The Bio Inspired Tactile Sensor

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Introduction: For decades, researchers have been working on tactile transduction technologies which lead to many sensor prototypes and devices in their effort to solve the tactile sensing problems, but they remain unsatisfactory.

The Idea:

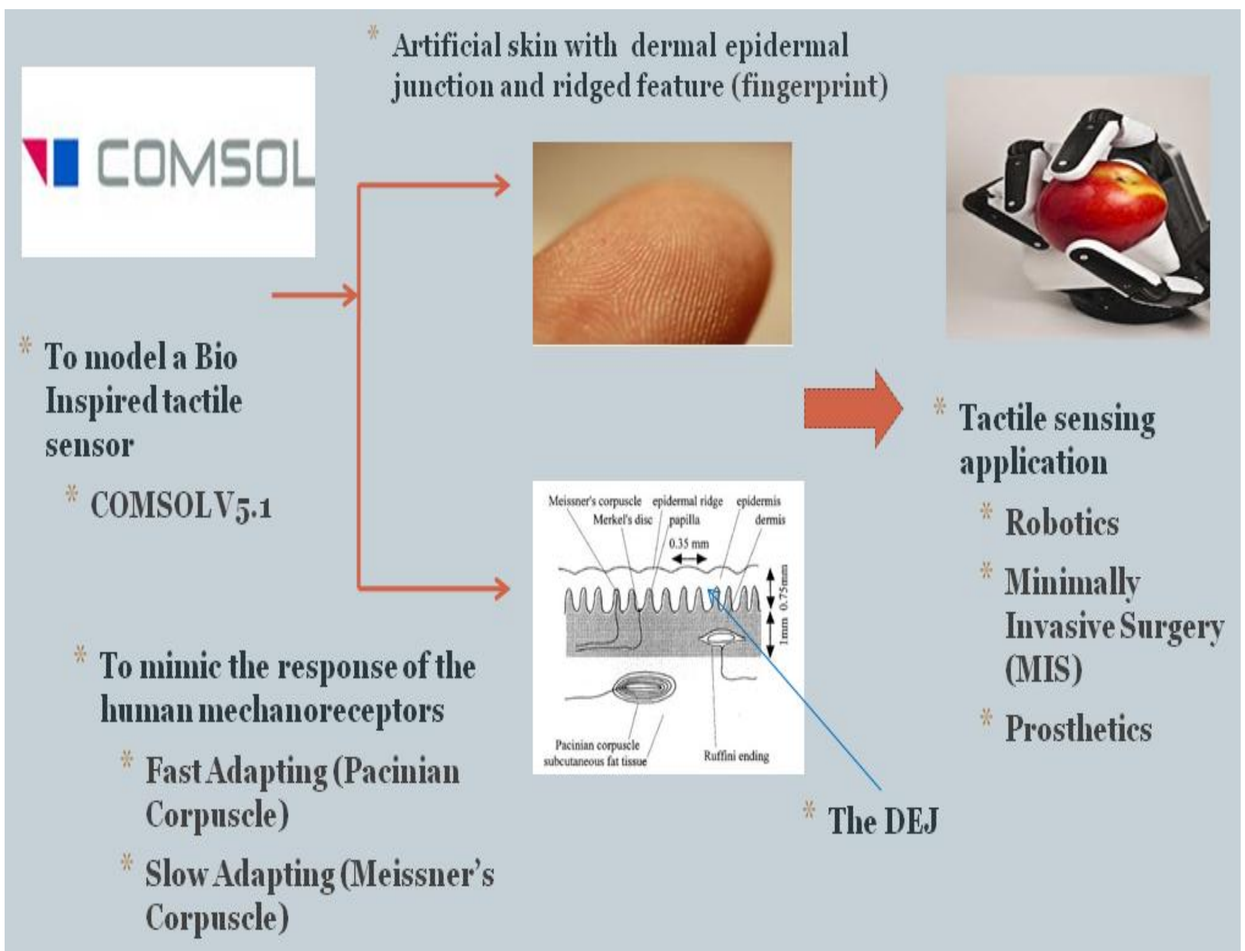

Figure 1. Brief Idea of the project

Computational Methods:

The unit sensor was modelled as:

✓ Hyperelastic presented by a neo hookean material.

✓Solid Mechanics Multiphysics together with Shell Multiphysics interface was used in modelling the artificial skin and the strain gauges.

✓Piezoelectric Devices Multiphysics interface used in modelling the PVDF thin film. (V=0)

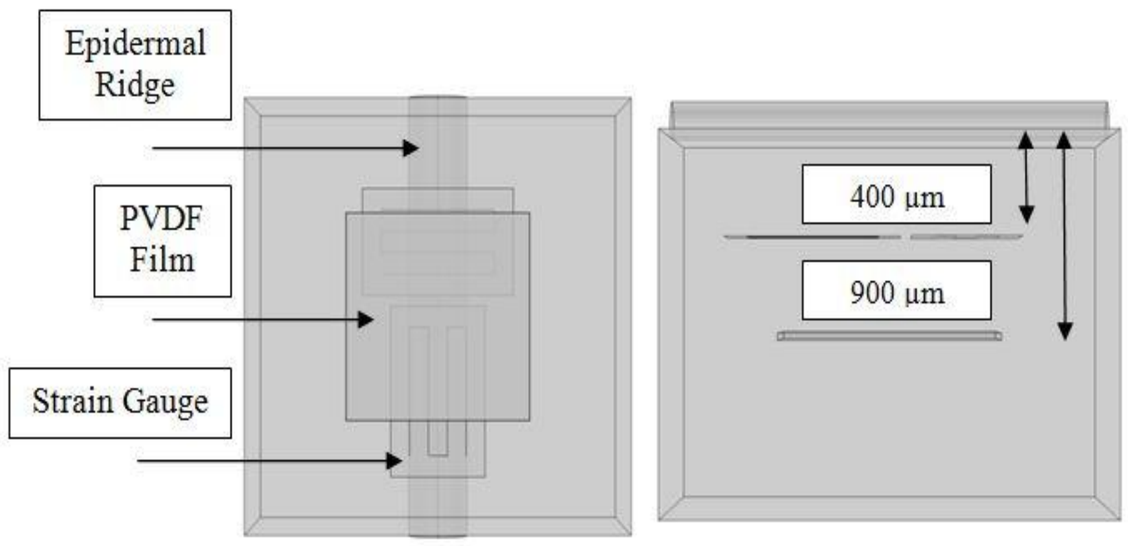

Figure 2. The proposed Bio inspired tactile sensor

Results:

✓The gauge model was able to detect all three components of force, in normal and shear directions.

✓Simulated strain gauge outputs are related to each component of force.

✓The findings are statically significant.

✓The *k*-NN classification demonstrates high percentage of accuracy.

✓PVDF graphs produced the output voltage of negative spike with load (touch), and positive spike with release of load (release), similar to the response of the Pacinian Corpuscle (PC).

$$Fx(i) = \beta_0 + 26.314E7(S_1) - 40.4466E7(S_2) + \varepsilon_i$$

$$Fy(i) = \beta_0 + 0.59512E7(S_1) - 0.3721E7(S_2) + \varepsilon_i$$

$$-Fz(i) = \beta_0 - 0.0561E7(S_1) - 0.23549E7(S_2) + \varepsilon_i$$

Equations. The regression coefficients

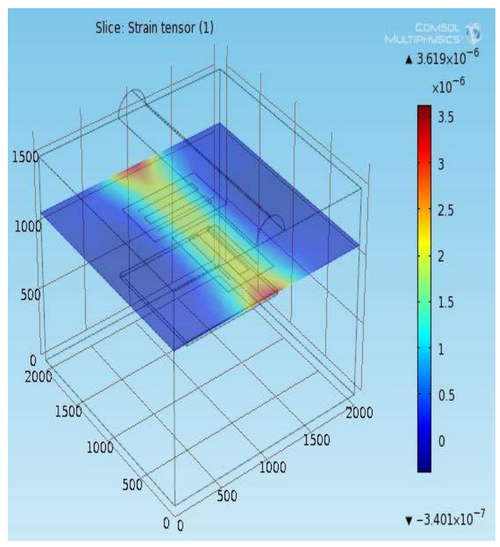

Figure 3. The strain distribution

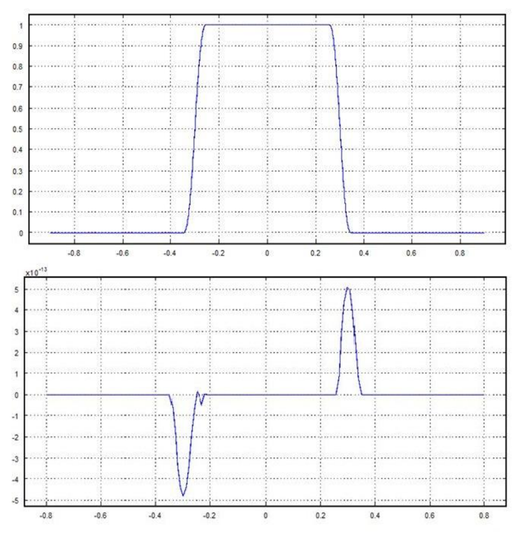

Figure 4. PVDF input and output

Conclusions: The project was successfully done in obtaining a bio-inspired tactile sensor mimicking the human glabrous skin properties. In future, these FEA findings will be compared to sensor's prototype and to produce mathematical algorithms.

References:

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2.Yamada, D., Yamada, Y., & Maeno, T. (2001). Design of Artificial Finger Skin Having Ridges and Distributed Tactile Sensors *Proceedings of the 32nd ISR (International Symposium on Robotics)* (Vol. 19, pp. 21).