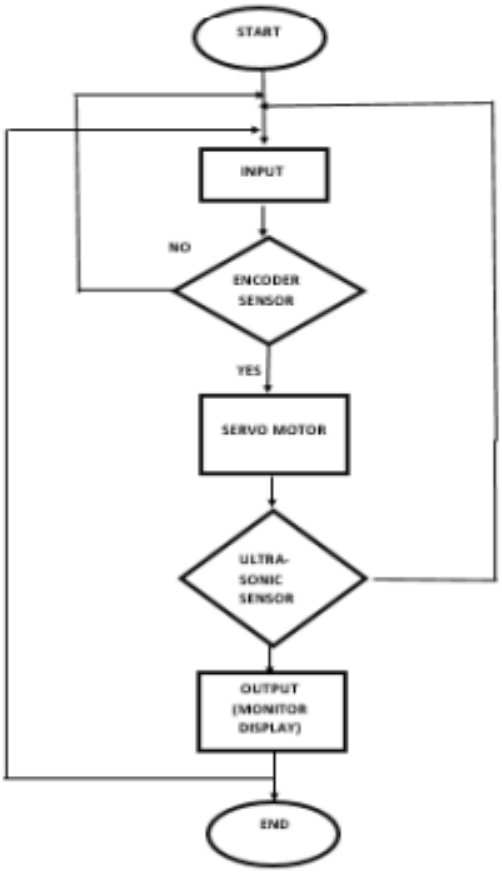
## 5. Proposed Approach / System Design

### 5.1 Hardware Module Design

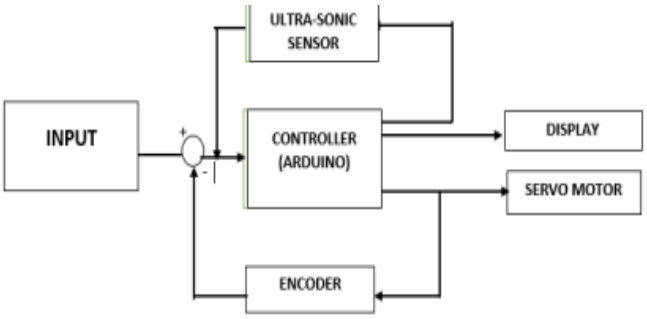
Hardware system consist of basically 3 components named as Arduino, servo-motor, and ultra-sonic sensor. Ultrasonic sensor is mounded upon a servo motor which helps it to move and provide it a turning mechanism. Both ultrasonic sensor and servo motor are controlled and powered by Arduino. The development of Radar system involves various steps such as design of different components, their testing and implementation.

### 5.2 Flow chart

The above flow chart explains the working and the decision flow of this framework. As it can be seen the system starts with an input i.e. when the ultrasonic sensor detects an object or does not detect any object at any condition the encoder feeds the information in the controller while the servomotor keeps constantly rotating. As soon as any object or obstacle is sensed by the ultrasonic sensor the data is immediately processed by the controller and is feed to the IDE which displays it on the monitor screen. Here the procedure ends with a predictable distance of the object from the system with the angle at which it is located.



### 5.3 Block Diagram




### 5.4 Hardware description

#### A) Ultrasonic sensor

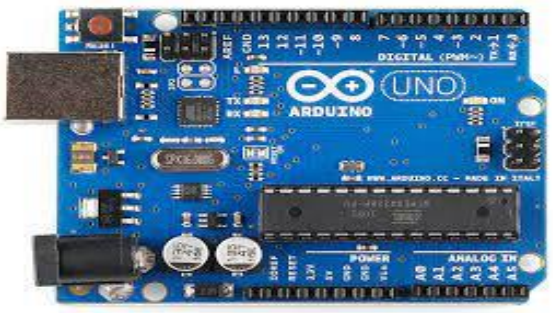
An ultrasonic sensor is an electronic device that measures the distance of the target object by emitting ultrasonic waves and converting the reflected sound into an electrical signal. Acoustic waves are traveling at a rate equivalent to sound velocity, i.e. sounds humans can hear by themselves. The ultrasonic sensors consist of two main components: a transmitter which is capable of transmitting the sound via piezoelectric crystals, and a receiver which receives the sound after it has travelled to or away from the target.


#### B) Servomotor

A servomotor, which moves parts of the machine with high efficiency and very precise accuracy, is an electronic device that exists on its own. As a matter of fact, the servo motor is an BLDC and it's equipped with sensors for position feedback. Therefore, the output shaft can be moved in a certain angle, position and speed that is impossible to achieve with an ordinary motor. But a servo motor alone is just one part of the Closed Loop Motion Control System. Servo motor is controlled by PWM (Pulse with Modulation) which is provided by the control wires. There is a minimum pulse, a maximum pulse and a repetition rate. Servo motor can turn 90 degree from either direction form its neutral position.


#### C) Arduino UNO

A microcontroller based on ATmega328P is called the Arduino UNO. It includes 14 digital input output pins, six of which can be used as PWM outputs, 6 analog inputs, a 16 MHz ceramic resonator, USB connection, power jack, ICSP header and reset button. It's packed with the components necessary to support the microcontroller, and you can simply connect it to your computer using a USB cable or charge it at its AC adapter or battery in order to get started. The Uno board was the successor of the Duemilanove release and was the 9th version in a series of USB-based Arduino boards.

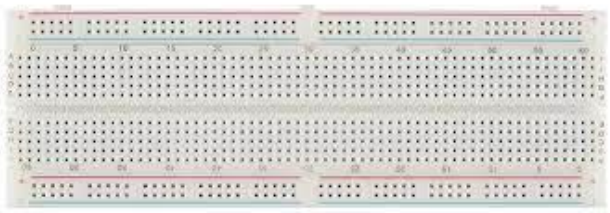



#### D) Buzzer

Electrolectromechanical or piezoelectric or mechanical type of audio signal device such as a beeper or a buzzer. Converting the signal from audio to sound is the main function. In general, it can be used as an alarm controller, timer, printer, scanner, computer, etc. and its power is generated through DC voltage. Different sounds, for example alarm, music, bell and siren, can be generated by a variety of designs.


**E) Breadboard**

A breadboard, solderless breadboard, or protoboard is a construction base used to build semi-permanent prototypes of electronic circuits. breadboards do not require the soldering or destruction of the tracks, unlike the perfboard or the stripboard, and therefore can be reused.



## 6. Methodology

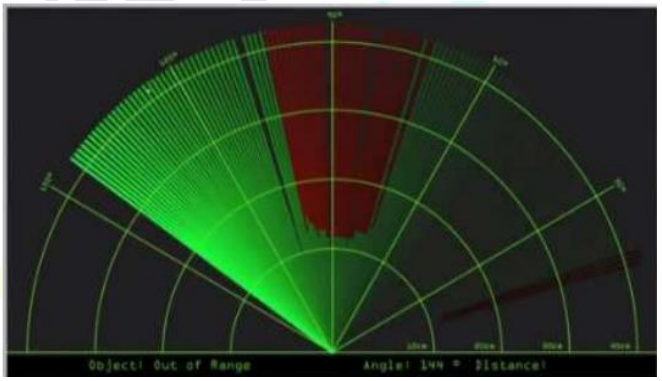
Arduino is a free open source microcontroller. It can interface with a variety of components, having input and Output Digital and Analog Pins. We have interfaced A ultrasonic sensor that's like the heartbeat of a radar. Then to display output LCD (16*2 module). It's capable of running in read /write mode. We've been using it in write mode because of our purpose. It has enable pin which indicates as acknowledgement. Arduino uses a servo motor in an angle from 0 to 180 degree therefore covering the radar range. We've set up an ultrasonic sensor on this servo motor. For the indication of obstacles, LED flags and buzzers shall be used.

## 7. Working

The objective of this project is to calculate the position and velocity of an object which has been located at a certain distance from the sensor. By spinning with the aid of a servo motor, an ultrasound sensor is transmitting waves from one direction to another. This wave travels in air and gets reflected back after striking some object. The sensors will again detect this wave, analyze its characteristics and display on the screen an output indicating parameters such as distance or position of object. The Arduino IDE is used to create and upload code, which enables us to determine where the servo motors are located as well as their distance from the nearest object in its path by sending them into a serial port. The output of the sensor, assisted by processing software, is displayed on a display screen to produce its ultimate output.

## 8. Software Implementation

This project points to the use of an ultrasonic sensor by integrating it with Arduino UNO, which has a signal coming from the sensor later forwarded towards the screen create on the laptop to compute that there is the existence of any The obstacle in front of the sensor shall be identified, as well as the distance and angle at which the barrier is recognized by the sensors. Arduino is an electronic platform, built upon the idea that allows you to use hardware easily and software. The Open-source Arduino Software (IDE) makes it simple to write down code and up-load onto the board. This can be done in Windows, Mac and Linux. The computer programmer is written code in Java and based upon processing software, where this software can be used in any Arduino board. The programmer writes the code in IDE which is named "sketches."




## 9. Advantages

- Color and transparency have no effect on it. The ultrasonic sensor is transmitting the sound from the object, so the color and transparency do not affect the radar.
- It's easy to design at a low cost. The market is full of all the components.
- Dust and dirt do not affect the sensor.

- There is no effect on the sensors of the dark environment**.**

## 10. Disadvantages

- The Arduino Radar Sensor conducts sound to maintain the work. So, it is not working in a vacuum as there is no air
  for the sound to travel through.
- A very soft fabric can absorb more sound waves. Therefore, it is hard to detect objects which are covered with soft fabric.
- If temperature changes of 5 to 10 degree or more then it is the effect on the sensing accuracy. Even though this is right there have many more temperature compensated sensors available.
- Another limitation is the exposure range. This depends on which Ultrasonic sensors have used to make the Arduino
  Radar Sensor.
- While the radar using for check up purpose, make sure it should be water resistive. If not highly chances of damage.

## 11. Applications

1) Through the wall sensors: It registers motion inside closed spaces.
2) Meteorological Applications: microwave radars used
to provide information about distribution, type and intensity of precipitation in atmosphere.
3) UAV Navigations: Unmanned aerial vehicles or drones commonly used ultrasonic sensors for monitoring any objects in the UAV's path and distance from the ground.

## 12. Conclusion

In this paper, a system of radars was designed by using Arduino, servomotor and ultrasonic sensors which are capable of sensing position, distance from obstacle that would come in their path to render them visually represented. In robotics, this system may be applied for detection and avoidance of objects as well as detecting intrusions on a location scale. The system can be operated from a range depending on the type of ultrasonic sensor used. We used HC-SR04 sensor which range from 2 to 40 cm. The project we're recommendations for the best way to map an entire system are evaluated. The field we chose to use for our Radar System is a very large area, and the future scope of this technology will be enormous. We're operating or using the radar system in a wide range of applications. Due to its security capacity, the scope of this design is working on, In small principles or on a scale, extensive for several more years. It can be used in many applications. This construction can also be developed or modified according to the rising needs and demands.

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