International Journal of Scientific Research in Computer Science, Engineering and Information Technology

Ultrasonic Ranging and Detecting Using Arduino and Processing

Govind Mishra, Yogendra, Vinay Singh, Mukesh Verma, Nilesh Verma, Ashutosh Mishra
Department of Electrical and Electronics Engineering, RSRRCET, Kurud, Bhilai, Chhattisgarh, India

ABSTRACT

RADAR is an object detection system which uses radio waves to determine the range, altitude, direction, or speed of objects. The radar dish or antenna transmits pulses of radio waves or microwaves which bounce off any object in their path. Arduino is a single-board microcontroller to make using electronics in multidisciplinary projects more accessible. This project aims at making an ULTRASONIC RADAR that is efficient, cheaper and reflects all the possible techniques that a radar consists of.
Keywords : RADAR, Ultrasonic, Radio Waves, Arduino, Processing

I. INTRODUCTION

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. Radar was secretly developed by several nations before and during the World War II. The term RADAR itself, not the actual development, was coined in 1940 by United States Navy as an acronym for Radio Detection and Ranging. The modern uses of radar are highly diverse, including air traffic control, radar, astronomy, air-defence systems, antimissile systems, antimissile systems; marine radars to 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 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.

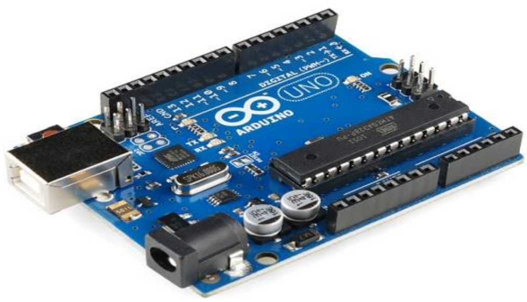
II. LITERATURE SURVEY

"The Idea" Army, Navy and the Air Force make use of this technology. The use of such technology has been seen recently in the self-parking car systems launched by AUDI, FORD etc. And even the upcoming driverless cars by Google like Prius and Lexus. This setup can be used in any systems the customer may want to use like in a car, a bicycle or anything else. The use of Arduino in this provides even more flexibility of usage of the above-said module according to the requirements. The idea of making an ULTRASONIC RADAR came as a part of a study carried out on the working and mechanism of "mini radar". Hence this time we were able to get a hold of one of the Arduino boards, Arduino UNO. So knowing about the power and vast processing capabilities of the Arduino, we thought of making it big and a day to day application specific module that can be used and configured easily at any place and by anyone. Moreover, in this fast moving world there is an immense need for the tools that can be used for the betterment of the mankind rather than devastating their lives. Hence, from the idea of the self-driving cars came the idea of self-parking cars. The main problem of the people in the world is safety while driving. So, this gave up a solution to that by making use of this project to continuously scan the area for traffic, population etc.

and as well as protection of the vehicles at the same time to prevent accidents or minor scratches to the vehicles.

III. COMPONENTS REQUIRED

(a). Arduino UNO: The Arduino Uno is a microcontroller board based on the ATmega328. It has 14 digital Input /Output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16MHz ceramic resonator, USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0. The Uno and version 1.0 will be the reference versions of Arduino, moving



forward. The Uno is the latest in a series of USB Arduino boards, and the reference model for the Arduino platform.

(b). Servo Motor: A servomotor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a different class of motor, on the basis of fundamental operating principle, but uses servomechanism to achieve closed loop control with a generic open loop motor. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

(c). Ultrasonic Sensor: Ultrasonic sensors (also known as transceivers when they both send and receive, but more generally called transducers) work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor. Sensors calculate the time interval between sending the signal and receiving the echo to determine the distance to an object. This technology can be used for measuring wind speed and direction (anemometer), tank or channel level, and speed through air or water. For measuring speed or direction a device uses multiple detectors and calculates the speed from the relative distances to particulates in the air or water. To measure tank or channel level, the sensor measures the distance to the surface of the fluid. Further applications include: humidifiers, sonar, medical ultra sonography, burglar alarms and non-destructive testing. Systems typically use a transducer which generates sound waves in the ultrasonic range, above 18,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed.

IV. STEPS INVOLVED

(a). Using Arduino Software

The Arduino integrated development environment (IDE) is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiring projects. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. A program or code written for Arduino is called a "sketch". Arduino programs are written in C or C++. The Arduino IDE comes with a software library called "Wiring" from the original Wiring project, which makes many common input/output operations much easier. Users only need define two functions to make a run able cyclic executive program: • Setup (): a function run once at the start of a program that can initialize settings • Loop (): a function called repeatedly until the board powers off. Open the Arduino IDE software and select the board in use. To select the board: • Go to Tools. • Select Board. • Under board, select the board being used, in this case Arduino Uno. • Go to Tools and to Port and select the port at which the Arduino board is connected. • Write the code in the space provided and click on compile. Once the code is compiled, click on upload to upload the sketch to the Arduino board.

(b). Connecting Servo Motor**:** A servomotor is a rotary actuator that allows for precise control of angular position, velocity and acceleration. A normal servo motor has three terminals: 1.VCC 2. GND 3. PULSE. A servo motor works at normally 4.8 to 6 volts. Ground is provided by connecting it to the Ground of the Arduino. The total time for a servo motor pulse is usually 20ms. To move it to one end of say 0 degree angle, a 1ms pulse is used and to move it to other end i.e. 180 degrees, a 2ms pulse is applied. Hence, according to this to move the axis of the servo motor to the centre, a pulse of time 1.5 ms should be applied. For this, the pulse wire of the servo motor is connected to the Arduino that provides the digital pulses for pulse width modulation of the pulse. Hence, by programming for a particular pulse interval the servo motor can be controlled easily.

(c). Connecting Ultrasonic Sensor: An Ultrasonic Sensor consists of four wires. One for VCC, second for Ground, third for trigger signal and fourth for echo. The ultrasonic sensor is mounted on the servo motor and both of them further connected to the Arduino board. The ultrasonic sensor uses the reflection principle for its working. When connected to the Arduino, the Arduino provides the pulse signal to the ultrasonic sensor which then sends the ultrasonic wave in forward direction. Hence, whenever there is any obstacle detected or present in front, it reflects the waves which are received by the ultrasonic sensor. If detected, the signal is sent to the Arduino and hence to the PC/laptop to the processing software that shows the presence of the obstacle on the rotating RADAR screen with distance and the angle at which it has been detected.

(d). Processing Software: Processing is an open source programming language and integrated development environment (IDE) built for the electronic arts, new media art, and visual design communities with the purpose of teaching the fundamentals of computer programming in a visual context, and to serve as the foundation for electronic sketchbooks. The project was initiated in 2001 by Casey Reas and Benjamin Fry, both formerly of the Aesthetics and Computation Group at the MIT Media Lab. One of the stated aims of Processing is to act as a tool to get nonprogrammers started with programming, through the instant gratification of visual feedback. The language builds on the Java language, but uses a simplified syntax and graphics programming models.

V. APPLICATIONS

The idea of making an Ultrasonic RADAR appeared to us while viewing the technology used in defence, be it Army, Navy or Air Force and now even used in the automobiles employing features like automatic/driverless parking systems, accident prevention during driving etc. The applications of such have been seen recently in the self-parking car systems launched by AUDI, FORD etc. And even the upcoming driverless cars by Google like Prius and Lexus.

(a). Air Force: In aviation, aircraft are equipped with radar devices that warn of aircraft or other obstacles in or approaching their path, display weather information, and give accurate altitude readings. The first commercial device fitted to aircraft was a 1938 Bell Lab unit on some United Air Lines aircraft. Such aircraft can land in fog at airports equipped with radar-assisted ground-controlled approach systems in which the plane's flight is observed on radar screens while operators radio landing directions to the pilot.

(b). Naval Applications: Marine radars are used to measure the bearing and distance of ships to prevent collision with other ships, to navigate, and to fix their position at sea when within range of shore or other fixed references such as islands, buoys, and lightships. In port or in harbour, vessel traffic service radar systems are used to monitor and regulate ship movements in busy waters.

(c). Applications in Army: Two video cameras automatically detect and track individuals walking anywhere near the system, within the range of a soccer field. Low-level radar beams are aimed at them and then reflected back to a computer, which analyzes the signals in a series of algorithms. It does this by comparing the radar return signal (which emits less than a cell phone) to an extensive library of "normal responses." Those responses are modeled after people of all different shapes and sizes .It then compares the signal to another set of "anomalous responses" – any anomaly, and horns go off. Literally, when the computer detects a threat, it shows a red symbol and sounds a horn. No threat and the symbol turns green, greeting the operators with a pleasant piano riff.

VI. CONCLUSION

This work aims on the use of Ultrasonic Sensor by connected to the Arduino UNO R3 board and the signal from the sensor further provided to the screen formed on the laptop to measure the presence of any obstacle in front of the sensor as well as determine the range and angle at which the obstacle is detected by the sensor. For this screen, we use Processing 2 software by Benjamin Fry and Casey Reas, Massachusetts Institute of Technology, Cambridge.

VII. REFERENCES

[1]. S. Murakami, Y. Nishida, T. Hori, H. Mizoguchi, A Minimally Privacy-Violative Activity Observation System: Tracking People and Objects Using a Combined Tag-Radar Ultrasonic System (in Japanese), in Proceedings of JSME Robotics and Mechatronics Conference 2005 (ROBOMEC2005), 1A1-N-095(1)-(4), June 2005.

[2]. Y. Nishida, S. Murakami, H. Toshio, H. Mizoguchi, "Minimally Privacy-Violative System for Locating Human by Ultrasonic Radar Embedded on Ceiling," in Proceedings of 2004 IEEE International Conference on Systems, Man and Cybernetics (SMC '04), pp. 1549- 1554, October 2004.

[3]. S. Murakami, Y. Nishida, T. Hori, H. Mizoguchi, Detecting Human Head Location Using a Simply Installed Ultrasonic Radar System, in Proceedings of the 22nd Annual Conference of the Robotics Society of Japan, 1A23(1)-(2), September 2004.