IMPLEMENTATION OF RADAR USING ULTRASONIC SENSOR

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ABSTRACT

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 [1] [2]. The investment required in developing RADAR is enormous and for less critical purposes like surveillance in close proximity, automatic parking systems in vehicles, and object detection in small ranges it would unreasonable to spend capital in large amounts. So, this is an attempt to use Ultrasonic Sensor (HC - SR04) to implement the similar working concept as used in RADAR to detect nearby object. Arduino UNO board is sufficed to control ultrasonic sensor and also to interface the sensor and display device.

KEYWORDS: RADAR, Ultrasonic sensor, Arduino UNO.

Technology in 21st century puts an emphasis on making the devices autonomous, be it self-driving car or a delivery system using drones all are being made autonomous. The idea of self-driving cars is not only to make the experience of travelling comfortable and convenient but also to ensure safety of both passenger and vehicle. With the age of technological advancements, the economic growth has taken a giant leap, resulting in the elevated standards of life style. All people who have achieved financial stability are looking safer and expedient means to work out the tasks that are to be carried out in day-to-day life. The number of automobiles have drastically increased in the last few decades and with the increase of automobiles the probability of accidents and mishaps have also increased. The loss due to such events are both physical and financial, in order to prevents these incidents and ease up the experiences, a lot of precautionary measures are taken by installing various protective gears in the vehicle. To an extent the implementation of proper safety measures can minimize the loss but what if instead of minimizing the loss we can somehow completely avoid it. The mayhem caused due to negligence and incompetency of driver takes a toll on all the passenger in the vehicle and people around the vehicle.

Many researches has been carried out for making driving safer like Crashless Car [3], anti-collision device using ad hoc wireless network, V2V communication, GPS and Radar implementation. The idea behind most of these researches is to warn or simply notify the driver that there is possibility of an accident but ultimately it depends on the driver to control the vehicle. This paper is inspired by research that was conducted by members of University of Petroleum and Energy Studies, India [4]. This paper attempts to increase the accuracy of object detection so that the command to implicitly control the vehicle can be given with great precision. The Arduino board is connected with ultrasonic sensor which is mounted on servo motor. The servo motor rotates and provides the sensor with wider range. The data collected by sensor is transmitted to display device via Arduino board. The programming for display is done in MATLAB.

Objective of Project

The objective of the project is to detect the obstacle using Ultrasonic Sensor, Arduino UNO board and MATLAB as a platform to display the results.

LITERATURE REVIEW

After going through some of the papers regarding RADAR implementation using ultrasonic sensor we found that this concept is quite sought everywhere and is a popular concept which is still in progress. These papers had some really innovative ideas for prevention from accidents and driving safer. The techniques that were illustrated were par excellence and can bring about a major change in the field of automobiles. The technologies used were not only efficient and reliable but also economically feasible. This paper deals this deals the major causes of accidents and the simple ways in which they can be prevented. The existing system uses microcontroller and LCD display, we have used Arduino UNO and MATLAB for respective purposes. Our major aim is display the obstacle position as accurately as possible. The conclusion made here are

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that the concept RADAR can be easily duplicated with help of ultrasonic sensor for small ranges. For data transmission from sensor to display device Arduino UNO is used. Arduino UNO is used because it compatible with MATLAB R2015a.

SYSTEM DEVELOPMENT

Arduino

Arduino is an open-source project that created microcontroller-based kits for building digital devices and interactive objects that can sense and control physical devices.[5]

The project is based on microcontroller board designs, produced by several vendors, using various microcontrollers. These systems provide sets of digital and analog input/output (I/O) pins that can interface to various expansion boards (termed shields) and other circuits. The boards feature serial communication interfaces, including Universal Serial Bus (USB) on some models, for loading programs from personal computers. For programming the microcontrollers, the Arduino project provides an integrated development environment (IDE) based on a programming language named Processing, which also supports the languages C and C++.

The first Arduino was introduced in 2005, aiming to provide a low cost, easy way for novices and professionals to create devices that interact with their environment using sensors and actuators. Common examples of such devices intended for beginner hobbyists include simple robots, thermostats, and motion detectors.

Arduino boards are available commercially in preassembled form, or as do-it-yourself kits. The hardware design specifications are openly available, allowing the Arduino boards to be produced by anyone. Adafruit Industries estimated in mid-2011 that over 300,000 official Arduinos had been commercially produced [6], and in 2013 that 700,000 official boards were in users' hands.[7]

Figure 1: Arduino UNO board

Servo Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. [7] 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 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. Servomotors are used in applications such as robotics, CNC machinery or automated manufacturing.

More sophisticated servomotors use optical rotary encoders to measure the speed of the output shaft and a variable-speed drive to control the motor speed. [8]

Figure 2: Servomotor

Ultrasonic Sensor

Ultrasonic sensors “are based on the measurement of the properties of acoustic waves with frequencies above the human audible range,” often at roughly 40 kHz. They typically operate by generating a high-frequency pulse of sound, and then receiving and evaluating the properties of the echo pulse. 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.

Figure 3: Ultrasonic sensor (HC-SR04)

The Ultrasonic sensor is mounted on servomotor which provides desired rotation to sensor to increase range of sensor which is connected to Arduino UNO board. Arduino UNO board is connected to computer which has Arduino IDE and MATLAB. With the help of suitable programming the position object is displayed.

APPLICATIONS

1. In underwater networks.
2. In driverless vehicle system.
3. In speed detection of mobile objects.
4. In various military operations such as to guide automatic weapons.
5. In aircrafts to warn them about any obstacle in the way.

ADVANTAGES

1. Implementation of RADAR at very low cost.
2. Mobile RADAR system.
3. Readings are updated rapidly.
4. Small in size.
5. Easy to construct.

LIMITATIONS

1. Height of objects cannot be determined.
2. 3D mapping of object is not possible.
3. The range depends upon the characteristics of the sensor

RESULTS

The developed module detects and displays the obstacle successfully and subsequently plots the changes in position of the obstacle. The results are accurate with minor error probability,

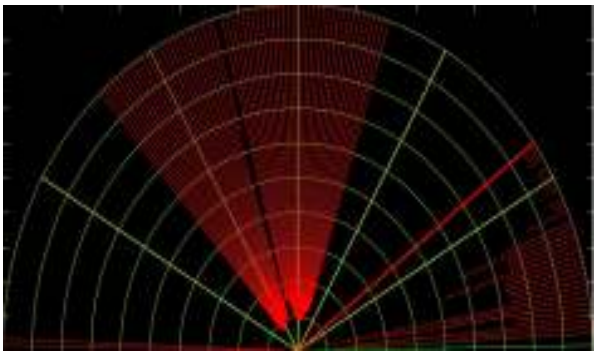

Figure 4: Screenshot of output

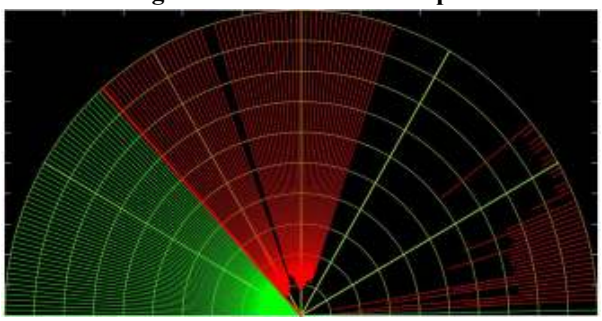

Figure 5: Screenshot of output

CONCLUSION

In this paper we have attempted to use ultrasonic sensor for implementation of RADAR and got results that exceeds our presumed expectations. The basic system is created for preventing collisions of vehicles and self-driving cars. With some enhancements the system can be used for real time purposes.

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