Short Range Radar System with Arduino

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***Abstract*—Radar is an object detection system that uses electromagnetic waves to identify range, altitude, direction, or speed of both moving and fixed objects such as aircraft, ships, vehicles, weather formations, and terrain. When we use ultrasonic waves instead of electromagnetic waves, we call it ultrasonic radar . The main components in any ultrasonic radar are the ultrasonic Sensors. Ultrasonic sensors work on a principle similar to radar or sonar which evaluates attributes of a target by interpreting the echoes from radio or sound waves respectively. Radar's information will appear in different ways.Basic and old radar station used sound alarm or LED, modern radar uses LCD display to show detailed information of the targeted object. We use Computer screen to show the information (distance and angle).**

- **It is an open-source project, software/hardware is extremely accessible and very flexible to be customized.**
- **It is easy to use, connects to computer via USB and communicates using standard serial protocol, runs in standalone mode and as interface connected to PC/Macintosh computers.**
- **It is cheap.**
- **Arduino is backed up by a growing online community, lots of source code is already available and we can share and post our examples for others to use.**

***Index Terms*—Arduino Board UNO Model,Processing software,Ultrasonic sensor HC- SR04,Servo Motor tower pro micro servo 9g,Breadboard and Jumping Wires.**

I. Introduction

Radar is an object-detection system that uses radio waves to determine the range, angle, or velocity of objects. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain., This project gives sufficient knowledge of Arduino, MATLAB Simulink for Arduino and mechanics. Servos are small but powerful motors that can be used in a multitude of products ranging from toy helicopters to robots. In this project we are using the Ultrasonic Sensor for operate by emitting a burst of sound waves in very rapid succession. These sound waves hit the intended target, bounce back to the sensor, and travel at known speed. An ultrasonic sensor, radar is much less affected by temperature, improving consistency and accuracy. Radar was developed secretly for military use by several nations in the period before and during World War II. The term RADAR was coined in 1940 by the United States Navy as an acronym for Radio Detection and Ranging. Radar can track storm systems, because precipitation reflects electromagnetic fields at certain frequencies. Radar can also render precise maps. Radar systems are widely used in air traffic control, air craft navigation and marine navigation. United States and four commonwealth countries: Australia, Canada, New Zealand and south Africa also developed their own radar systems.

A. HISTORICAL REVIEW OF RADAR

The word RADAR is an acronym derived from the words Radio Detection and Ranging. In the United Kingdom it was initially referred to as radio direction finding (RDF) inorder to preserve the secrecy of its ranging capability (Boerner, W-M. et al., 1985).

The scientist Heinrich Hertz, after whom the basic unit of frequency is named, demonstrated in 1886 that radio waves could be reflected from metallic objects.

In 1903 a German engineer obtained a patent in several countries for a radio wave device capable of detecting ships, but it aroused little enthusiasm because of its very limited range. Marconi, delivering a lecture in 1922, drew attention to the work of Hertz and proposed in principle what we know today as marine radar. Although radar was used to determine the height of the ionosphere in the mid-1920s, it was not until 1935 that radar pulses were successfully used to detect and measure the range of an aircraft. In the 1930s there was much simultaneous but independent development of radar techniques in Britain, Germany, France and America. Radar first went to sea in a warship in 1937 and by 1939 considerable improvement in performance had been achieved. By 1944 naval radar had made an appearance on merchant ships and from about the end of the war the growth of civil marine radar began. Progressively it was refined to meet the needs of peacetime navigation and collision avoidance (Alan Bole, Bill Dineley, and Alan Wall., 2005).

While the civil marine radars of today may, in size, appearance and versatility, differ markedly from their ancestors of the 1940s, the basic data that they offer, namely target range and bearing, are determined by exploiting the same fundamental principles unveiled so long ago (Alan Bole, Bill Dineley, and Alan Wall., 2005).

The term ’Radar’ is an acronym for radio detection and ranging (Boerner, W-M. et al., 1985). Radar system arrives in an assortment of sizes and have distinctive performance particulars. Some radars are utilized for aviation authority at air terminals and others are utilized for long range observation and early-cautioning frameworks (Onoja, A.E. et al., 2017) There are some ways to show radar working data. There are also some modified radar systems which have advanced technology of handling the systems. These modified systems are used at higher levels to get or extract the helpful or important data (Tiwari, S. et al., 2018).

Technology has become available that can detect targets on the land, on the sea, in the air and outside the earth’s atmosphere. These include aircraft, land vehicles, ships, air breathing and ballistic missiles and others. Radar has also been used to detect targets ranging from buried ordnance (Daniels, D.J., Gunton, D.J., and Scott, H.F., 1988) to weather systems (Mahapatra, P.R.,1998), to being the cruise control and collision avoidance sensor in luxury cars, to measure the distances and rotational speeds of our planetary neighbor’s in the solar system (Eriksson, L.H. and Broden, S. 1996).

B. *BASIC CONCEPTS OF RADAR*

Radar is an electromagnetic system for the detect and determine the locations of objects and determine distance, and ranges. It operates by transmitting a particular type of waveform, a pulse-modulated, and detects the nature of the echo signal. Radar is used to extend the capability of one’s senses for observing the environment, especially the sense of vision (Merrill l. Skolnik, 1981).

An elementary form of radar consists of a transmitting antenna emitting electromagnetic radiation generated by an oscillator of some sort, a receiving antenna, and the receiver. A portion of the transmitted signal is intercepted by a reflecting object (target) and is radiated in all directions. The receiving antenna collects the returned energy and delivers it to a receiver, where it is processed to detect the presence of the target and to extract its location and relative velocity.

The distance to the target is determined by measuring the time taken for the radar signal to travel to the target and back. The direction of the target determined from the direction of arrival of the reflected wavefront (Merrill I. Skolnik, 1981).

The basic concept of a radar transmitting a signal and receiving a return from a target is shown in Figure (1-1).

The radar generates a signal, which is transmitted through an antenna into the desired direction. The antenna is designed to concentrate the radar energy in a particular direction. Only a small proportion of the transmitted radar energy reaches the 20 target, with the rest missing it or illuminating other nearby objects, including the earth’s surface or going off into space, as the radar beam is normally much wider than the angular dimensions of the target. The radar beam broadens as the wave propagates from the radar, so is reduced in strength with distance and the energy incident upon the target also reduces with distance (P. Tait, 2009).

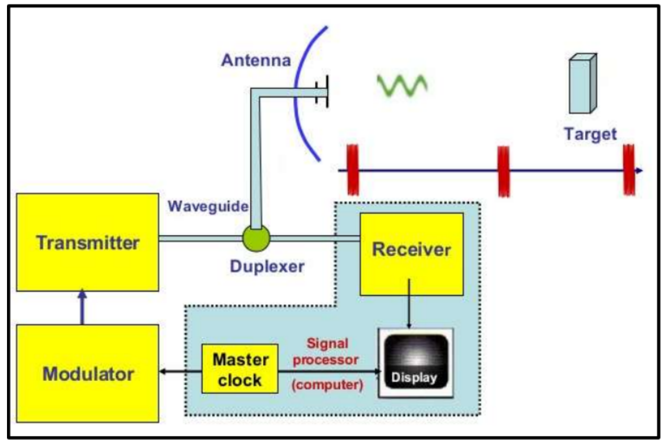

Fig. 1. Simplified radar block diagram

C. *THE ECHOES PRINCIPLE*

An object (normally referred to as a target) is detected by the transmission of a pulse of radio energy and the subsequent reception of a fraction of such energy (the echo) which is reflected by the target in the direction of the transmitter. The phenomenon is analogous to the reflection of sound waves from land formations. If a blast is sounded on a ship’s whistle, the energy travels outward and some of it may strike. The energy which is intercepted will be reflected by the cliff. If the reflected energy returns in the direction of the ship, and is of sufficient strength, it will be heard as an audible echo which, in duration and tone, resembles the original blast. In considering the echo principle the following points can usefully assist in a preliminary understanding of radar detection:

- The echo is never as loud as the original blast.
- The chance of detecting an echoes depends on the loudness and duration of the original blast.
- Short blasts are required if echoes from close targets are not to be drowned by the original blast.
- A sufficiently long interval between blasts is required to allow time for echoes from distant targets to return.

While the sound analogy is extremely useful, it must not be pursued too far, as there are a number of ways in which the character and behavior of radio waves differ from those of sound waves. In particular at this stage it is noteworthy that the speed of radio waves is very much higher than that of sound waves.

II. LITERATURE REVIEW

Research on the use of radar is increasing and has been published in journals in various disciplines. For example, there was a proposal of a system that can detect an object and a human in still or motion by using two ultrasonic sensors, LPC2148 and DC geared motor ; a distance measurement by using Arduino ultrasonic sensor; a radar system that can detect distance and direction of object ; distance and direction mapping with a processing App; distance and direction measurement by using an Arduino ultrasonic radar embedded system

; distanceand direction detection by using a microcontroller ATmega16; and a height detector with ultrasonic sensor by using a microcontroller ATmega16 . What should be noted is that the detection of moving object has not examined in the previous papers . The current study aims to fill the gap by examining this by using a low cost device and an algorithm to solve the calculation problems. Arduino code and salient analysis were also used to observed objects in different shapes and sizes.In previous research, ultrasonic sensor was used to detect the presence of human in a place is filled with smoke . The height of an object could also be detected by using an ultrasonic sensor connected to a smartphone . The length of an object could also be detected by using an ultrasonic sensor combine with an additional equipment named Raspberry Pi . Another system can detect more than one object position . A radar system can also be developed to cover a larger range of ultrasonic sensor and turned into a mobile robot with a sonar system .However, the technologies used in the research projects above are expensive. The current research proposes a method that is simpler, more affordable but effective. An intelligent driver monitoring and vehicle control system is introduced in this research. This technology is create to avoid accidents by monitoring the driver's activities. The writer states some of the main reasons of accidents today. These are alcohol consumption by the driver, carelessness, drowsiness or medical illness. The various units in the framework, including motors, relays, power unit and ESP8299 module are tried and are observed to be in working condition. Ultrasonic sensor is utilized to alarm the driver if any vehicle draws close to his vehicle. The status of the driver can be observed by the assistance of sensors executed in the vehicle and the subtle elements are refreshed to the proprietor. This system overcomes all the different aspects due to which other technologies designed for this purpose have failed, making the system more useful, efficient and less costly and less time consuming .In this research paper authors have given information about the detection of radio waves and tracking or ranging through radar set which is built from components like an ultra-sonic sensor, a servo motor and an Arduino. The author discuss about the linear measurement problem because of which distance measurement was not possible between some objects, was resolved with the introduction of Ultrasonic distance measurer. It allows to take non contact measurements. This radar system can drastically reduce power consumption. The author says, that this system is an extremely handy radar system, it can read or track the distance and angle of an obstacle and shown it up on the monitor screen. The ultra-sonic was attached on top of the servo motor to detect obstacles at 0 degree to 180 degree from right to left. Both the ultra-sonic sensor and the servo were fueled and controlled by the Arduino controller. The GUI was built using the JAVA programming language to show the result on the monitor .

III. NOVELTY

At the same time we have added the Buzzer here. We used lights here because a person can focus on the blinking of lights. The reason for adding the Buzzer is many times we are focused on other tasks but we can be distracted by the sound.

IV. OBJECTIVES

The objective of this paper is Short Range Radar System with Arduino. Radar (radio detection and ranging) is a detection system that uses radio waves to determine the distance (ranging), angle, and radial velocity of objects relative to the site. It can be used to detect aircraft, ships, spacecraft, guided missiles, motor vehicles, weather formations, and terrain.

Radar, electromagnetic sensor used for detecting, locating, tracking, and recognizing objects of various kinds at considerable distances. It operates by transmitting electromagnetic energy toward objects, commonly referred to as targets, and observing the echoes returned from them.

V. METHODOLOGY

In this study, ultrasonic sensor and servo were both major components. These were connected with and controlled by an Arduino UNO. Ultrasonic sensor transmits ultra sound and the servo motor rotates the ultrasound sensor. The Arduino UNO consists of USB connector, microcontroller, analogue input pins, power port, digital pins, crystal, oscillator reset switch, USB interface chip, TX RX LEDs. It functions as a controller and provides a coding environment so it requires direct connection to a computer. HC-SR04 ultrasonic sensor is used in this study as it transmits the sound wave of high frequency near about 40 kHz to 70 kHz. Humans cannot hear it. If the wave gets reflected by an obstacle, then the reflected sound will be picked up by the receiver. Sonar is used to identify the object. The four pins of the sensor are: VCC=5VDC, trig pin=trigger pin/input pin, echo pin=output pin and GND or ground pin. A10us trigger pulse is generated with the help of trig pin and to produce sound wave of 8 cycles. Normally echo pin stays in a low state (0V) but when it receives the sound wave it goes to a high state of 5V. The total high state (5V) of echo pulse is counted as the travelling time of the sound wave.

- System Overview:

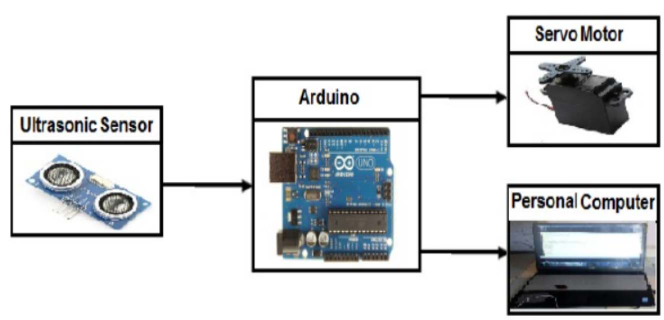

Fig. 2. Systemetic Process

Servo motor (SG90) is a rotatory motor which runs with the help of servo mechanism. Servo motor is used here to detect the angle of the moving object. 0 to 180 degree is the rotatory range of servo motor, but depending on the manufacturing it can go up to 360 degrees . Servo motor receives the control signal and tunes the shaft. Servo motor is used to set up the position and velocity of the ultrasonic sensor. Three wires from the servo motor have to be connected manually. For the implementation of the components, the trig pin and the echo pin of the ultrasonic sensor (HC-SR04) areconnected to the PWM pins and the SPI pins of Arduino UNO. Servo and ultrasonic sensor are connected in such a manner where ultrasonic sensor can be mounted on the servo motor. The Arduino UNO power is supplied by thecomputer. The code that has been uploaded onto the Arduino UNO software will run through the data generate results.

VI. BLOCK DIAGRAM DESCRIPTION

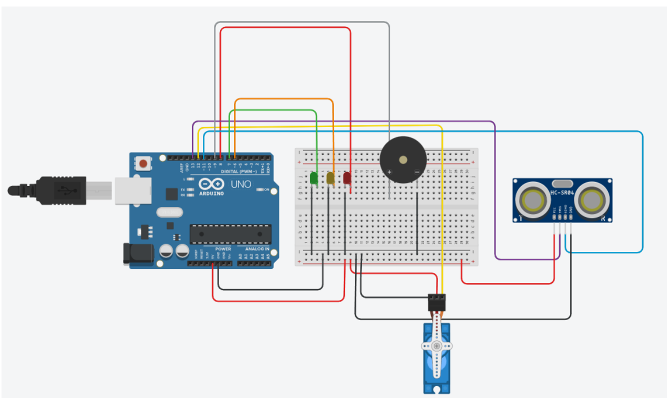

Fig. 3. Experimental Setup

VII. EQUIPMENT

Here we use Arduino Unomicrocontroller which is open source to implement embedded based system. ATMEGA 328 microcontroller send 10 micro second pulse width to ultrasonic transmitter, echo back signal receive by TX module of ultrasonic. After then receive pulse width calculated by micro controller. Here we use servo motor on which ultrasonic module is mounted for receive 180 degree signal. Microcontroller and MATLAB communicated through UART protocol with the baud rate of 9600. This protocol work on ASCII value. So calculated distance transmit from microcontroller to MATLAB COM PORT. According sensing different obstacle which are around 180 degree and 250 cm range, visible as a red spot on MATLAB GUI.

A. *ARDUINO UNO*

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.. We can tinker with our Uno without worrying too much about doing something wrong, worst case scenario you can replace the chip for a few dollars and start over again.

”Uno” means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0. The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform; for an extensive list of current, past or outdated boards see the Arduino index of boards.

The Arduino project provides the built-in development environment (IDE) for the programming of microcontrolling systems to allow code writing and uploading to the board. It runs on Mac OS X, 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 of the Arduino.

Arduino based heart rate monitor is more advanced than a simply measure a user’s heart rate. Our heart rate monitors talks! Each button gives a verbal description of its functionality and makes the measurements visible on the screen. This monitor will save the last four readings, display them, average them, and also offer some inspirational quotes [3]. This sensor is used for fever, hypothermia, and activity levels and patterns detections [15]. This device can sense the facial expressions. With the help of this Arduino device we can find out breathing rate, breathing depth, activity level and arousal level [12]. For the movement monitoring we use this Arduino device, it can detect the occurrence of muscle contractions and strength of muscle contractions.

Fig. 4. ARDUINO UNO

B. *ARDUINO IDE*

An ultrasonic sensor is an instrument that measures the distance to an object using ultrasonic sound waves. An ultrasonic sensor uses a transducer to send and receive ultrasonic pulses that relay back information about an object’s proximity. in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor. This displays serial sent from the Arduino board over USB or serial connector. To send data to the board, enter text and click on the ”send” button or press enter. Choose the baud rate from the drop-down menu that matches the rate passed to Serial.begin in your sketch. Note that on Windows, Mac or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor. Please note that the Serial Monitor does not process control characters; if your sketch needs a complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board.

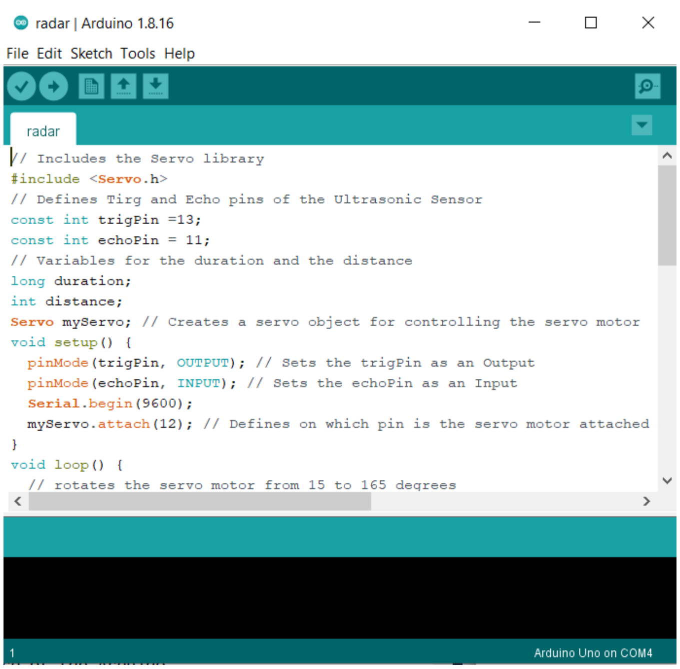

Fig. 5. IDE Software

C. *ULTRASONIC SENSOR*

As the name indicates, ultrasonic sensors measure distance by using ultrasonic waves. The sensor head emits an ultrasonic wave and receives the wave reflected back from the target. Ultrasonic Sensors measure the distance to the target by measuring the time between the emission and reception.An optical sensor has a transmitter and receiver, whereas an ultrasonic sensor uses a single ultrasonic element for both emission and reception. In a reflective model ultrasonic sensor, a single oscillator emits and receives ultrasonic waves alternately. This enables miniaturization of the sensor head.

- What does it do?

Multiple areas of engineering use ultrasonic sensors. “No-contact” distance measuring is very useful in automation, robotics, and instrumentation. Below, we investigate the applications of ultrasonic sensors: 1.Ultrasonic Anemometers:Weather stations commonly used anemometers since they detect wind speed and direction efficiently. The 2D anemometers can measure only the horizontal component of wind speed and direction, whereas 3D anemometers can measure the vertical component of wind, as well.

Apart from measuring wind speed and direction, ultrasonic anemometers can also measure temperature because the speed of ultrasonic sound waves is affected by variations in temperature while maintaining independence from changes in pressure. Temperature is calculated by measuring speed variations in ultrasonic sound.

The ultrasonic anemometer is more durable as compared to the cup anemometer and vane anemometer since it has no moving parts and it operates using ultrasonic sound waves.

2.Tide gauge:A tide gauge is used to monitor sea level. It also detects tides, storm surges, tsunamis, swells, and other coastal processes. [vii] A tide gauge can use an ultrasonic sensor to detect real-time water level. The gauge is often linked to an online database where a record is maintained, and in case of a risky situation, the system can trigger an alarm.

3.Tank level:Measuring fluid level in a tank is similar to a tide gauge. However, in this case, the fluid can be clear water, a corrosive chemical, or a flammable fluid. Unlike optical sensors and float switches, ultrasonic sensors are less likely to corrode as they do not make contact with the fluid.

4.Functional in sunlight:The sunlight at Earth’s surface is composed of around 52-55

5.Web-guiding systems:Web-guiding systems position flat materials (e.g., newspaper, plastic film) and widely use ultrasonic sensors. According to Maxcess, “In 1939, Irwin Fife invented the first web guide in his Garage in Oklahoma City, Oklahoma, solving a newspaper owner’s challenge of keeping paper aligned in his high-speed newspaper press.“ [x] A web-guiding system uses a non-contact sensor for detecting and tracking objects at multiple stages. The purpose is to ensure that the material is positioned correctly. If the material is moving out of alignment, the system mechanically places it back on the machine’s processing path. Ultrasonic sensors are suitable for web-guiding systems as the process requires non-contact, high-speed, and efficient functionality.

6.UAV navigation:Unmanned aerial vehicles (UAVs)—or drones—commonly use ultrasonic sensors for monitoring any objects in the UAV’s path and distance from the ground. The autonomous feature of detecting safe distances enables the aircraft to avoid crashing. And as the flight of path changes instantaneously, the ultrasonic detection of distances can prenvent a drone from crashing.

- How does ultrasonic sensor work?

Fig. 6. ULTRASONIC SENSOR

The ultrasonic sensor (or transducer) works on the same principles as a radar system. An ultrasonic sensor can convert electrical energy into acoustic waves and vice versa. The acoustic wave signal is an ultrasonic wave traveling at a frequency above 18kHz. The famous HC SR04 ultrasonic sensor generates ultrasonic waves at 40kHz frequency. Three different properties of the received echo pulse may be evaluated for different sensing Purposes:

1)Time of flight,

2)Doppler shift,

3)Amplitude attenuation.

Typically, a microcontroller is used for communication with an ultrasonic sensor. To begin measuring the distance, the microcontroller sends a trigger signal to the ultrasonic sensor. The duty cycle of this trigger signal is 10µS for the HC-SR04 ultrasonic sensor. When triggered, the ultrasonic sensor generates eight acoustic (ultrasonic) wave bursts and initiates a time counter. As soon as the reflected (echo) signal is received, the timer stops. The output of the ultrasonic sensor is a high pulse with the same duration as the time difference between transmitted ultrasonic bursts and the received echo signal. Theoretically, the distance can be calculated using the TRD (time/rate/distance) measurement formula. Since the calculated distance is the distance traveled from the ultrasonic transducer to the object—and back to the transducer—it is a two-way trip. By dividing this distance by 2, you can determine the actual distance from the transducer to the object. Ultrasonic waves travel at the speed of sound (343 m/s at 20°C). The distance between the object and the sensor is half of the distance traveled by the sound wave.

But there are some limitations of ultrasonic sensors. Ultrasonic sensors such as the HC-SR04 can efficiently measure distances up to 400 cm with a slight tolerance of 3 mm. [xiii] However, if a target object is positioned such that the ultrasonic signal is deflected away rather than reflected back to the ultrasonic sensor, the calculated distance can be incorrect. In some cases, the target object is so small that the reflected ultrasonic signal is insufficient for detection, and the distance cannot be measured correctly.

Furthermore, objects like fabric and carpet can absorb acoustic signals. If the signal is absorbed in the target object's end, it cannot reflect back to the sensor, and hence, the distance cannot be measured.The intense sensitivity of ultrasonic sensors makes them efficient, but that sensitivity can also cause problems. Ultrasonic sensors can detect false signals coming from the airwaves disturbed by an air conditioning system and a pulse coming from a ceiling fan, for instance.

Ultrasonic sensors can detect objects placed within their range, but they cannot distinguish between different shapes and sizes. However, one can overcome this limitation can by using two sensors instead of just one sensor. One can install both sensors a distance away from each other, or they can be adjacent. By observing the overlapped shaded region, one can get a better idea of the shape and size of the target object.

D. SERVO MOTOR

A servomotor (or servo motor) is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. Servomotors are used in applications such as robotics, CNC machinery, or automated manufacturing.It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system.

Servo motors are part of a closed-loop control system and consist of several parts namely a control circuit, a servo motor, a shaft, a potentiometer, a drive gear, an amplifier, and either an encoder or a resolver. A servomotor is a self-contained electrical device that rotates parts of a machine with high efficiency and great precision.

The output shaft of this motor can be moved to a specific angle, position, and velocity that a normal motor does not have. The servo motor uses a regular motor and couples it with a sensor for position feedback.

The controller is the most important part of the servo motor specially designed and used for this purpose. The servo motor is a closed-loop mechanism that incorporates position feedback to control rotational or linear speed and position. The motor is controlled with an electrical signal, either analog or digital, that determines the amount of movement that represents the final commanded position for the shaft. A type of encoder serves as a sensor that provides speed and position feedback. This circuit is built directly into the motor housing, which is usually equipped with a gear system.

- How does a servo motor work?

Fig. 7. SERVO MOTOR

A servo motor is an electromechanical device that generates torque and velocity based on the supplied current and voltage. A servo motor operates as part of closed-loop control, providing torque and velocity as commanded by a servo controller which uses a feedback device to close the loop.

The feedback device provides information such as current, velocity, or position to the servo controller, which adjusts the motor action depending on the commanded parameters. Servos are controlled by sending a variable width electrical pulse or pulse width modulation (PWM) over the control cable. There is a minimum heart rate, a maximum heart rate, and a repetition rate. A servo motor can normally only rotate 90 ° in each direction. Which adds up to a total of 180 ° of movement.

The neutral position of the motor is defined as the position where the servo has the same potential rotation in both clockwise and counterclockwise directions. The PWM sent to the motor determines the position of the shaft and is based on the duration of the pulse sent over the control cable; the rotor turns into the desired position.

The servo motor expects a pulse every 20 milliseconds and the length of the pulse determines how far the motor turns. A pulse of 1.5ms, for example, causes the motor to turn to the 90 ° position.

For less than 1.5ms it moves counterclockwise towards the 0 ° position, and longer than 1.5ms rotates the servo clockwise towards the 180 ° position.

When a move command is given to these servos, they will move into position and hold that position. If an external force is pressing against the servo while the servo is holding a position, the servo will resist moving from that position.

The maximum force the servo can exert is called the servo's torque. Servos won't hold their position forever, however; The position pulse must be repeated to tell the servo to stay in position.

E. BUZZER

Buzzer is a kind of voice device that converts audio model into sound signal. It is mainly used to prompt or alarm. According to different design and application, it can produce music sound, flute sound, buzzer, alarm sound, electric bell and other different sounds.

Fig. 8. BUZZER

Typical applications include siren, alarm device, fire alarm, air defense alarm, burglar alarm, timer, etc. It is widely used in household appliances, alarm system, automatic production line, low-voltage electrical equipment, electronic toys, game machines and other products and industries. Since the self-excited buzzer is driven by DC voltage, it does not need to use AC signal to drive. It only needs to output the driving level at the drive port and amplify the driving current through the triode to make the buzzer sound. It is very simple, and the self-excited buzzer is not explained here. This paper only explains the other excited buzzer which must be driven by 1/2-D square wave signal.

There are two ways to drive the separately excited buzzer: one is to drive the PWM output port directly; the other is to drive the buzzer by using I/O timing flip level to generate driving waveform.

PWM output port direct drive is to use PWM output port itself can output a certain square wave to drive buzzer directly. In the software setting of MCU, several system registers are used to set the output of PWM port. Duty cycle, cycle and so on can be set. After setting these registers to generate the frequency waveform meeting the requirements of buzzer, as long as PWM output is opened, PWM output port can output square wave of this frequency. At this time, the buzzer can be driven by using this waveform. For example, when driving a buzzer with a frequency of 2000Hz, you can know that the period is 500 S. in this way, you only need to set the PWM cycle to 500 s and the duty cycle level to 250s, and then a square wave with a frequency of 2000Hz can be generated. Through this square wave, the buzzer can be driven by using a triode.

However, it is more troublesome to use I/O timing flip level to generate driving waveform. Timer must be used to do timing. The frequency waveform meeting the requirements of buzzer can be generated by timing flip level. This waveform can be used to drive buzzer. For example, when driving a 2500Hz buzzer, you can know that the period is 400S. in this way, only the I/O port of the buzzer needs to be turned over every 200s to generate a square wave with a frequency of 2500Hz and a duty cycle of 1/2duty. Then, the buzzer can be driven by the amplification of triode.

***Index Terms*—Modern applications**

- Novelty uses
- Judging panels
- Educational purposes
- Annunciator panels
- Electronic metronomes
- Game show lock-out device
- Microwave ovens and other household appliances
- Sporting events such as basketball games
- Electrical alarms
- Joy buzzer (mechanical buzzer used for pranks)

F. BREAD BOARD

A breadboard, or protoboard, is a construction base for prototyping of electronics. Originally the word referred to a literal bread board, a polished piece of wood used when slicing bread.[1] In the 1970s the solderless breadboard (a.k.a. plug-board, a terminal array board) became available and nowadays the term ”breadboard” is commonly used to refer to these. Because the solderless breadboard does not require soldering,

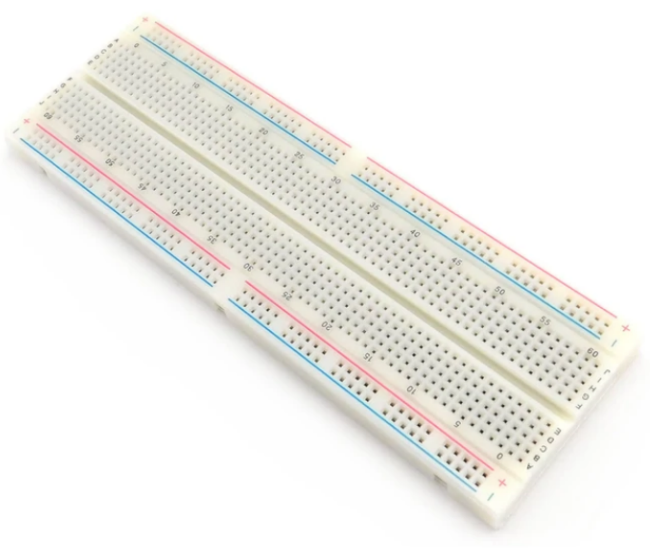

Fig. 9. BRAED BOARD

it is reusable. This makes it easy to use for creating temporary prototypes and experimenting with circuit design. For this reason, solderless breadboards are also popular with students and in technological education. Older breadboard types did not have this property. A stripboard (Veroboard) and similar prototyping printed circuit boards, which are used to build semi-permanent soldered prototypes or one-offs, cannot easily be reused. A variety of electronic systems may be prototyped by using breadboards, from small analog and digital circuits to complete central processing units (CPUs).

Compared to more permanent circuit connection methods, modern breadboards have high parasitic capacitance, relatively high resistance, and less reliable connections, which are subject to jostle and physical degradation. Signaling is limited to about 10 MHz, and not everything works properly even well below that frequency.

A common use in the system on a chip (SoC) era is to obtain an microcontroller (MCU) on a pre-assembled printed circuit board (PCB) which exposes an array of input/output (IO) pins in a header suitable to plug into a breadboard, and then to prototype a circuit which exploits one or more of the MCU’s peripherals, such as general-purpose input/output (GPIO), UART/USART serial transceivers, analog-to-digital converter (ADC), digital-to-analog converter (DAC), pulse-width modulation (PWM; used in motor control), Serial Peripheral Interface (SPI), or I²C.

Firmware is then developed for the MCU to test, debug, and interact with the circuit prototype. High frequency operation is then largely confined to the SoC’s PCB. In the case of high speed interconnects such as SPI and I²C, these can be debugged at a lower speed and later rewired using a different circuit assembly methodology to exploit full-speed operation. A single small SoC often provides most of these electrical interface options in a form factor barely larger than a large postage stamp, available in the American hobby market (and elsewhere) for a few dollars, allowing fairly sophisticated breadboard projects to be created at modest expense.

G. THE JUMPER

Jumper wires are simply wires that have connector pins at each end, allowing them to be used to connect two points to each other without soldering. Jumper wires are typically used with breadboards and other prototyping tools in order to make it easy to change a circuit as needed. Fairly simple. In fact, it doesn’t get much more basic than jumper wires.Though jumper wires come in a variety of colors, the colors don’t actually mean anything. This means that a red jumper wire is technically the same as a black one. But the colors can be used to your advantage in order to differentiate between types of connections, such as ground or power. The jumper is an electrical wire, or group of them in a cable, with a pin at each end, which is normally used to interconnect the components of a breadboard internally or with other components or equipment’s without soldering.

Individual jump wires are fitted by inserting their ”end connectors” into the slots provided in a breadboard, the header connector of a circuit board or a piece of test component.

H. PROCESSSING

All processing is an open-source computer programming language and integrated development environment (IDE) built

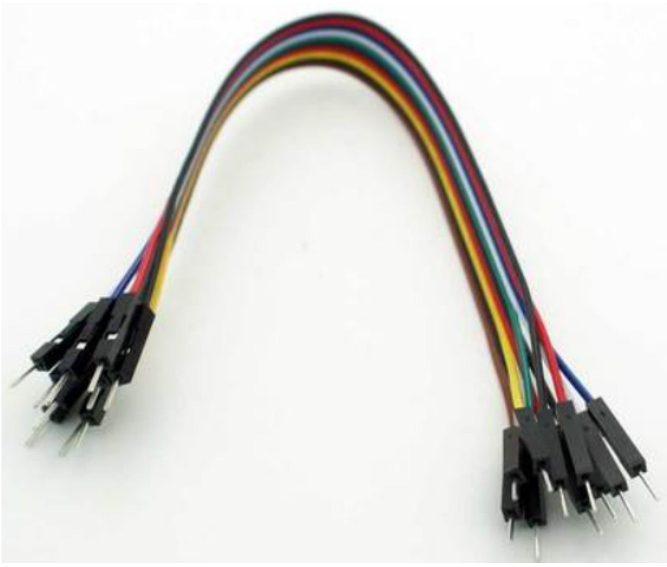

Fig. 10. JUmping Wire

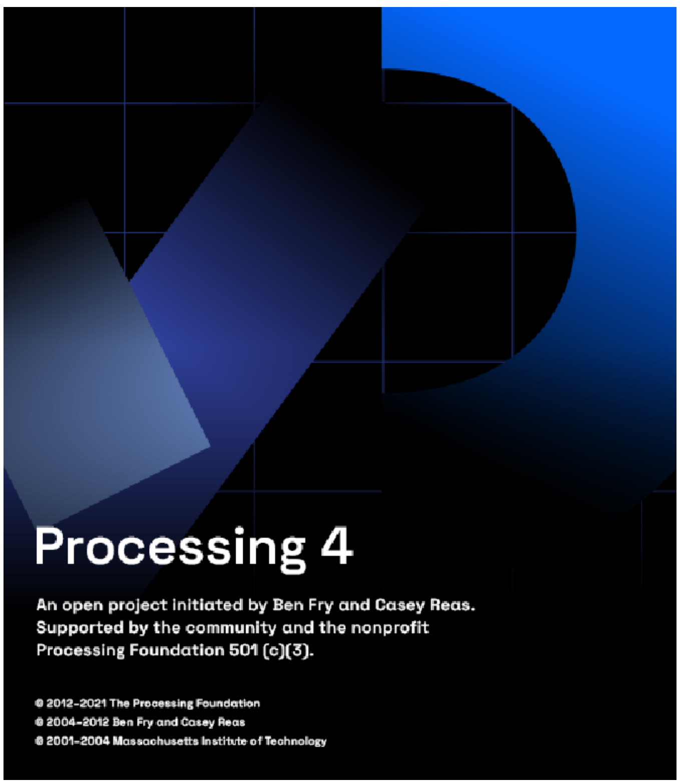

Fig. 11. Processing Software Starting.

for the electronic arts, new media art, and visual design communities to teach the fundamentals of computer programming in a visual context .

Processing is a flexible software sketchbook and a language for learning how to code within the context of the visual arts. Since 2001, Processing has promoted software literacy within the visual arts and visual literacy within technology. There are tens of thousands of students, artists, designers, researchers, and hobbyists who use Processing for learning and prototyping.

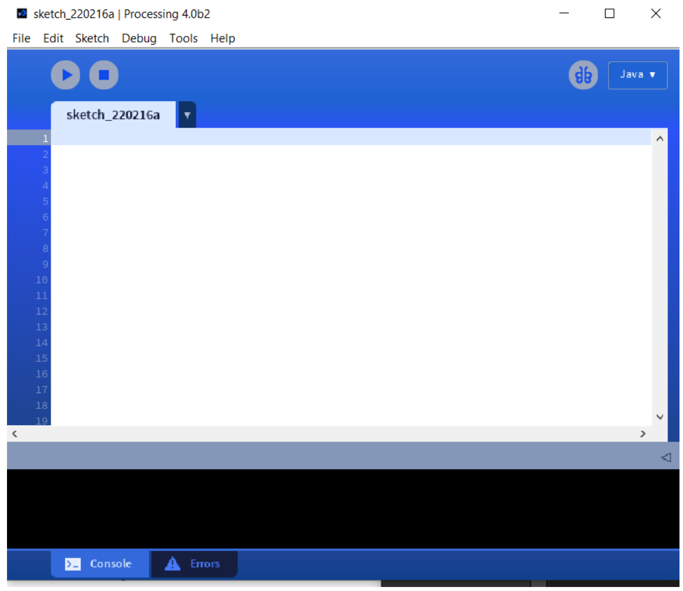

Fig. 12. Processing Software interface.

I. *THE SPECIFICATIONS OF PROGRAMMING:*

- Free to download and open source
- Interactive programs with 2D, 3D or PDF output
- OpenGL integration for accelerated 2D and 3D
- For GNU/Linux, Mac OS X, and Windows
- Over 100 libraries extend the core software
- Well documented, with many books available.

WORKING

The aim of this project is to calculate the distance position and speed of the object placed at some distance from the sensor.Ultrasonic sensor sends the ultrasonic wave in different directions by rotating with help of servo motor. This wave travels in air and gets reflected back after striking some object. This wave is again sensed by the sensor and its characteristics is analysed and output is displayed in screen showing parameters such as distance and position of object.

Arduino IDE is used to write code and upload coding in Arduino and helps us to sense position of servo motor and posting it to the serial port along with the distance of the nearest object in its path. The output of sensor is displayed with the help of processing software to give final output in display screen.

After its designing, construction and programming we begin to test our prototype. We placed few objects in front of the ultrasonic sensor. As the motor rotates, our monitor starts 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 placed.

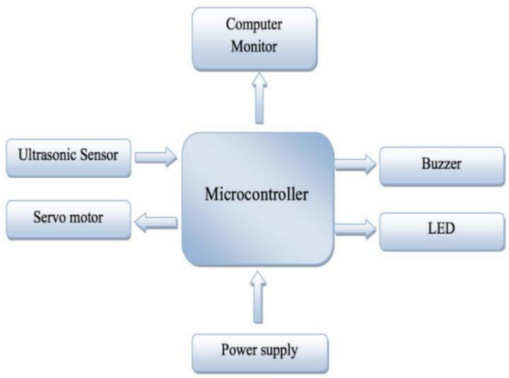

Fig. 13. CIRCUIT DESIGN

The block diagram explains how this radar system works. 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 fro, 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 operation 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 goal of our design is to ascertain the distance position and speed of the obstacle set at some distance from the sensor. Ultrasonic sensor sends electromagnetic wave in various ways by rotating via servo motors.

APPLICATIONS

The radar system is used mostly for mapping and has several uses for protection purposes.

- Application in Air Force:

This is used for the identification of items that come in by aeroplanes or aircraft devices that have a radar device in it. It is often used for the height measurement calculation

- Application in Marine:

It is also used in ships or in marine applications. The distance of other boats or ships is measured on big ships and can be minimized by not colliding with the aid of this sea accident. It can also be used at ports to see the distance from other vessels and track or monitor the movements of the vessels.

- Application In Meteorology:

Wind tracking or monitoring is also done with radar systems. It has become a major climate monitoring equipment. For starters, storms are used to detect tornado.

EXAMPLE:-

RESULT

Ultrasonic sensor is mostly used to find distances, but the current paper aims to measure three parameters (distance, speed and direction) at the same time. The radar's performance

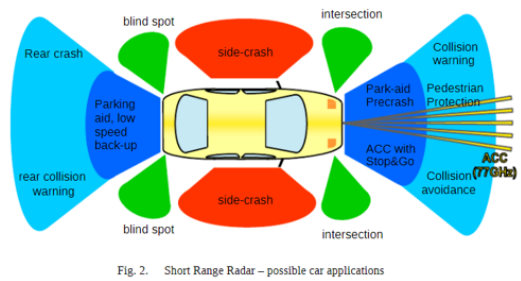

Fig. 14. Application of Short Range Radar

is also evaluated against different objects' shapes and sizes.The novelty and effectiveness of the work can be evaluated by looking at the comparison results of the current study with those of the previous ones. The hardware model of the project is shown. Following figures expresses the results of the

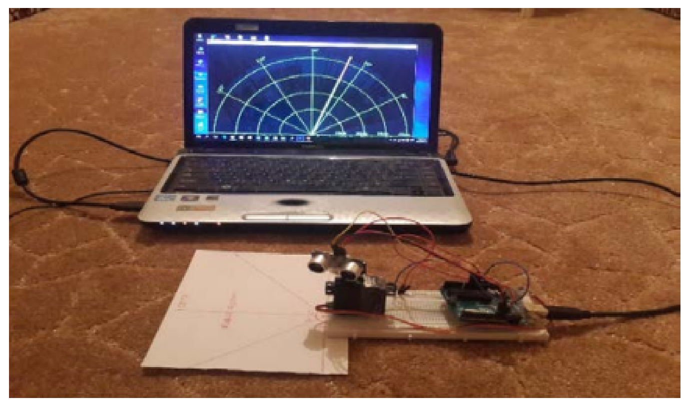

Fig. 15. Hardware model of the projec

monitor screen of our design when the sensor rotates through the area and detects obstacle in the way.

The radar workspace is shown.

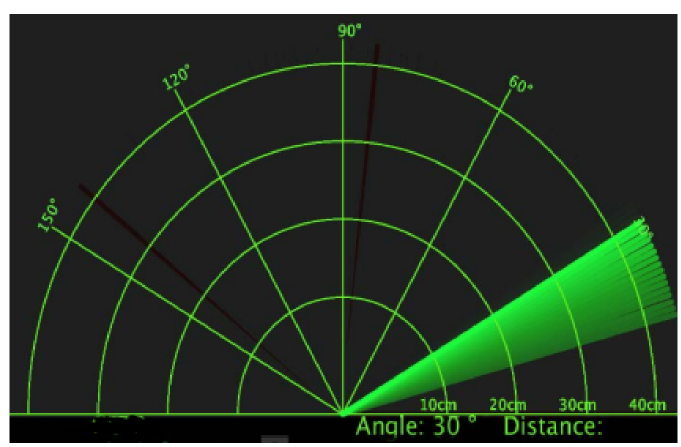

Fig. 16. Radar workspace

Illustrates the radar when detects an object.

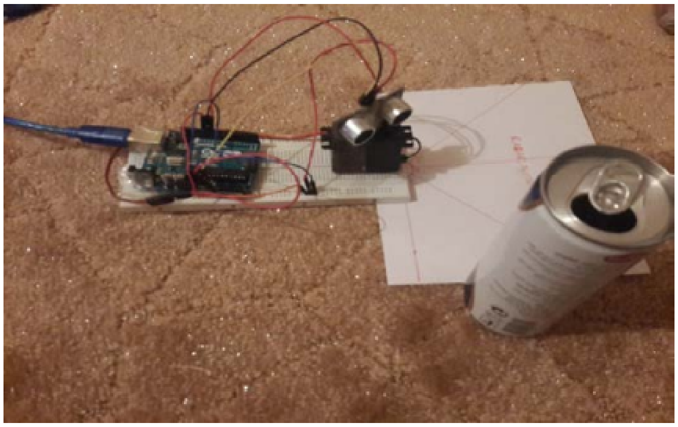

Fig. 17. Radar with object

This figure shows object radar information on radar workspace where the distance between object and radar. Following figures expresses the results of the monitor screen of our design when the sensor rotates through the area and detects obstacle in the way.

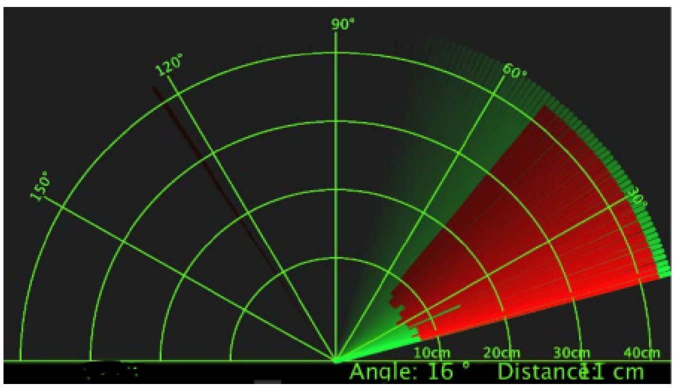

Fig. 18. Radar information

ADVANTAGE

- Radar procurable value is very low
- Working and maintenance value is low
- Distance active resolution is high
- Radar's jam is troublesome
- It can work in any place
- NASA uses radio detection and ranging to map the world and alternative plants
- Activity gets updated in conclusion ultrasonic sensor has high sensitivity, high frequency and high penetrating power therefore it can easily detect the external or deep objects.
- The use of ultrasonic sensor makes this system more accurate and precise than other methods.
- This system is easy to use, not dangerous during operation for nearby objects, person, equipment or material.

FUTURE WORK

This prototype reflects basic working principle of mainstream radar technology. This prototype is limited with its hardware specification because we tried to make a low cost device. The information flow is wired right now, but in future we plan to make it over a secure encrypted WIFI channel that has camera enabled features. This system can only detect objects from 0 to 180 degrees only because the servo motor that we have used can rotate only to this range. So, due to this limitation our design cannot be applied to places or areas for obstacle detection on a larger scale. Usage of a 360 degrees rotating servo motor can make the system more efficient. We look forward to modify this system and enhance our research work by using a fully 360 degrees rotating servo and a higher ranged ultrasonic sensor.

DISCUSSION

Ultrasonic sensor is mostly used to find distances, but the current paper aims to measure three parameters (distance, speed and direction) at the same time. The radar's performance is also evaluated against different objects' shapes and sizes.The novelty and effectiveness of the work can be evaluated by looking at the comparison results of the current study with those of the previous ones. Cost, complexity, efficiency, decremental value of error and simplicity are the key success factors. The proposed system can detect moving object with the speed of 3.00 cm/s, which is similar to what has been done in previous research.What makes differences in the maximum range inside (366 cm) and outside of the room (251 cm) is the soundwave's speed as influenced by the environment parameter. For the same ultrasonic distance of 5 cm, a metal object shows 88.88 percent efficiency and a non-metal object shows 75 percent efficiency. That means this radar system provides better efficiency for metal objects compared to thenon-metal objects. The results in Table 5 are identical to other works with a new numerical analysis done for different shape of objects. We can see that ultrasonic radar responds better to a square-shaped object than a cylindrical-shaped object. When a cylindrical object is very close to the sensor, it fails to detect it. The best identification is when the object is big. The accuracy of small object and cylindrical object identification started to decrease after 8 cm distance and totally fails to detect when the distance reaches 10 cm. The radar is unable to detect small objects like LEDs in any distances. The connection setup also fails to differentiate between two different objects; and detect object size of unknown object. Future studies will benefit from examining these areas.

CONCLUSION

We have represented a project on Ultrasonic RADAR for security system for human or object interference in a short range. The system has been successfully implemented and the aim is achieved without any deviation. There is a lot of future scope of this project because of its security capacity. It can be used in many applications. This project can also be developed or modified according to the rising needs and demand.

RECOMMENDATIONS

- Using of other sensors work as radar to determine the distance, motion, range of an object (targets) for a wide range of distances.
- Using the technology in the department by exam committees to find out if any person tries to enter the exam committee room or near from it and not take into consideration the distance allowed.
- Using this technique and methods as military batches, by operating the alarm when any object approaches the restricted (forbidden) zone.
- Recommendation to use this technique and method to protect the traces byinvesting one of the benefits of the radar, which is not affected by weather conditions from rain, snow and fog compared to the camera.
- The sensor can be placed in the car to alert the driver as he approaches an object and to decrease the accident occurs in the street.

ACKNOWLEDGMENT

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Many people, especially my classmates have made valuable comment suggestions on my paper which gave me an inspiration to improve the quality of the assignment.

RADAR is an object detection system which uses radio waves to determine the range, altitude, direction, or speed of objects. Radar systems come in a variety of sizes and have different performance specifications. Some radar systems are used for air-traffic control at airports and others are used for long range surveillance and early-warning systems. A radar system is the heart of a missile guidance system. Small portable radar systems that can be maintained and operated by one person are available as well as systems that occupy several large rooms.

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