

handske.

PROVIDING DATA TO TOUCH

Students:

Quyen Hoang
Carl Demolder

Mentors:

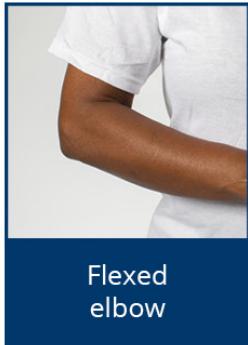
Moran Amit, PhD
Prof. Tina Ng
Prof. Hari Garudadri

Problem: Spasticity

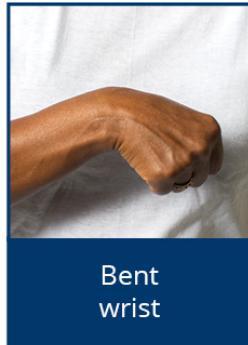
Cause: Upper-Motor Neuron Dysfunction

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

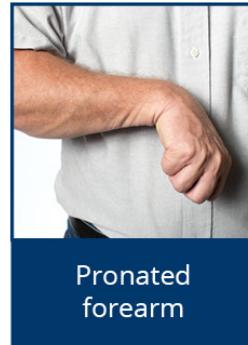
Complications: Severe Bone/Joint Deformities & Inhibition of Protein Synthesis of Muscle Cells



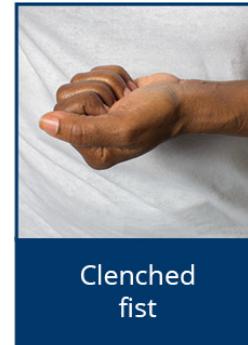
Flexed
elbow



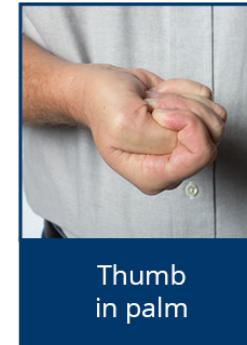
Bent
wrist



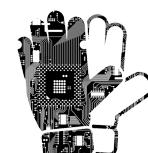
Pronated
forearm



Clenched
fist



Thumb
in palm

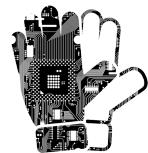


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Prevalence: Spasticity

Diagnosed In:

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



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Clinical Assessment:

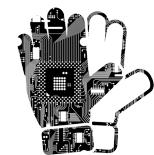
Qualitative Evaluation:

- 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:

- Spasticity = Non-Curable
- Medication to Reduce Symptoms

Excessive Drug Doseage:

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

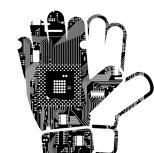
Inadequate Drug Doseage:

- Ineffective Treatment of Spasticity

Intrathecal Drug Therapy



Oral Medication



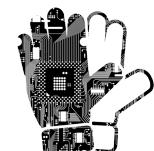
Market/Product Need:

Spasticity Evaluation **Critical**:

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

Quantitative Evaluation of Spasticity:

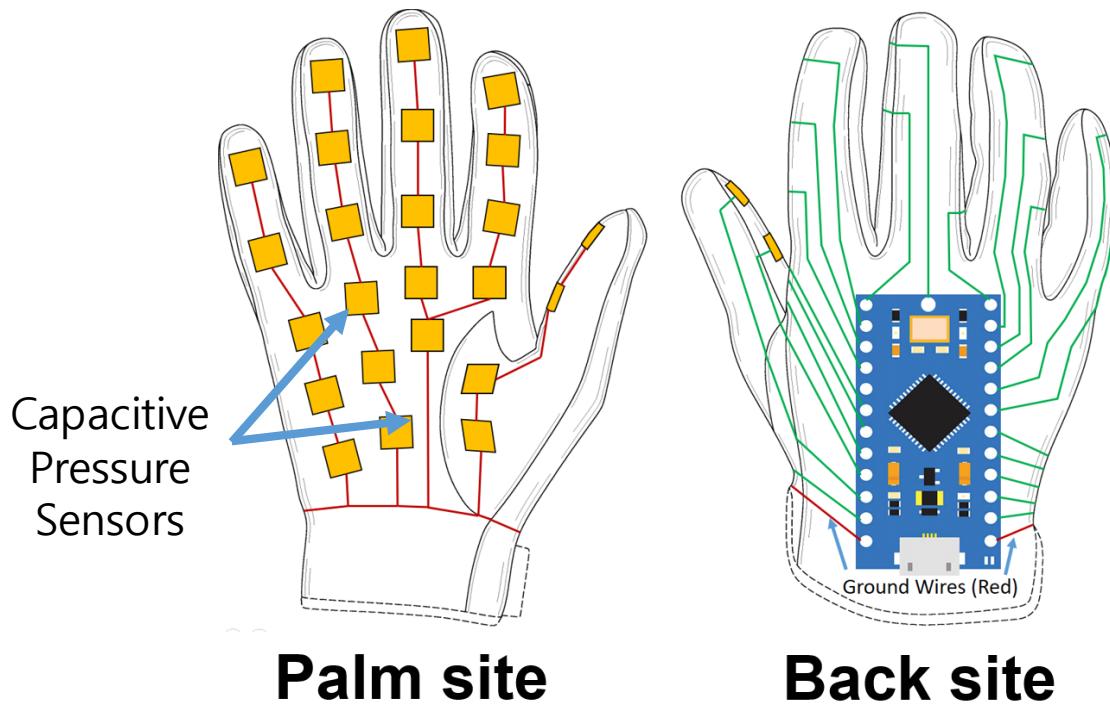
- Robust Device
- Sensitive
- Consistent
- Reliable
- Repeatable Tests



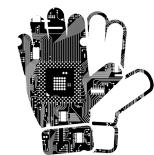
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Solution Schematic:

Quantitative Spasticity Evaluation Device:



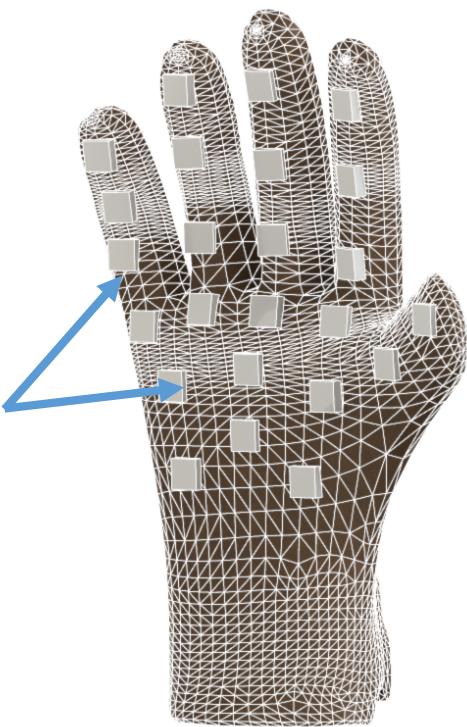
- Features:
- PDMS Capacitive Sensors
 - BLE & USB Communication
 - Long Battery Life
 - Portable/Lightweight
 - GUI to Collect/Display Data
 - Durable Glove Construction
 - Quantify Spasticity
 - Accurate 16 bit Resolution



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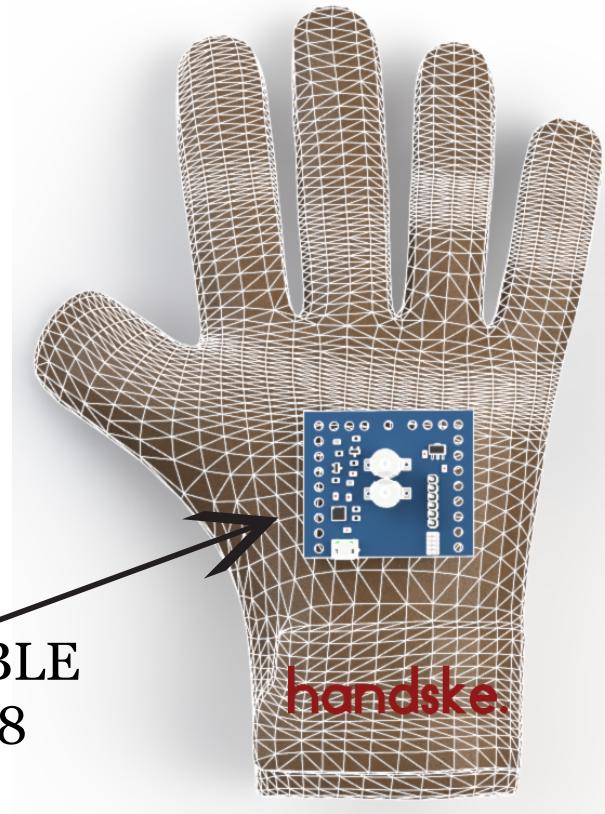
Glove Construction: CAD

Capacitive
Pressure
Sensors



FRONT GLOVE

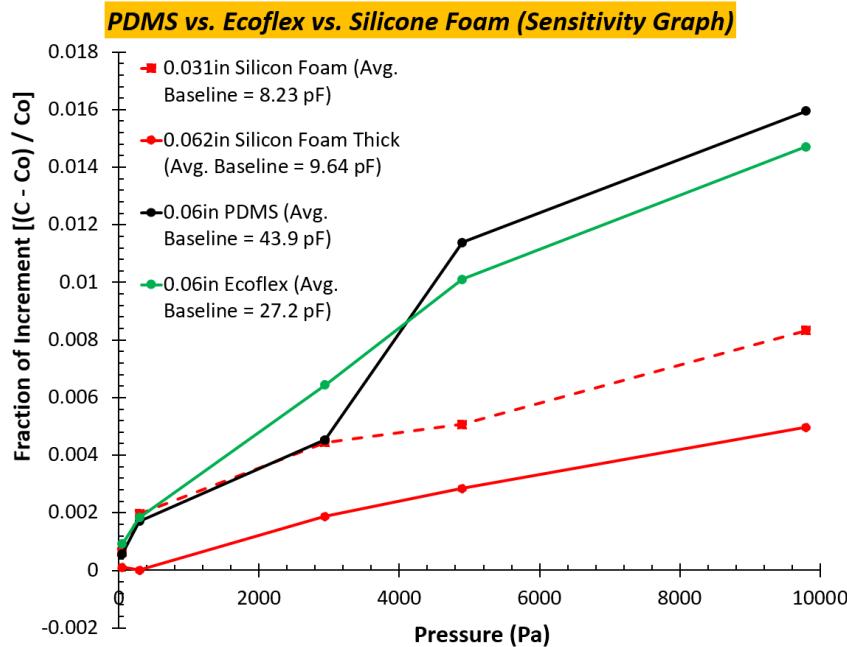
DAQ/BLE
XR48



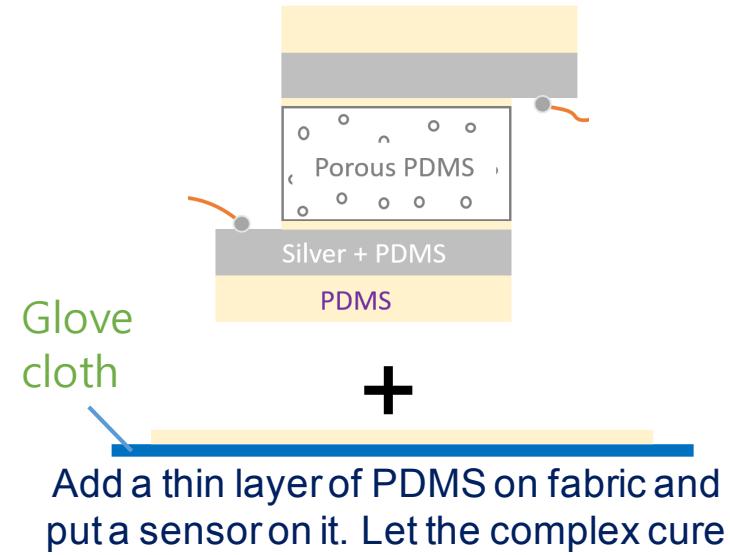
BACK GLOVE



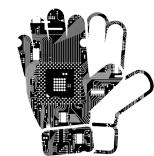
Glove Construction: Sensors



SENSOR SENSITIVITY

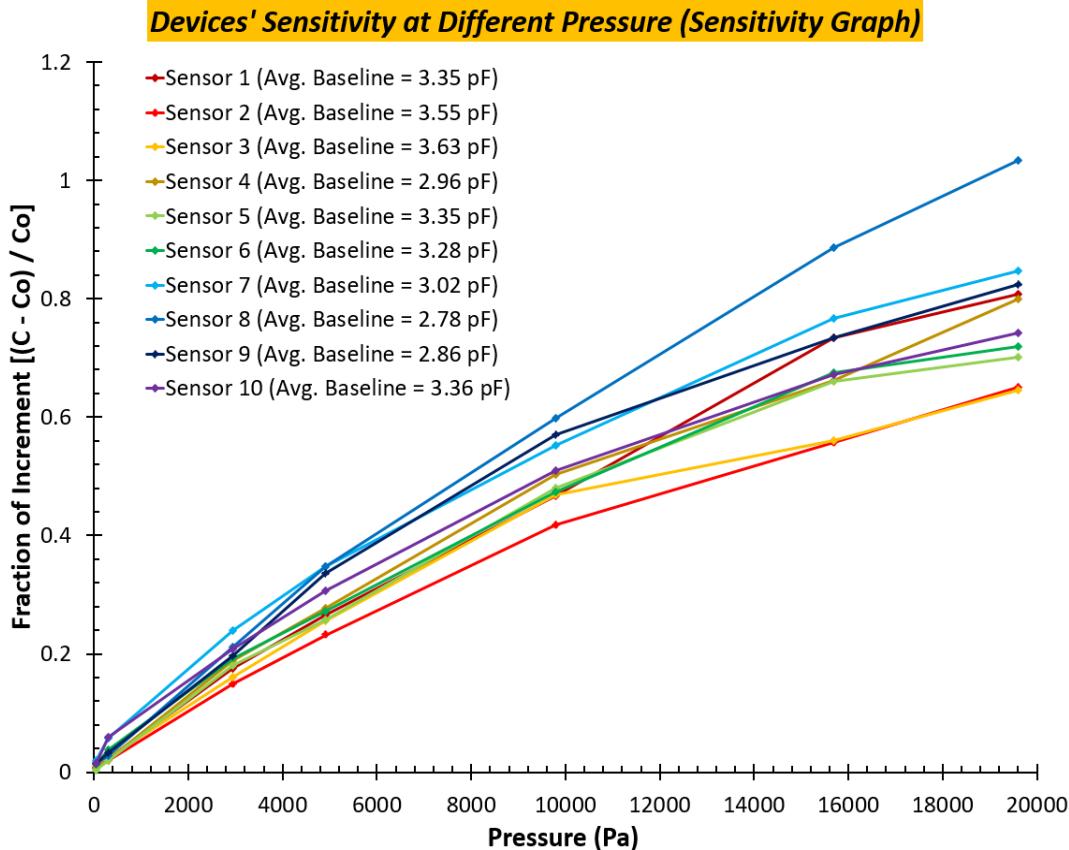


SENSOR CONSTRUCTION



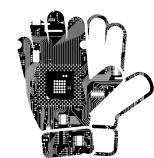
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Prototype: Sensor Sensitivity

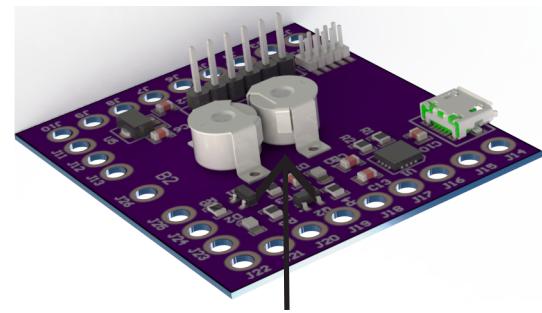
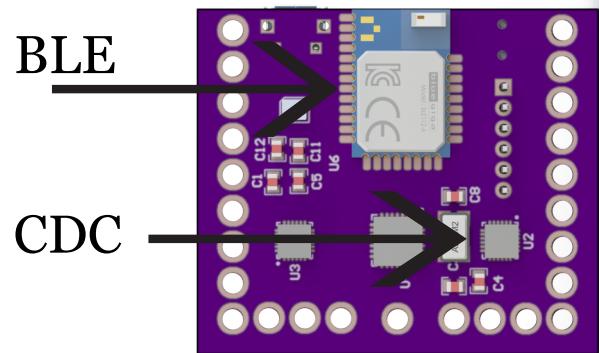
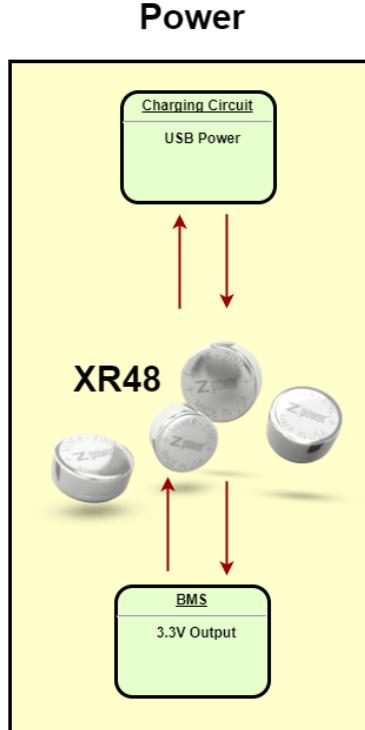
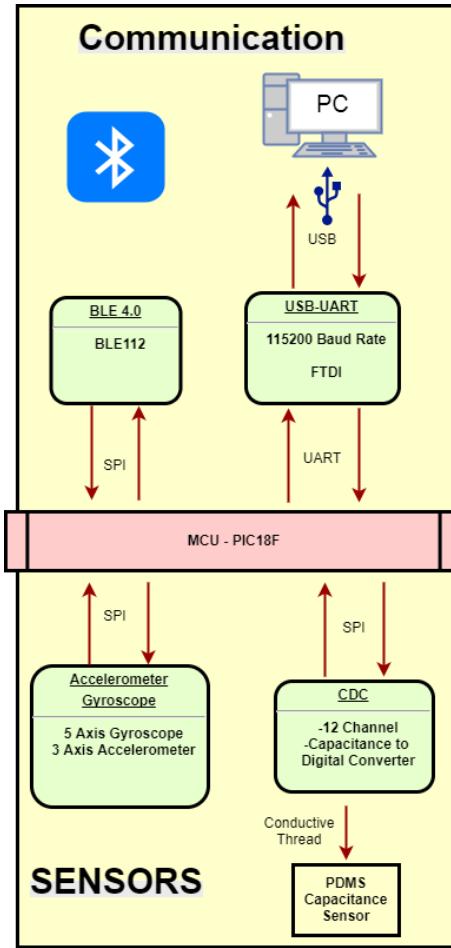


Capacitive Sensors:

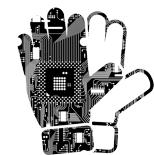
- Highly Sensitivity
- Large Range
- Higher Resolution
- Numerical Value of Force
- Low ESR = Longer Battery



Glove Construction: PCB

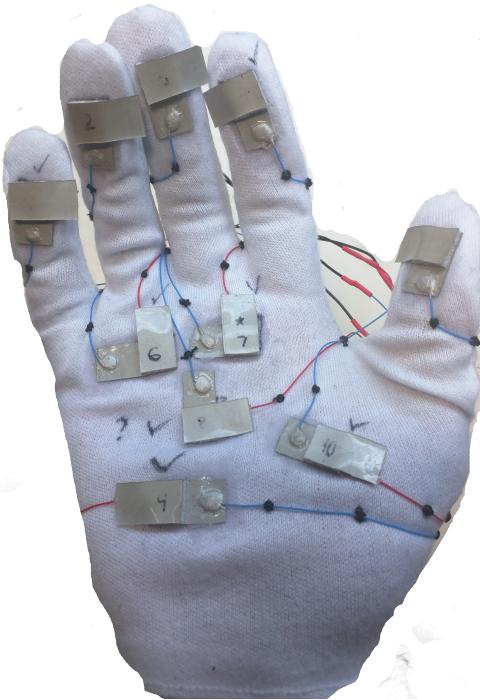


XR48

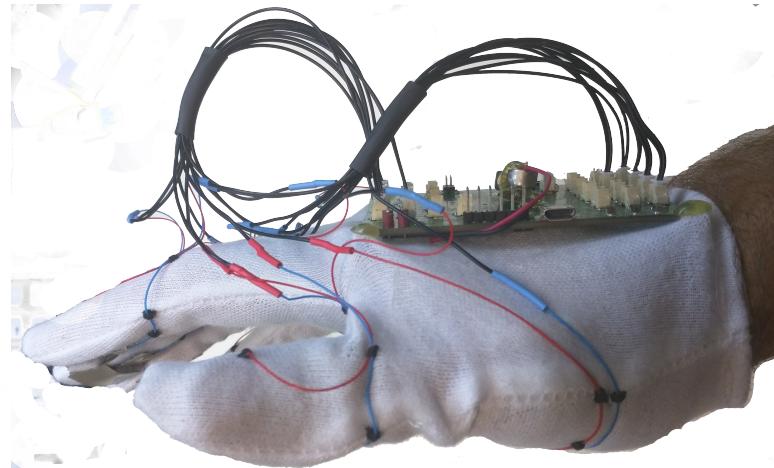


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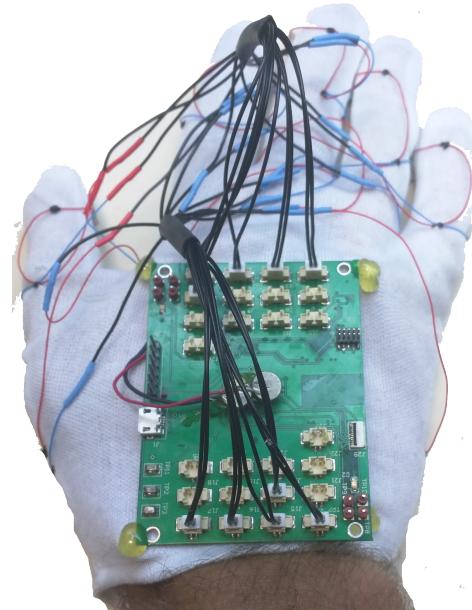
Existing Prototype:



FRONT



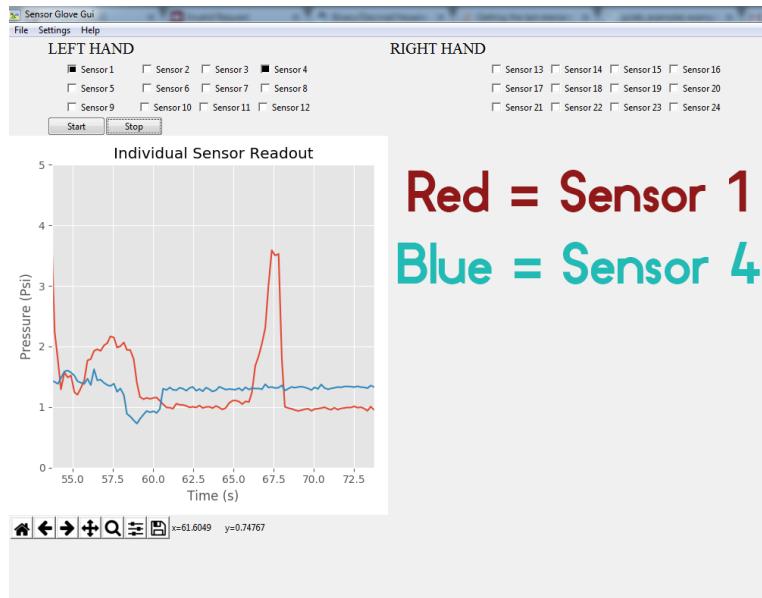
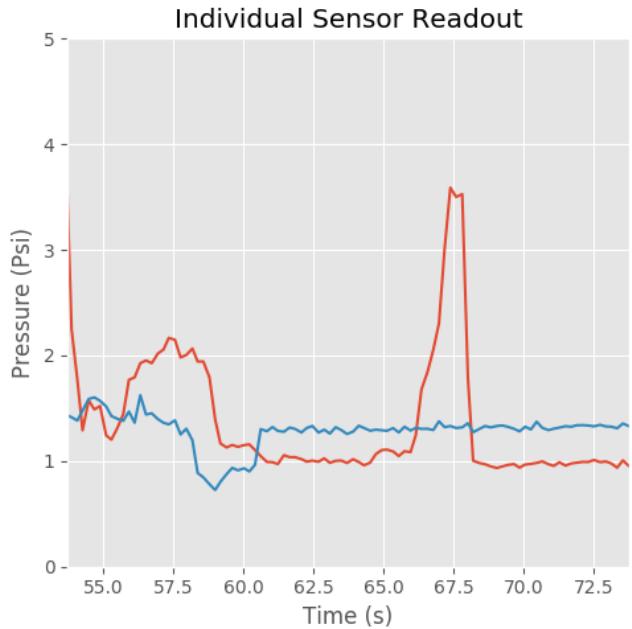
SIDE



BACK

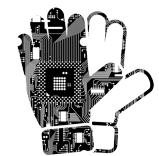
VIDEO LINK: https://youtu.be/DI_IPKCn5Hs

Existing GUI:



PYTHON GUI:
-Live Plotting
-Sensor Calibration

-Graph Image Saved
-EXCEL Data Saved



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Prototype: Power Management

Power Requirements:

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

Battery Needs:

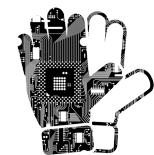
- High Energy Density
- Small Package Size
- Numerous Recharges



XR48



Estimated Battery Life: 1.3 Hour Active Data Recording



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