ENGINEERING

McMaster University

Project 3 – Independent Research Summary *

Capacitive Proximity Sensor

ENGINEER 1P13 – Integrated Cornerstone Design Projects

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Summary of Working Principle

The main function of a capacitive proximity sensor is to sense the presence of objects without making any physical contact with the object being sensed. They operate by noting a charge in the capacitance read by the sensor. It usually consists of two conductive plates which are separated by some kind of insulating material. It uses electric fields to detect contactless objects like human body.[1] The way a capacitive proximity sensor works is that one of the conductive plates is inside the sensor itself while the other one is the object to be sensed. The internal plate is connected to an oscillator circuit that generates an electric field. The air gap between the internal plate and the external object serves as the insulator or dielectric material. When an object is present, that changes the capacitance value and registers as the presence of the object. [2]

Summary of Significant Material Properties

Capacitive proximity sensors are primarily made up of electrodes and a soft dielectric layer. Electrodes are made up of PVA/Carbon nanotube $Ni(HCO_3)_2$ flexible film. CNTs are used to increase polymer conductivity and double-layer capacitance by acting as a charge transfer route. $Ni(HCO_3)_2$ decorated CNTs provide pseudo capacitance while PVA matrix provides bendability and stretchability.[3] By pressing the capacitor, the electrodes are brought closer together, increasing capacitance. Using dielectric materials that are soft and having a high dielectric constant maximizes sensitivity to a given force. A liquid metal elastomer foam (LMEF) that is extremely soft (elastic modulus 7.8 kPa), highly compressible (70 percent strain), and has a high permittivity can be used as the soft dielectric layer. Interestingly, due to the geometric deformation of the liquid metal droplets, the permittivity of such materials decreases when compressed to large pressure. Electromagnetic theory and finite element simulation are used to validate this process.[4]

References

[1]
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