BITNG LAB UPDATE

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Date 1/07/2021

Outline

- Progress to date
- Path forward

PROGRESS TO DATE

Georgia Tech
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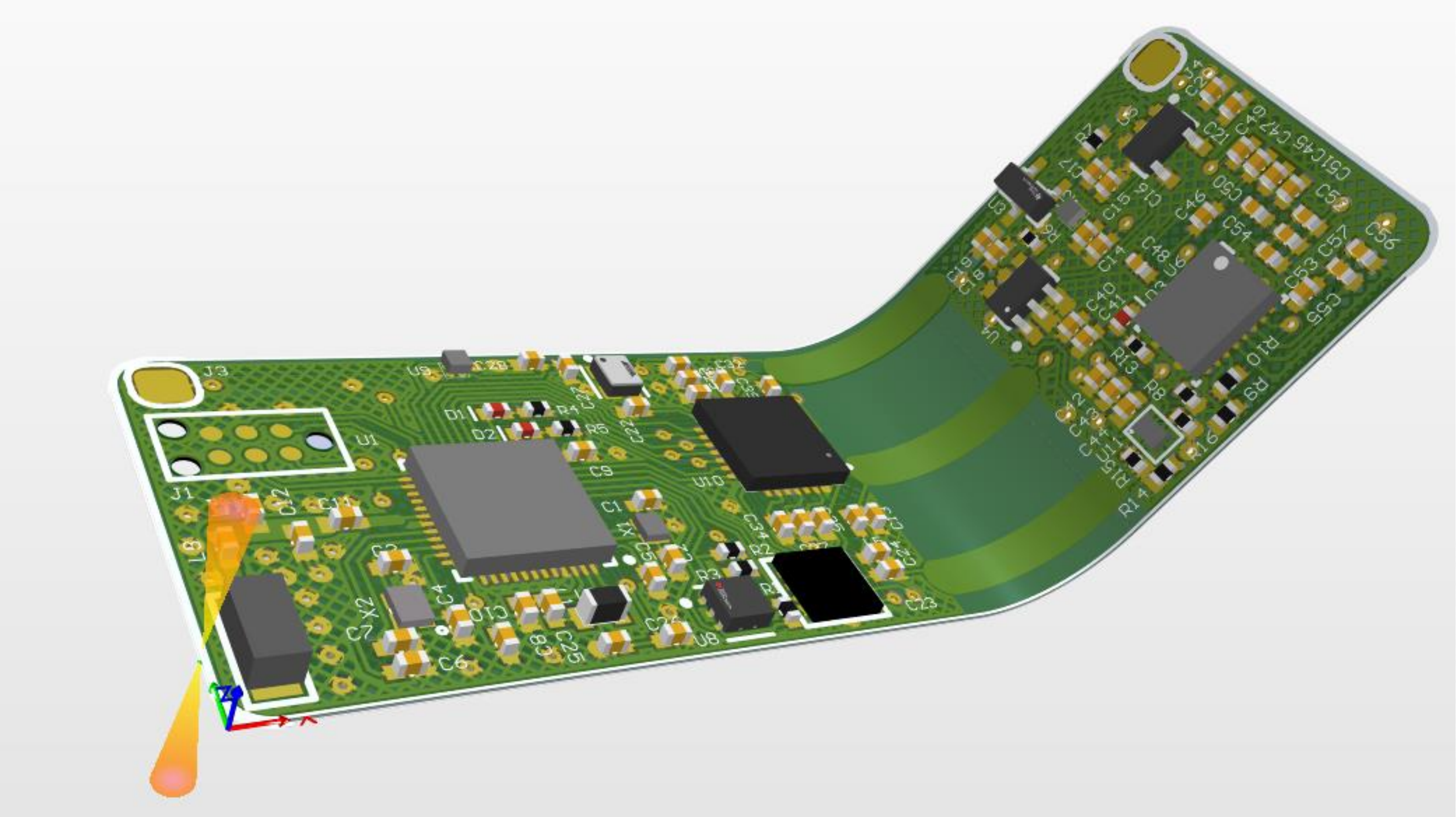
Progress from last week

- LP ECG
  - PCB procurement
- Shriner’s project
  - Literature review

LP ECG PROJECT

PCB layout

- ORDERED 12/31



SHRINER'S PROJECT

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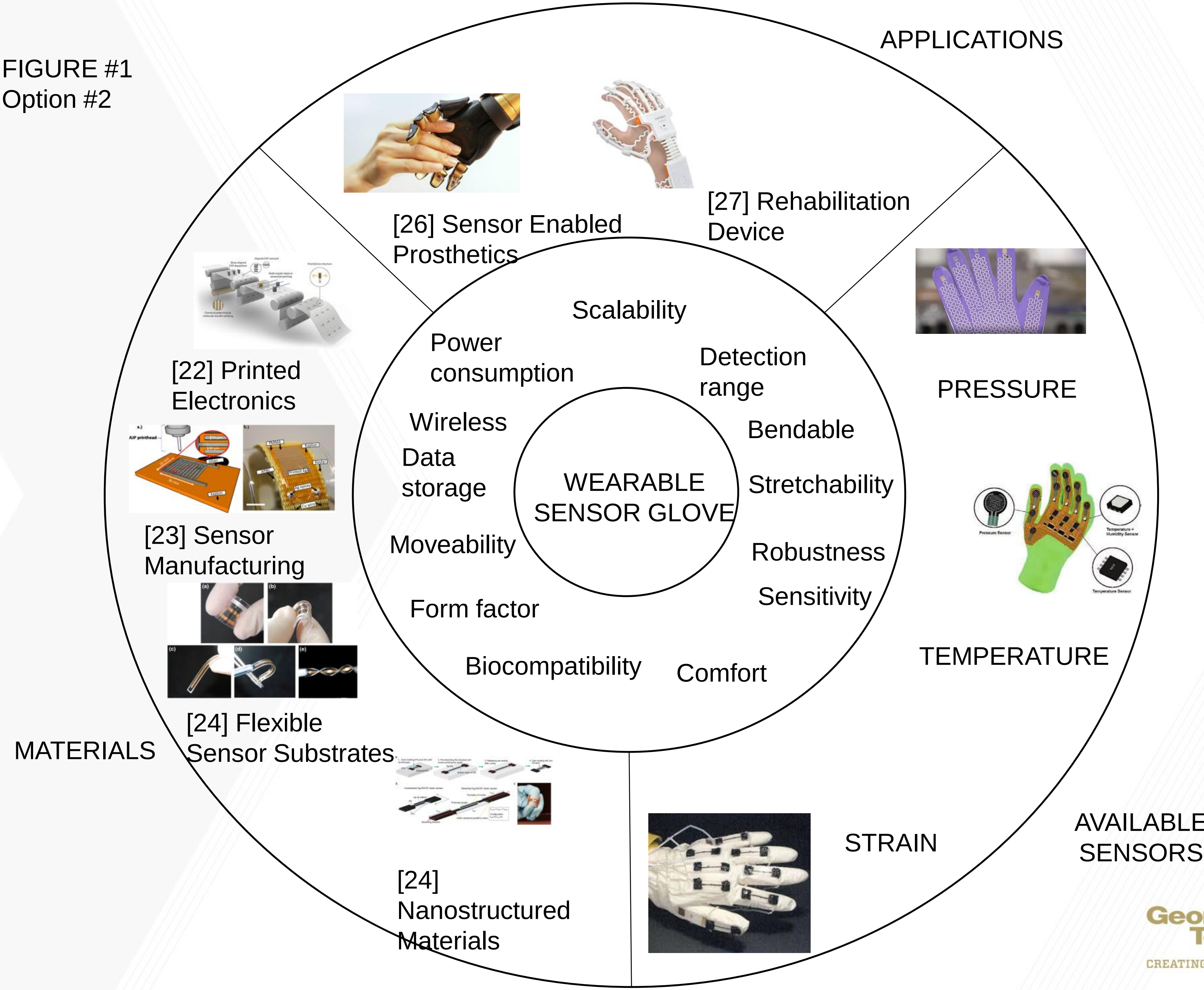
Literature review

- Tables:
  - Existing Technology Overview
    - Pressure sensors (wearable sensor glove)
    - Temperature sensors (wearable sensor glove)
    - Strain sensors (wearable sensor glove)
  - Glove Application
  - Glove Characteristics
- Figures:
  - Pie chart showing all three sensor nodes
  - Applications of sensor glove

Sensor	Academic paper title	Sensor properties			Glove application	Reference
		Material	Mechanical	Electrical		
Temperature						
	Multisensory smart glove for tactile feedback in prosthetic hand	OTS Texas Instruments Contact Temperature Sensor	2.80 mm x 2.95 mm	0.0625 C/Bit using TC77 IC	Prosthetic and robotic hand sensory enhancement	Polishchuk et al. [16] (2016)
	Protective Temperature Glove	DuPont Nomex and Kevlar knitted fabric with silicone coating	Silicone covered glove	-50°C to 500°C	Protective gloves; data transmitted via BLE	Holik SensPro [19] (2017)
Pressure	Multisensory smart glove for tactile feedback in prosthetic hand	OTS Interlink Electronics FSR	Piezoelectric sensor; 0.2” Diameter	22 N/MΩ	Prosthetic and robotic hand sensory enhancement	Polishchuk et al. [16] (2016)
	Towards a modular soft sensor-embedded glove for human hand motion and tactile pressure measurement	Galinstan liquid metal in EcoFlex silicone rubber	H = 500 um, W = 300 um, L = 157.4 mm	Pressure sensitivity = 125 kPa / V	Elastomer film to integrate sensors onto hand	Hammond et al. [17] (2014)
	TactileGlove-Hand Pressure Measurement	Proprietary capacitance pressure sensors	Thickness = 2.6 mm	Minimum sensitivity = 0.04 N; Range = 55 N/cm^2	65 sensing elements in the glove transmitted via BLE	Pressure Profile Systems [21] (2020)
Strain	Soft stretchable bending sensor and data glove applications	EPR, Scotch Electrical Semi-Conducting Tape 13	Elongation = 800%; 5 mm x 20 mm	Resistance change = 30.6%	Fabric sensor glove using silver plated nylon thread	Shen et al. [3] (2016)
	A wearable hand rehabilitation system with soft gloves	OTS Flexion sensors	H = 0.43 mm; L = 112 mm; W = 6.35 mm	> 1 million cycles; Flat resistance = 10 kΩ	Mirror therapy and task-oriented therapy	Chen et al. [10] (2019)
	Towards a modular soft sensor-embedded glove for human hand motion and tactile pressure measurement	Galinstan liquid metal in EcoFlex silicone rubber	H = 500 um, W = 300 um, L = 97 mm	1.58 N / V	Elastomer film to integrate sensors onto hand	Hammond et al. [17] (2017)
	Flexpoint -Flexible Sensor Systems- USB Glove Kit	Proprietary Bend Sensor; Single conductive layer on polyimide substrate	90° Bend on a 6 mm radius	Resistance change = 1000%; > 30 million cycles	USB wired glove kit with bend sensors	FlexPoint USB Glove Kit [20](2016)

FIGURE #1
Option #1

FIGURE #1
Option #2



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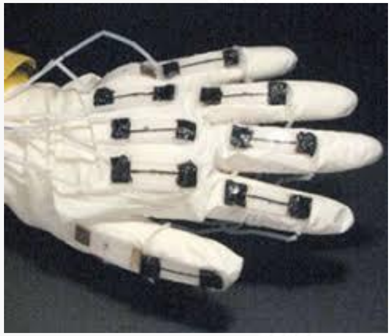
A

B



C

Figure XX. Various type of wearable sensor gloves for recording physical signals. A)

EXAMPLES FROM PREVIOUS LITERATURE REVIEW

TABLE I
GLOVES CHARACTERISTICS

Sensor information*	continuous; discrete
Sensor number* per finger/thumb	1; >1
Sensor mounting*	cloth support; mechanical structures attached directly to fingers
Sensor location*	hand joints; fingertip positions; exact location not important (see IV.A.1)
External connections	tethered; wireless
Sensor technology	piezoresistive; fiber optic; Hall-effect
Sensor performance low/high	precision; number of records/sec
Interface	serial; parallel; USB
Special requirements yes/no	special users (e.g. motor disabled [99]); special materials (e.g surgery [184], sport [185], fMRI [165])
Calibration*	required; not required

The characteristics indicated with * will be discussed in section IV.

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TABLE V
SUMMARY OF APPLICATIONS

Classical Applications	Design/manufacturing	Rationale	interact with computer-generated environments in a more natural way
		Alternative	keyboard, mouse
		Purpose	virtual architecture: test environments before their contruction virtual prototypes: test artifacts before their production 3D modelling virtual training
	Information visualization	Rationale	interact with data in a more natural way
		Alternative	keyboard, mouse
		Purpose	scientific visualization: manipulate scientific data audio-visual presentations: manipulate data
	Robotics	Rationale	control and program robots in a more natural way
		Alternative	keyboard, mouse
		Purpose	mobile robots: control a robot or a team of robots multi-DoF robots: control many DoFs simultaneously programming by demonstration: teach skills to robots in a natural way
	Arts/entertainment	Rationale	interact with computer-generated environments in a more natural way
		Alternative	keyboard, mouse
		Purpose	computer-animated characters: control many DoFs simultaneously musical performance: control acoustic parameters videogames
	Sign language understanding	Rationale	automatic translations
		Alternative	camera-based device
		Purpose	communication systems for the deaf
Recent Applications	Medicine/ Health care	Rationale	easy/quick measurement of hand motion
		Alternative	motion analysis system, goniometer, keyboard, mouse
		Purpose	motor rehabilitation: diagnosis, treatment human motion analysis ergonomics medical education and training
	Computers	Rationale	enhance computers' portability
		Alternative	keyboard and mouse
		Purpose	wearable computers

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PATH FORWARD

Path forward (1/4/21 – 1/11/21)

- Shriner's Project:
  - Literature review
    - Tables and figures

APPENDIX

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