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The Original BUSCA

ECE 4011 - B

Technical Review of FSR01CE for BUSCA Capstone Design Project

Introduction:

The BUSCA project's purpose is to provide a study space availability service to students on campus, and in order to do so, it is necessary to successfully and reliably detect the presence of people occupying a study space. A straight-forward approach to detecting a person's presence at a table would be to detect an increment in the weight of the table. For this reason, a Force Sensing Resistor (FSR) is in consideration for this project. In this paper we will consider FSRs as an overall solution and analyze Ohmite's FSR01CE as a candidate.

How FSRs work:

FSRs are the most viable way to detect weight change in the context of this problem. FSRs are essentially resistors that change their resistance value when a force is applied to them. This is achieved by having two conductive plates, interleaved yet not directly touching, and between them is a pressure sensitive, flexible, resistive material that changes in resistance in response to pressure [1]. The change in resistance will cause a change in the output voltage and passing a threshold determined after calibrating the device will be interpreted as a person occupying the study space.

About the FSR01CE:

Ohmite's FSR01CE is a particularly good candidate for the application of this project, due to its relatively low cost and accuracy. According to its datasheet [2], it has a square-shaped active sensing area of side length 39.7mm, and a thickness of only 0.375mm. It can sit underneath almost any table leg and remain fairly discrete.

In terms of cost, the FSR01CE is a good candidate compared to similar FSRs in the market. The closest comparable FSR in the market is the Interlink Electronics FSR406, which has similar dimensions, however, has a higher cost per unit, and lower sensing range. The FSR01CE costs $11.09 [3] for a single unit and has bulk discount pricing for orders of higher quantity, whereas the FSR406 costs $12.40 [4] for a single unit. The FSR406 also has bulk discount pricing, however it is still more expensive than the FSR01CE for every bulk quantity. The FSR01CE has a sensing range of approximately 0.2 N to 50 N, whereas the FSR406 has a smaller range of 0.2 N to 20 N [5].

Challenges with the FSR01CE:

The datasheet [2] specifies that the linear region in the log/log Force vs. Resistance plot is linear for forces up to 5 Kg (approximately 50 N). We can observe what the linear region on, which shows the Force vs. Resistance plot for an FSR from [6]. For our application, this would not be a large enough region, since any table easily weighs more than 5 Kg. However, this region can be extended by using actuation techniques, such as experimentally determining the optimal measuring resistor (R_m) resistance value. Also, a non-linear relationship may still be adequate for this application since the device would only need to detect if the force applied passes a certain threshold. This could potentially be accounted for in software.

Another challenge facing the FSR01CE is durability. According to the datasheet [2], its resistance value can change up to 17% after approximately 1.3 moths of normal operation. This is enough to be taken under serious consideration, however it could be accounted for in software as well.

Conclusion:

Although there are several challenges in the use of the FSR01CE by Ohmite as a way of sensing people sitting at a table, we still consider it to be a good candidate, since people using a table essentially requires them to have items on top, it's harder to get a false reading of someone occupying the space. Also, it is the best option in the market at the moment since the only other comparable FSR is more expensive and has a smaller sensing range.

Scalability is a very important aspect to consider in this project. Using this FSR will allow the project to be successful, as its characteristics (small size, accuracy and bulk-discount pricing) are necessary in order to scale.

References

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