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Arduino Based Radar System using Ultrasonic Sensor

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ABSTRACT: This project is about Arduino based radar system using ultrasonic sensor. This RADAR system consists of an ultra-sonic sensor and servo motor; these are the most important components of the system. Basic working of the system is that it has to identify objects in its defined range. Ultra-sonic sensor is attached to the servo motor it rotate on 180 degree and gives visual representation on the software called processing IDE. Processing IDE gives graphical representation and it also gives angle or position of the object and distance of the point.

In this project we used Arduino. Arduino UNO board is sufficed to control ultrasonic sensor and also to interface the sensor and display device. We learn about existing navigation and obstacle detection innovation and different systems where ultrasonic sensors are used efficiently. Main application of this RADAR system comes into different field of navigation, positioning, object detection, mapping, spying or tracking and different applications. The effectiveness of the proposed design is measured using a statistical analysis of the distance error between the radar and the obstacles. The results obtained for all types of obstacles are tabled and graphed to prove that a very small error can be achieved using the proposed design.

Keywords: Arduino, Radar, Ultrasonic Sensor, Surveillance, Obstacles Detection, Positioning.

I. INTRODUCTION

RADAR is an object detection system which uses radio waves to verify 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.

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 large number of products ranging from toy helicopters to robots. In this project we are using the Ultrasonic Sensor for control by emit a burst of sound waves in very rapid succession. These sound waves strike 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.

Several radar is make use of for flight right at airport gates and others are make use of for long range monitoring and in advance precaution structure. There are several methods to indicate functioning information of radar. Here is also several improved radar method which contain modern mechanism of managing the systems. These modern methods are use at upper levels to obtain or remove the cooperative or main information.

II. PROBLEM DEFINITION

As, electronic components while used to form various circuit need several amount of troubleshooting to create the circuit job according to our prospect. In our project, there were several problems that we had to deal with.

III. HARDWARE IMPLEMENTATION

A) Arduino Uno

The Arduino Uno is a microcontroller board based on the ATmega328. It has 32k Byte in system programmable flash, 14 digital I/O pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack and a reset button. Arduino is an open-source display place used for construct and programming of electronics

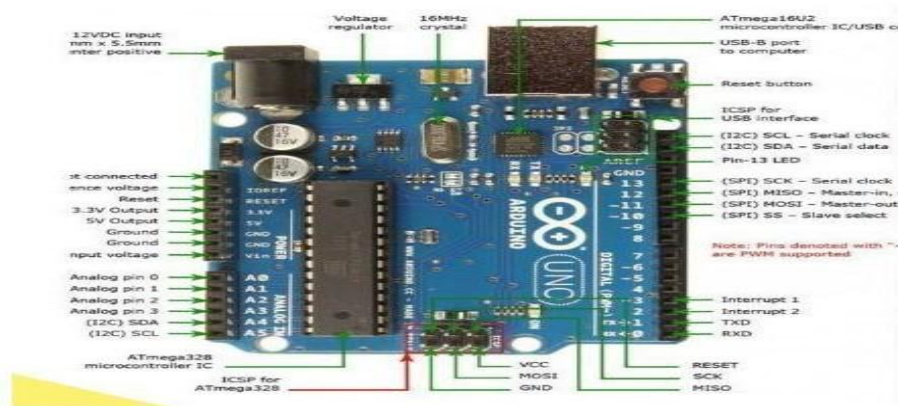


Fig-1:Arduino Uno

B) Ultrasonic sensors

Ultrasonic sensors are based on the measurement of the properties of acoustic waves with frequencies on top of the human audible range a lot at roughly 40 kHz. 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. Ultrasonic ranging module HCSR04 provides 2cm-400cm non-contact measurement function, the ranging accuracy can reach to 3mm.



Fig -2:Ultrasonic sensor

C) Servo Motor

A servo motor is an electrical device which can push or rotate an object with great precision. If you want to rotate and object at various specific angles or distance, then you use servo motor. It is just made up of simple motor which run through servo mechanism. Servo Motor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.



Fig-3: Servo Motor

D) ATmega328P

The ATmega328P is a single chip micro-controller created by Atmel and belongs to the mega AVR series. The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte oriented 2-wire serial interface, SPI serial-port, a 6-channel 10 bit Analog to Digital converter (8-channels), programmable watchdog timer with internal oscillator and five software selectable power saving modes.



Fig-4: ATmega328P

E) Crystal Oscillator

A crystal oscillator is an electronic oscillator circuit that uses the mechanical resonance of a vibrating crystal of piezoelectric material to create an electrical signal with a very precise frequency. This frequency is frequently used to keep track of time (as in quartz wristwatches), to provide a stable clock signal for digital integrated circuits, and to stabilize frequencies for radio transmitters and receivers.



Fig-5: Crystal Oscillator

F) Voltage Regulator

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. With the exemption of shunt regulators, all modern electronic voltage regulators operate by comparing the actual output voltage to some internal fixed reference voltage. Any difference is amplified and used to control the regulation element.



Fig-6: Voltage Regulator

IV. SOFTWARE IMPLEMENTATION

This project points on the using of Ultrasonic Sensor via attached with the Arduino UNO board and the signal coming from the sensor later forwarded towards the screen create on the laptop to compute that there is the existence of any obstacle in front of the sensor and also determine the range and angle at which the barrier is recognize by the sensor.

The Arduino is an electronics platform which based upon the concept which is convenient to use the hardware and software. The Open-source Arduino Software (IDE) makes it simple to write down code and up-load onto the board. This could be run in Window, Mac, as well as 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 computer programmer writes the code on IDE is named as the sketches.

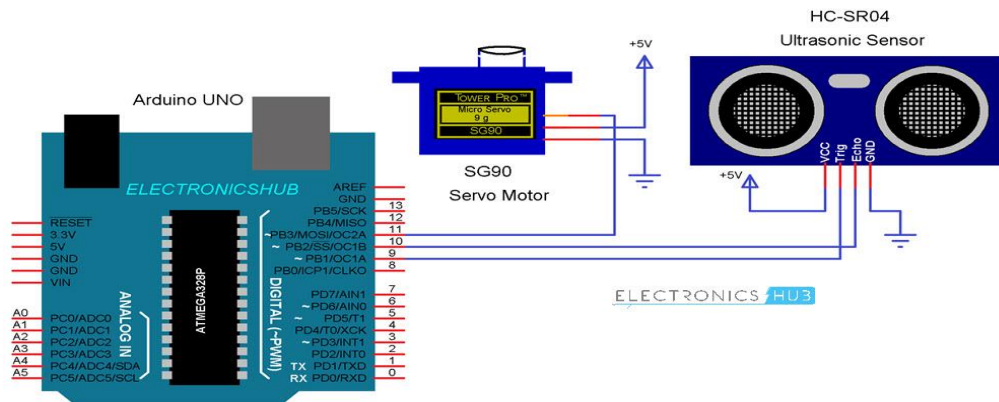


Fig 7: Circuit Diagram of Arduino based radar system using ultrasonic sensor

V. WORKING

Figure shows the system's block diagram. Here, it shows that how the work-flow in this 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 regularly revolving to and fro, thus assemble the sensor movable. The data acquire, is then encoded and given to the processing IDE which is used to represents it's on the panel. After that results are display on this paper. These complete tasks are done by Arduino micro-controller from the rotary motion of the servo motor, collecting of the data from the sensor; feed the data to encoder for moving it to the display.

The main purpose to design this project is to find out the distance location and rate of the barrier situated at several distance coming from the sensor. Ultra-sonic sensor transmits the ultra-sonic wave in the different directions by revolving by using the servo motors. These waves transmitted in air and gets return back subsequent to striking several object. This wave is again sense by the same sensor and its standards are examine and output is display in screen representing parameters, e.g., distance and position of object. Arduino IDE is used to create code and transfer coding in Arduino and causes us to spot location or angle of servo motor and it is communicated throughout the serial port along with the covered distance of the nearest object in its way. The result of the functioning of this project is shown in the software named as processing, and it will show the input/output and the area of the object. Implementations of the sensors are done in this way that the ultrasonic sensor is connected on peak of the servo-motor since it has to sense the object.

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 detects any object, at any condition the encoder feeds the information in the controller while the servo keeps constantly rotating. As soon as any obstacle or

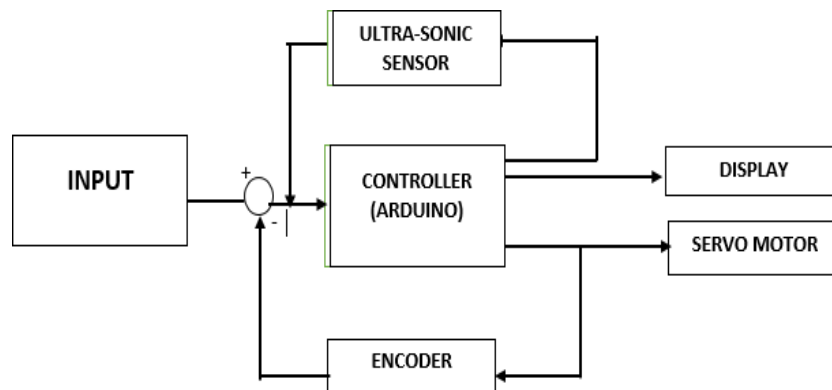


Fig8: Block Diagram of Arduino based radar system using ultrasonic sensor

object is sensed by the ultra-sonic sensor the data is immediately processed by the controller and is feed to the IDE which shows us 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.

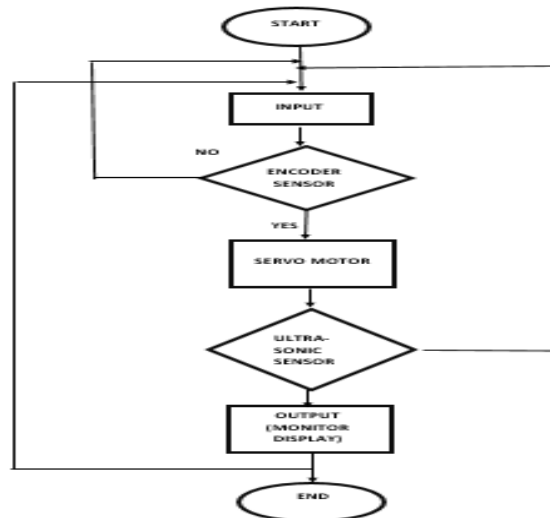


Fig: Flow Chart

Advantages

- 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.

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.
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- While the radar using for check up purpose, make sure it should be water resistive. If not highly chances of damage.

V. CONCLUSION

This project aim on the use of Ultrasonic Sensor by connected to the Arduino UNO R3 board and the signal from the sensor further provide to the screen produced on the laptop to measure the presence of any barrier in front of the sensor as well as determine the range and angle at which the obstacle is detected by the sensor. In our project, the recommended mapping method of whole system is assessed on small principles or scale. The field that we have chosen for our “Radar System” is a very vast field and future scope of this technology is very high. We have tremendous applications in which radar system have been implemented or used. There is a lot of future scope of this design because of its security capacity. 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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