Team 10: Developing a Conductive Prosthetic Finger

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Identified Need

- Technology throughout the world is rapidly changing and more devices/machines are relying on touch screen technology.
  - Touchscreens work by detecting a change in capacitance from a finger or conductive material being placed near it
- Amputees lack a seamless way to use touch screen devices
  - Prosthetics lack conductive properties and the ability to handle a capacitive load
- Current solutions involve external components
  - Glove with conductive threads
  - Stylus
- Providing amputees with a prosthetic with conductive abilities would improve their quality of life
- Bilateral amputees have expressed great concern concerning the difficulty they have using touch screens with their current prosthetics
- Only prosthetics with conductive properties on the market are for finger or partial-hand amputees.

Conductive stylus on phone screen [1]

Conductive gloves [2]

Design Criteria

Compatible with a variety of touch screens

Durable. Can withstand years of use

Consistently manufacturable

Smooth and sleek finish. Conductive material is not visible

Ease of use

Silicone must be flexible to ensure low PSYONIC Energy Units (PEUs)

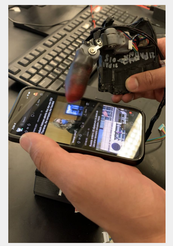
Prototype - Carbon Fiber

Concept
- Carbon fiber shards create a conductive network when connected [3]

Test
- Combine PSYONIC's ratio for carbon fiber and silicone. Mold using standard procedure

Outcome
- Prosthetic was conductive
- Thumb prosthetics need additional conductive silicone to retain conductive properties

3D Printed finger mold in mold



Carbon fiber thumb on iPhone

Prototype - Graphite Powder

Concept
- Graphite powder is a commonly used substance for conductive applications [4], [5]

Test
- Ratios of graphite powder and silicone ranging from 0.20%-1% to determine curing and conductivity properties

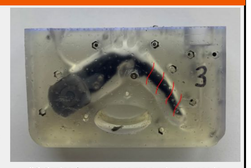
Outcome
- None of the ratios produced conductive silicone
- At 0.9% and 1% the silicone had difficult effectively curing

Prototype - Wire

Concept
- Wire is a widely known source of conductivity [6], [7]

Test
- Wrap a wire around a bone and proceed with the silicone molding process to determine curing and conductivity properties

Outcome
- The wire was visible through the silicone
- Prosthetic was not conductive
- Silicone cured



3D Printed finger bone in mold with red lines to simulate wire placement

Prototype - Thermal Paste

Silicone paste in syringe

Finger molded with thermal paste and silicone mixture

Concept
- Thermal paste is a common material used to add conductive properties to fabrics [8], [9]

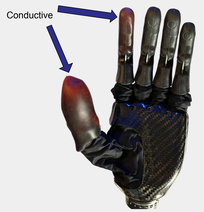
Test
- Combine paste with silicone in a ratio of 2% to test curing and conductive properties

Outcome
- Prosthetic was not conductive
- Silicone cured

Prototype Testing + Results

- Fingers with carbon fiber shards added to the silicone were conductive 100% of tests
- Thumbs with carbon fiber shards were conductive 50% of tests
  - A change in procedure was identified necessary after first round of tests
  - Thumbs require double the amount of silicone infused with carbon fiber shards a finger needs
- Fingers made with carbon fiber shards had high correlation between success rate and years of molding experience
- Graphite powder, wire, and thermal paste were not viable solutions

Prosthetic finger on iPhone



Fully assembled Ability Hand with conductive fingers

Results

Future Plans

- Improve molding process to increase manufacturability
- Edit thumb mold to improve conductive abilities
- Conduct tests with multiple brands and types of silicone to ensure optimal silicone choice
- Distribute conductive prosthetics to PSYONIC patients to receive patient feedback
- Improve design based on patient feedback

Mold modification to improve process

Engineering Standards

Regulation	Relevance to Design
ASTM A1093	Handling of conductive materials, primarily metals
JAI100431	Properties of carbon fiber and composites combined with carbon fiber

Acknowledgements & References

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Full Documentation

Poster References