ENGINEERING

McMaster University

Project 3 – Independent Research Summary

Ultrasonic Distance Sensor

ENGINEER 1P13 – Integrated Cornerstone Design Projects

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Summary of Working Principle

The ultrasonic sensor utilizes ultrasonic waves to determine how far an object is. Since almost all objects can reflect sound waves, the transmitter and receiver are able to send/receive waves at fast rates by transforming electrical energy into sound waves using a piezoelectric crystal and turning the received sound wave back to electrical energy [1][2]. When a voltage is applied to the piezoelectric crystal, it vibrates and causes the sound wave to be formed. The crystal takes in a voltage from the trig pin and when the sound wave is received, the echo pin produces the voltage. The ultrasonic sensor determines how far an object is by measuring the time that has passed between when the sound wave was first sent off and when it is received back, also known as the "echo" [1]. Using this time measurement, the sensor is able to calculate how far a certain object.

Summary of Significant Material Properties

The piezoelectric crystal is one of the most crucial components of the ultrasonic distance sensor, as it is the component responsible for sending out and receiving the sound wave [2]. The crystal is able to transfer mechanical energy into electrical energy using the piezoelectric effect which then creates the sound wave [3]. It was discovered that the piezoelectric strain constant is the most dominant material property that determines power output and is directly proportional to it [3]. Some of the material properties of the piezoelectric crystal in an ultrasonic distance sensor can affect how the sensor functions. Piezoelectric ceramic crystals are the most common transducers in ultrasonic distance sensors. The ceramics are able to convert compressive strength into electrical energy (and vice versa) [4], but due to the fact that piezoelectric ceramics are brittle, they are not very efficient, and only useful in small deformations [5].

References

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