A Virtual Reality Glove for Kinesthetic Feedback Using Electroadhesive Clutches

Jonathan Alvarez, Dr. Carmel Majidi | Carnegie Mellon University

Goal

- Improve overall user-experience in virtual reality by introducing a mechanism of haptic feedback.
- Develop a low-cost and versatile kinesthetic feedback glove for use in Virtual Reality using Electroadhesive Clutches.

Motivations and Objectives

Motivations

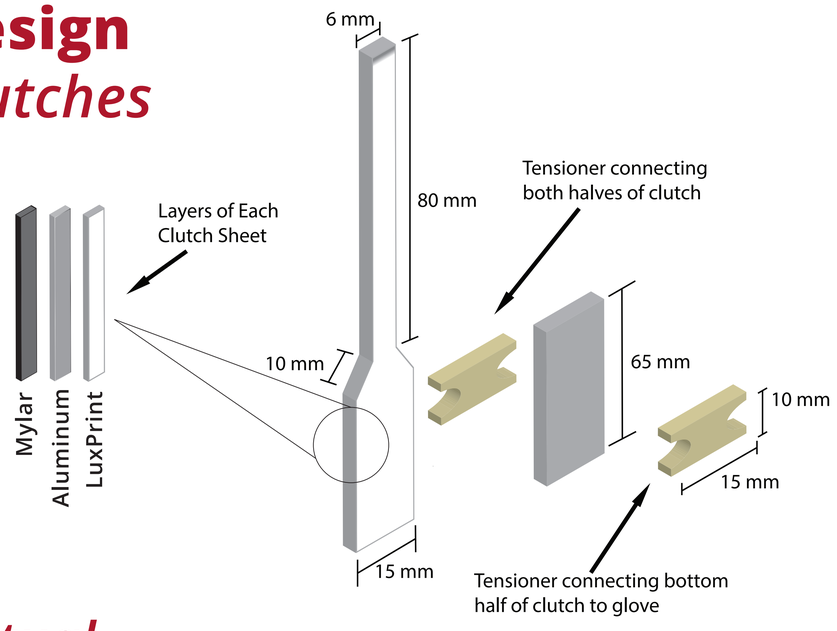
- Current wearable haptic technology in virtual reality is limited to expensive exoskeletons or inelegant tactile glove designs.
- Two current problems:
  - (a) tactile feedback solely is ineffective in emulating proprioceptive forces and sensations;
  - (b) current kinesthetic designs employing mechanical dampeners or actuators are too bulky and expensive to provide a lasting solution.

Objectives

1. Develop a reliable manufacturing method of producing Electroadhesive Clutches.
2. Develop a Virtual Environment for testing the haptic glove.
3. Interface between the Virtual Environment and the Glove using an Arduino UNO.

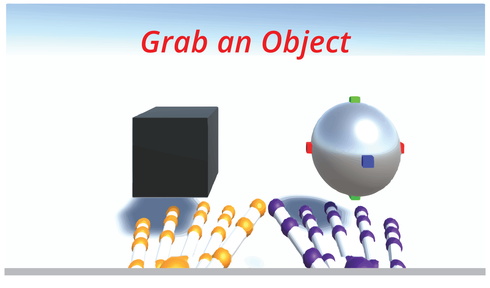
Design

Clutches



Virtual Environment

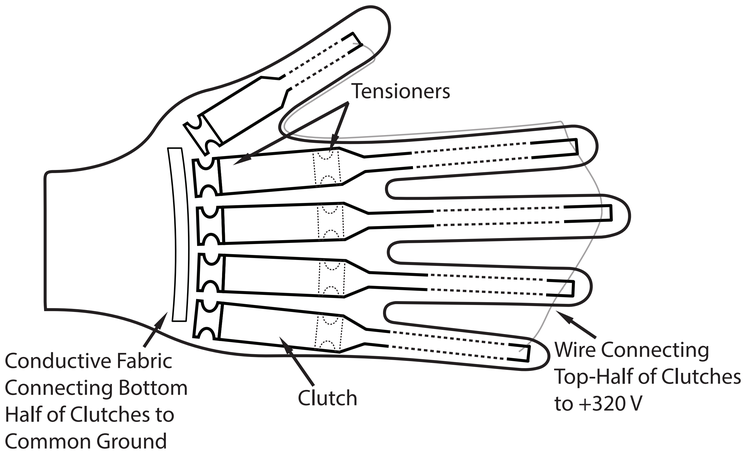
- Developed in Unity3D Game Engine.
- Motion capture was provided by a LeapMotion Near-IR Camera.
- The Virtual Environment consists of different objects to grab.



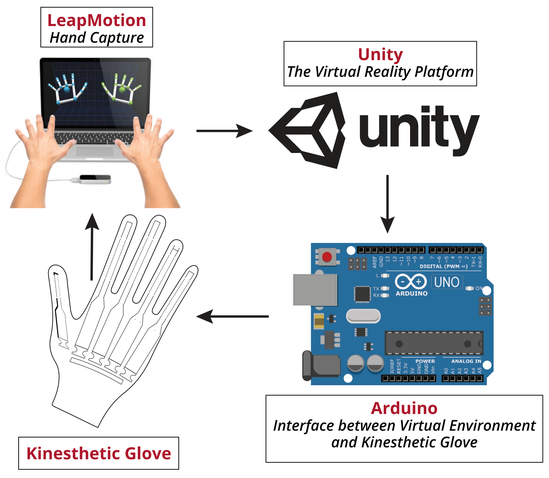
Approach

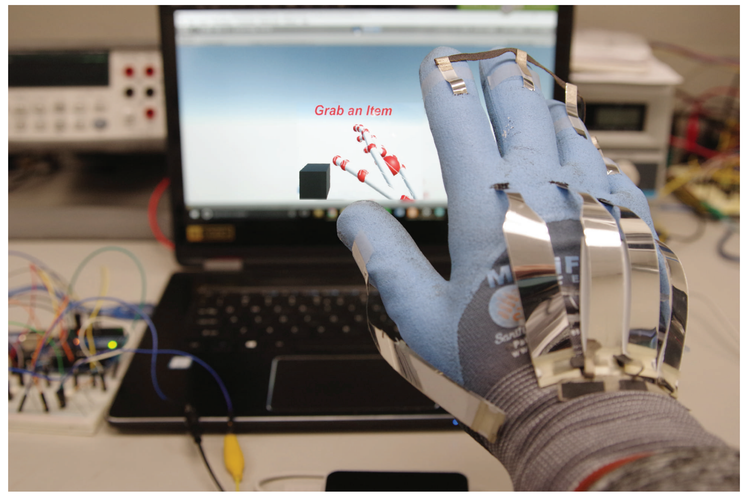
Glove Assembly

- Each clutch was assembled and mounted onto thin cut outs of PLA plastic using 3M™ VHB™ Tape and Fabric Adhesive.
- 320V is applied to the electrically-common top-half of clutches in order to polarize them.
- The bottom-half of clutches are tied to common ground.
- When connected, each polarized clutch is electrostatically attracted to the other, and both clutches adhere, preventing applying passive proprioceptive force to the users hands.



Integration

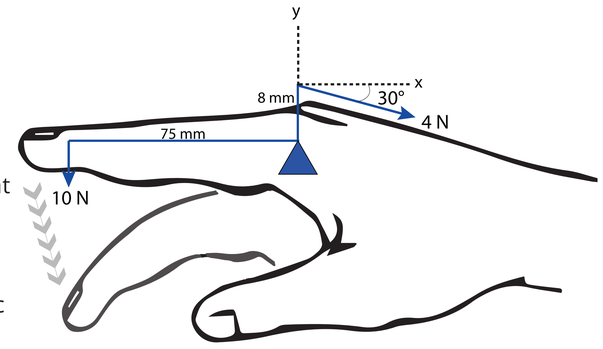




Findings and Future Work

Findings

- A single clutch provides approximately 4N of resistance to an individual finger upon activation.
- This force exerted by the activated clutches has been found adequate in emulating the feeling of true object manipulation.



Future Work

- Future work will seek to activate each clutch individually, so as to further mimic the true experience of grasping an object.

Acknowledgements

Special thanks to Dr. Carmel Majidi and all the members of the Integrated Soft Materials Lab, especially Stuart Diller and Yichu Jin. I would also like to thank the Robotics Institute for the opportunity to be a part of the Summer Scholars program.

SML INTEGRATED SOFT MATERIALS LABORATORY for human-compatible machines and electronics

RISS ROBOTICS INSTITUTE SUMMER SCHOLARS