Ultrasonic Distance Sensor

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ABSTRACT- This report is based on how does an ultrasonic distance sensor work. What kind of technical mechanism is used to analyze distance. To study what all major as well as minor steps are involved for providing us accurate distance.

INDEX TERMS: HC-SR04 Ultrasonic Sensor, Arduino nano

INTRODUCTION

In this project I will introduce you to the HC-SR04 Ultrasonic sensor and Arduino. It works by sending sound waves from the transmitter, which then bounce off an object and then return to the receiver. You can determine how far away something is by the time it takes for the sound waves to get back to the sensor.

WORKING

- The ultrasonic sensor uses sonar to determine the distance to an object. Here's what happens:

    1. The ultrasound transmitter (trig pin) emits a high-frequency sound (40 kHz).
    2. The sound travels through the air. If it finds an object, it bounces back to the module.
    3. The ultrasound receiver (echo pin) receives the reflected sound (echo).

- The time between the transmission and reception of the signal allows us to calculate the distance to an object. This is possible because we know the sound's velocity in the air.
- We need to first set the **TRIG** (triggered) pin to **HIGH**. It will send out the burst of 8 cycles called the sonic burst, which will travel at sound speed. It will be further received by the ECHO pin. The time traveled by the sound wave is considered the ECHO pin's output time in microseconds.

RESEARCH

What is the range of distance ultrasonic sensor can measure?
Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm.
Ultrasonic sensors function by emitting a sequence of short, high-frequency sound waves. These sound waves are produced at regular intervals and travel through the air at a consistent speed, known as the speed of sound. When these ultrasonic waves encounter any object in their path, they are reflected toward the sensor, creating an echo that is detected by the sensor's receiver.

The sensor is equipped with the capability to calculate the distance to the object by analyzing the time interval between the moment the sound pulse is emitted and the moment the echo is received. This time interval is directly related to the round-trip distance that the sound waves have traveled.

CONCLUSION

Distance measured using ultrasonic detectors and Arduino is protean and very cost effective.

Ultrasonic sensors are non-intrusive in that they do not require physical contact with their target and can detect certain clear or shiny targets otherwise obscured to some vision-based sensors. On the other hand, their measurements are very sensitive to temperature and to the angle of the target. Temperature and humidity affect the speed of sound in the air. Therefore, range finders may need to be recalibrated to make accurate measurements in a new environment.

Round objects are therefore most easily sensed since they always show some perpendicular face. When targeting a flat object, care must be taken to ensure that its angle with respect to the sensor does not exceed a particular range.

Ultrasonic sensors typically have a "dead zone" immediately in front of them in which objects cannot be detected because they deflect the wave back before the receiver is operational. (This is because reverberations from the transmitter force the receiver to pause a moment before beginning to listen for the echo). Some materials are more absorbent than others, and these will reflect less ultrasound. This complicates using the attenuation method to measure the distance of arbitrary objects.

APPENDIX

The history of ultrasonic sensors can be traced back to 1826 when Jean-Daniel Colladon discovered sonography. Colladon used an underwater bell to measure the speed of sound in water.

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