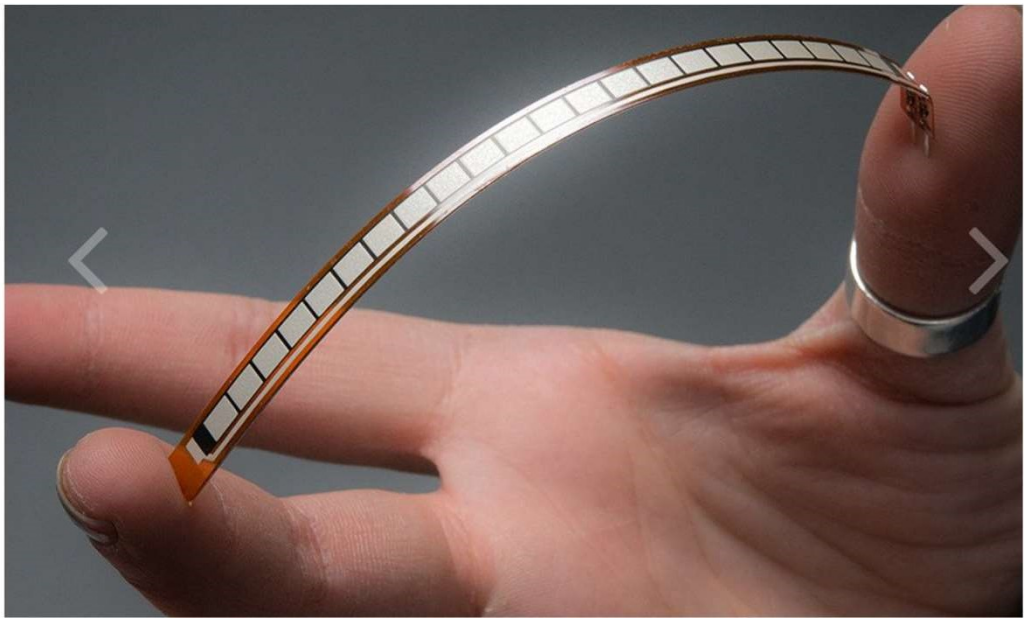
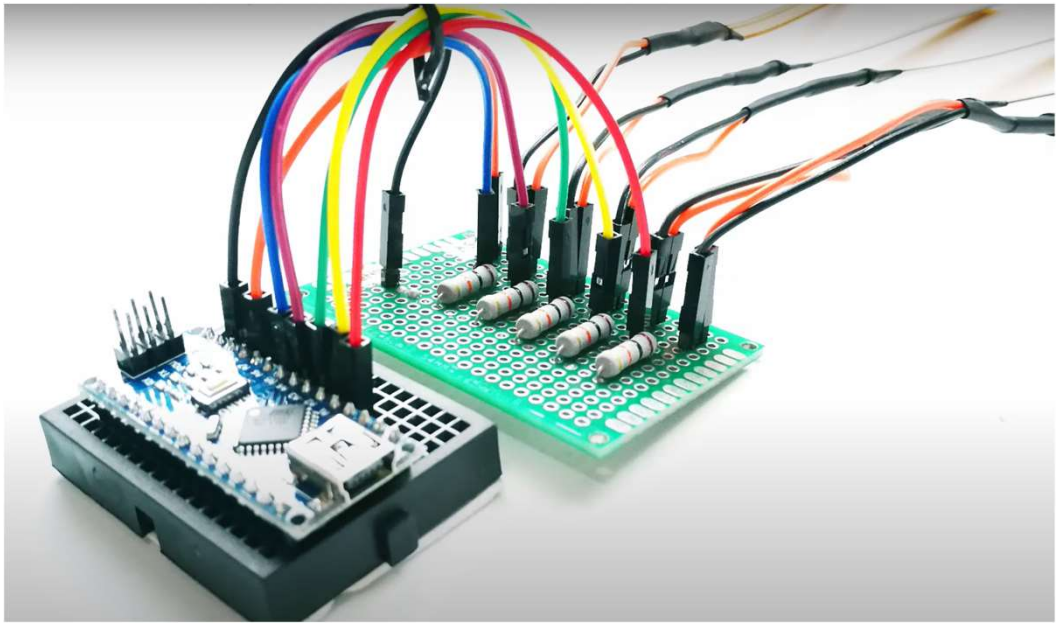
Document for [Hand Project]
Gloves idea: flex sensor + human/foam hands

Please refer to github:
https://github.com/CatStrain/Cat_skin/tree/Development_Jiaoran/Flex%20sensor%2Bgloves

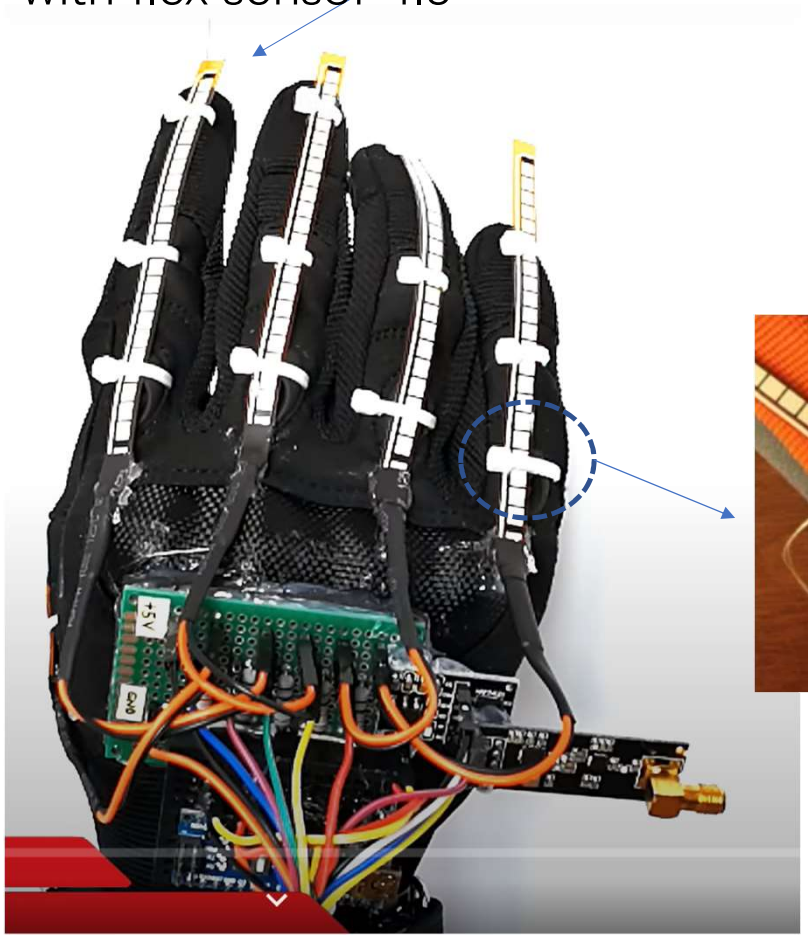
Flex sensor, circuit and connection

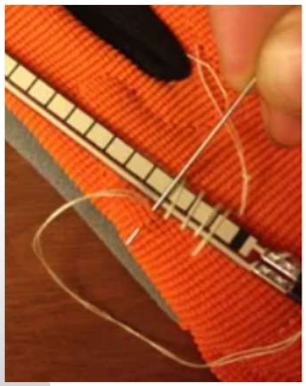




[Datasheet] https://cdn-shop.adafruit.com/datasheets/SpectraFlex.pdf
[1] https://www.instructables.com/DIY-Robotic-Hand-Controlled-by-a-Glove-and-Arduino/
[2] video ** check the next page for instruction.
[circuit] https://learn.sparkfun.com/tutorials/flex-sensor-hookup-guide/all#example-circuit

Implementation example
with flex sensor 4.5’’





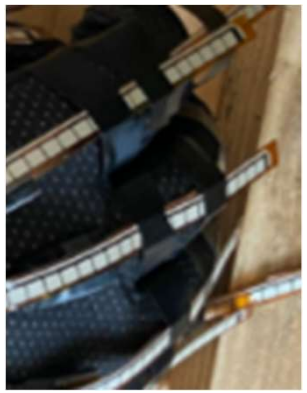


Fig.2 Sewing detail (For special notice, the joint fixer for sensor can be different, please check the gloves in the lab)

Fig.1 Sensor + glove design (** From https://www.instructables.com/DIY-Robotic-Hand-Controlled-by-a-Glove-and-Arduino/)

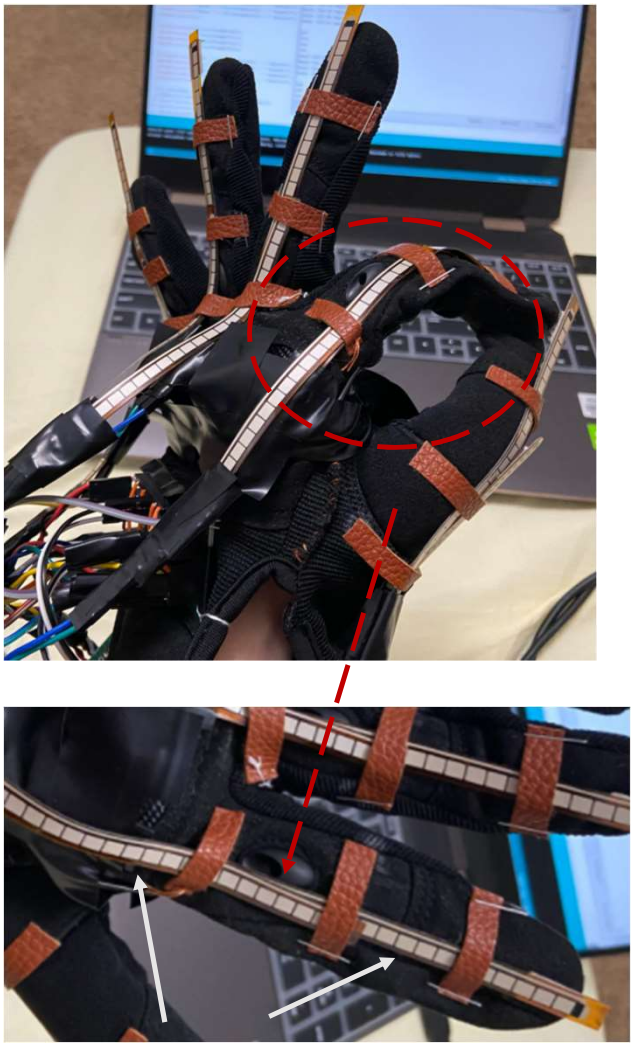


Fig.1 Sensor 1(cross first joint) and sensor 2(cross three joint)

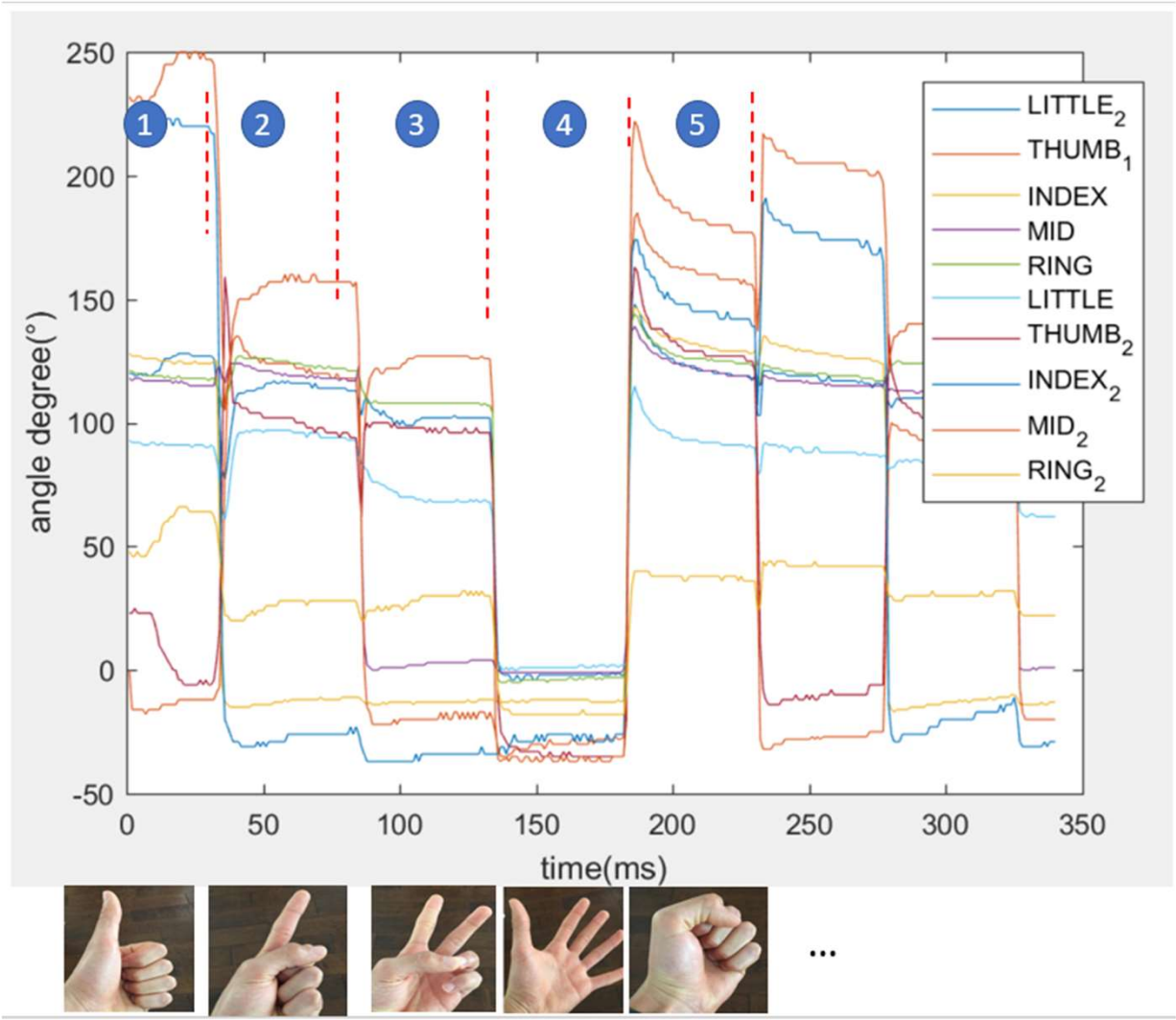


Fig.2 signal from 10 finger sensors

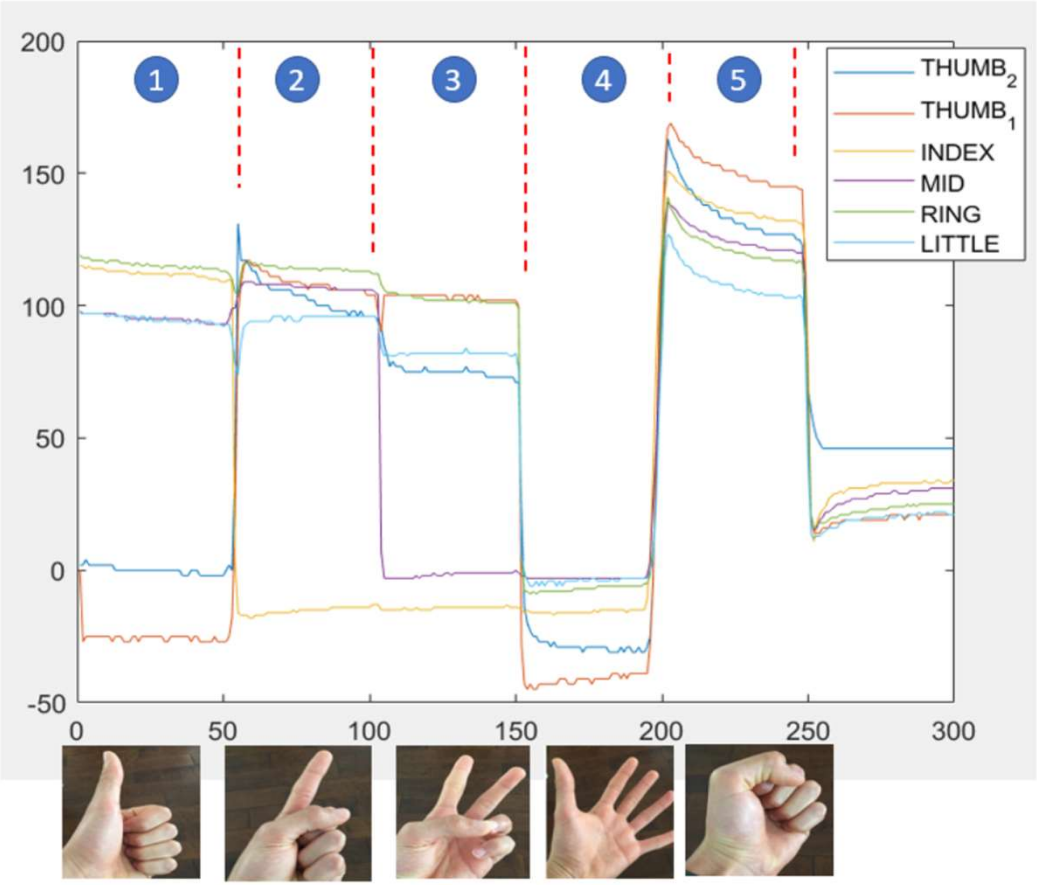
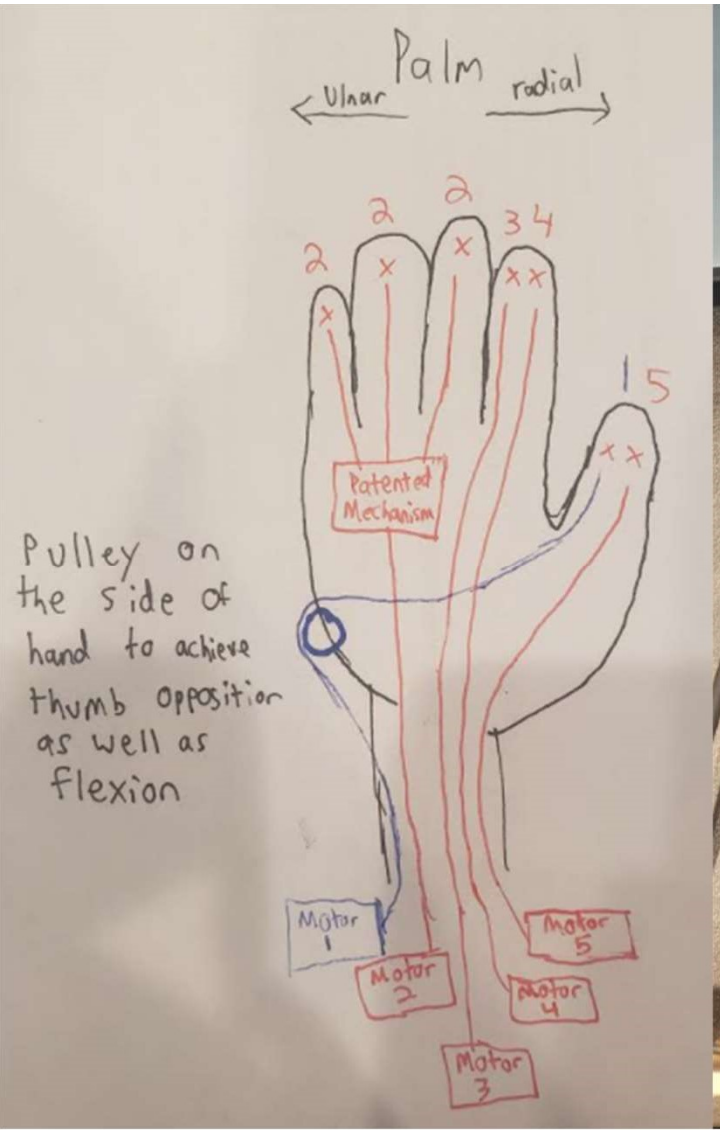


Fig.3 signal from 6 finger sensors

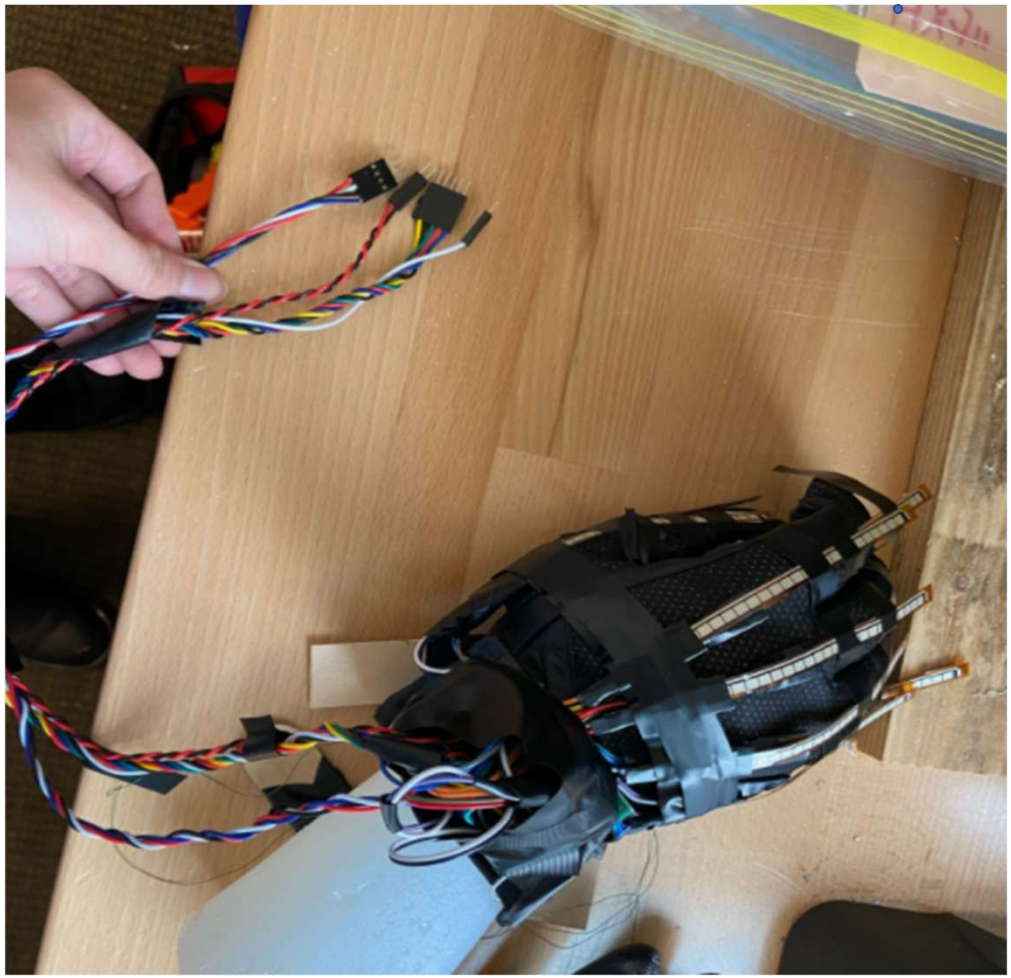


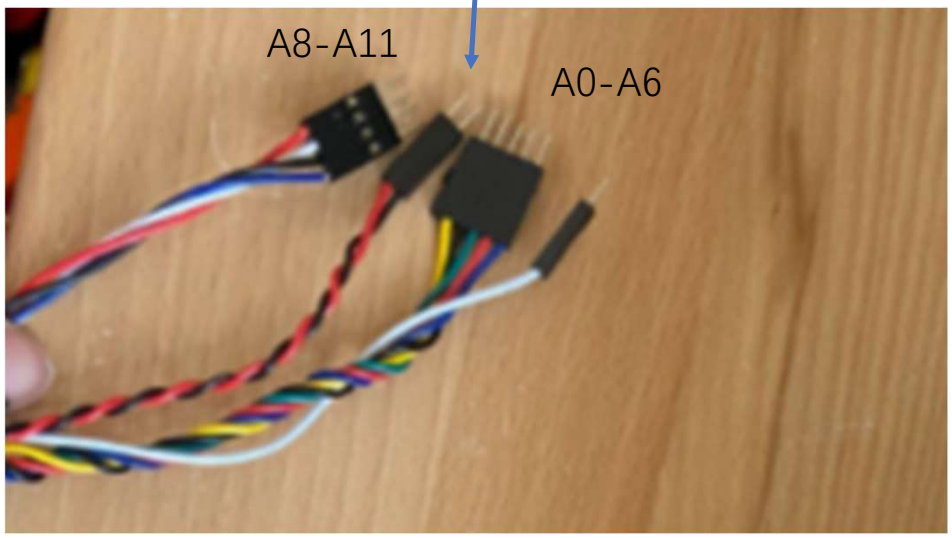
- Hand size: Human hand size?
- Gloves: braided fabric?

**Can we consider tighter and fits better gloves?

[fishing line]
https://www.amazon.com/gp/product/B0007O3IIU/ref=ppx_yo_dt_b_search_asin_title?ie=UTF8&psc=1

Foam hand (right hand with wrist) + glove + sensor (*10)





Please use the <flex-sensor-circuit-single-glove-right-hand >.ino for testing

Previous thoughts and ideas:

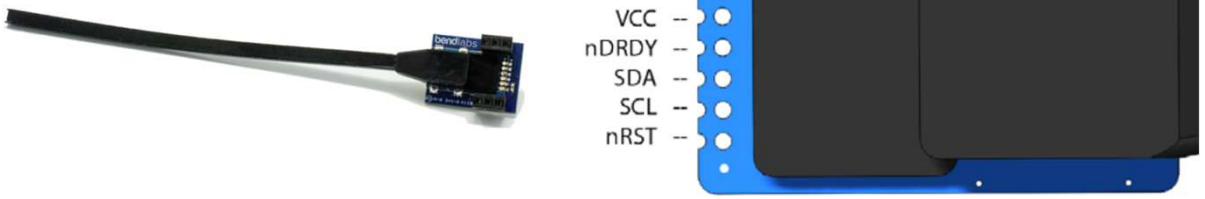
- **2-Axis Soft Flex Sensor**

Features:
- Flexible two axis bidirectional sensor (measures two angles in orthogonal planes for 3D orientation)
- Only measuring the angular change. Elongation signal is rejected.(Although these sensors are stretchable, the differential measurement of each axis assures that common mode signals such as stretching are rejected and only flexion is measured.)

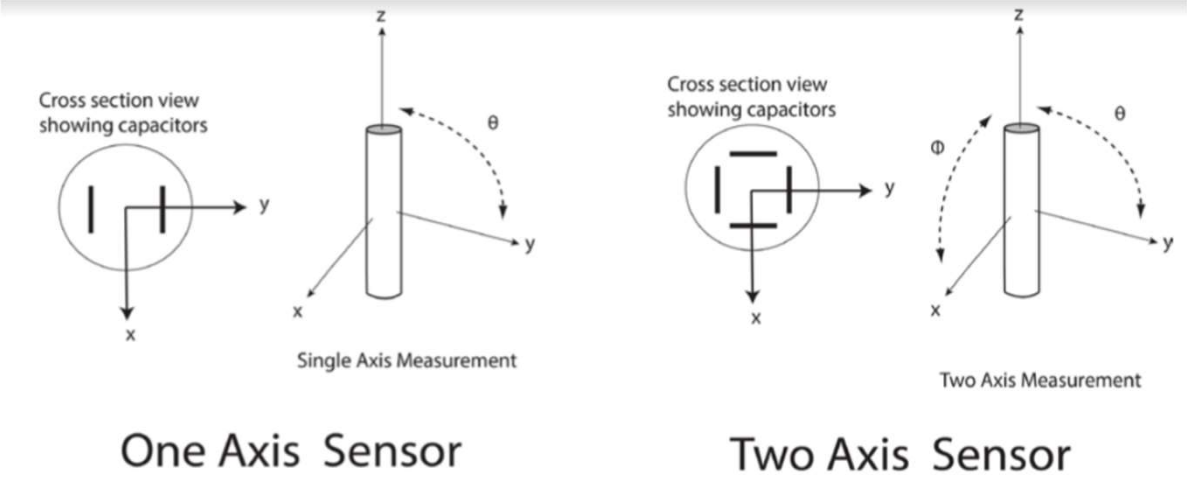
Buying link:
https://www.bendlabs.com/products/2-axis-soft-flex-sensor/

How to use:
Low-power integrated analog front end, with I2C interface, provides angular data in degrees:
https://github.com/bendlabs/two_axis_ads

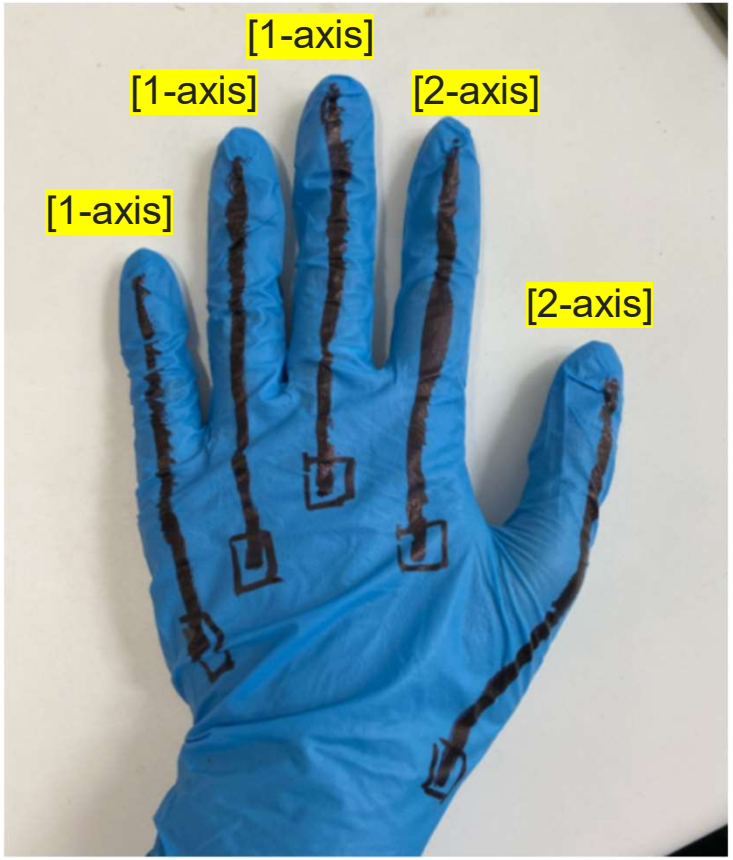
Datasheet:
https://www.bendlabs.com/two_axis_datasheet.pdf
Theory:
https://www.bendlabs.com/ad_theory_guide.pdf



- Fig.1 Flex angular sensor(1 or 2 axis)



- Fig.2 Measurement



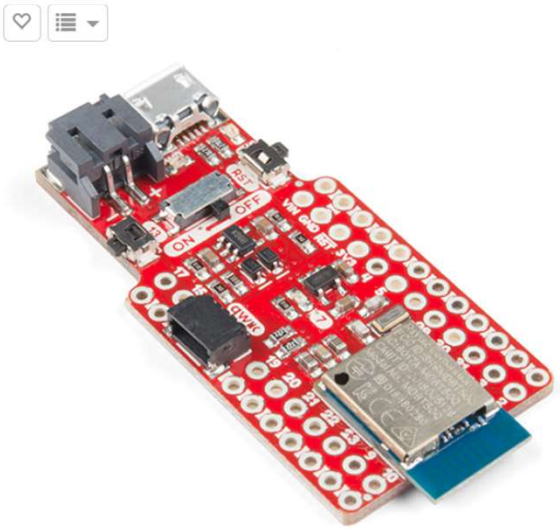
- Fig.3 Flex sensor mounting diagram

[2-axis] Dimensions: 100mm x 4mm x 4mm
[1-axis] 100mm x 7.62mm x 1.27mm

1: Connect the One Axis sensor to the SparkFun Pro nRF52840 Mini via Qwiic Cable Breadboard Jumper and wires as shown below:

https://www.sparkfun.com/products/15025
[adafruit set up]
https://learn.adafruit.com/adafruit-trinket-m0-circuitpython-arduino/arduino-ide-setup
https://forum.arduino.cc/index.php?topic=634417.0

BOARD



SparkFun Pro nRF52840 Mini - Bluetooth Development Board

DEV-15025 ROHS

$29.95

Volume sales pricing

Shipping outside of the US?
Click here for info

- 1 +

ADD TO CART

Quantity discounts available

DESCRIPTION | FEATURES | DOCUMENTS

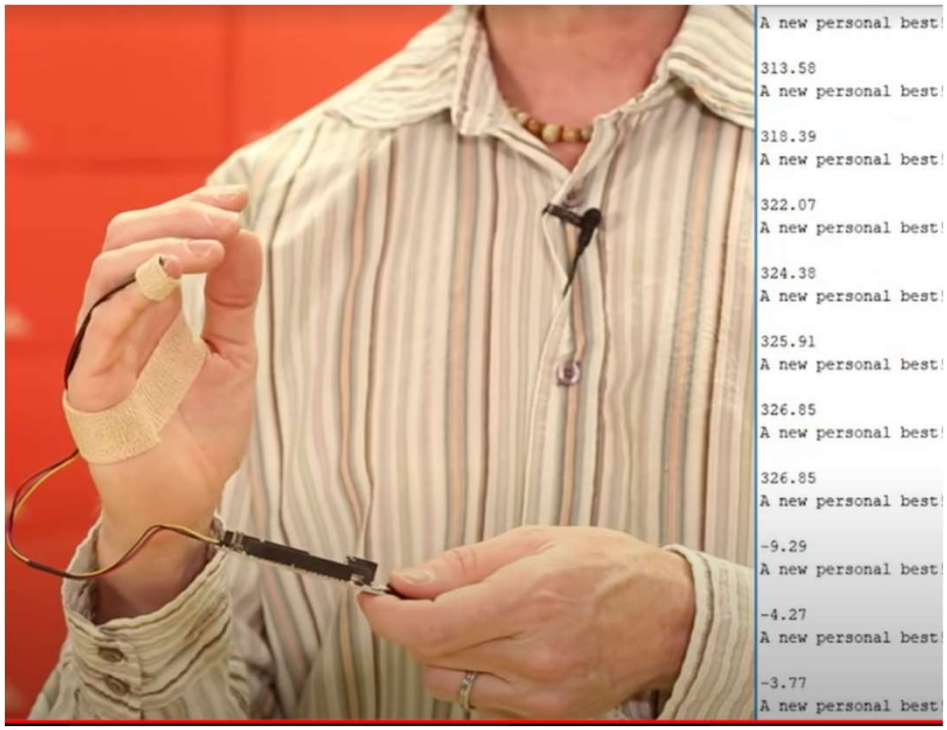
The SparkFun Pro nRF52840 Mini is a breakout and development board for Nordic Semiconductor's nRF52840 – a powerful combination of ARM Cortex-M4 CPU and 2.4GHz Bluetooth radio. With the nRF52840 at the heart of your project, you'll be presented with a seemingly endless list of project-possibilities in an incredibly small package.

Our mini development board for the nRF52840 breaks out most of the critical I/O

1. The attachment of the sensor and gloves is simple. But it will also depend on the material of the gloves.

As the "2-Axis Soft Flex Sensor" will only measure the bending degree between head and end effector. We only need to consider fixing the sensor head and limiting excessive lateral movement of the sensor body.
The sewing could do some damage to the enveloped sensor, but it's considerable. I prefer the removable clamping or permanent adhesive connection.

Please check this figure and the video to see how it works to measure the angles when connecting to hand:



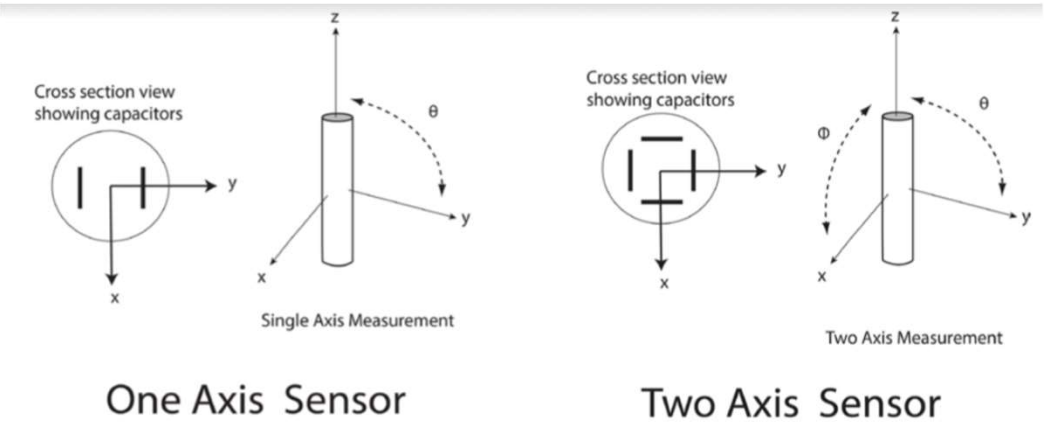
link: https://www.youtube.com/watch?v=yhr_GTLUBUk&t=140s

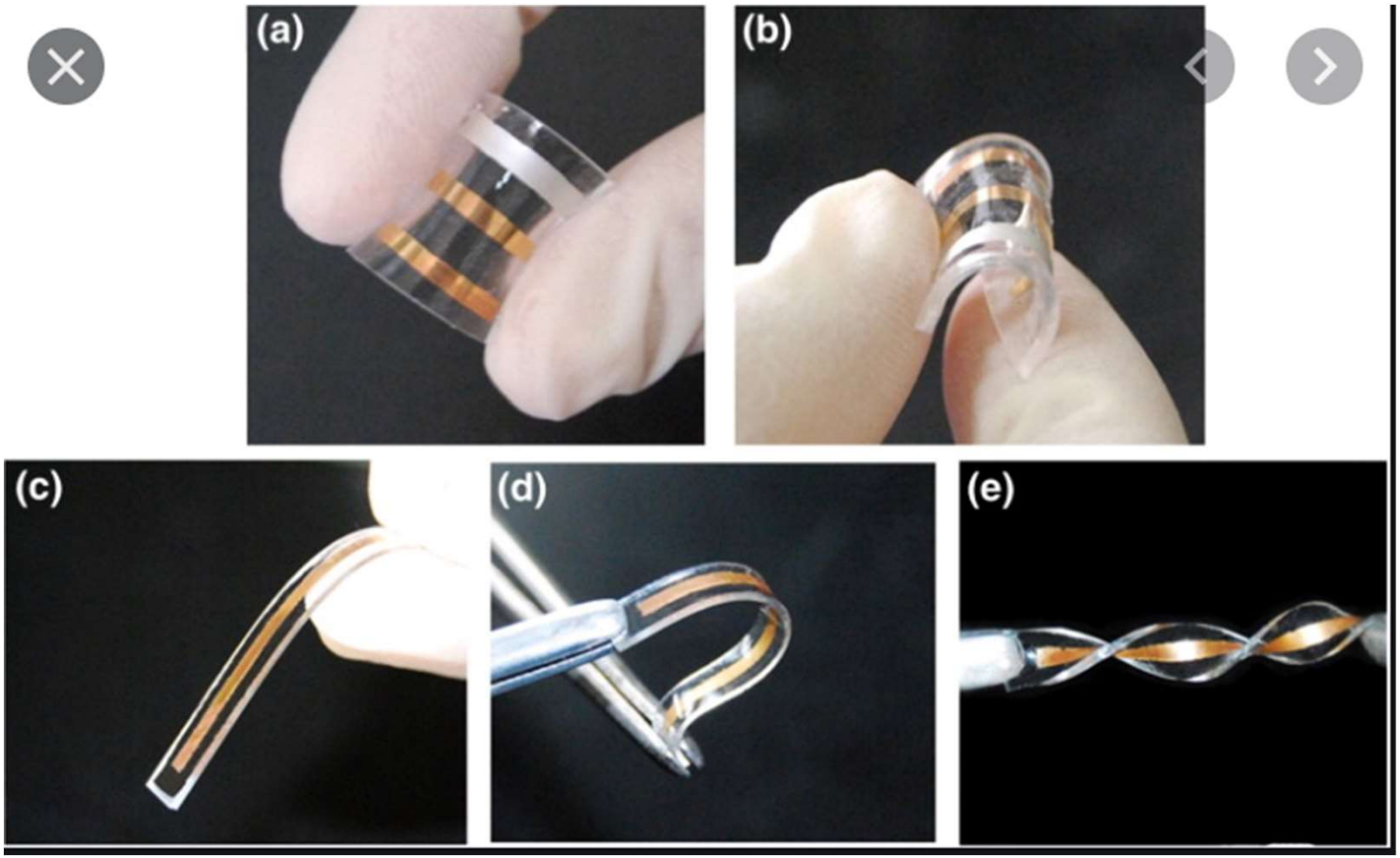
2. Sensor Specifications
[2-axis]
- Dimensions: 100mm x 4mm x 4mm (3.94in x 0.16in x 0.16in)
- Average Sensitivity: 0.274 pF/°
- Repeatability: 0.18°

[1 axis]
- Dimensions: 100mm x 7.62mm x 1.27mm (3.94in x 0.30in x 0.05in)
- Average Sensitivity: 0.274 pF/°
- Repeatability: 0.18°

3. Is the thumb having two identical sensors for different orientation? Actually the '2-axis sensor' can measure the two angles in orthogonal planes, like the following figure shows:

If the thumb is 2 Dof, while the other figures are 1 Dof(just bending), we can consider 2-axis for the thumb and 1-axis for the other four fingers on the blue dot line.

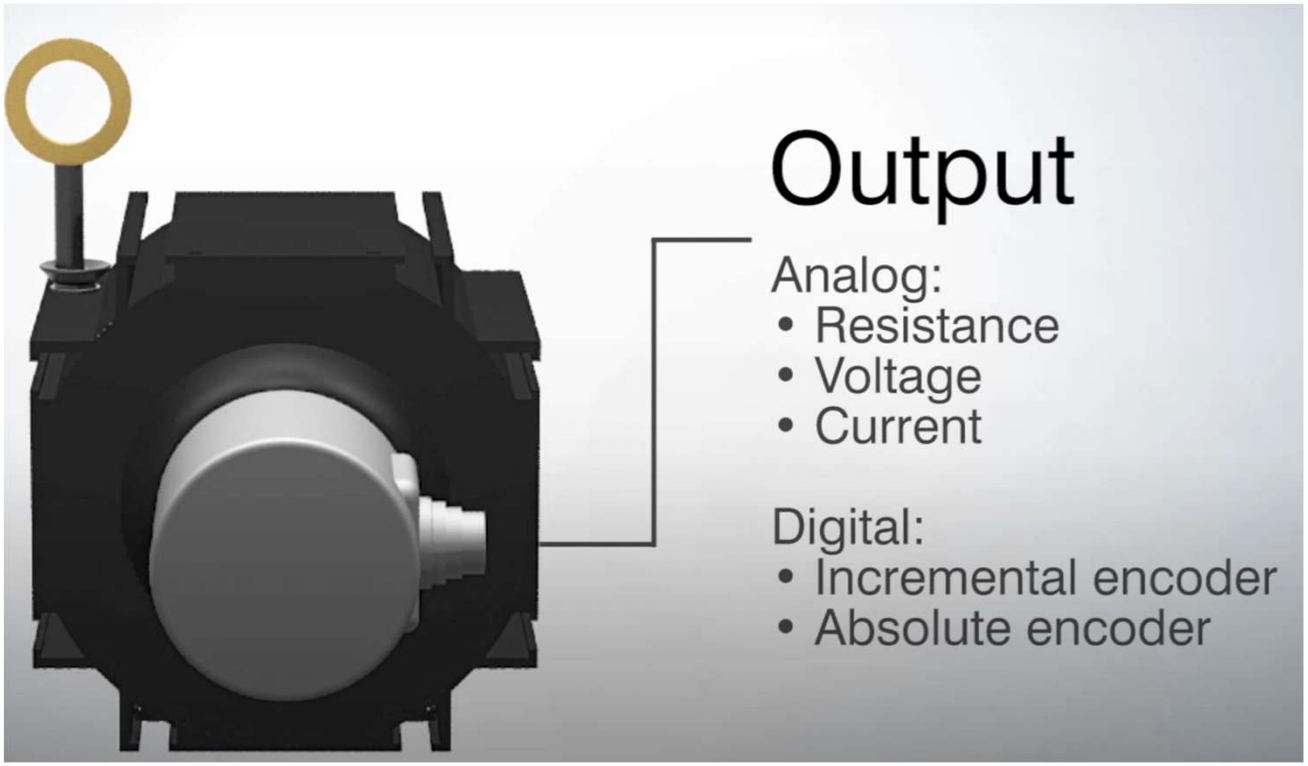


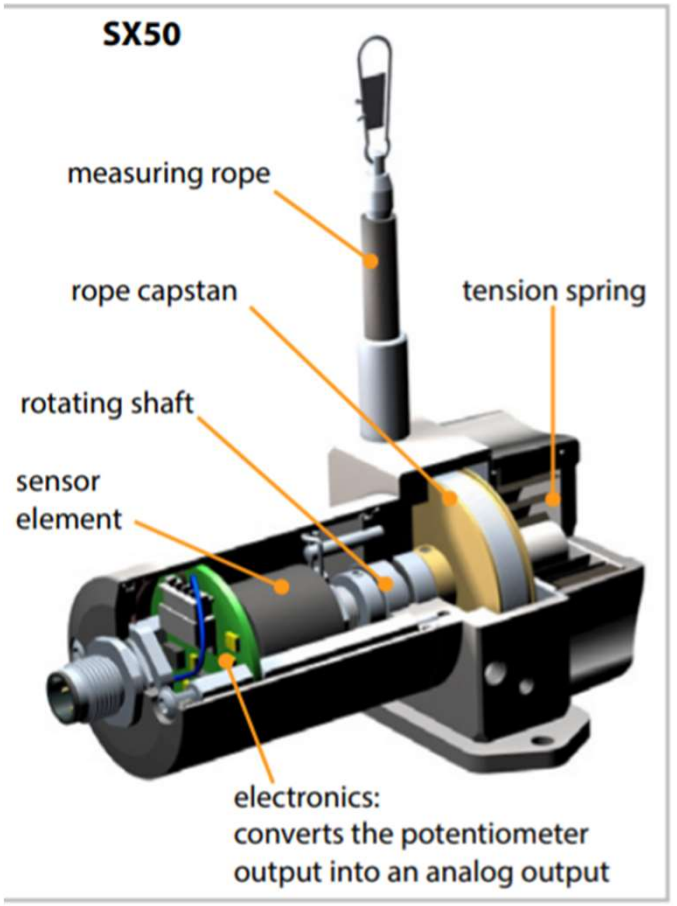


The sensor(e.g. strain gauge) can be packaged into the PDMS during the fabrication[1-2].

Ref:
[1] https://www.sciencedirect.com/science/article/pii/S1388248110003899
[2] https://arstechnica.com/science/2009/01/electrodes-flex-for-artificial-muscles-and-more/
[3] https://www.worldscientific.com/doi/abs/10.1142/S1793604719500899

Draw-wire displacement sensors





[video] https://www.youtube.com/watch?v=WbISZV1-my8
[data sheet] https://www.way-con.cn/fileadmin/draw-wire-sensors/Draw-Wire-Sensor-SX50.pdf
[where to buy] https://www.way-con.cn/products/drawwiresensors/