Rotating Ultrasonic Distance Sensor

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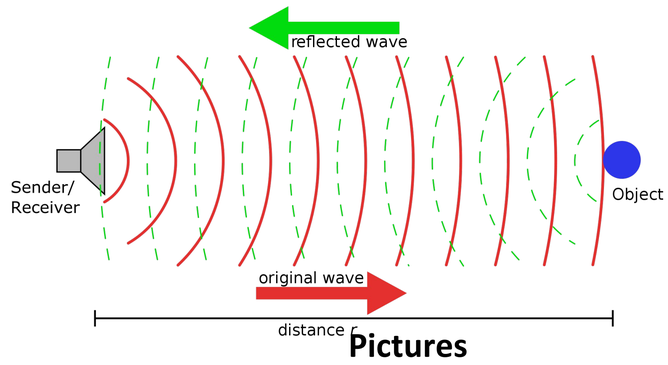
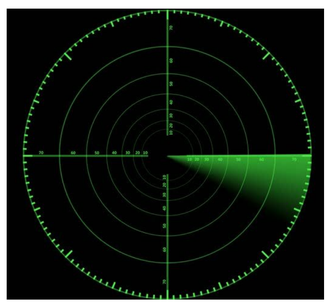
Abstract

This project puts an ultrasonic distance sensor on top of a servo to get various distance measurements at various different angles in front of the device. These measurements are then output to the serial monitor using the RS232 communication. This device then could be mounted to a moving object to prevent the object bumping into something since the sensor range varies from 2cm - 400cm with low tolerance, providing a fairly accurate guide.

Introduction

The device we designed and built was inspired by the characteristics of the ultrasonic waves. When the waves make contact with an object, they bounce off of the object and back to the receiver. Using the speed of sound, you can calculate the distance from the object.



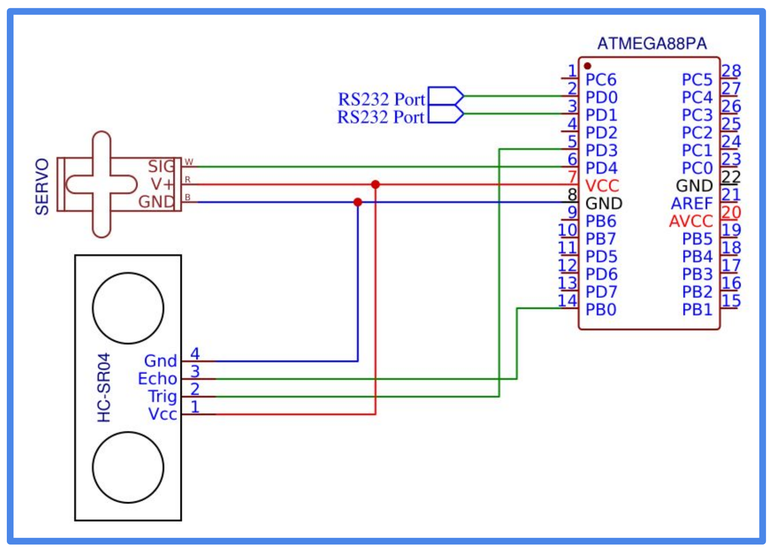


Pictures

The device we designed is very similar to something like a radar. By rotating a singular ultrasonic sensor to a servo motor, it is able to tell when an object is in front of the device by calculating the distance to the object keeping the device informed of the surroundings.

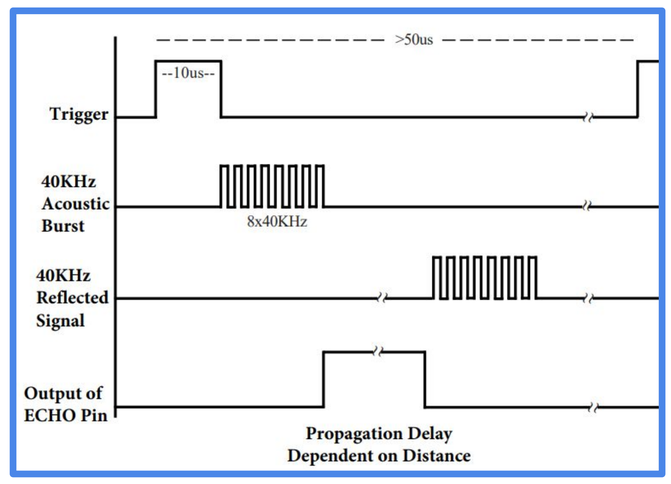
System Description

Shown are the major components of the system. The microcontroller (ATmega88PA), the Ultrasonic Distance Sensor (HC-SR04), and the Servo Motor (KY66). When the Ultrasonic Distance Sensor receives a 10us trigger pulse, it will output an echo pulse back to the microcontroller. Measuring the length of this pulse provides the microcontroller with the ability to calculate the distance. By mounting this sensor to a servo, we are able to take the distance at several different points in front of the device. The Servo Motor takes PWM input to determine the position it will rotate to. Out device will rotate 30° at a time from starting at 0° and stepping up to 180°. These measurements are then sent back to the microcontroller and output to the serial (RS232) communication for display on the computer.

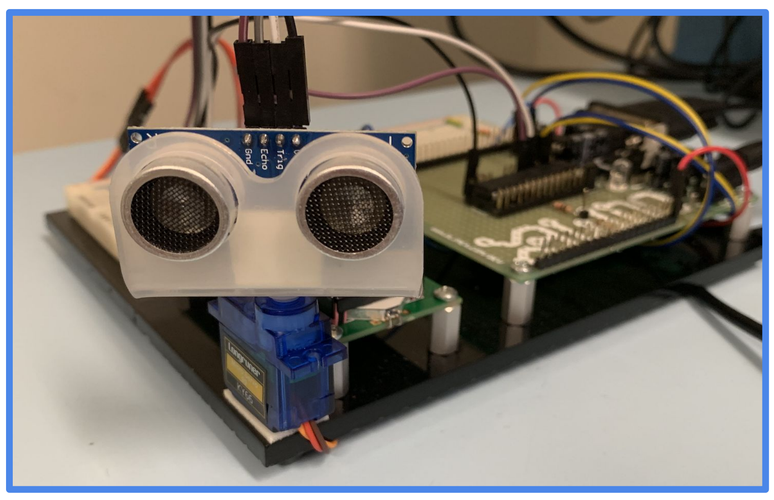


Schematic of our design

Timings of Ultrasonic Sensor



Results



Completed ultrasonic sensor mounted onto a servo motor.

Shown is the the ultrasonic distance sensor mounted on a servo motor (left). The collected data is then sent back from the ultrasonic sensor and is then shown in the serial monitor (right).

Overall the project was very successful. The ultrasonic distance sensor is accurate in getting distances, and the servo appropriately spins to the correct position for measurements. The communication using RS232 between the device and the computer works perfectly and displays the distance measurements with the angle in a readable way.

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Angle: 0 Degrees
Distance: 14.594722 cm

Angle: 30 Degrees
Distance: 47.244194 cm

Angle: 60 Degrees
Distance: 116.873540 cm

Angle: 90 Degrees
Distance: 104.568350 cm

Angle: 120 Degrees
Distance: 92.233154 cm

Angle: 150 Degrees
Distance: 62.936523 cm

Angle: 180 Degrees
Distance: 62.216221 cm
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Example data output to serial monitor

Lessons Learned

During this project, we learned more about using the timers built into the ATMega88 and how they work. We learned how to use both PWM and input capture on a timer. We also learned the importance of looking at the datasheets for the timings of each device. Taking time to figure out how to use two different timers for different components.

Conclusion

The design is successful and functions properly. The ability for us to learn how more external devices function without much guidance was very enjoyable. In the future, the motor could be swapped out for one that can rotate a full 360° to give distances all the way around an object rather than just in front of it. Also, a better user interface, buttons, and potentiometer, and can be added to the design for better control of the device.

Acknowledgement
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