Soft Robotic Gripper

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Diabetic Neuropathy

- 388MM people globally have diabetes, about two thirds with diabetic neuropathy
- About 20 million people in US alone suffer from peripheral neuropathy
- Common neuropathy symptoms include lack of sensation, pain, tingling and numbness in the hands, feet, legs sensitivity to touch on the skin and loss of balance.
- Amputations are a common complication of diabetic neuropathy
- Every year about 71,000 non-traumatic amputations are performed in the U.S. alone
- Researchers believe that making lifestyle changes and treating neuropathy before it progresses can lower these rates by 45 to 85 percent

Our Idea

Problem:

There is a large population of patients with peripheral neuropathy

They are prone to serious injury, burns and complications due to lack of sensation

There is a need for a device to help patients do everyday chores without risks

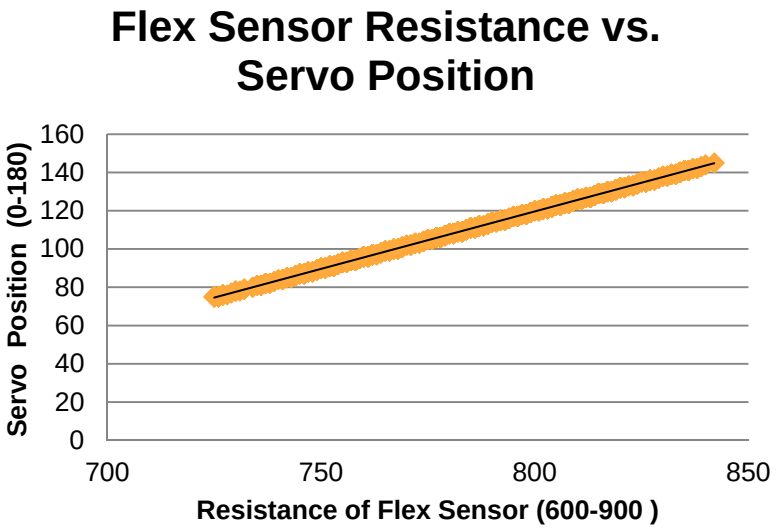
Objective:

To create a soft flexible gripper that can help patients suffering with neuropathy

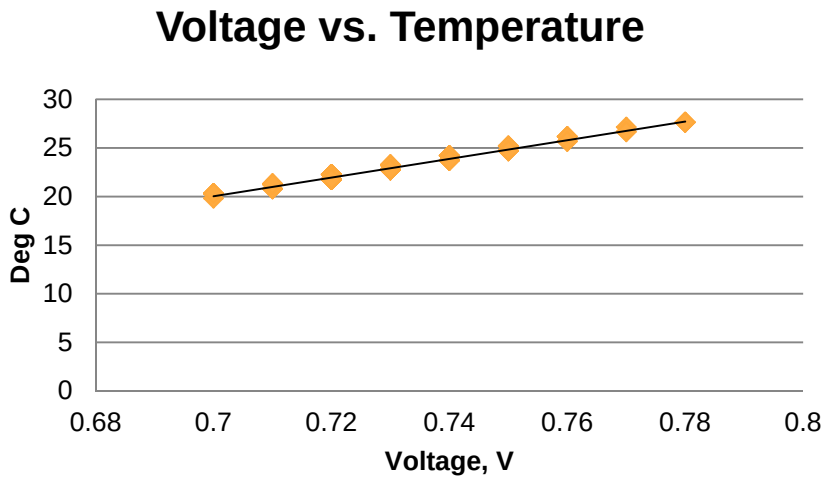
Research & Development - 3 stages

1. Evaluate linearity of sensors individually
    a. Temperature sensor between 16 - 42 degrees C - sensitivity of at least .05 to .2 degrees
    b. Pressure sensor needs to be up to 25 psi
    c. Flex angle should be 0-180 degrees with accuracy within 1 degree
2. Build a prototype as a working model
    a. Add sensors to microprocessor to build a prototype circuit
    b. Test soft robot in environment and change in parameters
3. Evaluate data
    a. Evaluate data in comparison to normal hand

Phase 1: Evaluate Sensor Accuracy



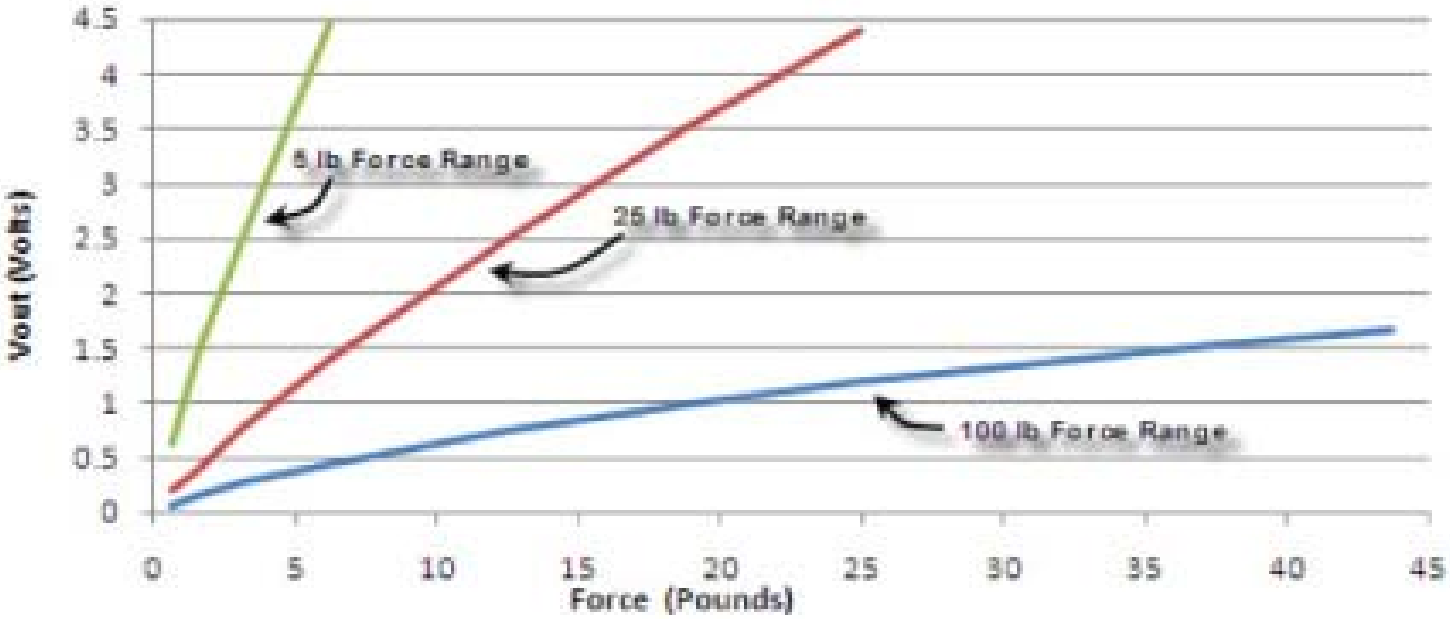
A flex sensor is a plastic strip with a conductive coating. As it bends resistance changes, and changes servo position.



The TMP36 sensor has a nominal 750 mV at 25°C (about room temperature)

Body temperature range is 36-37.5 °C

Pressure Sensor linearity



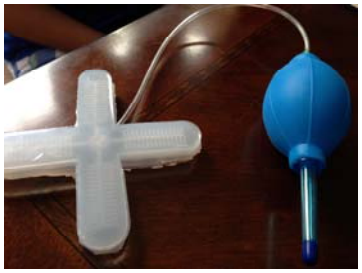
Phase 2: Build a Prototype

Tekscan A401

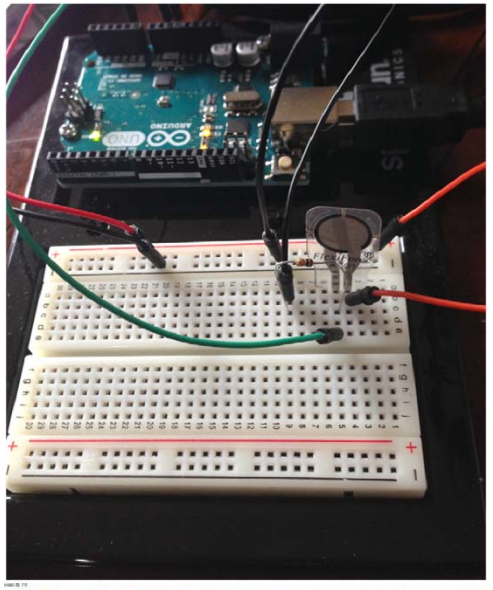
Flex Sensor 2.2

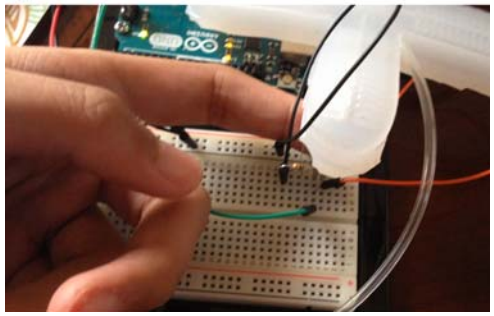
Arduino

TMP 36



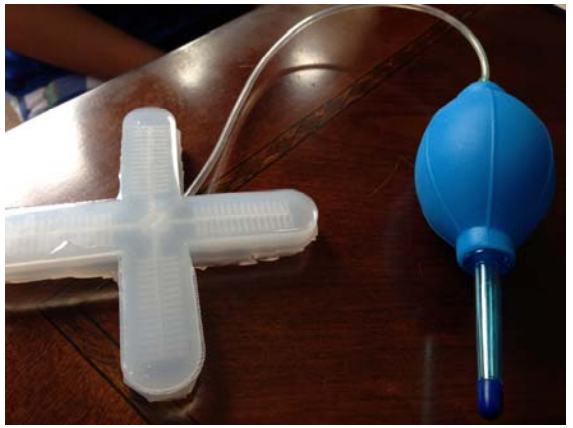
Soft Robot

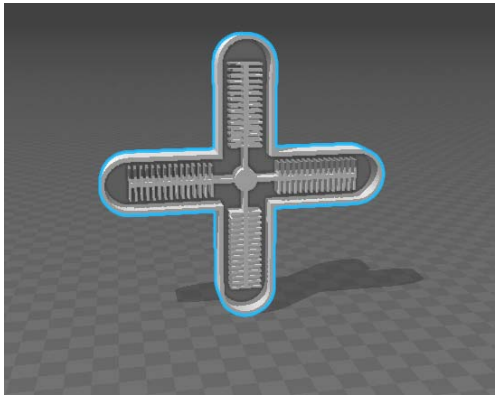


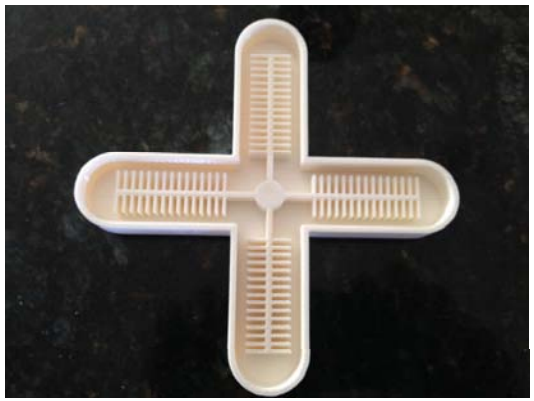


Building a soft robot

1. Use CAD model to 3D print a mold
2. Make the Silicone mixture and pour in the mold
3. Remove soft gripper from mold
4. Attach to a pressure source



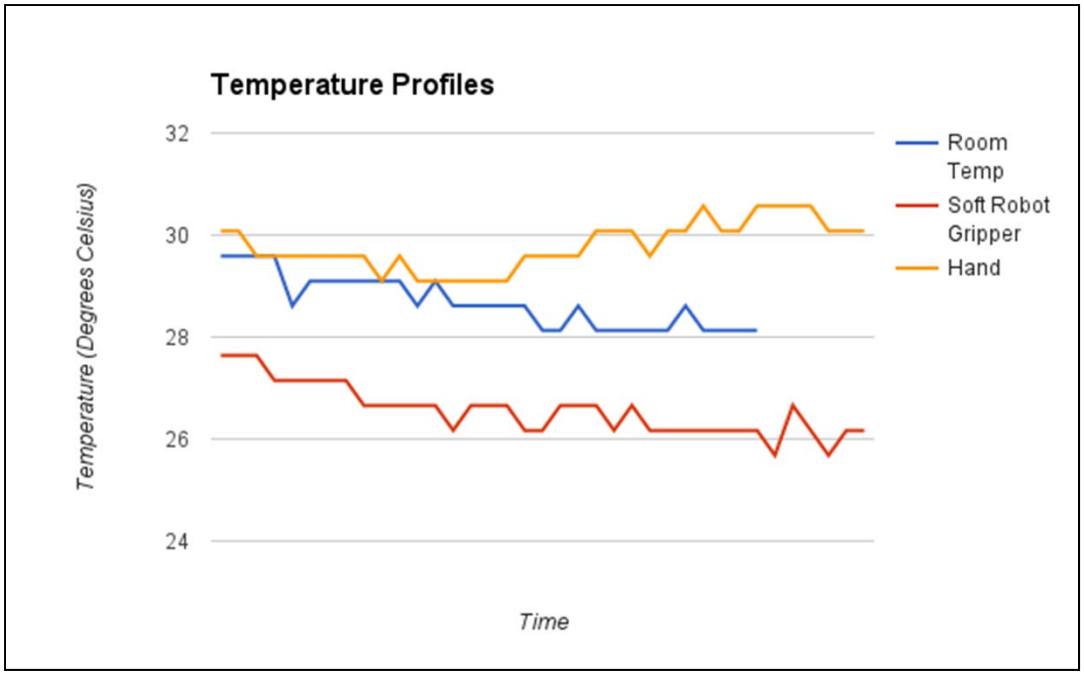




Flex Sensor

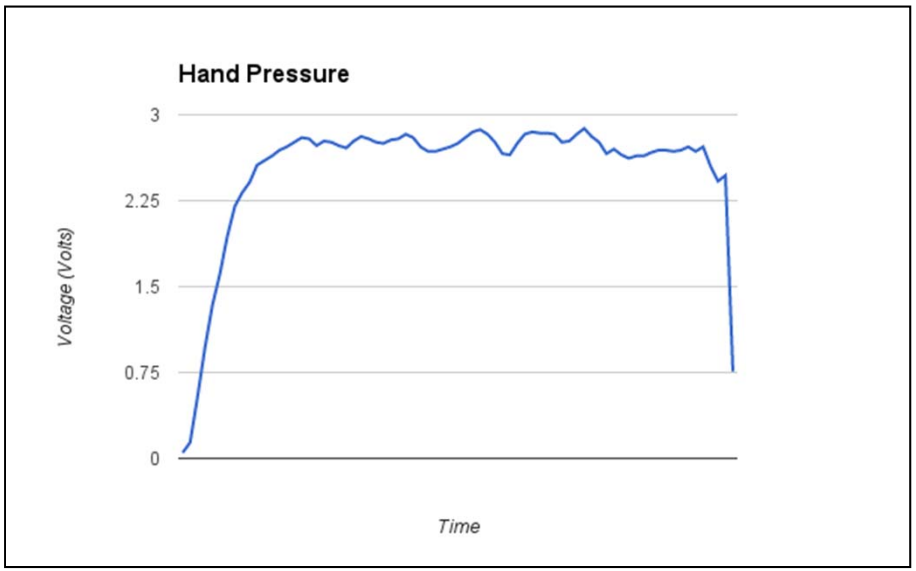
Soft gripper is flexible and the flex sensor can be used to give motion feedback

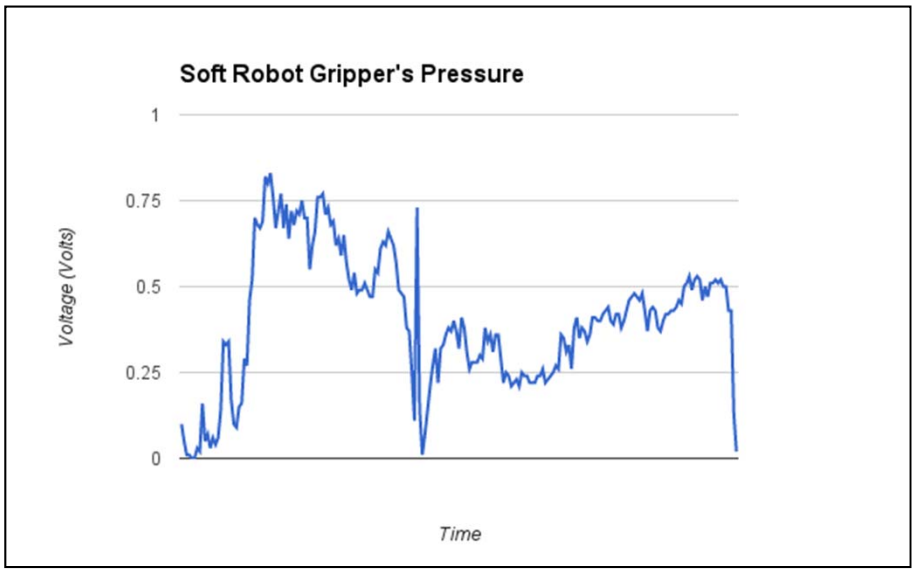
Temperature sensor



Soft gripper is slightly lower in temperature than a normal hand and some correction will be required for any heat loss on contact

Pressure Sensor





Hand pressure on grip is approximately 2.5 V (12.5 lbs), Soft gripper is less and varies with air from 0.25-0.75V (1.25-3.75 lbs)

Conclusion

- It is feasible to make a soft gripper that can function as a hand for neuropathic diabetics
- Sensors for flex, temperature and pressure can help characterize the motion, temperature and grip of the soft gripper
- Using a gripper can help diabetic neuropathic patients minimize risks of any accidents due to lack of sensation
- Future work is required to incorporate wireless sensors to make the soft gripper hand self sufficient