SeizureSense
Design Review 3

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Problem

- Many diagnostic indicators for seizures are underreported
  - Crucial for developing proper treatment plans
  - Ictal grasping occurs in 96.7% of frontal hyperkinetic seizures
- **Problem:** Lack of affordable + accurate seizure detection devices that can alert caretakers while patients are asleep

How can we detect/alert when motor seizures are occurring by measuring pressure/bend changes that occur due to hand-clenching?

Customer

- Adults (18+) with known history of hand-clenching symptom during seizure events
- Caretakers of mentioned individuals

User Needs

1. Functionality
2. Compatibility
3. Affordability

Design Considerations

- Survey results

Traceability Matrix

Functionality:

- Detect motor seizure activity (quickly)
- Alert user AND nearby caretakers

Mechanical Specifications:

- Lightweight
- Removable
- Worn while sleeping

Additional considerations:

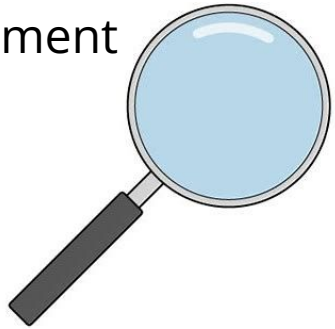
- Biocompatible
- Affordable
- Fits different hand sizes

Design Considerations

Pugh Matrix

Detection:

- Glove
- Watch/wrist attachment
- Ring
- Mouth piece



Alert:

- Phone notification
- Sound (buzzer)
- Light (LED)
- Vibration

Design Concepts/Brainstorming

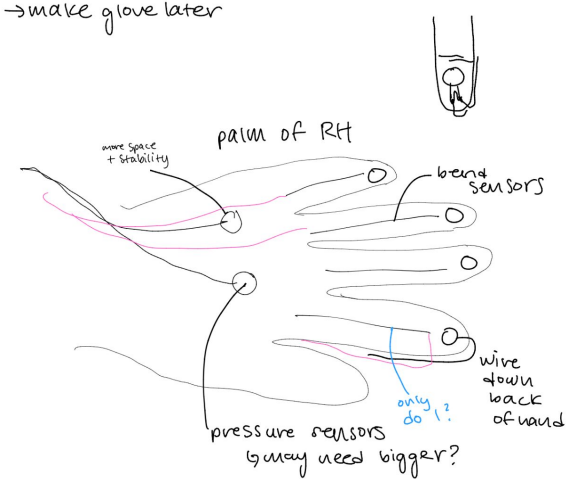
10/30/24

1st prototype
= POC w/ normal size

↳ user: people with history of seizures w/ hand clenching in fist

↳ (later) glove: put board on back of hand

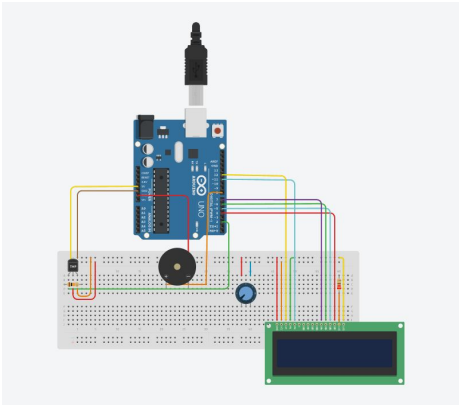
→ make glove later



Features/considerations:

- Bendable and pad-type pressure sensors
  - How many to attach
  - Sensor location
- Connection to alarm using microcontroller
- Glove material/size
  - Finger covered vs. fingerless
- Consideration of comfort
- Ease of removal
- Variation in hand clenching pressure

Previous Models



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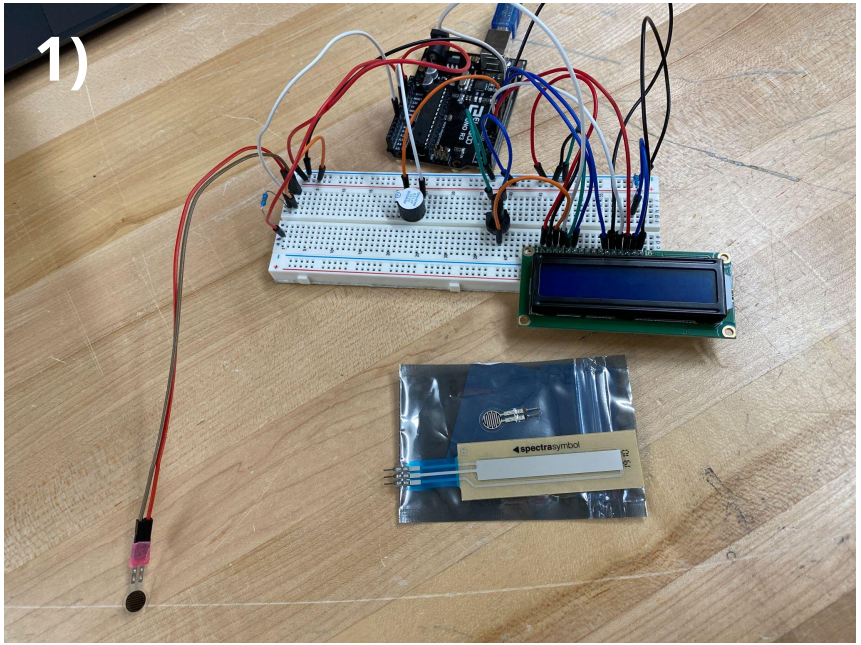
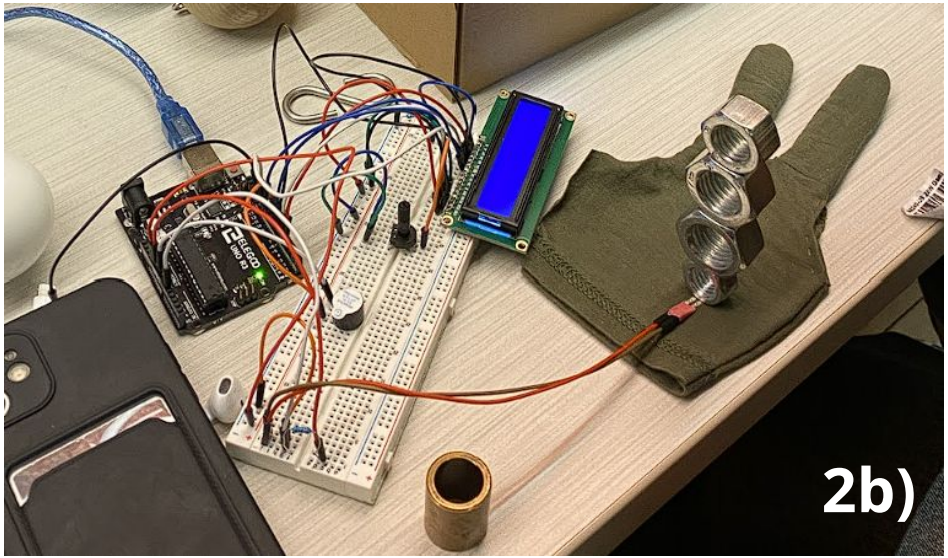


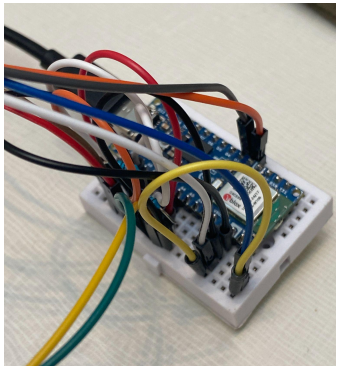


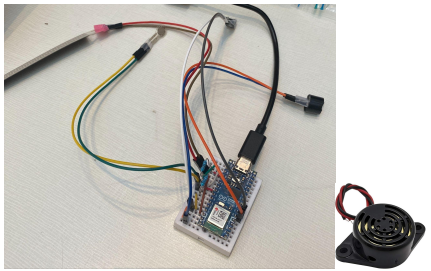
Final Prototype - Glove

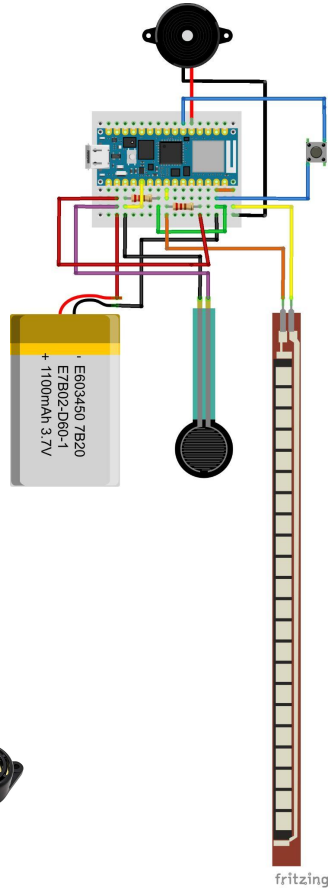
- Hand-sewn glove
  - Custom measurements (size small)
  - Cotton material
- Velcro closure
- External pocket
  - Consolidate circuit components
- Duct tape/painter's tape

Final Prototype - Circuit

- Nano Arduino ESP32
- Mini breadboard
- Thin film flex sensor (bend)
- Thin film pressure sensor
- Buzzer (louder)
- Button
- Minimizing wiring
    - Breadboard wires, short jumper wires

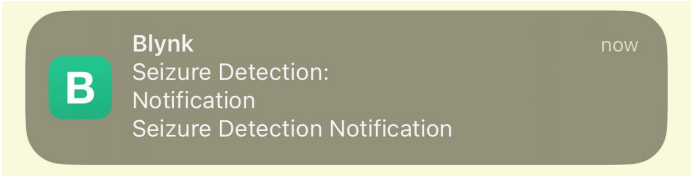






Final Prototype - Features

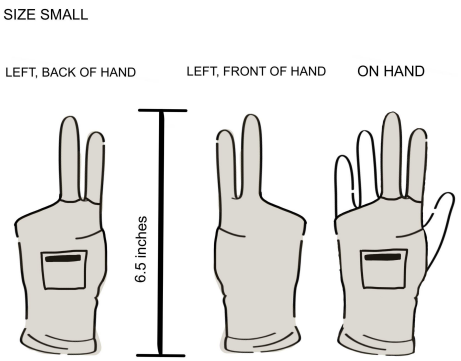
- Pressure and bend requirement
  - if (pressure > X && bend < Y)
- Alarm continues sounding until button is pressed/acknowledged
  - Even when hand becomes unclenched
- Button double-press function
  - Limit accidental turning off of alarm
  - Single press, long press prevention
- Phone notification
  - Wifi connection, Blynk app
  - Sound alert from caretaker’s phone



Verification and Validation

User Needs	Design Verification	Design Validation
Hand clenching detection	Benchtop test with pressure and bend values	Clinical trial testing detection
Alarm sound as an alert	Measure of alarm sound level	Clinical trial for sound level
Durability	Bench top test for device attachment	Clinical trial for attachment of device overnight
Accuracy of detection	Benchtop test measuring false positives	Clinical trial on # seizures accurately detected
Phone notif. alert to caretakers	Benchtop test of receiving notif.	Clinical trial for % motivations received by caretakers
Affordable	Manual review of costs	User survey on satisfaction
Glove sizes	Silicone casted hand model	User survey on comfort and fit

Glove size output

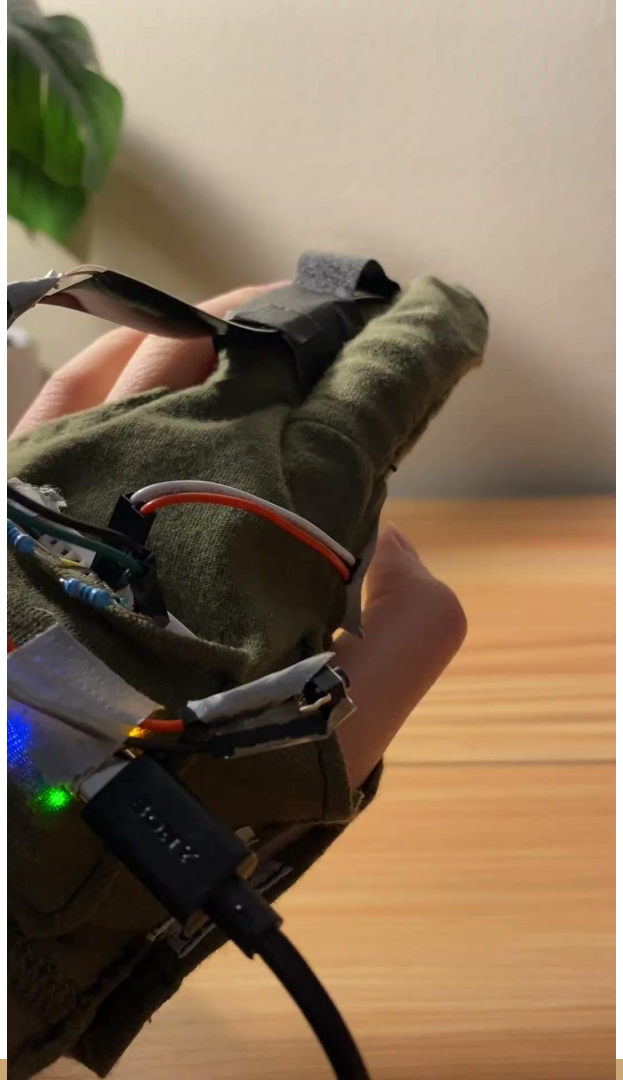


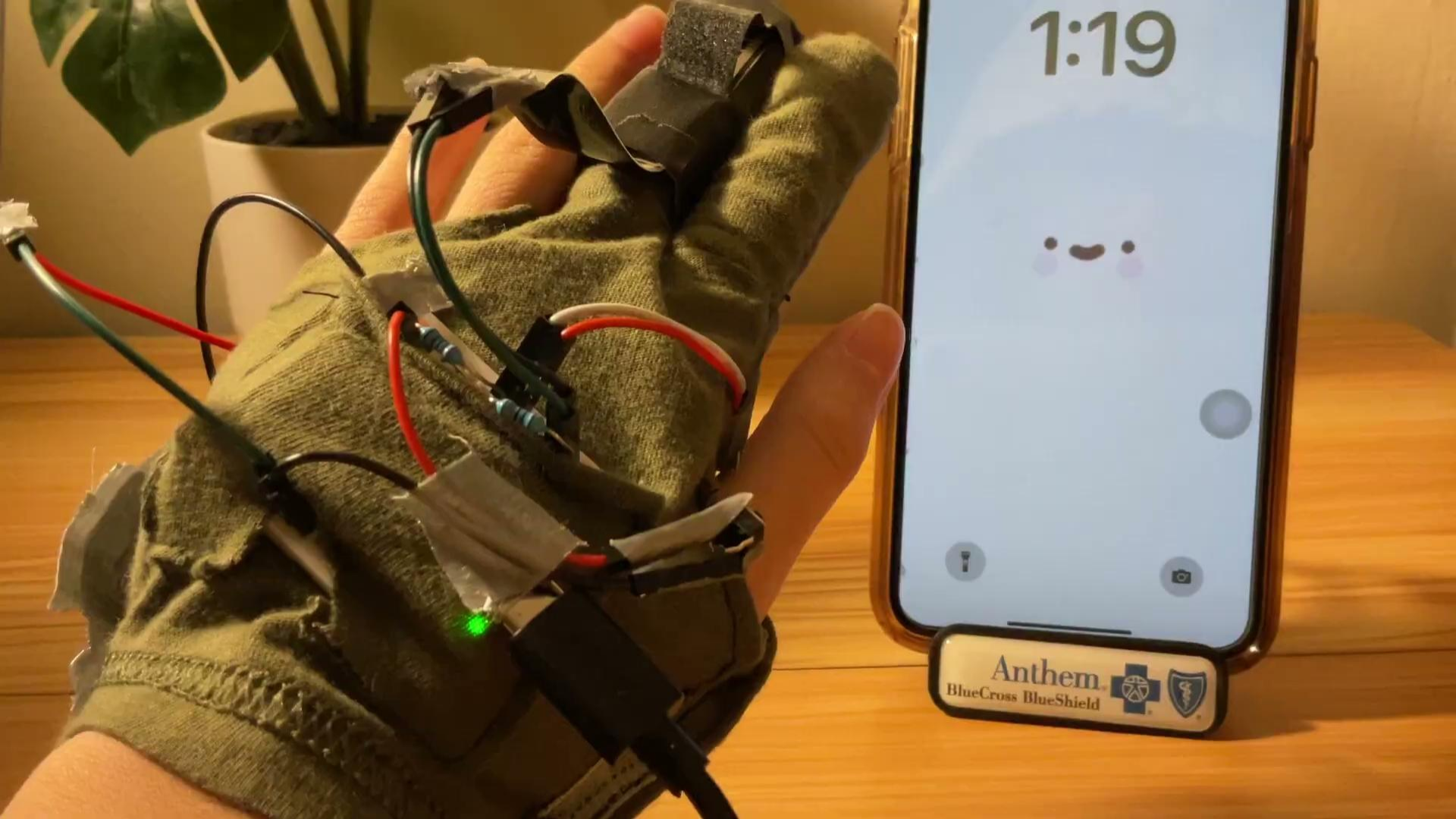
Output = Input

Risk Analysis

Concern	Mitigation
False positives and negatives	Accurate pressure threshold values in code; thorough device testing
Wire constriction or come loose	Securing wires to glove to prevent loose parts
Device components fall off	Strong adhesive to attach device parts
Electric shock	Insulating barrier between skin and device components; reducing component exposure to external environment
Skin irritation	Specification of glove material; choosing non-allergenic material

DEMO




1:19
Anthem
BlueCross BlueShield

We are asking for **$100k** in exchange for 5% equity of our company !!

Thank you!!

References

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