

# handske.

PROVIDING DATA TO TOUCH

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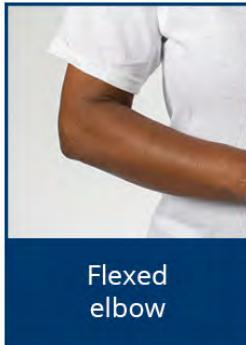
# Problem: Spasticity

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Cause: Upper-Motor Neuron Dysfunction

Symptoms: Muscle Stiffness, Involuntary, Rough Limb Movements, and Painful Contractures

Complications: Severe Bone/Joint Deformities & Inhibition of Protein Synthesis of Muscle Cells



Flexed  
elbow



Bent  
wrist



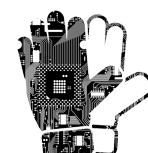
Pronated  
forearm



Clenched  
fist



Thumb  
in palm



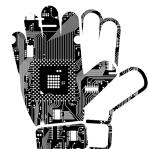
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# Prevalence: Spasticity

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Diagnosed In:

- Multiple Sclerosis
- Stroke
- Traumatic Brain Injury
- Spinal Cord Damage
- Cerebral Palsy (0.4% Live Birth Rate)



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# Clinical Assessment:

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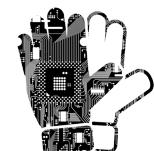
## Qualitative Evaluation:

- Modified Ashworth Scale
- Tardieu Scale
- Tendon Reflect Scale

Score	Modified Ashworth Scale [28]
0	No increase in muscle tone
1	Slight increase in muscle tone, manifested by a catch and release or by minimal resistance at the end of the range of motion (ROM) when the affected part(s) is moved in flexion or extension
1+	Slight increase in muscle tone, manifested by a catch, followed by minimal resistance throughout the remainder (less than half) of the ROM
2	More marked increase in muscle tone through most of the ROM, but affected part(s) easily moved
3	Considerable increase in muscle tone, passive movement difficult
4	Affected part(s) rigid in flexion or extension

## Subjective:

- Therapists' Feelings and Experiences
- Lack of a Sensitivity and Consistency
- May affect Patients' Health and Treatment



# Treatment Methods:

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- Spasticity = Non-Curable
- Medication to Reduce Symptoms

## **Excessive Drug Doseage:**

- Severe Side Effects
- Seizures, Coma, Hypothermia
- Respiratory Depression
- Loss of Consciousness

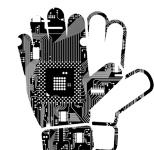
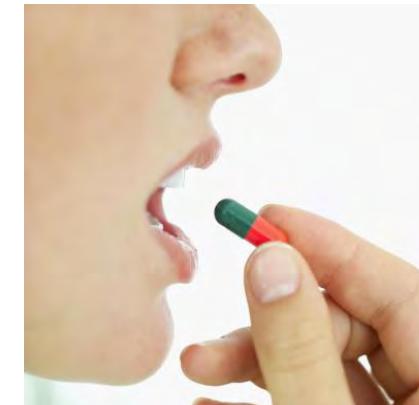
## **Inadequate Drug Doseage:**

- Ineffective Treatment of Spasticity

### Intrathecal Drug Therapy



### Oral Medication



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# Market/Product Need:

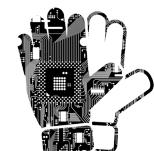
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Spasticity Evaluation **Critical**:

- Selecting appropriate Treatment
- Evolution of Spasticity over Time
- Monitoring Patient's Response to Drugs & Therapies

Quantitative Evaluation of Spasticity:

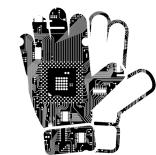
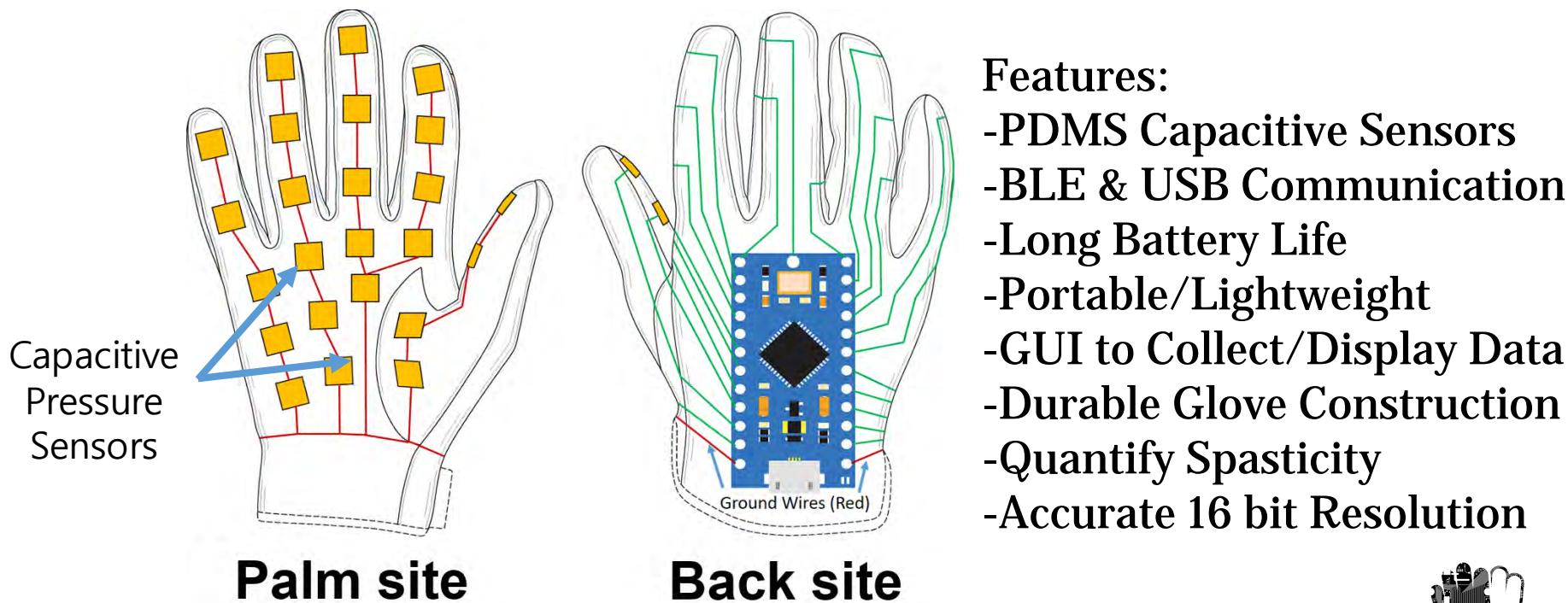
- Robust Device
- Sensitive
- Consistent
- Reliable
- Repeatable Tests



# Solution Schematic:

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## Quantitative Spasticity Evaluation Device:

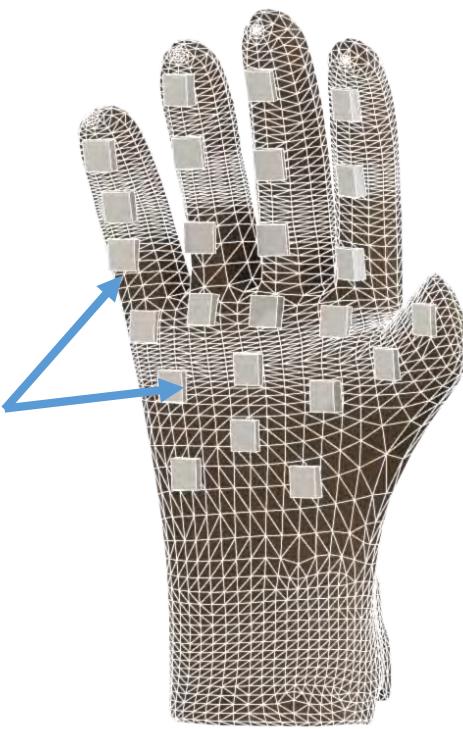


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# Glove Construction: CAD

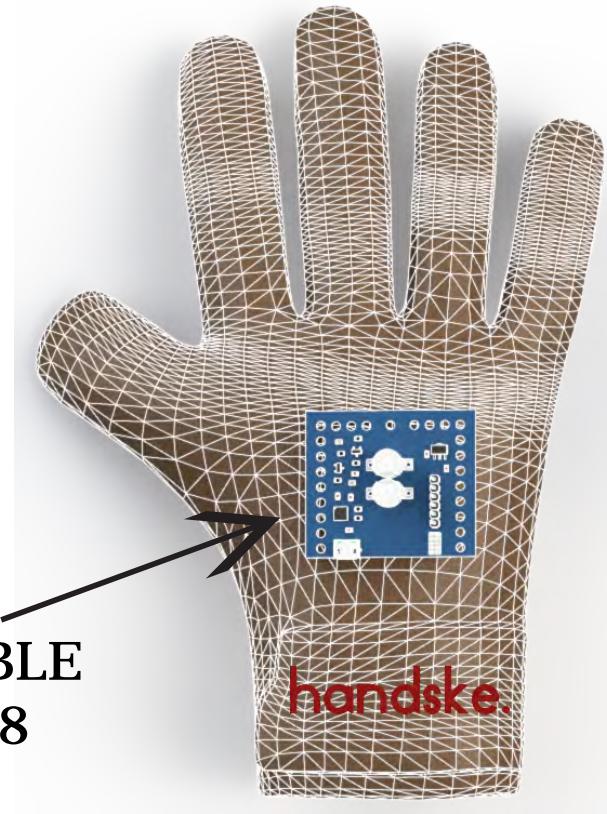
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Capacitive  
Pressure  
Sensors



FRONT GLOVE

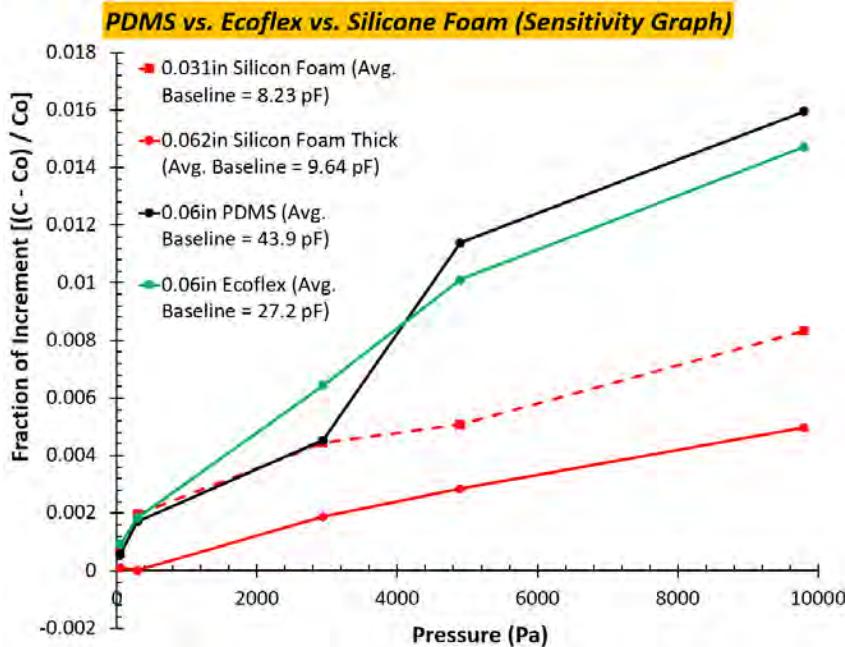
DAQ/BLE  
XR48



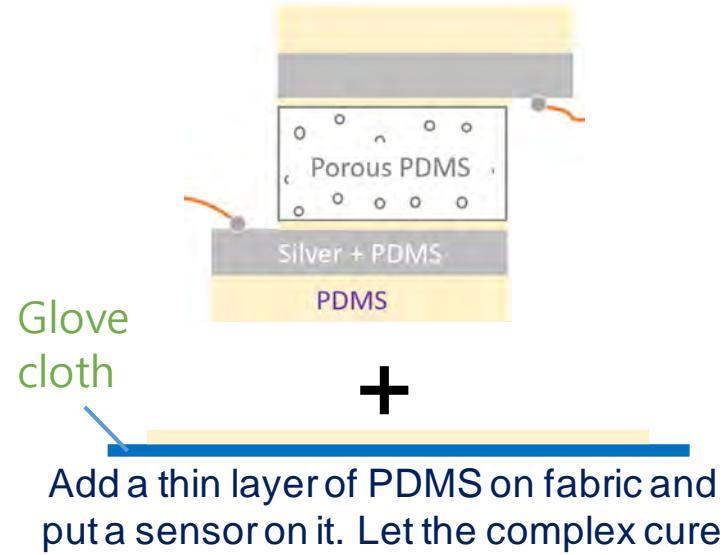
BACK GLOVE



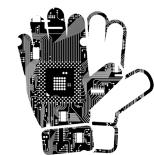
# Glove Construction: Sensors



SENSOR SENSITIVITY

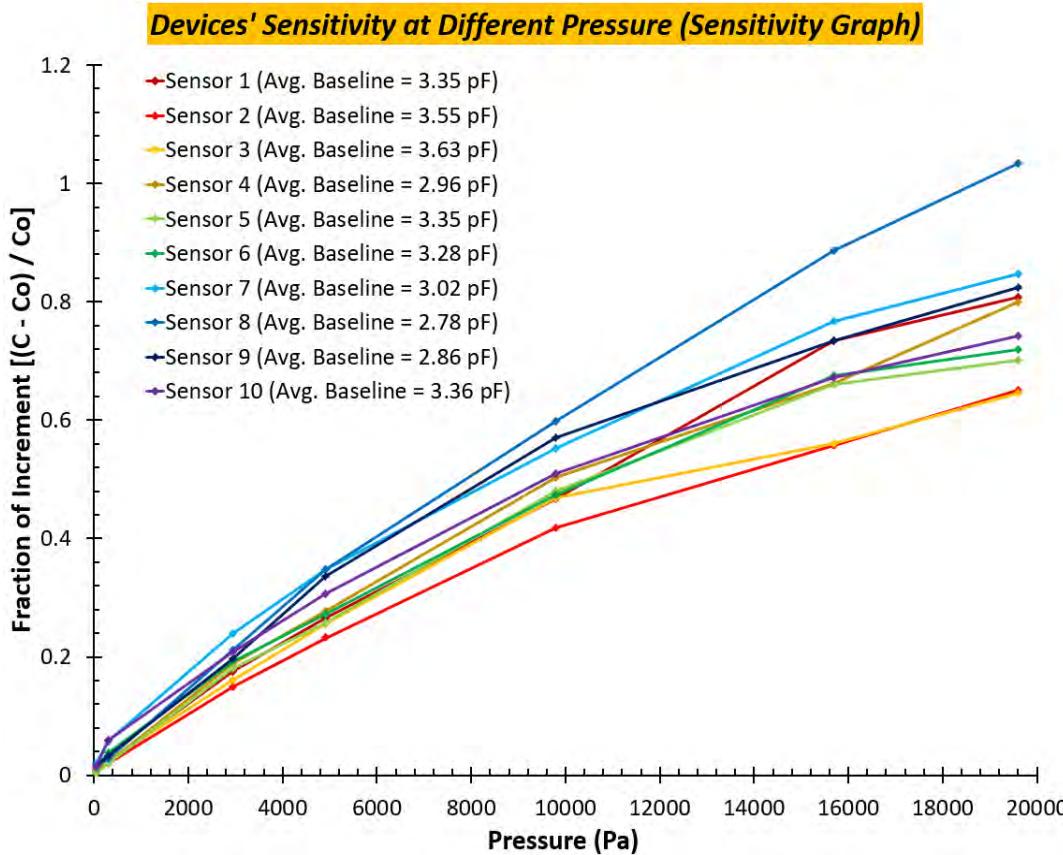


SENSOR CONSTRUCTION



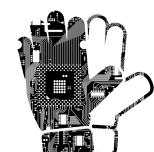
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# Prototype: Sensor Sensitivity

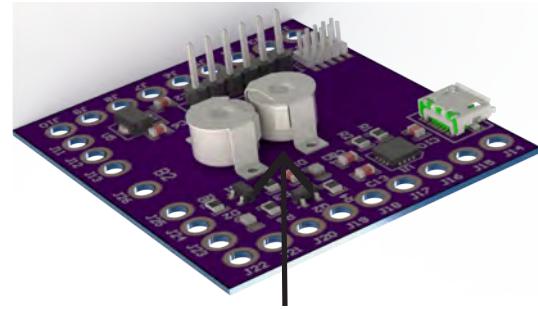
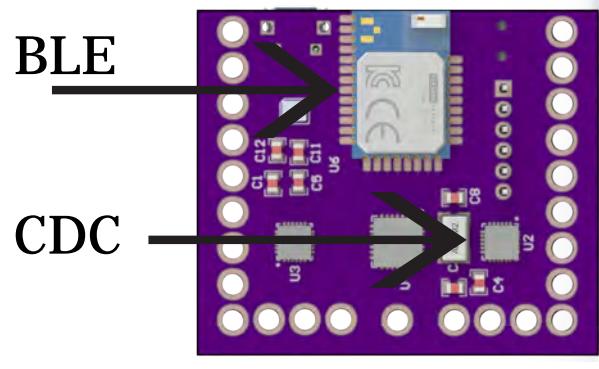
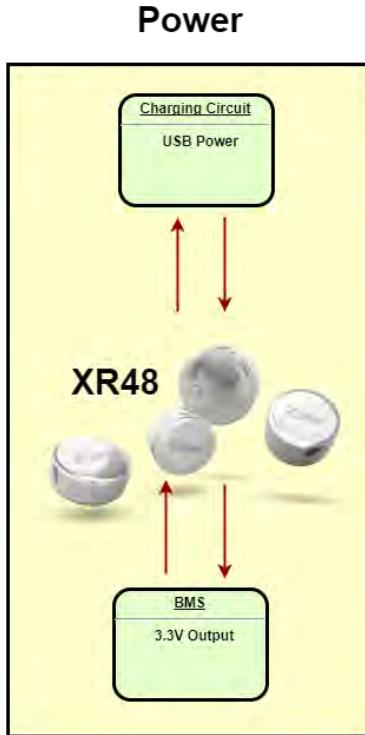
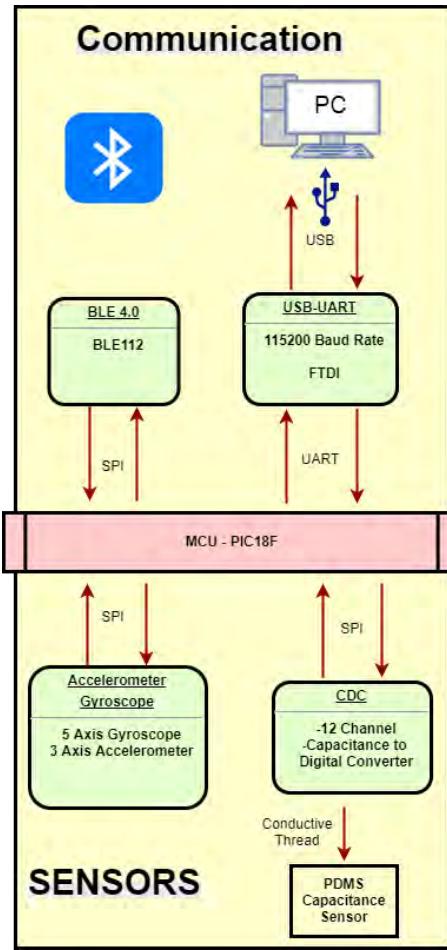


**Capacitive Sensors:**

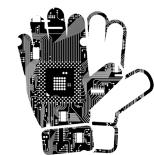
- Highly Sensitivity
- Large Range
- Higher Resolution
- Numerical Value of Force
- Low ESR = Longer Battery



# Glove Construction: PCB

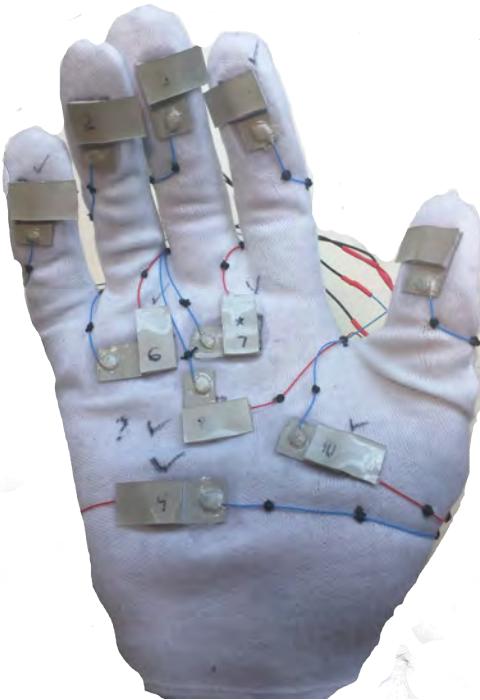


XR48

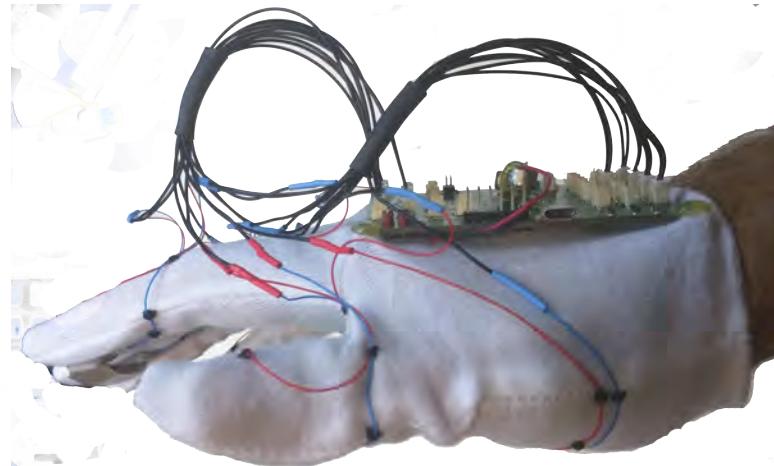


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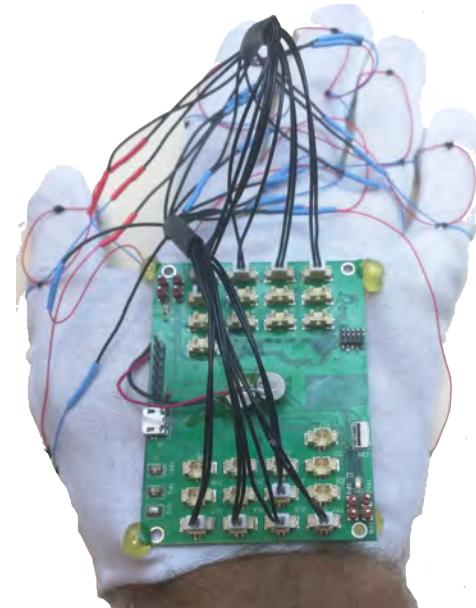
# Existing Prototype:



FRONT



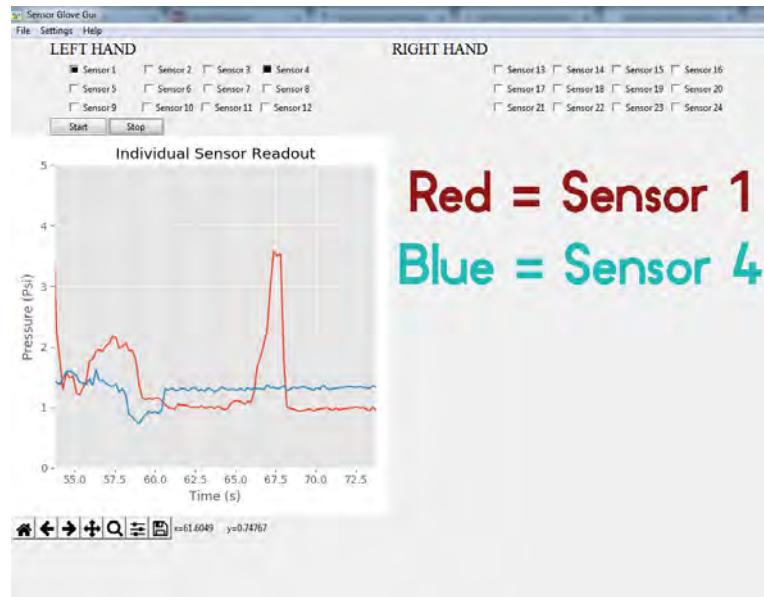
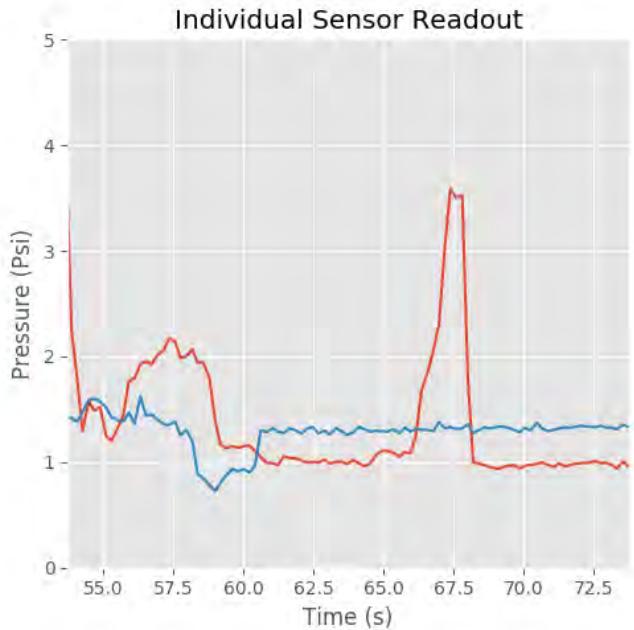
SIDE



BACK

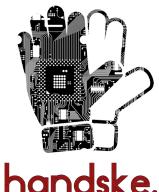
VIDEO LINK: [https://youtu.be/DI\\_IPKCn5Hs](https://youtu.be/DI_IPKCn5Hs)

# Existing GUI:



PYTHON GUI:  
-Live Plotting  
-Sensor Calibration

-Graph Image Saved  
-EXCEL Data Saved



# Prototype: Power Management

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Power Requirements:

- CDC 1 mA (x2)
- MCU 10 mA(x1)
- BLE 27 mA(x1)
- Duty Cycle: 0.5 Seconds

Battery Needs:

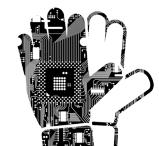
- High Energy Density
- Small Package Size
- Numerous Recharges



XR48



**Estimated Battery Life: 1.3 Hour Active Data Recording**



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