



IOWA STATE
UNIVERSITY

Senior Design Project II Spring 2025

Pressure Sensor Patch

sdmay25-12

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Advisor:

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Clients:

Adaptive Adventures & BAE Systems

Adaptive
adventures

BAE SYSTEMS

Agenda

Overview

Requirements

Hardware In Depth

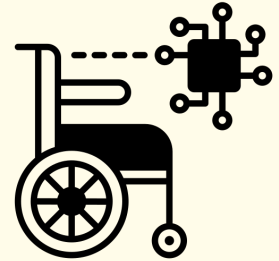
Software In Depth

Testing/Demo

Conclusion

Overview

- People with disabilities need special equipment to participate in sports.
- Modern technology enables safer participation in physical activities.
- Even with current equipment, challenges persist-especially for those with lower extremity damage or related disabilities.
- These individuals may not sense incorrect sitting posture, leading to prolonged pressure on the sit bones.
- This can cause pressure sores, which may result in life-changing consequences or even be fatal.

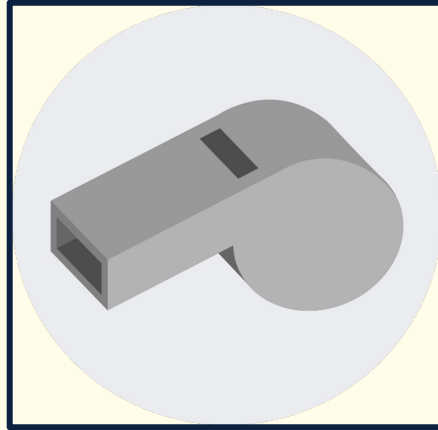


Intended Users

**Athletes with
Adaptive Equipment**



**Caregivers/Coaches
for Adaptive Sports
Athletes**

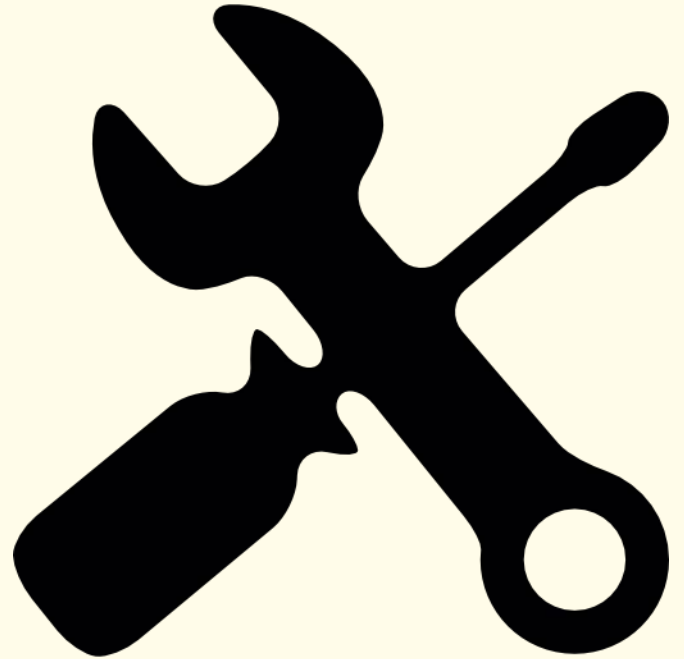


**Medical Practitioners
and Healthcare
Providers**



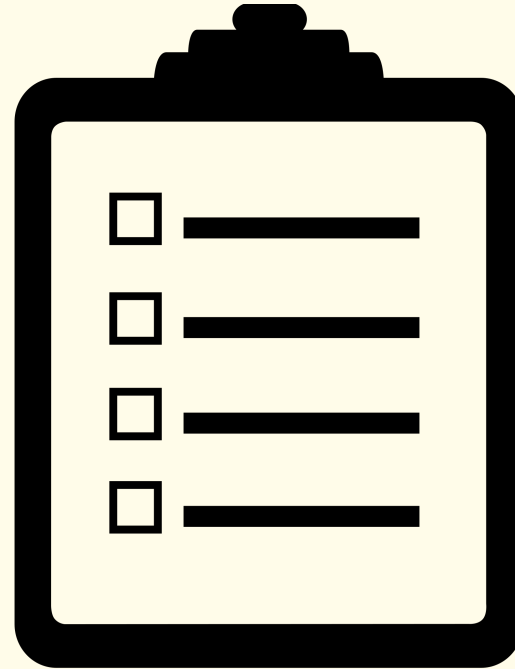
Functional Requirements

- Detects pressure
- Communicates with a mobile app
- Identifies imbalances
- Alerts user of pressure sore risk

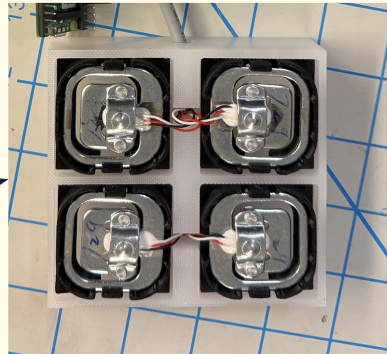
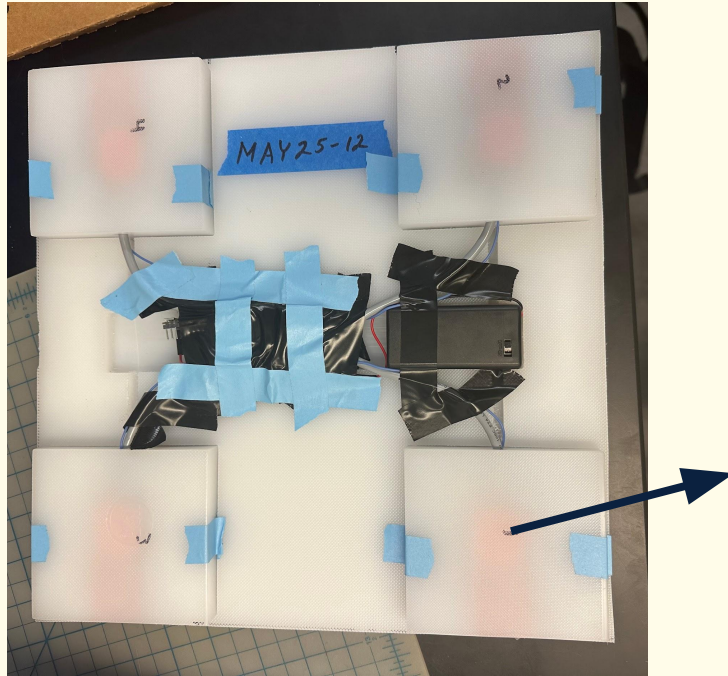


Non-Functional Requirements

- Comfortable to sit on
- Easy to use
- Multipurpose



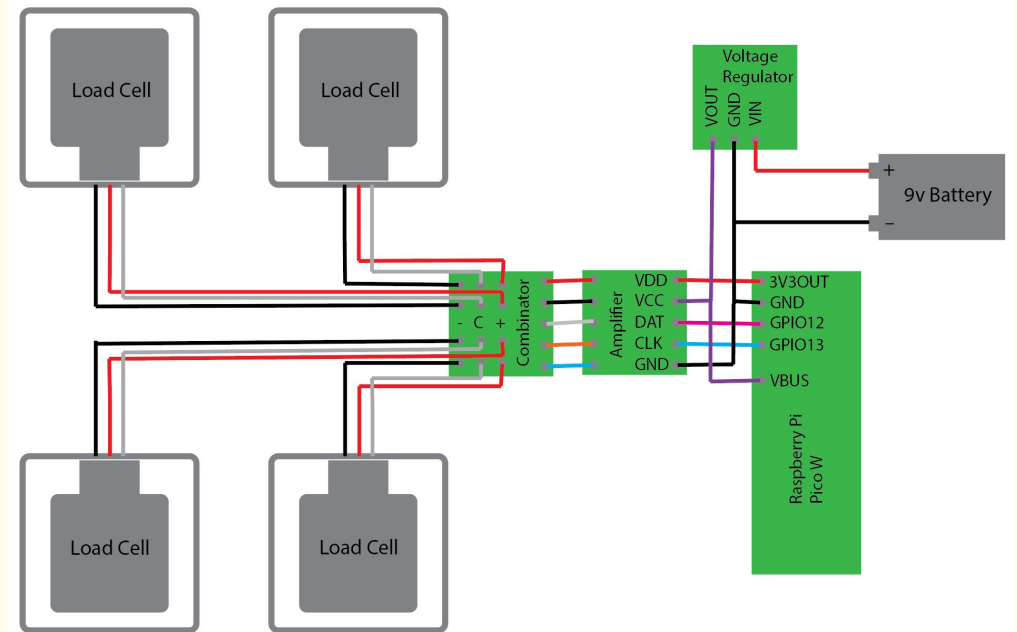
Final Prototype - Hardware



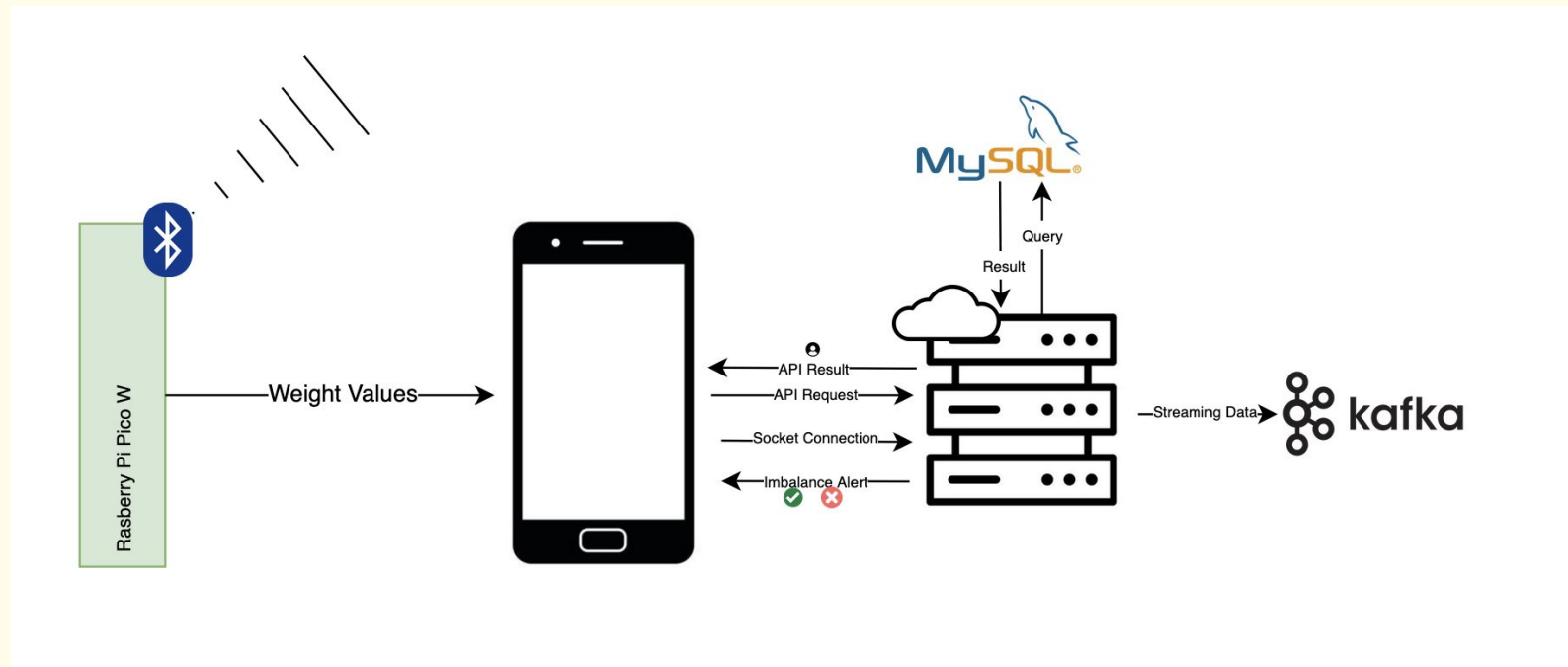
- Polyethylene and PLA construction
- Central computation and power
- Outer sensor tiles

Design - Hardware

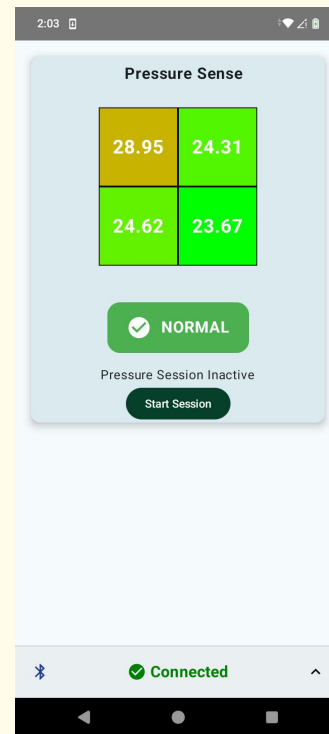
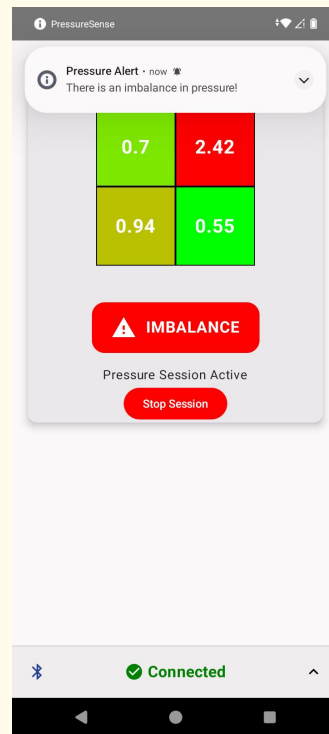
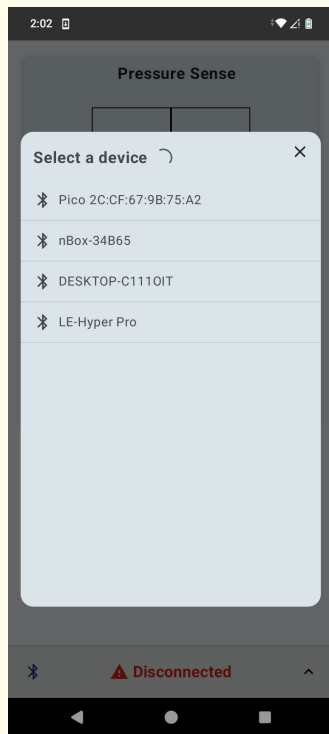
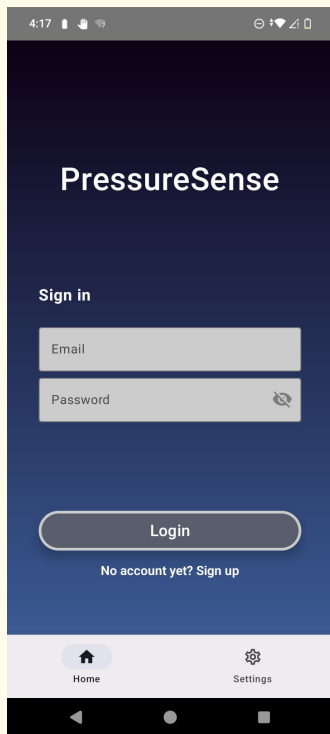
- Load Cells
- Combinator
- Amplifier
- Microcontroller
- Battery
- Voltage Regulator



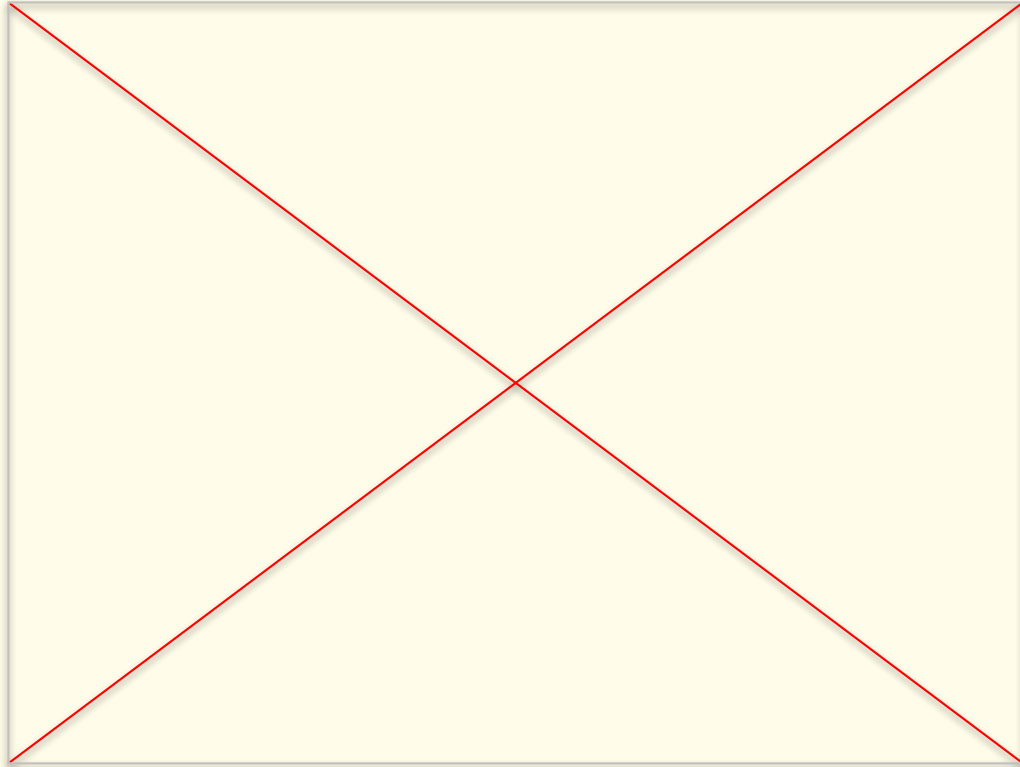
Communication System



Android Application

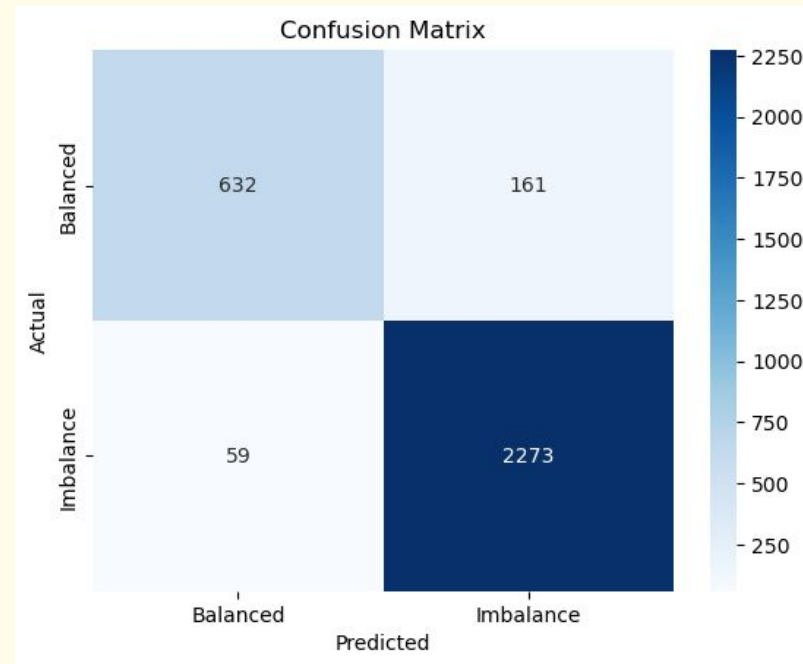


Application Video Demo



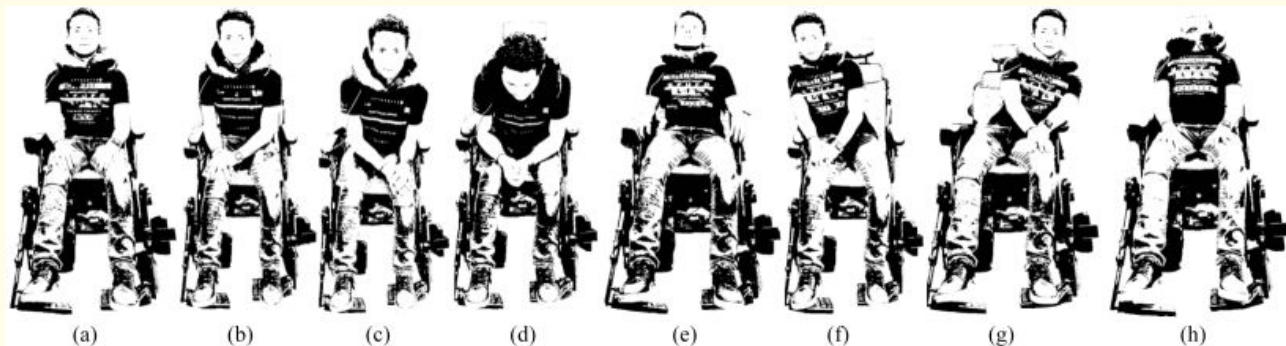
Logistic Regression Model

- Predicts imbalance based on:
 - Static user features
 - Real-time pressure readings
- ~2 minute threshold



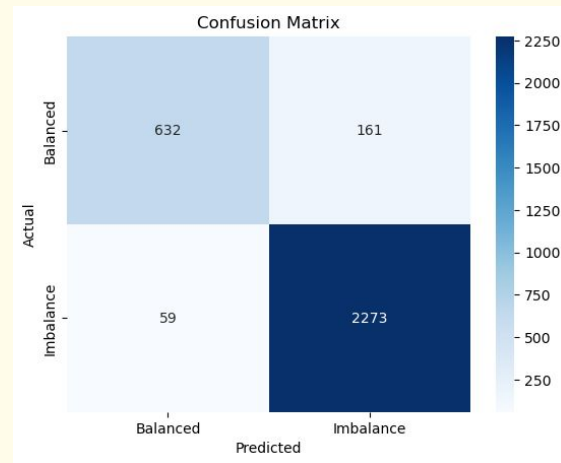
Testing/Collecting Data

- Identified 8 sitting positions
 - 7 imbalanced + 1 non-imbalanced
 - Collected data in each position with various users
- 12498 points of train data
- 3125 points of test data





Testing

- 93% accuracy on test data
- False positives > false negatives
 - Better for our application



	precision	recall	f1-score	support
0	0.91	0.8	0.85	793
1	0.93	0.97	0.95	2332
accuracy			0.93	3125

Challenges & Solutions

Aspect	Main Challenge 	Solution 
Hardware	Power Distribution Issues	Designed a separate, disconnected power circuit
Software	Sensor data rate limitations	Developed a custom software package

Project Success



#01

User-Centered
Design



#02

Effective Pressure
Visualization



#03

Addresses An
Unmet Need



#04

Ease of Use

Delivered the final
system to the
client, Adaptive
Adventure



#05

Real-World
Impact

Potential Future Work

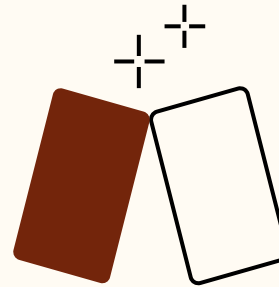
Prototype to
User-ready
Product

Easy & Cost
Effective to
Manufacture



**Product Design &
Manufacturability**

Transition from prototype
to production-ready
device.



**Software Application
Enhancements**

Improve user experience
and expand functionality.

Improve Visual
Aesthetics & User
Interface

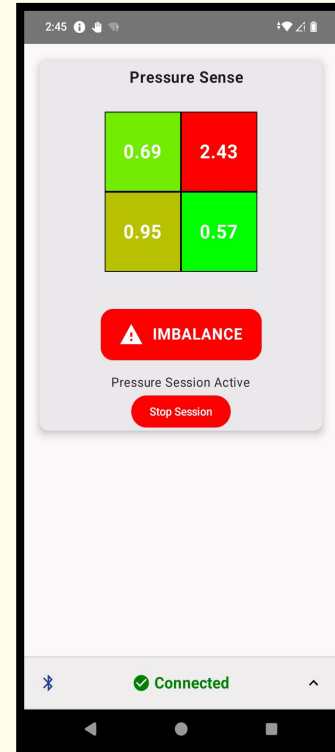
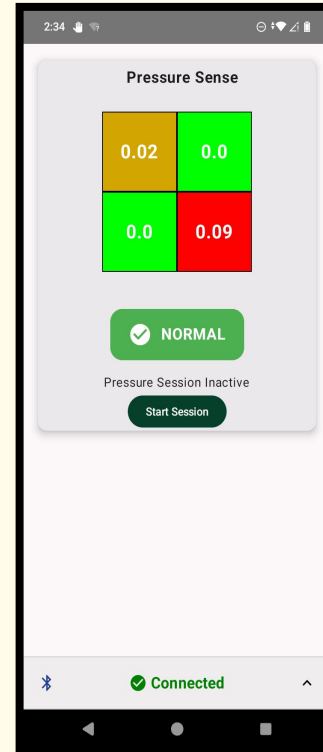
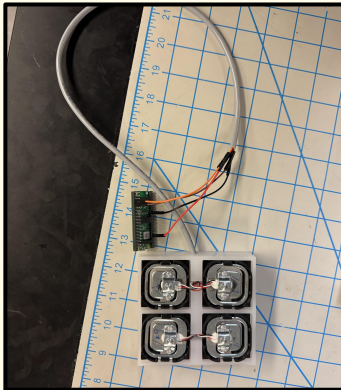
Add
Quality-of-Life
Features



- Offline Data Support
- Customizable Pressure Thresholds and Alerts

Conclusion

- Successfully created a **pressure sensing device** that communicates wirelessly with an Android application to display **real-time data**.



The image is a composite. The left side features a photograph of the Iowa State University dome and surrounding campus buildings, partially obscured by trees. The right side is a solid red background with a faint, large-scale image of the same campus scene. The text 'IOWA STATE UNIVERSITY' is overlaid on the left in a white serif font. The text 'Thank you' is centered on the right in a large white serif font. At the bottom right, contact information is provided in a smaller white serif font.

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Thank you

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Project Demonstration

