Design of a Low-Cost Tactile Sensing System for Robotic Manipulation

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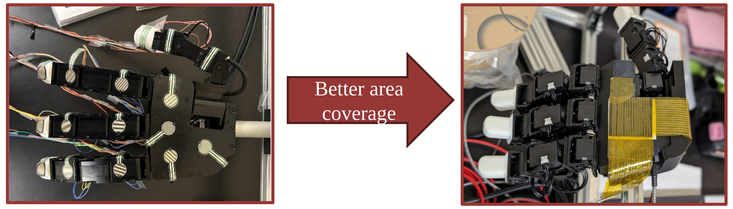
Research Motivation

Tactile sensing is crucial for humans to interact with the environment and perform everyday tasks and feedback from tactile sensors is important for robotic hands to achieve similar manipulation capabilities. Existing tactile sensors are bulky, expensive and not universally adaptable to all robotic hands. This research project aims to design a flexible, light-weight and low-cost tactile sensor pads that can be integrated to any robotic hand.



Previous setup Current setup

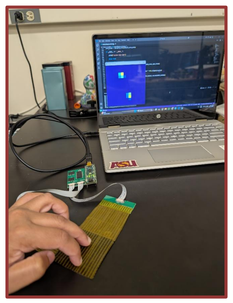
Methodology

Sensor fabrication step-by-step

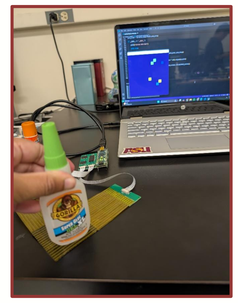
- This project involves designing a 16×16 tactile sensor array made by sandwiching Velostat (a piezo-resistive layer) between two orthogonally aligned sets of 16 conductive threads on a polyamide sheet.
- **Piezoresistive Principle:** When force is applied on the sensor array, the resistance of the piezoresistive layer changes and this mechanical pressure is converted to measurable electrical signals.
- The total material and electronics cost is under **$100** per unit!!

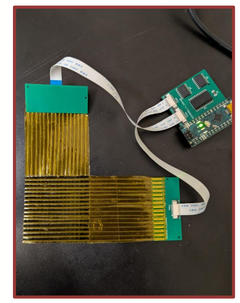
Results and Conclusion

- The sensor pads were able to successfully capture and transmit the change in resistance and this pressure data is visualized with OpenCV in python.
- Real time pressure map was generated from the sensor array indicating the area where the force is being applied.
- Brighter coloured areas indicate higher pressure values while dark patches show no contact.



Visualization results





Final setup

Parameter	Specification
Total sensing points	1024 units
Sampling rate	Up to 32.3 Hz (31ms)
Operational Frequency	10 Hz
Force range	~1N to 11N (Higher sensitivity 1N - 5N)
Sensor size	50mm × 50mm × 1mm

References

https://binghao-huang.github.io/3D-ViTac/

Acknowledgements

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