Department of Biomedical Engineering
University of Lagos

VENOSOCK: A SMART COMPRESSION SOCK-BASED EARLY WARNING SYSTEM FOR DEEP VEIN THROMBOSIS RISK MONITORING

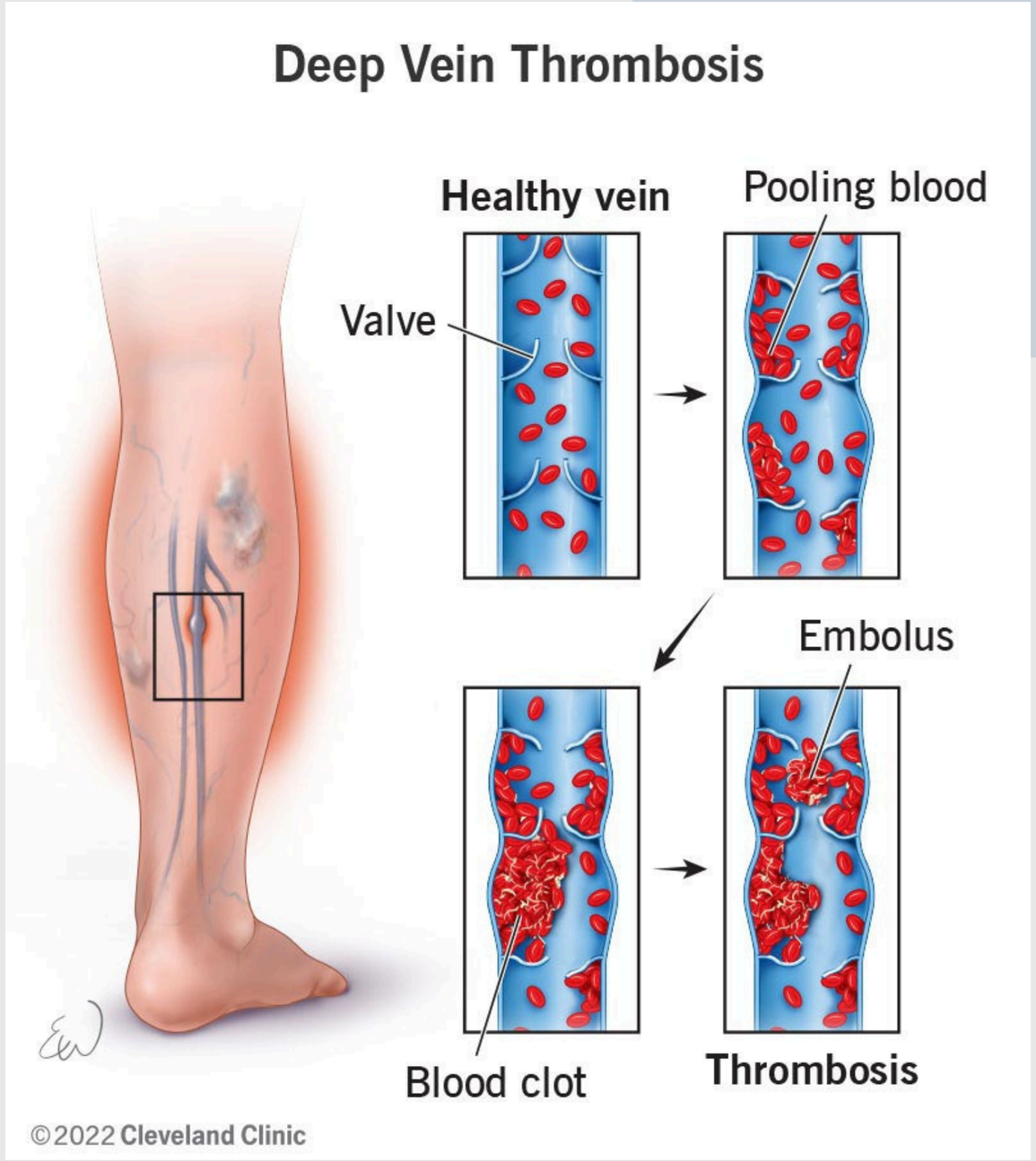
Presented by :
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CLINICAL BACKGROUND

Deep Vein Thrombosis (DVT)

- **Venous Obstruction:** Blood clot formation in lower extremities.
- **Lethal Progression:** Dislodged thrombus causes fatal pulmonary embolism.
- **Silent Threat:** High morbidity rate without proactive surveillance.



The Systemic Flaw

DVT in Resource-Constrained Settings



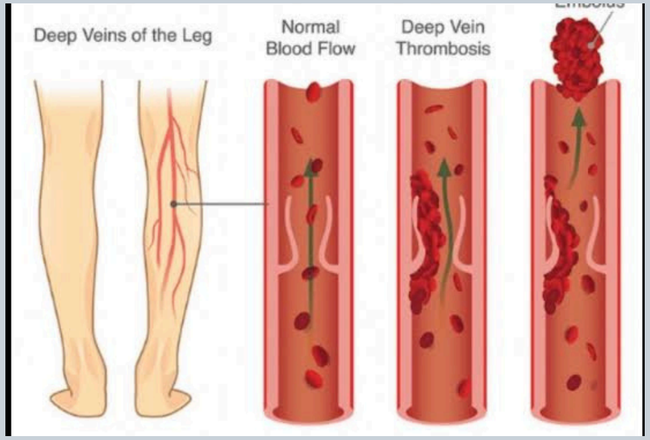
Reactive Standard

Doppler ultrasound only used post-clot formation.



Financial Barrier

Severe out-of-pocket costs restrict routine scanning.



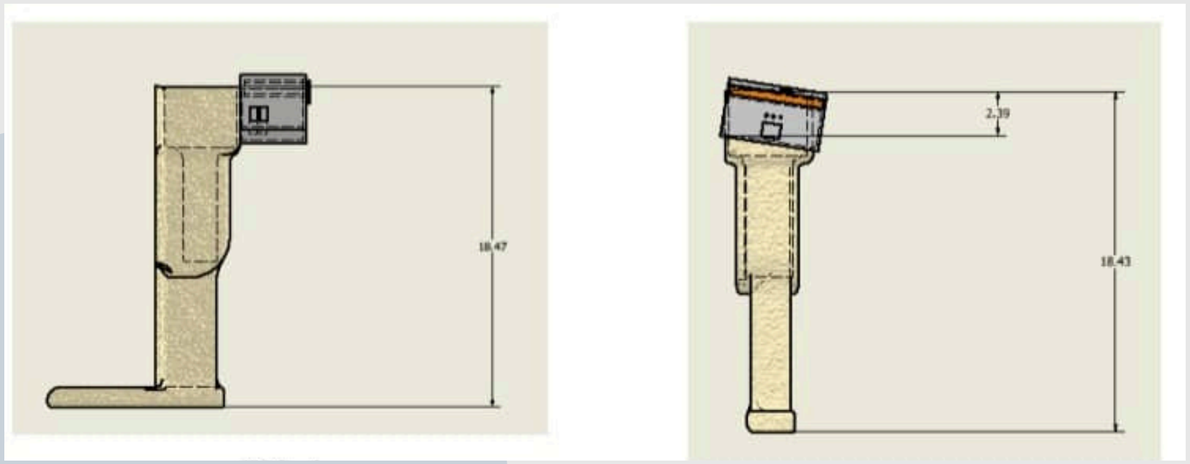
Late Presentation

Undetected progression leads to fatal complications..

Aim and Propsed Solution

Project Aim: To design and implement a low-cost, multimodal wearable risk-warning system that proactively determines the probability of DVT before severe complications arise.

Introducing: VENO SOCK



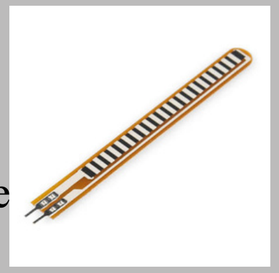


Physiological Targets & Proxies

Target: Localized Edema

Mechanical Strain

Measured via Piezoresistive Flex Sensor.



Target: Thermal Elevation

Skin Temperature

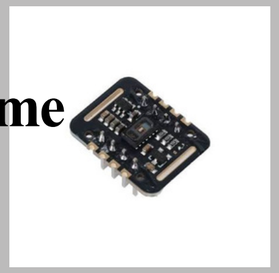
Measured via DS18B20 Digital Sensor.



Target: Venous Pooling

Pulsatile Blood Volume

Measured via MAX30102 PPG Module.



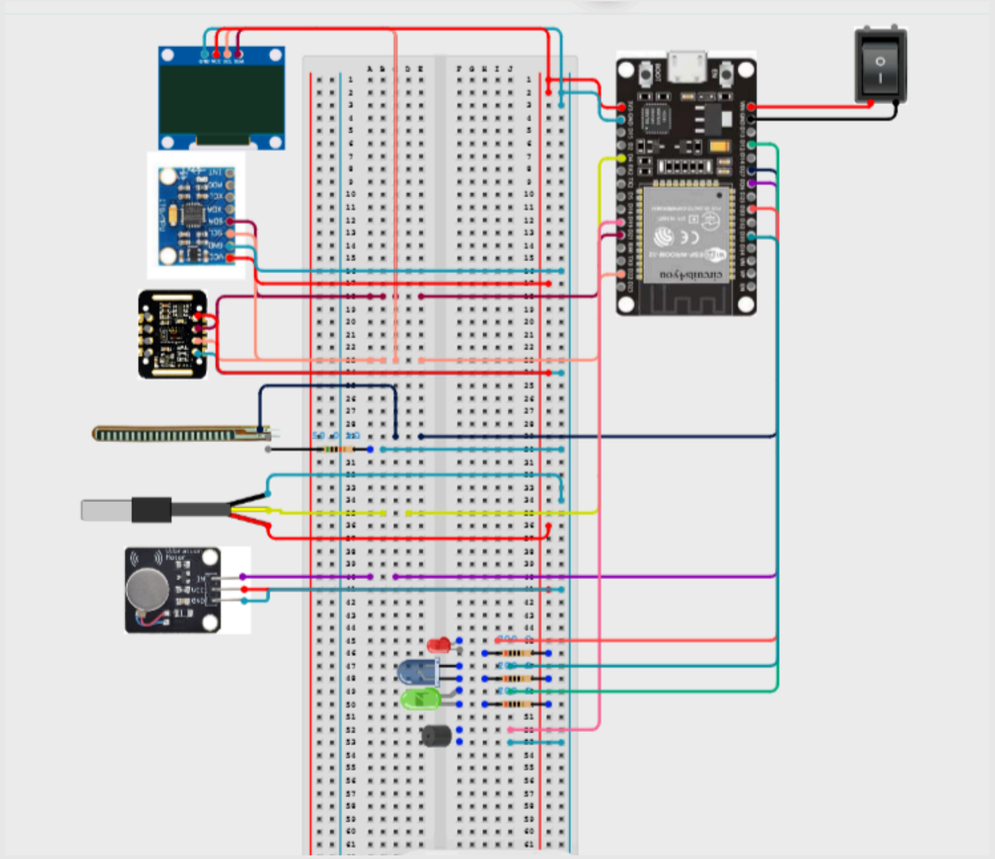
Target: Sedentary State

Calf Kinematics

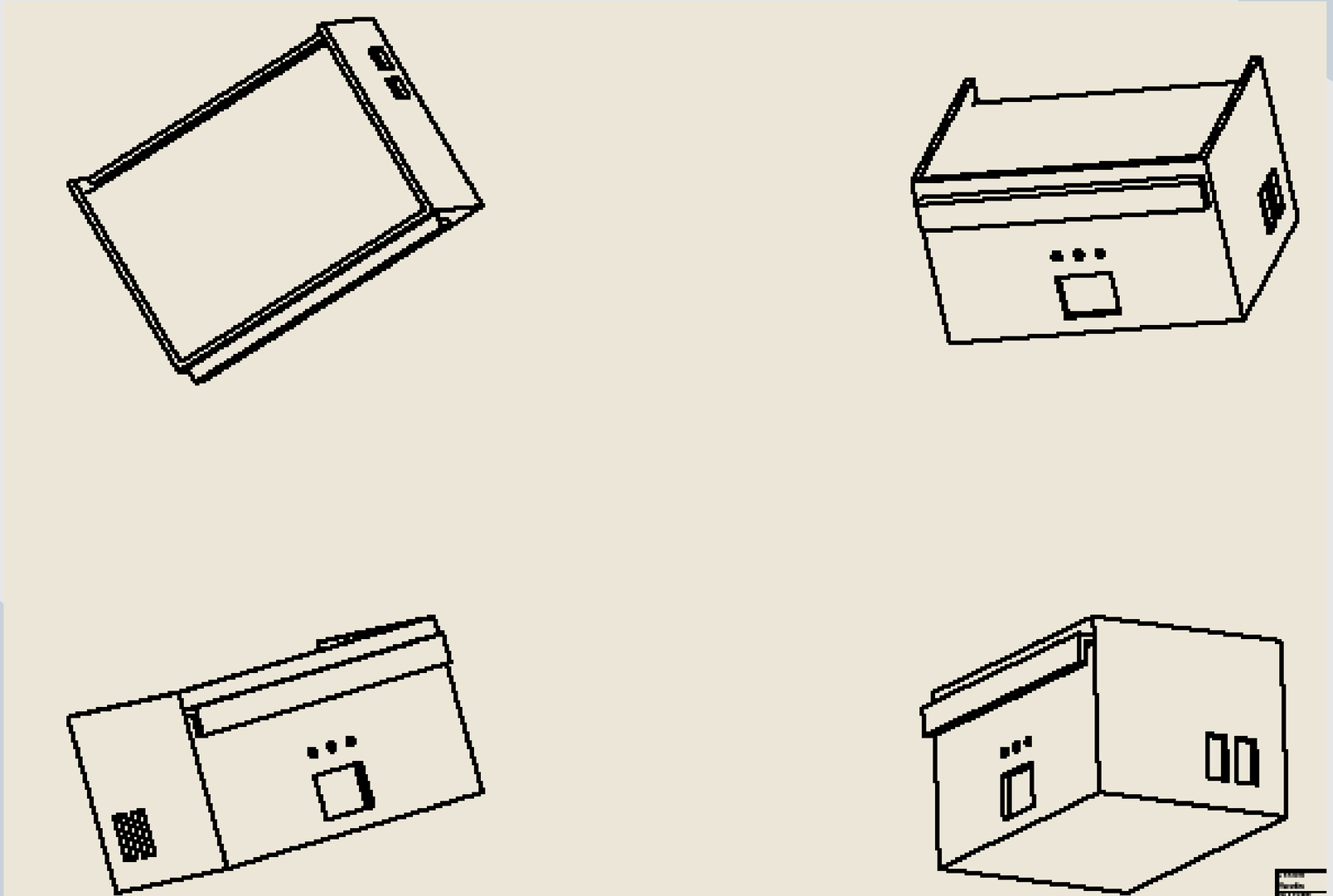
Measured via MPU6050 Accelerometer.



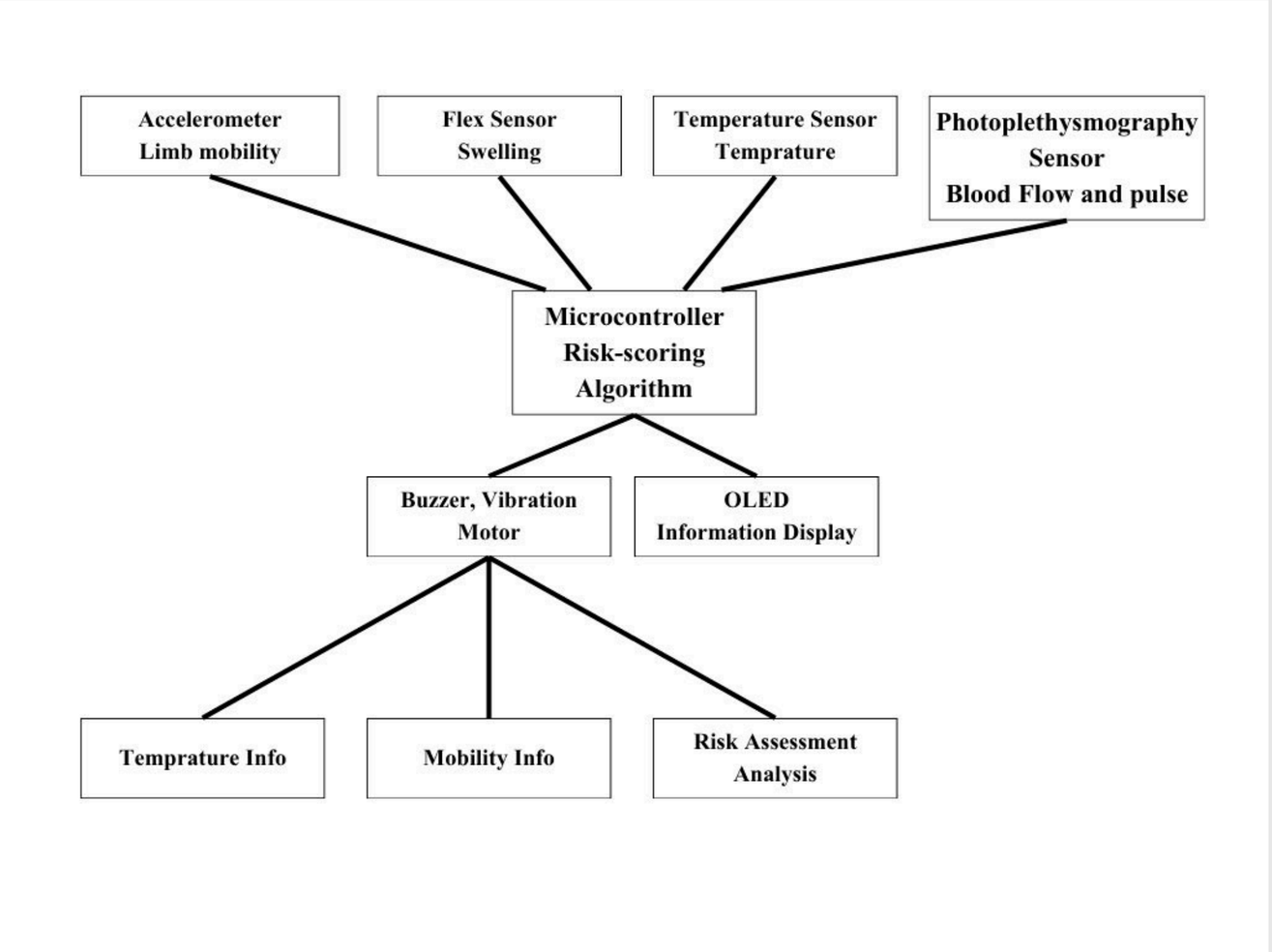
METHODS: Electrical Implementation



METHODS: CAD Design and Fabrication



METHODS: SYSTEM ARCHITECTURE



METHODS: Result and Bench evaluation

Scenario 1: Baseline Resting State

- Action: Normal ambient temperature and baseline calf geometry maintained.
- System Response: Successfully maintained a Low-Risk score (0 or 1).
- Output: Green LED remained active with no false-positive triggers.

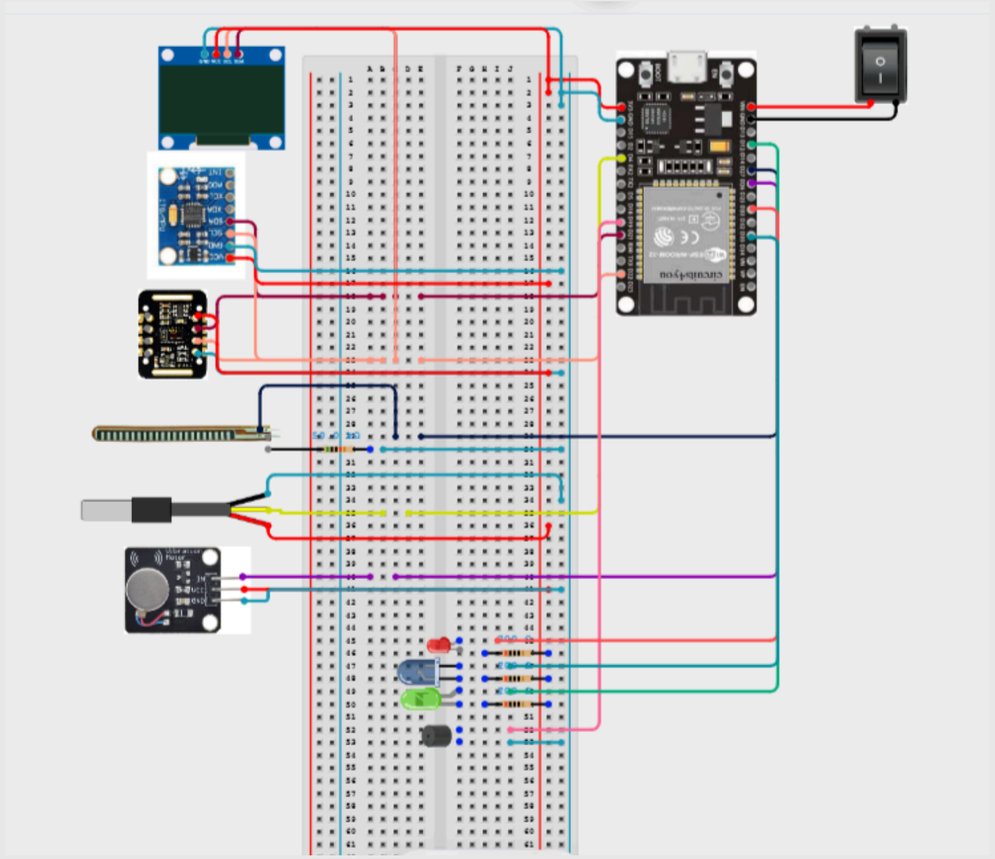
Scenario 2: Intermediate Deviation

- Action: Localized thermal elevation physically simulated while maintaining absolute immobility.
- System Response: Algorithm detected exactly two concurrent parameter deviations (Score of 2).
- Output: Successfully escalated to the Intermediate Warning state (Blue LED).

Scenario 3: High-Risk Threshold

- Action: Simulated severe unilateral swelling (muscle flex against sensor) alongside thermal and kinematic deviations.
- System Response: System fused three distinct data streams recognizing a High-Risk probability (Score of 3 or 4).
- Output: Instantly triggered the Red LED and Haptic Vibration motor.

METHODS: Electrical Implementation



METHODS: Result and Bench evaluation

Scenario 1: Baseline Resting State



Scenario 2: Intermediate Deviation



Scenario 3: High-Risk Threshold



CONCLUSION

Next Steps

- **Hardware Optimization: Transitioning to conductive elastomer stretch sensors and flexible printed circuit boards (FPCBs) to resolve current wearability and mechanical constraints.**

- **Bilateral Architecture: Developing a paired, two-garment system to accurately measure true contralateral thermal asymmetry and unilateral edema.**

- **Clinical Validation: Securing formal ethical approval for human-subject testing to generate time-series data and align our abnormality scoring with established clinical risk tools (e.g., Wells or Caprini scores).**

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THANK YOU *