Test 1

Full Range of motion on each finger - The device should be able to move in the full range of motion for each finger. Determine through flex sensor data in the amount of flexion (degrees).

Scope:

- **System:** Robotic/assistive hand device equipped with flex sensors
- **Goal:** To determine if each finger achieves its full range of motion
- **Test Expectations (Hypothesis):** The device should enable each finger to achieve range of motion within 5% error of an average human's natural finger range.

Administrative Details:

- **Client/Organization:** UCSC BSOE CSE123A Winter 2025.
- **Test Conductors:** Research Team under Prof. David Harrison.

Design of Experiment:

- **Type of test method:** Controlled experiment using flex sensors to track finger flexion
  - Significance: Ensures the device can replicate the expected movement range of human fingers.

Testing Apparatus & Equipment:

- Glove with integrated flex sensors
- Voltage divider circuit with known resistor (? ohms)
- Arduino
- Computer for data logging and visualization

Independent variable(s): Actuation movement signal sent to device.
Dependent variable(s): Measured flexion angle (degrees) from flex sensors
Number of Factors: Single-factor (flexion range per finger)
Sampling Procedure:

- **Sample Collection:** Each finger tested individually through repeated movement cycles.
- **Sample Size:** Minimum of 30 repetitions per finger to ensure statistical validity.

Procedure:

1. **Setup:** Mount the device securely and ensure proper calibration of flex sensors.
2. **Baseline Measurement:** Record natural rest position of each finger.
3. **Testing:**
   - Actuate each finger from full extension to full flexion.
   - Record flex sensor data at key points of movement (0°, 45°, 90°, etc.).
   - Repeat the process for each finger, ensuring consistency.
4. **Safety Precautions:**
   - Ensure the device does not exceed mechanical limits to prevent damage.
   - Wear protective gear when handling moving parts.
5. **Data Collection:**
   - Data logged digitally via the DAQ system (laptop).
   - Observations recorded manually for potential external influences.
6. **Observation of External Factors:**

    - Ambient temperature variations.
    - Device vibrations and mechanical inconsistencies.
    - Any potential latency in response times.

Expected Outcomes:

- The device should demonstrate flexion within the expected biomechanical range (0°- 90° for DIP, 0°- 100° for PIP, 0°- 90° for MCP, depending on finger).
- Deviation beyond 2.5% of standard human range to be flagged for recalibration.
- If the device does not meet the expected range, adjustments in control algorithms and mechanical design may be necessary.

Test 2

Ability to fit on a common hand - The device should be able to fit securely and comfortably on common hand sizes. Using straps for adjustability.

Scope:

- **System Identified:** Robotic/assistive hand device designed for human use with adjustable straps.
- **Goal/Purpose:** To determine if the device can fit securely and comfortably on common hand sizes.
- **Parameters Defined:** Fit assessment will be conducted based on security, comfort, and adjustability of the straps.
- **Justification for Inclusion:** Ensuring the device can be worn by a range of users with different normal hand sizes is critical for usability.
- **Test Expectations (Hypothesis):** The device should fit securely around the middle of the hand and forearm using adjustable straps, providing a snug but comfortable fit.

Administrative Details:

- **Client/Organization:** UCSC BSOE CSE123A Winter 2025.
- **Test Conductors:** Research Team under Prof. David C. Harrison.

Design of Experiment:

- **Type of Testing Method:** Physical fit testing using standardized hand models.
    - **Significance:** Ensures that the device can accommodate a range of hand sizes.

Test Apparatus & Equipment:

- Robotic/assistive hand device with straps for adjustability.
- 3D hand model (male/female).

- Measuring tools for assessing gaps and pressure points (ruler, measuring tape, etc.).
- User feedback for qualitative comfortability assessment

Variables Identified:

- **Independent Variable:** Strap tension and hand size.
- **Dependent Variable:** Fit security, pressure distribution, and comfort level

Number of Factors Considered: Two-factor (strap-adjustability and hand size variations)

Sampling Procedure:

- **Sample Collection:** Fit tested on different hand models.
- **Sample Size:** Two hand sizes tested (male and female 3D models), three trials per size

Procedure:

1. **Setup:**
    - Prepare the hand models and device with adjustable straps.
    - Ensure straps are at their default adjustment before each trial.
2. **Baseline Measurement:**
    - Measure the circumference of each hand model at the middle of the hand and forearm.
3. **Testing:**
    - Place the device on each hand model and secure it using the straps.
    - Adjust the straps for a snug but comfortable fit.
    - Record strap tension using measuring tape and pressure sensors.
    - Conduct subjective assessment for comfort and stability.
4. **Safety Precautions:**
    - Ensure straps do not exert excessive pressure that could restrict circulation.
    - Confirm that the device does not cause discomfort or excessive movement restrictions.
5. **Data Collection:**
    - **Quantitative data:** Strap tightness, pressure distribution, and movement stability.
    - **Qualitative data:** User comfort feedback (1-10 scale).
6. **Observation of External Factors:**
    - Impact of movement on strap security.
    - Any noticeable discomfort due to prolonged wear.

Expected Outcomes:

- The device should securely fit common hand sizes without excessive gaps or pressure points.
- The adjustable straps should allow for a customized fit without discomfort.
- If fit issues arise, modifications to strap length, padding, or buckle placement may be necessary.

	Name(s):	Date:	Location:
Test 1: Full Range of Motion on each finger			
Test 2: Ability to fit on common hand			
Test 3:			