Project: Human Touch Sensor

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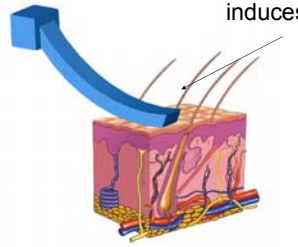
Project Goal: Develop an improved human touch sensitivity measurement device to apply and measure forces in the range of 200 to 2000 μN.

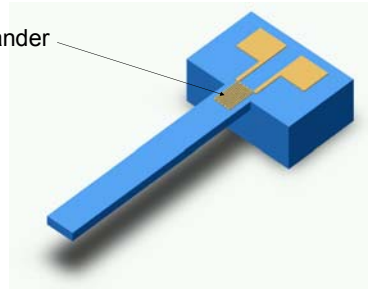
Need:

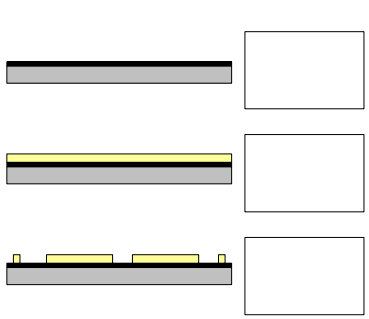
•A robust device that can measure forces in the range of 200uN to 2000uN
•An interface that is amenable to the skin surface and robust to skin movements
• A device that can be calibrated
•An system with easy to interpret results

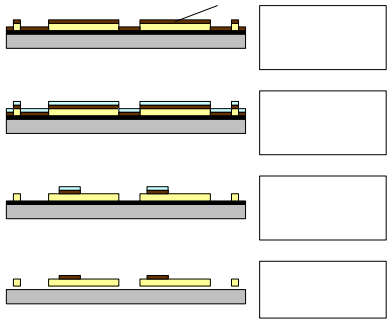
Design:

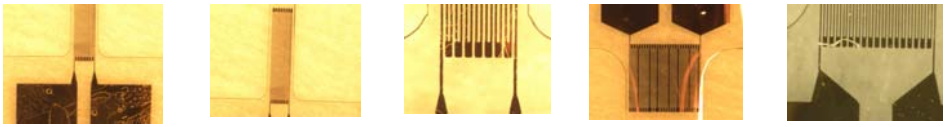
- Cantilever beam with integrated strain gauge.
- SU-8 beam material
- Gold (1000 A) strain gauge conductors with Chrome (100 A) adhesion layer.
- Multiple beam designs to target a range of stiffness (0.1 – 2.0 uN/um) and applied deflections (0 – 5 mm.)
- Experimental Setup for calibration using a precision actuator and a sub-mg weight scale and a precise resistance measurement.
- Experimental setup for measuring human touch response involving a device to clamp down the finger tip an actuator drive and a precise resistance measurement.

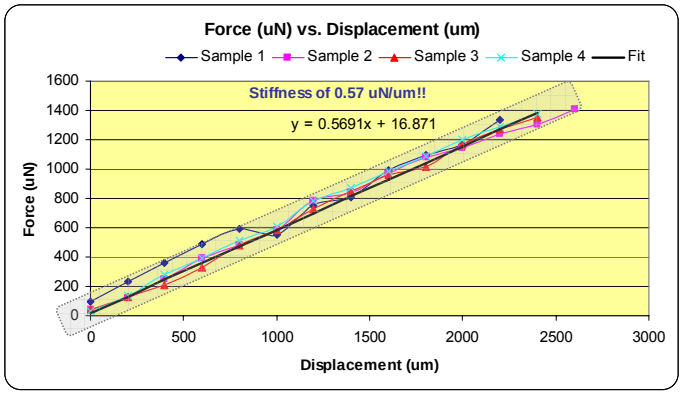












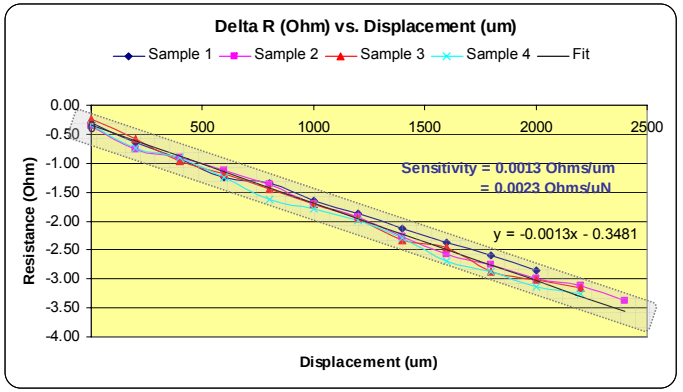
Results:

•Stiffness within 14% of predicted value for SU beam, 0.57 uN/um vs. 0.50 μN/ μm

•Sensitivity of 0.0023 Ω/μN

•Measured ΔR/R = 0.42% per 1000 μN.

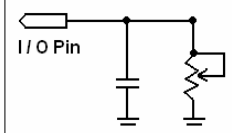
• Actual Gauge Factor = 2.5 (predicted for Au is 2)



Conclusions:

The beam design functioned near predicted values, with a very linear behavior. However, the system resolution is limited by noise and was not measured. Coupled with an appropriate electrical circuit and actuator system the device has the potential to characterize human touch sensitivity in the range of 200 to 2000 μN.

Circuit design:



Circuit process:

1. I/O pin is set high to 5V; this charges the capacitor.
2. I/O pin is set low to 0V; the capacitor discharges through the variable resistor.
3. The microprocessor measures Δt between V_i = 5V and V_f = 1.4V of the capacitor and calculates the RC value. The micro-processor then converts this to a force value in uN using a programmed function and displays the force value on an LCD panel.

Circuit results:

Measurable variations in the applied force output display were subsumed by the noise of the circuit. Improvements could be made potentially through the use of a more precise microprocessor or the replacement of the RC circuit with a Wheatstone bridge circuit and an associated microprocessor.