BME Design-Fall 2025 - NIKOLAI HESS
Complete Notebook

PDF Version generated by

Norah Greer

on

Dec 10, 2025 @11:13 PM CST

Table of Contents

Team contact Information

Cassity DeChenne - Dec 07, 2025, 12:10 PM CST

Last Name	First Name	Role	E-mail	Phone	Office Room/Building
Dean	David	Advisor	ddean8@wisc.edu		
Kutschera	Daniel	Client	dankutschera@gmail.com		
Hess	Nikolai	Leader	nphess@wisc.edu	6123800755	
Dechenne	Cassity	Communicator	dechenne@wisc.edu	2628880974	
Thao	Jetzu	BSAC	jthao27@wisc.edu	6512424608	
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Project description

Cassity DeChenne - Dec 07, 2025, 12:28 PM CST

Course Number: BME Design 200 & 300

Project Name: Weight Bearing Sensor

Short Name: Weight Bearing Sensor

Project description/problem statement: Develop a sensor to assist a physical therapist in measuring and showing a patient what partial weight bearings (20%, 50%, etc.) actually feel like. Design a device to assist a physical therapist in measuring the amount of weight put onto the leg(s) of an individual they are working with. The sensor should be small and thin enough to maintain comfort and functionality whilst fitting within a patient's shoe, and the supporting strap and exterior parts should be adjustable in order to fit all patients regardless of foot size or swelling.

About the client: Daniel Kutschera is a physical therapist working for ThedaCare. He has worked with other design projects through UW Madison and is interested in continuing his involvement with the program. His main interest with the program is helping to develop devices and tools that can aid in patient rehabilitation.

9/16/25 - Client Meeting

Jetzu Thao - Sep 18, 2025, 5:11 PM CDT

Title: First Client Meeting

Date: 9/15/25

Content by: Jetzu

Present: Jetzu, Niko, Keira, Cassity

Goals: Discuss project specifications and other details with client (Daniel Kutschera)

Content:

- Client wants device to be easily accessible and to work similar to a beeper boot
- Wants screen so it can easily be read how much weight patient is putting onto foot
- Wireless is desired, may be out of scope for this semester, potential future addition.
- Soft material to avoid irritation of skin
- Able to change sizes easily, one size fits all
- 500 dollar budget (can be increased if need be)

Conclusions/action items:

Work on PDS, contact Dan if we have quesitions

10/6/25 - Client Meeting 2

Jetzu Thao - Oct 06, 2025, 5:18 PM CDT

Title: Client Meeting 2

Date: 10/6/25

Content by: Jetzu

Present:

Goals:

Content:

- **Design Question:** Likes or dislikes?
  - Strap design preferred
  - 100kg load cell is fine
  - Weight display in pounds
  - Sanitization - easily wipeable by a mild sanitizer
  - Dan Kutschera, PT
  - Would prefer Venmo for payment
  - Send Dan schedule for presentations
  -

Conclusions/action items:

Get orders in by Friday-ish, start fabricating next week, try to get circuits done by today.

Advisor Meeting - 9/12/25

Jetzu Thao - Sep 12, 2025, 12:57 PM CDT

Title: Advisor Meeting

Date: 9/12/25

Content by: Jetzu

Present: Jetzu, Niko, Norah, Keira, Cassity

Goals: Discuss project with advisor, overview progress, ideas, meeting with client

Content:

- Discussed group members, member's tracks, future plans,
- **FIND EACH PERSON'S PLACE IN PROJECT!**
  - **What can you contribute to the project?**
- Discuss progress:
  - Productive documentation
  - Creative documentation
- Meet with client before getting started
  - Find what they're looking for
  - Accessibility, Current device improvement
- Design specificity
  - Look into what you're interested in
  - Find what each person to contribute
- Future meetings - designated room
- What to ask client in meeting?
  - Go in open minded
  - Come with questions
  - Use time wisely
  - Don't tell them how they can help you, ask how you can help them
- Lab Notebook
  - Contact info
  - Document what happens
  - Data, Reports,
  - Have things in two places
  - Thoughts / Ideas
  - Open ended, be thorough and detailed with what we're doing
  -

Conclusions/action items:

Advisor Meeting 2 - 9/19/25

Jetzu Thao - Sep 19, 2025, 1:04 PM CDT

Title: Advisor Meeting

Date: 9/19/25

Content by: Jetzu

Present: Niko, Keira, Norah. Jetzu

Goals: Discuss w/ Advisor

- Progress
  - PDS
- Goals
  - Design Matrix - Due Friday
    - Categories of Importance
    - Rubric for Design matrices
- Lab Archives
  - Grading
  - Expectations

Content:

- Progress
  - PDS complete
  - Budget - 500 dollars
  - Design specifications
- Meet with Advisor in office:
  - Conference room (2139)
  - In ECB - Engineering Centers Building
  - Dr. Dean will reach out for location
- Group Meeting times:
  - Tuesdays?
- Design Matrix - Due Friday
  - Work on it today, meet Tuesday, finalize design matrix on Friday before due.
  - Rough draft - Hand drawn designs, CAD needed for later reports
  - Need to go over categories
  - Matrix for Sensor pad
    - Possible use for sensor (arduino compatible - HX711 weight sensor)
  - Matrix for circuit
    - Battery Powered - Future design wireless?
  - Design Matrix Expectations:
    - Nobody is feeling unsure about what they're doing
    - Scores will be feedback for you --> highlighting involvement in project
- Reports
  - Preliminary report
    - requires data
    - shared folder for data --> get data into shared area ASAP
- **Ask Client about patient confidentiality / HIPPA (IMPORTANT)**
  - Clinical trials?
  - Client should feel safe that information is confidential
  - Client should be sure they're okay with what will be shared
  - How to handle data provided from patients? **Question that needs to be considered**
  - HIPPA training should be required and looked at
- Data collection / testing

- Gym weights for testing?
- Human data / testing
- Volunteers

Conclusions/action items:

Finish deliverables and get design matrices done.

Advisor Meeting 3 - 9/26/25

Norah Greer - Dec 07, 2025, 11:54 AM CST

Title: Advisor Meeting

Date: 9/26/25

Content by: Jetzu

Present: Niko, Norah, Cassity, Keira

Goals: Overview designs

Content:

- Meeting with Prof. Dean, overviewing designs and discussing questions we may have.
- Questions for client in future
- Issues with current design ideas

Conclusions/action items:

Go over roles for preliminary report and presentation.

Advisor Meeting 5 - 10/24/25

Norah Greer - Dec 07, 2025, 11:55 AM CST

Title: Advisor Meeting 5

Date: 10/24/25

Content by: Jetzu

Present: Niko, Norah, Cassity, Keira

Goals: Discuss plans / show progress

Content:

- **Progress**
  - Basic circuit, materials; strap, sensor, amplifier, LCD screen.
- Purchases from client
  - reimbursement
- Show and tell presentation
  - Show what we have so far
  - Flow of work
  - Flowchart for code
  - Assigned groups A or B?
    - Questioners and Presenters
    - One group at a time
    - 1 minute elevator pitch
    - Find out what client is looking for
  - Testing
    - Precision vs Accuracy
    - Testing standards
    - Technical specifications

Conclusions/action items:

Advisor Meeting - 11/7/25

Norah Greer - Dec 07, 2025, 11:55 AM CST

Title: Advisor Meeting

Date: 11/7/25

Content by: Jetzu

Present: Niko, Norah, Keira, Cassity.

Goals:

Content:

- Progress report makes sense
- Working in same directions but parallel
    - Need to put together materials for testing
- Meet with client ASAP to discuss the current
    - Discuss continuation of project- see if client wants to keep
- Testing protocol and ideas
- Final Report
    - Documentation for what we have
    - Include future planning and future work
- Breaking project down into milestones.

Conclusions/action items:

Advisor Meeting - 11/14/25

Norah Greer - Dec 07, 2025, 11:57 AM CST

Title: Advisor Meeting

Date: 11/14/25

Content by: Jetzu

Present:

Goals:

Content:

- Poster Session Prep
- Ask for anything we need right now (etc. power supplies, tables)
    - Request to Puccinelli
    - limited outlets, bring extension cord if need
- Power bank to power Arduino?
- Monitor size? - Display
- Printing Poster ($30)
    - Prices may vary
    - Cover the poster while transporting
        - Plastic sleeve, trash bag, paper cover, poster tube
- Font size: test sizes
- Less words is more, text can be bullets, include pictures
- References included
- Poster presentation after thanksgiving break
- Poster inclusions
    - Data: include design of test
        - Qualitative: should include reasoning
        - Quantitative: 5 minimum observations if we include
- Look at rubric beforehand
- Practice elevator pitch and practice what we are going to say
- Invite client
    - Allow them to come at any time and go
    - Posters will not be able to be distributed
- Peer evaluation
    - Form in canvas (Feedback Fruits)
- Notebook finalization
    - Lab notebook: don't go back
    - Summary: include what we did on project and what we impacted
    - Using notebook to record what happened
- Weekly Report
    - Testing coordination,
    - Difficulties with delivery
        - Contact Dr. Puccinelli
            - He has a stack of items
    - What time is left? Decide what are we going to leave with the client.
        - Leave the project or continue? Up to client to decide what he wants
        - Should give client more before knowing about continuation of project
        - Give client a timeline for the device's progress and possible ways to get to that point
    - Commenting on code
        - Pseudocode may be helpful for continuing project
- IP?
    - Not sure. Most likely not

    - Discoveries
    - Commercialization
        - Need to look more into it
    - Innovation
        - Bluetooth screen, adjustability, compatibility
    - Novelty
    - Patent
        - Should require everything, including user of product.

Conclusions/action items:

-

Advisor Meeting - 11/21/2025

Norah Greer - Dec 07, 2025, 11:57 AM CST

Title: Advisor Meeting

Date: 11/21/25

Content by: Jetzu

Present: Niko, Keira, Norah, Cassity

Goals:

Content:

- Testing protocols?
  - Testing try to complete by next week
  - Testing durability
  - Control groups?
    - Zero value, baseline, calibration
    - Difference between dumbbells and anatomy
    - Test ourselves instead of needing outside ppl for testing
- Presentation
  - Show work that we've done
  - Show any testing
  - Show if testing / design was validated
  - What was left / created / what is needed for future work
  - Less words = better
  - What was gotten out of the project
  - Setup early - try to come an hour before
  -
  -

Conclusions/action items:

Strap Designs

Norah Greer - Dec 07, 2025, 12:16 PM CST

Title: Initial Designs

Date: 9/23/2025

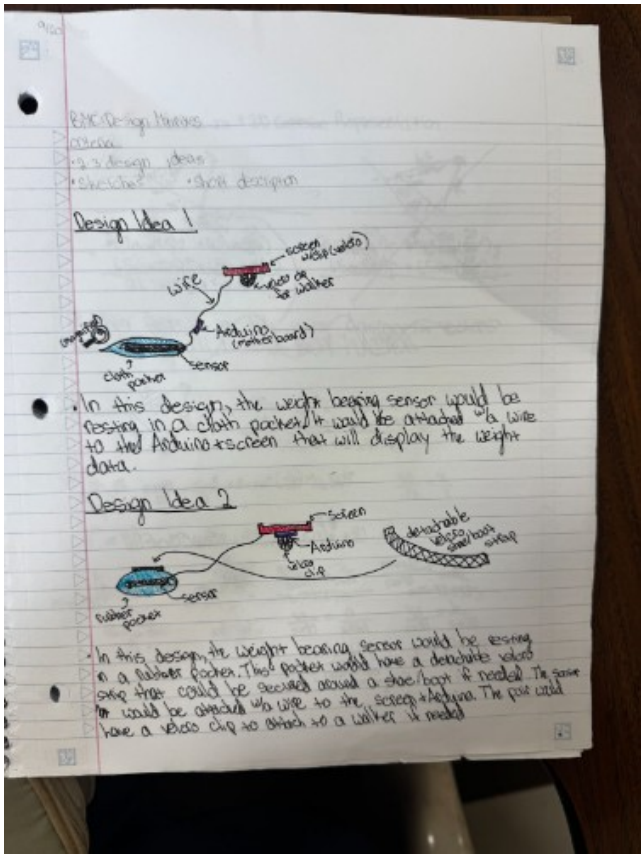
Content by: Norah

Present: Norah, Niko, Jetzu, Cassity, Keira

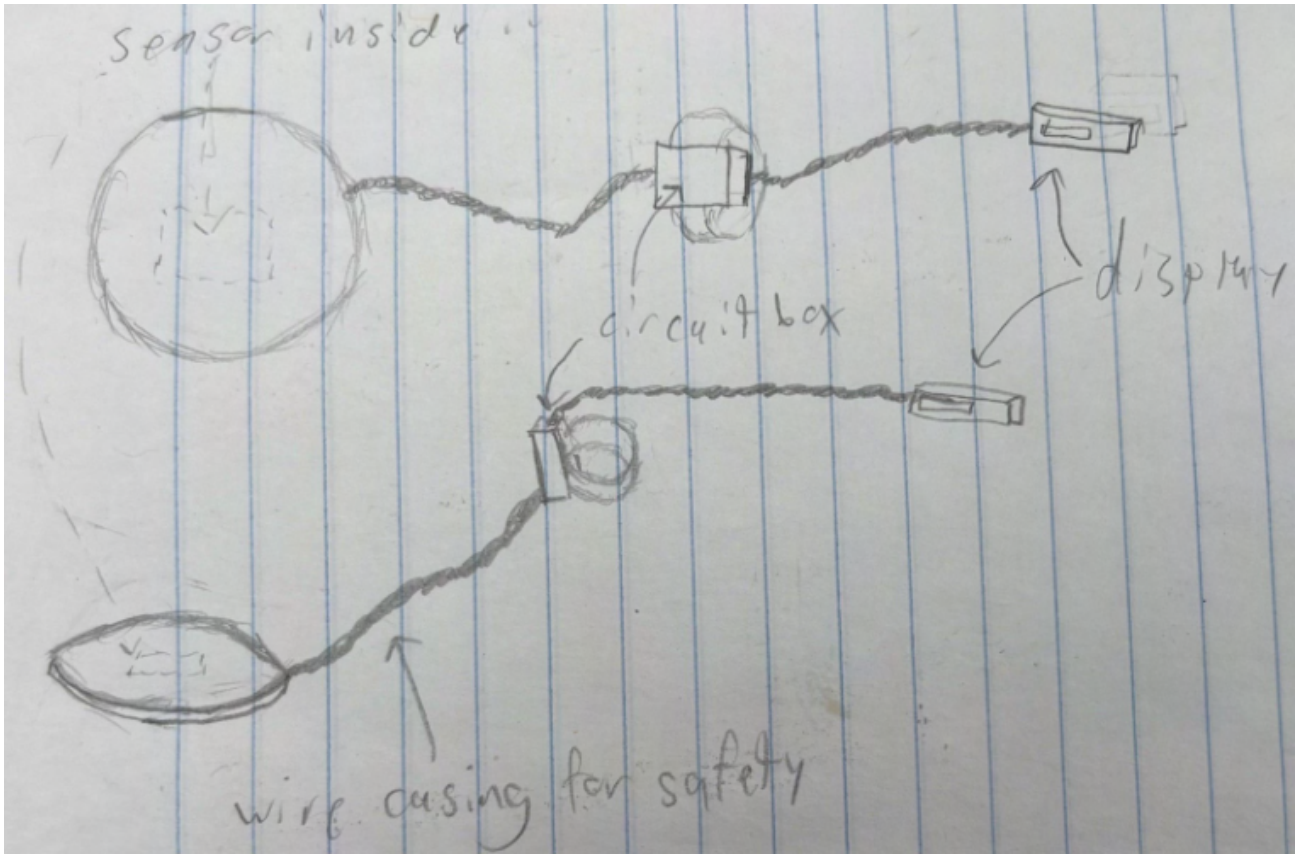
Goals: Share Preliminary Design Ideas

Content:

Strap Designs:

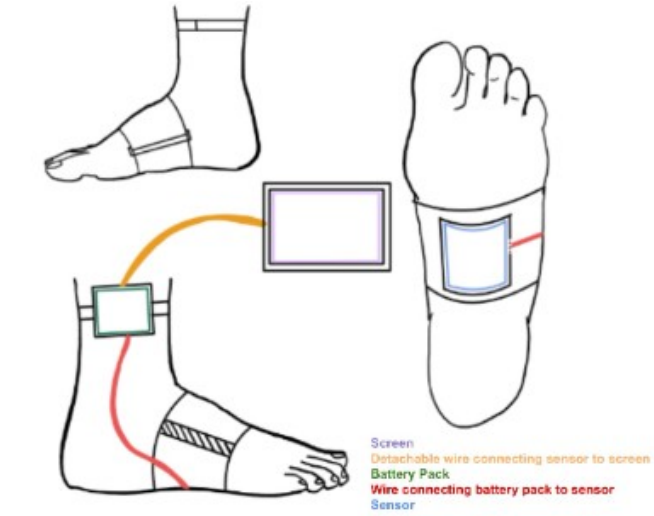


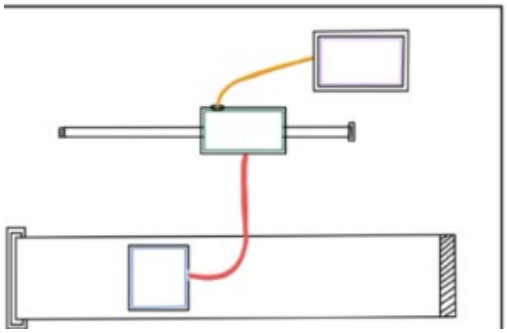
Firm Mini Pad:



The design uses a small, thin, circular pad with a sensor embedded inside. The pad would be quite small and fit in the sole of a shoe, as well as under the pad or ball of a foot. The top of the pad is made of a very soft, cushioned material, and the bottom attached to the pad is made of a slightly firm, but flexible material to provide better support and hopefully more consistent results. This bottom would have a velcro section on the back and include both a flat pad that could attach to avoid damaging shoes, as well as a strap that could attach to the velcro and hold the design to the foot of a patient. The wires feed out from one end of the pad, and connect to an anklet with the circuitry attached. The wiring to the display would feed out of the other side of the anklet. All wiring would be encased in a flexible, knitted fiber sleeve to protect both the wiring and the patient.

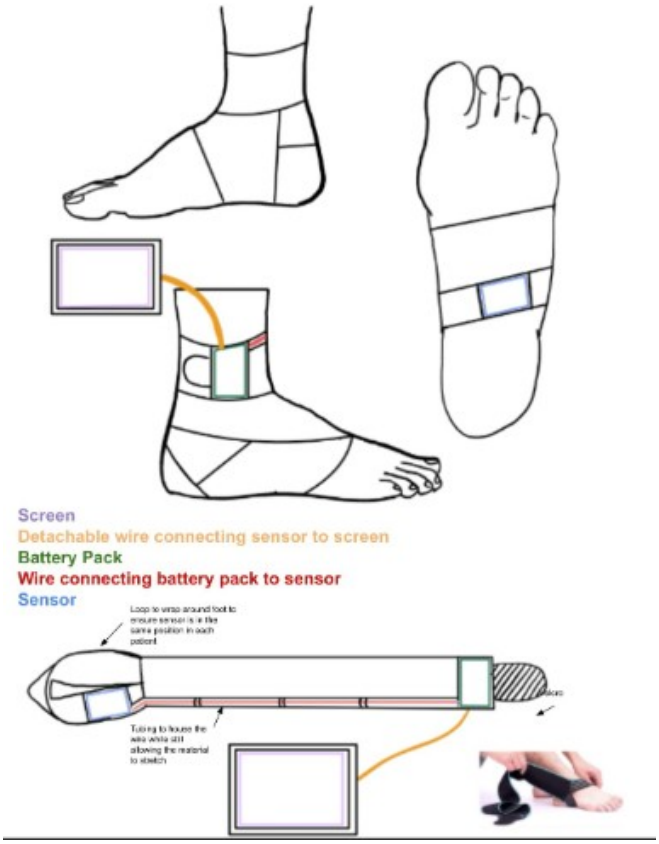
Simple Velcro Strap:





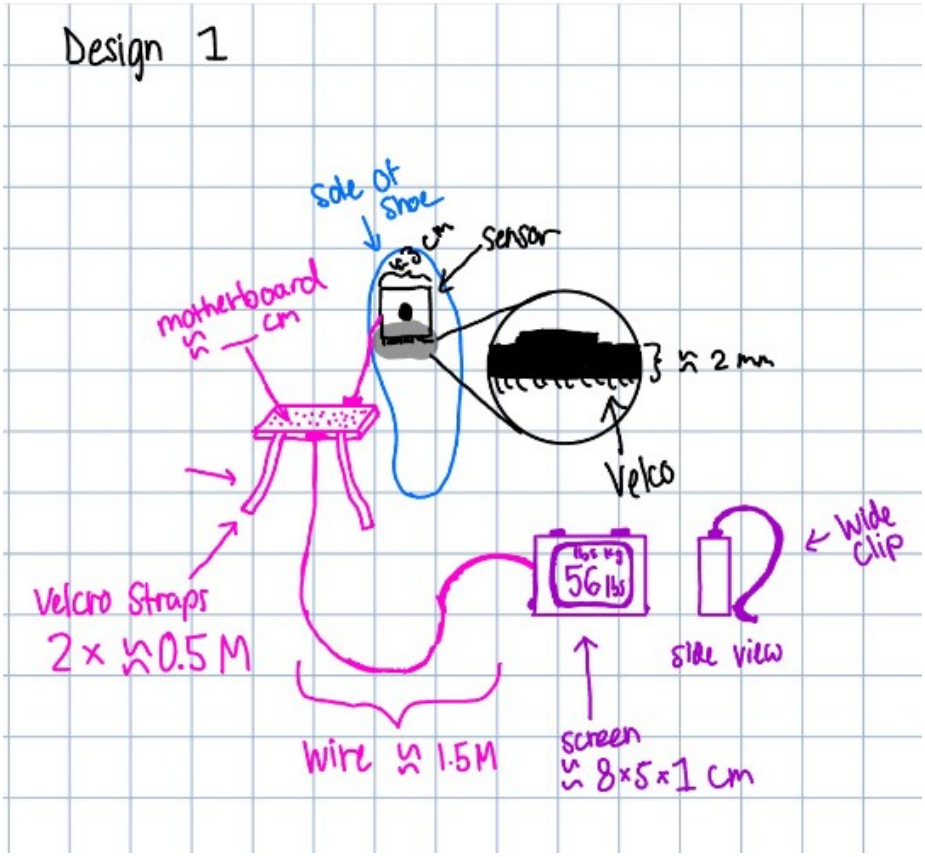
This design uses an adjustable Velcro strap similar in design and material to that on a blood pressure cuff. The sensor is embedded in the cuff with an opening to allow the wire to connect to the battery pack. The battery pack will also be located on an adjustable Velcro strap. The screen will be attached via a disconnectable wire to prevent tangling and increase the ease of use.

Ankle Wrap-Around:



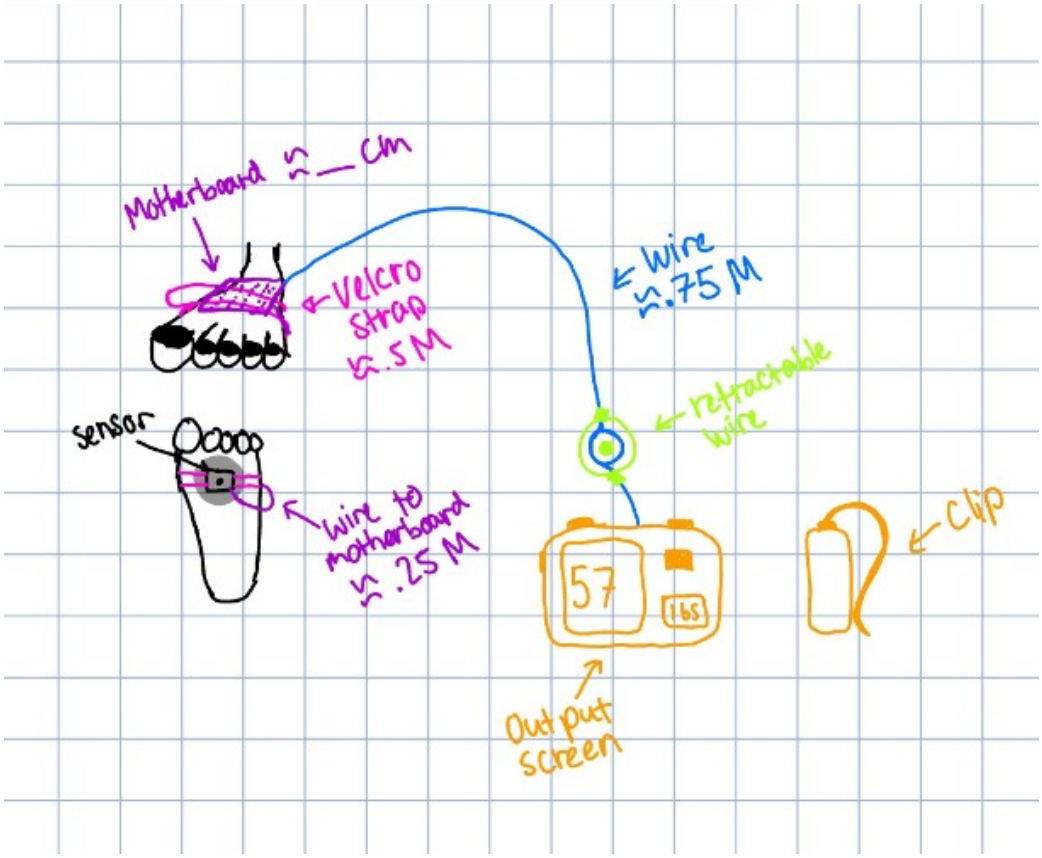
This device uses an ankle-brace like strip of elastic that can be adjusted to fit any patient. The loop at the end ensures that the sensor will sit in the same spot on each person's foot. The wiring will be fed through a tube of fabric to allow it to stay contained while the strap stretches. The battery pack will be attached to the Velcro end of the strap

Velcro Sensor:



This device adds a Velcro patch to the bottom of the sensor. The Velcro will be able to stick to any part of the sole of the shoe so that the weight bearing can be read from different parts of the food. In addition, I added a sort of ankle band that will hold the motherboard and wiring close to the sensor. I used long Velcro straps for this to be adjustable to accommodate different ankle sizing and swelling. A wire will then run from the ankle band up to the screen where the weight is displayed. This screen will have a wide clip on the back so that it can easily be clipped onto a walker for the patient.

Simple Velcro Strap:



This device incorporates the sensor being placed at the bottom of a foot and for it to be strapped around the foot itself. The straps will be velcro to accommodate the different sized and shaped feet. This device also has the motherboard strapped to the top of the foot so that it can stay near the sensor and still out of the way of the patient's gait. A wire will then be run from the motherboard to the display screen, however the wire will be retractable so that no excess wire will be in the way of the physical therapist of the patient. This display screen will also have a clip on it so that it can be easily read by the patient and the PT while it is attached to the walker.

Conclusions/action items:

Circuit Designs

Norah Greer - Dec 07, 2025, 12:18 PM CST

Title: Circuit Designs

Date: 9/23/2025

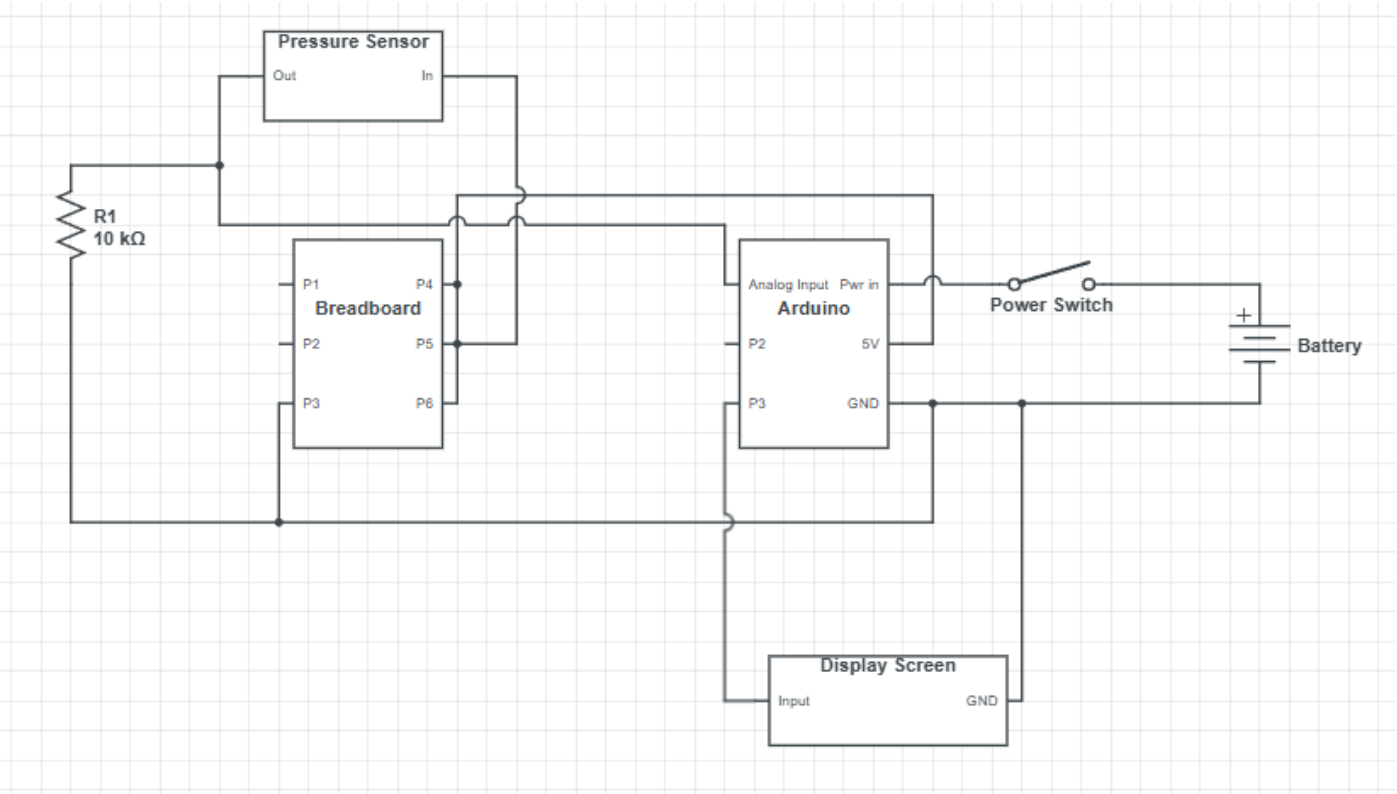
Content by: Norah

Present: Norah, Niko, Jetzu, Cassity, Keira

Goals: Discuss Possible Circuit Designs

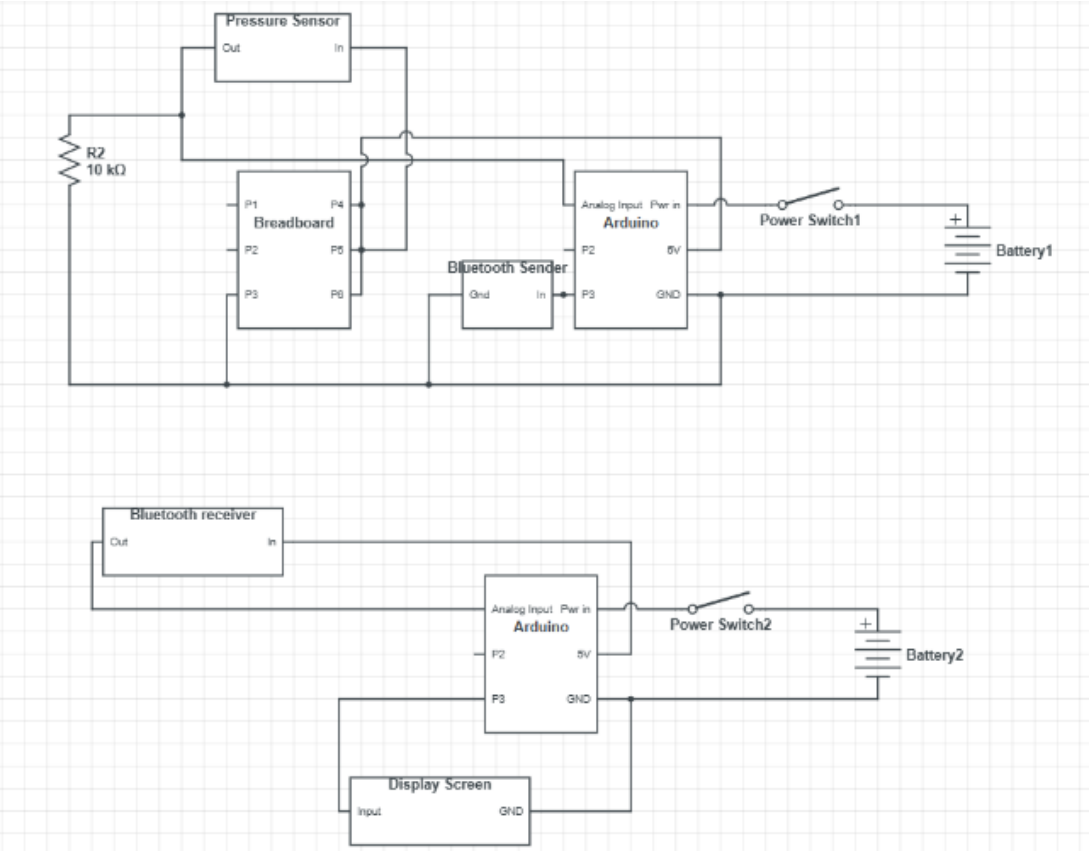
Content:

Basic Circuit:



This circuit design involves as little extra material and pieces as possible, involving a battery to power the arduino, and the arduino powering the pressure sensor with only the breadboard as an intermediate. The feedback from the pressure sensor is split with a resistor in order to keep the results stable and level. The display is wired directly from the arduino to ground.

Basic Circuit with Bluetooth:



This circuit remains almost as basic as possible, with the Arduino powered by the battery, and the sensor powered by the Arduino through the breadboard. The feedback is split by a resistor to ground for signal stability, and then fed to the arduino, which sends the signal for the display to a bluetooth device. The second half of the circuit includes an identical battery and arduino setup with a breadboard, connected to a bluetooth receiver to receive signal from the other Arduino. The second Arduino processes the input and projects it to the display, which then wires directly to ground

Conclusions/action items:

Running Expenses

Title: Expenses

Date: 12/7/2025

Content by: Norah

Present:

Goals: Keep track of expenses

Content:

Name of Material	Number/Amount	Cost per unit	Total Cost	Link
Velcro Strap for Arduino	1 (2" x 16')	$10.99	$10.99	https://www.amazon.com/Fastening-Buckles-Reusable-Storage-Organization/dp/B0DDPVJMYN/ref=sr_1_5_sspa?crid=39B57UXZ2WOWX&dib=eyJ2IjoiMSJ9.zwD8EBmxedRdJZUxe33qYGnJhJK4TwI0lkGgbnki9ypEVomHSlmxHu_dMP3a1tgwn_IQ9l0H2fYFP7I2Z88ZG3qf5sk6T6nZpq9rI1SPMEUKcpmeCLJMNFLxAUcHBApGHVRXF_oJoIE7dY-4fot5orJQ4RAS7g.kDF0AXDGk4o00kBDgDqDuFgKB3PM_Ta6TE&dib_tag=se&keywords=wide%2Bvelcro%2Bstrap%2B2%27%27%2B4%27&qid=1760118792&sprefix=wide%2Bvelcro%2Bs
Ankle Strap	1	$7.59	$7.59	https://www.amazon.com/gp/product/B06XBN24L2/ref=ewc_pr_img_1?smid=A19K0OZLY7K6B4&th=1
Uxcell 100kg 42mm x 38mm x 3mm Electronic Scale Body Load Cell Weighing Sensor	1 (42mm x 38mm x 3mm/1.7" x 1.5" x 0.12)	$8.12	$13.11	https://www.harfington.com/products/p-1195929?currency=USD&variant=44083328450809&utm_source=google&utm_medium=cpc&utm_campaign=Google%20Shopping&stkn=f8e3527768pmax-hw&utm_content=ywh&gad_source=1&gad_campaignid=23062083306&gbraid=0AAAAAoTFl2TfCjzEBpUEw7XHG6ebe3o4a&gclid=Cj0KCQ
Uxcell HX711 Module Weighing Sensor Pressure Sensor AD Module	1 (34 x 21 x 3mm)	$6.39	$11.38	https://www.harfington.com/products/p-1195929?currency=USD&variant=44083328450809&utm_source=google&utm_medium=cpc&utm_campaign=Google%20Shopping&stkn=f8e3527768pmax-hw&utm_content=ywh&gad_source=1&gad_campaignid=23062083306&gbraid=0AAAAAoTFl2TfCjzEBpUEw7XHG6ebe3o4a&gclid=Cj0KCQ
LCD display	1	$6.00	$6.00	Makerspace
pin headers (for amplifier and display)	6	$0.02	$0.12	Makerspace
2.8" ESP32-2432S028R ESP32 Display Resistive Touchscreen 240x320 TFT LCD Module ESP 32 Development Board + Acrylic Case for Arduino IDE	1	$20.98	$20.98	https://www.amazon.com/DIYmalls-ESP32-2432S028R-ESP32-Display-ESP-WROOM-32/dp/B0D8W9DSYZ/ref=sr_1_4?dib=eyJ2IjoiMSJ9.bLpt62lFqs7i5Zhv9jdCoCvX_zakTomjkLwZRSh1OyFiiZCTPlXbNrTp_3RbTDJVdaXny4xW9ZoKId3QAnSEU0fvS5aiTCXXKkVS7EYgcu0zTVXlSKFMnbYgrIi60.dMP8TSwkV6FvY9dtg0RaLsfFonorWUF_-XIWLfjhv1I&dib_tag=se&hvadid=557504008742&hvdev=c&hvexpln=0&hvlocphy=&hvqmt=b&hvrand=11135052734822653469&hvtargid=kwd-2428177694779&hydadcr=24388_13517673&keywords=esp32+cheap+yellow+c
Small Breadboard	1	$2.00	$2.00	Makerspace
ESP32-S3-WROOM-1	1	$15.00	$15.00	
Foam for load cell	3ft	$1.00	$3.00	Makerspace

Acrylic Material	1 sheet	$10	$10.00	Makerspace

Conclusions/action items:

Final Expenses

Title: Expenses

Date: 12/10/2025

Content by: Keira

Present:

Goals: Keep track of expenses

Content:

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total
Electrical Components									
Pressure Sensor	Uxcell 100kg 42mm x 38mm x 3mm Electronic Scale Body Load Cell Weighing Sensor	Uxcell	a15110200ux0235	Harfington	1094775	10/12/2025	1	$8.12	$13.11
Amplifier for Pressure Sensor	Uxcell HX711 Module Weighing Sensor Pressure Sensor AD Module	Uxcell	a14052100ux1429	Harfington	1195929	10/12/2025	1	$6.39	$11.39
LCD Display	Small, flat panel, screen					10/13/2025	1	$6.00	$6.00

Small Breadboard	white, small, breadboard					11/17/2025	1	$2.00	$2.00
Bluetooth Microcontroller	ESP32-S3-DevKitC-1-N8R8 Development Board	Espressif	ESP32-S3-DevKitC-1-N8R8	Amazon	ESP32-S3-DevKitC-1-N8R8	11/16/2025	1	$15.00	$15.98
Cheap Yellow Display	2.8'' ESP32-2432S028R	DIYmalls	ESP32-2432S028R	Amazon	B0D8W9DSYZ	11/16/2025	1	$20.98	$21.98

	ESP32 Display Resistive Touchscreen 240x320 TFT LCD Module ESP 32 Development Board + Acrylic Case for Arduino IDE								
Others									
Velcro Strap for Brace	Black, nylon, 2in x 16ft	Matenf	N/A	Amazon	VS-002	10/13/2025	1	$10.99	$11.34

Ankle Strap	Black, nylon, one-size-fits-all brace	Candy Li	N/A	Amazon	B07DCKMJ9D	10/13/2025	1	$7.99	$8.25
Screws	Small, metal			Makerspace		11/17	6	$0.02 per	$0.12
Pin Headers (for amplifier and display)	Black plastic, metal			Makerspace		10/15	1	$6.00	$6.00
Foam for Load Cell	Thin, white, foam tape			Makerspace		11/21	3	$1 per ft	$3.00
Acrylic	Black, sheet, acrylic			Makerspace		11/19	1	$10.00	$10.00
Spandex Fabric	Black, 80% Nylon, 20% Spandex	RoadtoFree	N/A	Amazon	B09WCF2LJ4	11/16/25	1	$9.99	$10.54

Clips for Walker	White, 1 in, 12 pack	XJKJ	XJKJ-SGGDJ-25MM-12P	Amazon	N/A	11/29/25	1	$6.99	$7.37

								TOTAL:	**$127.08**

Load Cell Platform

Norah Greer - Dec 07, 2025, 12:43 PM CST

Title: Load Cell Platform

Date: 11/20/2025

Content by: Norah

Present:

Goals: Print Load Cell Platform

Content:

Convert OnShape file to DXF for printing

Laser-cut Platform on 3mm Acrylic

OnShape File: https://cad.onshape.com/documents/b29ffd9a85a65287577b65aa/w/6f1753eaaf1996d0bb8f1dbd/e/eb3ad57aed74967bc23104bd?renderMode=0&uiState=6935ca488171a2be948433eb

Conclusions/action items:

Load Cell Assembly

Norah Greer - Dec 07, 2025, 12:36 PM CST

Title: Load Cell Assembly

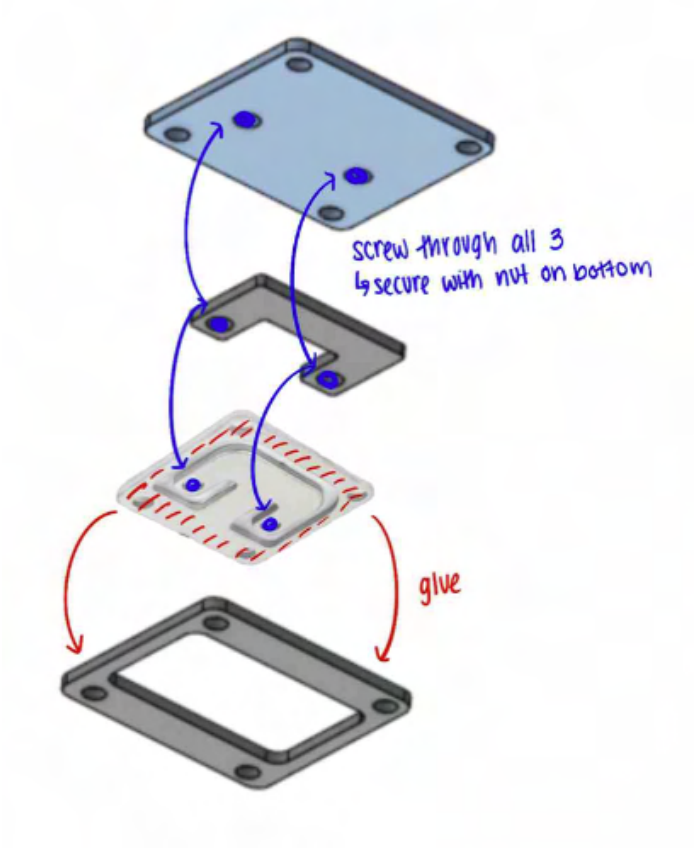
Date: 11/20/2025

Content by: Norah

Present: Norah, Niko, Jetzu, Cassity, Keira

Goals: Put together the load cell, platform, and foam

Content:



Once assembly is secured together, wrap entire thing in foam tape

Conclusions/action items:

Attaching Load Cell and Wires to Strap

Norah Greer - Dec 07, 2025, 1:07 PM CST

Title: Sewing Load Cell and Wires into Strap

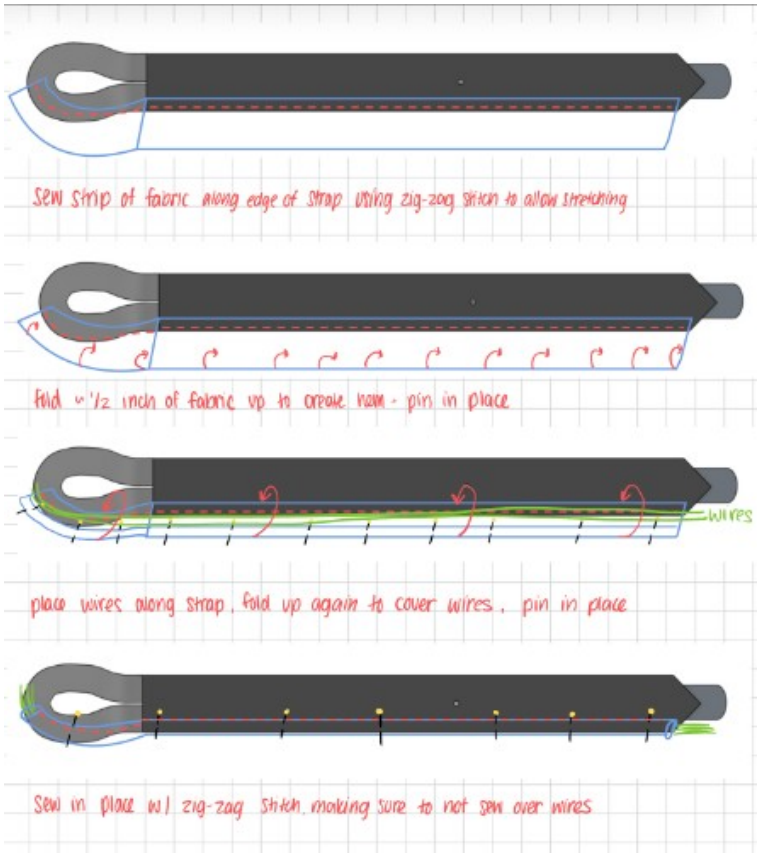
Date: 11/25/2025

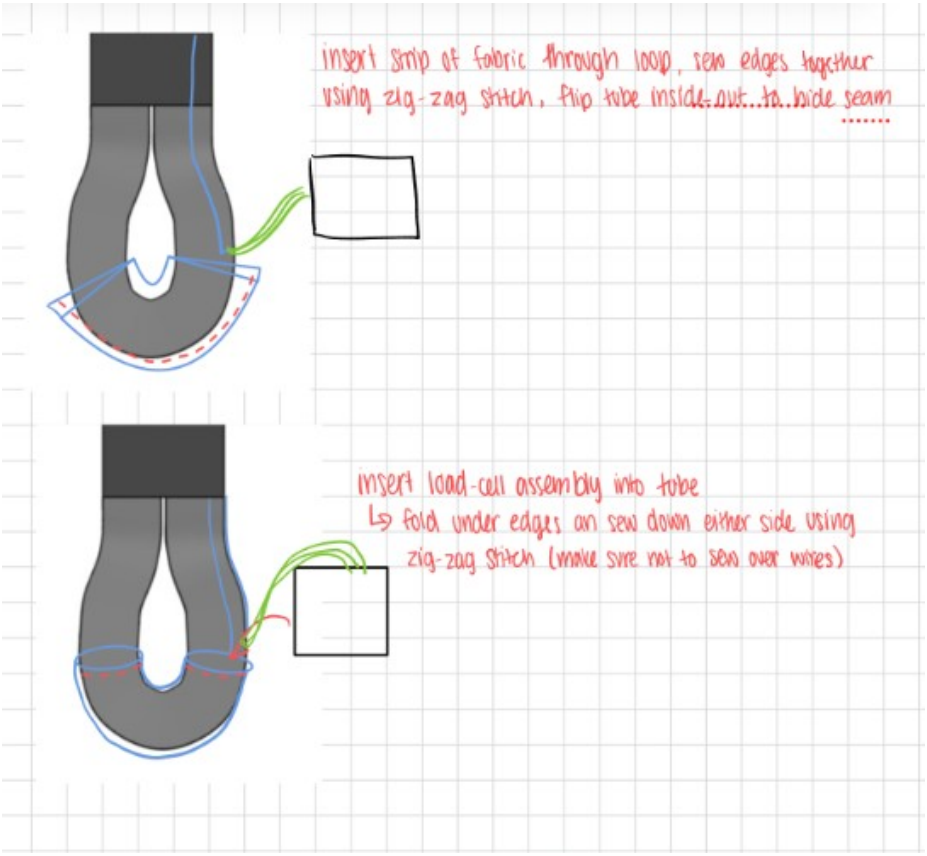
Content by: Norah

Present: Norah

Goals: Sew Wire and Load Cell into Strap

Content:





Conclusions/action items:

Sensor Testing Protocol

Norah Greer - Dec 07, 2025, 1:20 PM CST

Title: Sensor testing protocol

Date: 11/2/25

Content by: Cassity

Present:

Goals: Create Testing Protocol for Strap

Content:

Testing:

- Set sensor on platform on flat ground, attach to screen and circuit.
- Set a small, flat block on top of the sensor.
- Set a variety of different weights on the block and assess the sensor readout for difference from expected weight. Make sure to account for block weight.

Data analysis:

- Record each expected weight and actual weight readout in a spreadsheet.
- Add up the difference of each weight and divide by the number of tests to get the average weight deviancy.
- Calibrate sensor accordingly.

Conclusions/action items:

Strap Testing Protocol

Norah Greer - Dec 07, 2025, 1:21 PM CST

Title: Sensor Testing Protocol

Date: 11/2/25

Content by: Cassity

Present:

Goals: Create Testing Protocol for Strap Movement Over Time

Content:

Testing:

- Wrap strap around foot and mark with an erasable marker on the strap where the last wrap around the sole of the foot ends.
- Wear the strap around for some time, then mark on the strap where the last wrap around the sole of the foot ends now.
- Unwrap strap and measure the distance between the two marks.
- Repeat these steps with varying times of wear.

Data analysis:

- Record each mark distance in a spreadsheet that includes length of wear time.
- Add up the mark distances and divide by the number of tests to get the average strap movement.
- Make a plot of wear time and strap movement.

Conclusions/action items:

Sensor Testing Data

Norah Greer - Dec 07, 2025, 1:24 PM CST

Title: Sensor Testing Results

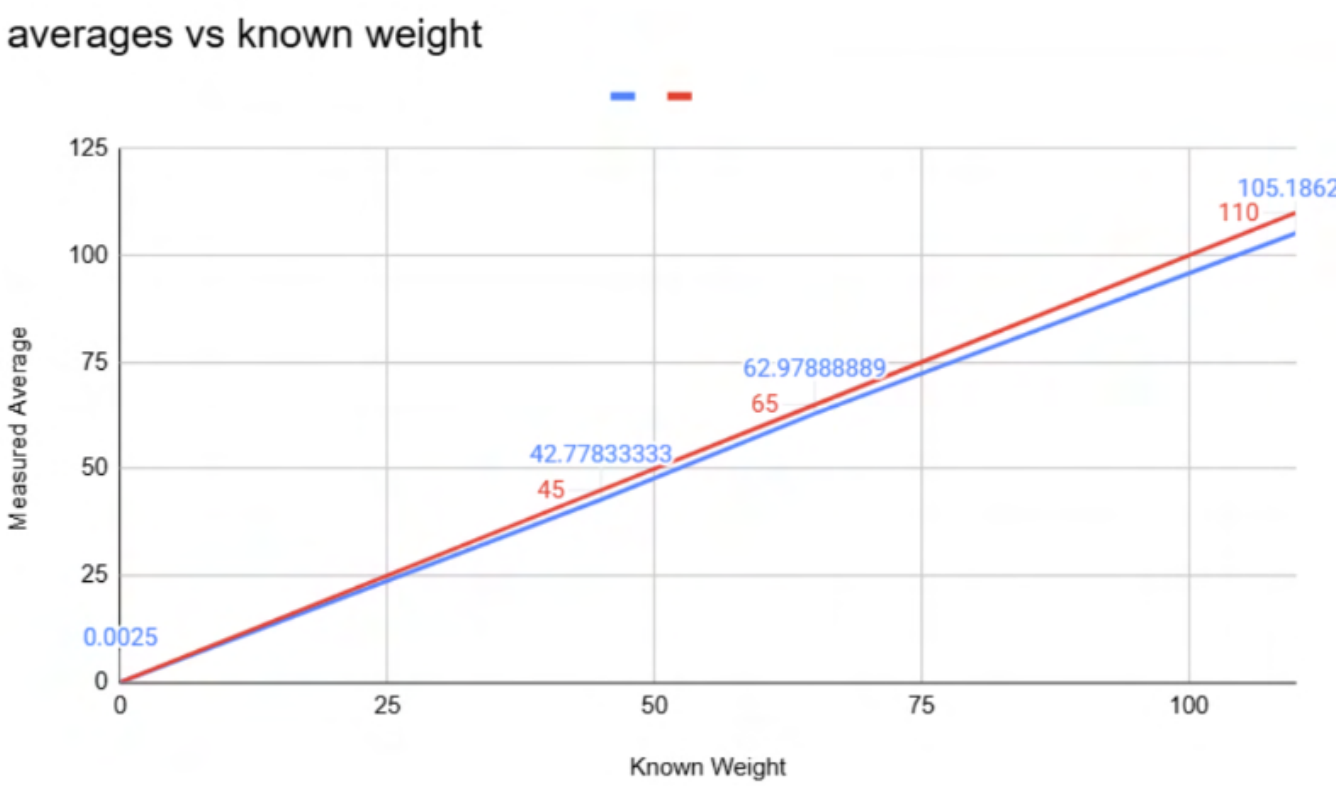
Date: 12/3/2025

Content by:

Present:

Goals: Test Accuracy of Sensor

Content:



Weight	0	45	65	110
Recording	0	43.05	64.1	105.52
	0	42.04	62.53	104.28
	0	43.5	61.84	103.39
	0.01	44	62.29	105.62
		42.45	63.65	104.93
		41.63	63.22	103.96
			62.84	105.94
			63.39	107.85
			62.95	
averages	0.0025	42.77833333	62.97888889	105.18625
Standard Deviati	0.005	0.9009642982	0.7006861716	1.3928587

Conclusions/action items:

Skin reactions to metal research

NIKOLAI HESS - Dec 10, 2025, 10:54 PM CST

Title: Metal-skin reaction research

Date: 12/10/2025

Content by: Niko

Content:

This article discusses contact dermatitis that can result from the exposure of skin to certain metals. The main metals of interest (aka the metals we should avoid in our device) were nickel, chromium, and cobalt. While these are not the most common of materials for the application, we should ensure that we are careful to avoid them in the selection of our final products for our device. While the consequences of an allergic reaction are somewhat high, they are quite easy to avoid with careful planning.

Citation:

[1] K. A. Pacheco and J. P. Thyssen, “Contact Dermatitis From Biomedical Devices, Implants, and Metals-Trouble From Within,” *J Allergy Clin Immunol Pract*, vol. 12, no. 9, pp. 2280–2295, Sept. 2024, doi: 10.1016/j.jaip.2024.07.016.

Conclusions/action items:

Think about the potential ways to avoid contact with the metal in the off chance that one of the products is fully necessary, or ways to recreate that product if so.

Insole patent

NIKOLAI HESS - Dec 10, 2025, 10:43 PM CST

Title: Insole patent

Date: 12/10/2025

Content by: Niko

Content:

The patent covers the exact specifications and dimensions of an example insole, which could be used to base an insole like design around. The insole has several distinct areas, from front to back, with differing thicknesses and widenesses.

Patent: https://patents.google.com/patent/US3161970A/en

Conclusions/action items:

Think about the potential applications of a load cell and insole combination, or some way a secondary insole insert could be created using our device.

Load cell patent

NIKOLAI HESS - Dec 10, 2025, 10:46 PM CST

Title: Load cell patent

Date: 12/10/2025

Content by: Niko

Content:

The patent covers the specifications and dimensions of an example load cell. The load cell can change resistance based on the applied force, just as ours does. This can be utilized to determine the weight live and can be used to make our product function.

Patent: https://patents.google.com/patent/US5391844A/en

T. H. Johnson and M. R. Wyatt, “Load cell,” US5391844A, Feb. 21, 1995 Accessed: Dec. 10, 2025. [Online]. Available: https://patents.google.com/patent/US5391844A/en

Conclusions/action items:

Think about the potential applications of a load cell and insole combination, or some way a secondary insole insert could be created using our device.

Medical Insole Code

NIKOLAI HESS - Sep 16, 2025, 12:54 AM CDT

Title: 21 CFR § 880.6280 - Medical insole.

Date: 9/16/25

Content by: Nikolai Hess

Content:

Code of federal regulation, Title 21, chapter 1, subchapter H, part 880, subpart g, 880.6280

(a) *Identification.* A medical insole is a device intended for medical purposes that is placed inside a shoe to relieve the symptoms of athlete's foot infection by absorbing moisture.

(b) *Classification.* Class I (general controls). The device is exempt from the premarket notification procedures in subpart E of part 807 of this chapter, subject to the limitations in § 880.9.

[45 FR 69682, Oct. 21, 1980, as amended at 54 FR 25050, June 12, 1989; 66 FR 38806, July 25, 2001]

Found at: https://www.law.cornell.edu/cfr/text/21/880.6280

This is an important section to note as this shows that our device will not be legally considered a medical insole, this means that it will not exempt from premarket notifications, and may fall under general medical devices.

Conclusions/action items:

Research more codes and regulations, see if there is some other subcategory our device would end up under, and what specific need that category would impart.

Force Measuring Platform Code

NIKOLAI HESS - Sep 16, 2025, 1:04 AM CDT

Title: 21 CFR § 890.1575 - Force-measuring platform.

Date: 9/16/25

Content by: Nikolai Hess

Content:

Code of federal regulation, Title 21, chapter 1, subchapter H, part 890, subpart B, 890.1575

(a) *Identification.* A force-measuring platform is a device intended for medical purposes that converts pressure applied upon a planar surface into analog mechanical or electrical signals. This device is used to determine ground reaction force, centers of percussion, centers of torque, and their variations in both magnitude and direction with time.

(b) *Classification.* Class I (general controls). The device is exempt from the premarket notification procedures in subpart E of part 807 of this chapter, subject to the limitations in § 890.9.

[48 FR 53047, Nov. 23, 1983, as amended at 61 FR 1125, Jan. 16, 1996; 66 FR 38816, July 25, 2001]

Found at: https://www.law.cornell.edu/cfr/text/21/890.1575

This is an important section to note as this will almost certainly be the section that our device falls under. It is important to note the premarket exemptions that will be allowed, as well as to note the precautions required for this classification.

Conclusions/action items:

Research more codes and regulations, look into exact exemptions etc that this will impart, and what we will still need to look into more and watch out for.

Coding background for load cell with arduino

NIKOLAI HESS - Dec 10, 2025, 10:56 PM CST

Title: Arduino to load cell code

Date: 12/10/2025

Content by: Niko

Content:

This article includes a lot of information about load cells, how to connect them to an arduino, and what to avoid. The site also includes some starter code which can be used for calibration. The code will be particularly helpful for testing, but likely will not be fully transferable to the secondary board.

Site:

[1] "Arduino with Load Cell and HX711 Amplifier (Digital Scale) | Random Nerd Tutorials." Accessed: Dec. 10, 2025. [Online]. Available: https://randomnerdtutorials.com/arduino-load-cell-hx711/

Conclusions/action items:

Think about the applications of the code and the advice that they give, continue using testing code and looking at ways to adapt to other motherboard.

Coding background for load cell with ESP32 board

NIKOLAI HESS - Dec 10, 2025, 11:02 PM CST

Title: ESP32 to load cell code

Date: 12/10/2025

Content by: Niko

Content:

This article includes a lot of information about load cells, how to connect them to an ESP32 board, and what to avoid. The site also includes some starter code which can be used for calibration. While the code could be qutie helpful for testing, some aspects of the code are not currently functioning. While most of the code runs without issue the small error makes it unusable. If this issue could be adressed the code could be incredibly helpful, as the code from the other article was.

Site: S. Santos, “ESP32 with Load Cell and HX711 Amplifier (Digital Scale) | Random Nerd Tutorials.” Accessed: Dec. 10, 2025. [Online]. Available: https://randomnerdtutorials.com/esp32-load-cell-hx711/

Conclusions/action items:

Think about the applications of the code and the advice that they give, continue trying to adapt the testing code and make it functional.

Coding background for bluetooth low energy

NIKOLAI HESS - Dec 10, 2025, 11:06 PM CST

Title: ESP32 board bluetooth basics

Date: 12/10/2025

Content by: Niko

Content:

This article goes over bluetooth functionality in ESP32 boards, and discusses both the roles of the receiver and the server when establishing connections. While the actual coding of the devices is only lightly touched on, this article provided a lot of very valuable information about the background to the bluetooth. This included that the specific board that we are using to wire the load cell only has low energy bluetooth capabilities, meaning the coding is slightly more complicated.

Site: “ESP32 Web Bluetooth (BLE): Getting Started Guide | Random Nerd Tutorials.” Accessed: Dec. 10, 2025. [Online]. Available: https://randomnerdtutorials.com/esp32-web-bluetooth/

Conclusions/action items:

Think about the background for the bluetooth functions we are implementing, and how we can use them to improve our device.

Coding background for establishing a bluetooth server and receiver using ESP32 boards

NIKOLAI HESS - Dec 10, 2025, 11:09 PM CST

Title: ESP32 bluetooth code

Date: 12/10/2025

Content by: Niko

Content:

This article includes direct information on coding the two ESP32 boards to send and receive bluetooth signal. The article also provides some amount of starter code to be used, though the code is slightly different from what we would require, as the code implements two variables to be read, and we only need one. While the code is helpful, many of the functions are included in packages that I have little knowledge of, so I am struggling to adjust the code to our purposes.

Site: “ESP32 Web Bluetooth (BLE): Getting Started Guide | Random Nerd Tutorials.” Accessed: Dec. 10, 2025. [Online]. Available: https://randomnerdtutorials.com/esp32-web-bluetooth/

Conclusions/action items:

Continue trying to adapt the code for the device to our purposes, look into the libraries and documentation for the utilized functions.

Coding background for using the cheap yellow display

NIKOLAI HESS - Dec 10, 2025, 11:12 PM CST

Title: Cheap yellow coding backgroun

Date: 12/10/2025

Content by: Niko

Content:

This article includes a lot of information about the cheap yellow board we are using, as well as providing example code utilizing both its writing and touch screen capabilities. While we are not plannig to use the touchscreen functionality at all, we will be using the writing functions they utilize. I have been able to repurpose the code and pull out only the bare minimum to use the writing functions included in it.

Site:

[1] “Arduino with Load Cell and HX711 Amplifier (Digital Scale) | Random Nerd Tutorials.” Accessed: Dec. 10, 2025. [Online]. Available: https://randomnerdtutorials.com/arduino-load-cell-hx711/

Conclusions/action items:

Think about the applications of the code and the advice that they give, continue using testing code and looking at ways to adapt to other motherboard.

Team Meeting 1 9/5

NIKOLAI HESS - Sep 05, 2025, 3:19 PM CDT

Title: Team Meeting 1

Date: 9/5

Content by: Nikolai Hess

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity Dechenne)

Goals: Assign roles and begin initial project work.

Content:

Our entire group met after project selection, and worked together to assign roles, discuss logistics, and organize ourselves for meeting with our client and advisor. We also discussed meeting schedules and when to meet with our advisor and client. We created a group chat and exchanged contact information, as well as starting on the first progress report.

Conclusions/action items:

Finish progress report one by next Thursday, Email our advisor and client, begin brainstorming and initial work on project. Once meeting times with advisor are set establish meeting time for our team.

Team Meeting 2 9/12

NIKOLAI HESS - Sep 12, 2025, 1:23 PM CDT

Title: Team Meeting 2

Date: 9/12

Content by: Nikolai Hess

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity Dechenne)

Goals: Assign roles for the PDS and initial project work.

Content:

Our entire group met after our first advisor meeting, and worked together to assign roles on the PDS, discuss logistics, and organize ourselves for our initial research.

Conclusions/action items:

Finish progress report one by next Thursday, Email our advisor and client, begin brainstorming and initial work on project. Once meeting times with advisor are set establish meeting time for our team.

Preliminary report 10/3

NIKOLAI HESS - Oct 03, 2025, 2:00 PM CDT

Title:

Date:

Content by:

Present:

Goals:

Content:

Team 1: diaper partition

Desigining a device to help separate stool and urine in a diaper in order to help caregivers track the volume of both stool and urine output, even in the case of diarhea. This will allow caregivers to more accurately track and monitor infants health. The device needs to be comfortable, safe, accurate, and keep the fluids both inside the diaper and separate from each other. Device they decided on was a diaper that had a separation in the middle and a perforated middle part for tearability.

Team 2: improved tick removal

Designing a device to improve removal process of ticks from the skin. Difficult to remove the whole of the tick, leading to danger of infections. Prioritized effectiveness, ease of use, containment, fabrication, and safety. Design they went with was a suction tube with bars to grab the tick and remove it, removing and containing it effectively.

Team 3: pavlik harness sensor

Designing a device to detect kicks and activity in an infant needing a harness in order to avoid pinching of the femoral nerve leading to femoral nerve palsy. Focusing on accuracy of detection, safety, ease of use, comfort and ease of fabrication, and decided to go with EMG detection for the device, as it had the highest accuracy and noise reduction, as well as sensitivity.

Team 4: preventing accidental urinary catheter removal

Designing a device to help prevent patient removal of catheters, as current countermeasures are unfavorable. Device should prevent both accidental and intentional removal of the catheter, should be minimally expensive, should remain easy to use, and should avoid damaging the patient. Design chosen would be a sleeping bag similar design that would prevent the patient from handling the catheter using a stiff material.

Team 5: double curve scoliosis brace

Designing a device to avoid difficulties with scoliosis, especially in double curve scoliosis patients. Devices to help with scoliosis exist, but none that effectively treat double curve scoliosis without other complications. Using a titanium chromium alloy, for strength, biocompatibility, and corrosion resistance. Prioritized surgical intervention, durability, robustness, and ease of fabrication and operation. Design decided uses a semistandard surgical spinal brace, with handles that could descend and tops of the handles that could detach to ease in the surgical process.

Team 6: wearable device with ultrasound to monitor RAP

Designing a device to help detect increases in right atrial pressure to help catch heart issues earlier than current devices do. The device should not get too hot, should be lightweight, and should accurately record the pressures needed. Must be sterile and avoid bacterial growth, provide accurate and quick data, and last for 7-28 days. The device they are using uses a contrinuous montioring ultrasound device and a hydrogel to keep the device fully functional.

Team 7: our group

Test more about sensor drift and calibration modes/weights, ensure that the sensor doesn't heat up or hurt the foot too much

Team 8: cast pressure sensor

Designing a device to monitor pressure inside of a cast in order to prevent pressure ulcers forming. Device must fit into the back of a cast around the foot and record live pressure, as well as store it in some way. The decided upon testing method was using an MTS device to get accurate data in a realistic environment, however testing with human controls if that is desired. Decided on the existing pressure sensor and more testing to ensure the sensor works with the desired stretch

Conclusions/action items:

Develop testing for the device and the sensor drift, as well as heat testing for the circuit. Continue working on the design.

Advisor Meeting 1 9/12

NIKOLAI HESS - Nov 07, 2025, 12:32 PM CST

Title: Advisor Meeting 1

Date: 9/12

Content by: Nikolai Hess

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity Dechenne)

Goals: Discuss obligations and expectations as well as PDS

Content:

- Met with our advisor to get to know him and introduce ourselves, as well as discussing expectations for the project this semester.
- Discussed input on the PDS and talked about what the expectations for the PDS are.
- Discussed backgrounds and both our and our advisor's backgrounds

Conclusions/action items:

Finish progress report one by next Thursday, Email our advisor and client, begin brainstorming and initial work on project. Once meeting times with advisor are set establish meeting time for our team.

Team Meeting 3 9/19

NIKOLAI HESS - Nov 07, 2025, 12:58 PM CST

Title: Team Meeting 3

Date: 9/19

Content by: Nikolai Hess

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity Dechenne)

Goals: Work on and finalize design matrix

Content:

Met after our second advisor meeting to finalize our design matrix and discuss our final design.

Conclusions/action items:

Start working on models and specifications for the final design, and continue research.

Advisor Meeting 2 9/19

NIKOLAI HESS - Dec 10, 2025, 4:36 AM CST

Title: Advisor Meeting 3

Date: 9/19

Content by: Nikolai Hess

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity Dechenne)

Goals: Discussing design matrix

Content:

Met with our advisor to discuss our design matrix and discuss initial design ideas. Talked about our ideas for the overall design of the device.

Conclusions/action items:

Start working on models and specifications for the final design, and continue research.

Adivsor Meeting 3 9/26

NIKOLAI HESS - Dec 10, 2025, 8:03 PM CST

Title: Advisor Meeting

Date: 9/26/25

Content by: Niko

Present: Niko, Norah, Cassity, Keira

Goals: Overview designs

Content:

Met with our advisor to og over designs and discussing questions, both about the project and to ask the client. Discussed current ideas of designs.

Conclusions/action items:

Divide preliminary report roles and start work.

Advisor Meeting 5 10/24

NIKOLAI HESS - Dec 10, 2025, 8:55 PM CST

Title: Advisor Meeting 5

Date: 10/24/25

Content by: Niko

Present: Niko, Norah, Cassity, Keira

Goals: Discuss project progress

Content:

Discussed progress and prelim presentation, as well as show and tell info and testing data. Talked about standards and potential difficulties in testing. Talked about the importance of an elevator pitch for show and tell

Conclusions/action items:

Work on elevator pitch and show and tell info/data

Team meeting 3 9/26

NIKOLAI HESS - Dec 10, 2025, 9:12 PM CST

Title: Team Meeting 4

Date: 9/26/25

Content by: Niko

Present: Norah, Keira, Cassity, Jetzu, Niko

Goals: go over design matrix and prelim presentation

Content:

Looked at and discussed designs and design matrix, decided on our final design, and decided how to split the preliminary presentation. Talked about expectations and format for the prelim presentation.

Conclusions/action items: Complete the Presentation, Practice Presenting.

Team meeting 5 10/10

NIKOLAI HESS - Dec 10, 2025, 9:14 PM CST

Title: Team meeting 5

Date: 10/10/25

Content by: Niko

Present: Norah, Keira, Cassity, Niko, Jetzu

Goals: think about prototype and next steps

Content:

Looked at several potential options for the fabric and the wires, battery pack, amplifier etc. mostly finalized materials to be purchased. Deliberated more about the exact specifications of the prototype.

Conclusions/action items: Finalize materials and some aspects of design, order materials.

Preliminary Presentations

NIKOLAI HESS - Dec 10, 2025, 9:19 PM CST

Title: Preliminary Presentation

Date: 10/3/25

Content by: Niko

Present: Norah, Cassity, Keira, Niko, Jetzu

Goals:

Present and hear feedback on our current design and ideas

Content:

Presented our presentation and answered questions, got some good insight from other groups.

Conclusions/action items:

Look into potential sensor drift and ways to address it.

Lecture Notes 1 - 9/10

NIKOLAI HESS - Sep 10, 2025, 1:54 PM CDT

Title: Lecture notes 1

Date: 9/10

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Learn more about internships and coops

Content:

- Keep track of what you do with internship, coop, and job search.
- Handshake, linkedin, indeed materials are good, quality of the tracking matters.
- Do your best to connect before applying if you can.
- Applying is often just step 1, should follow up.
- Don't let perfect be the enemy of good.

Important to keep track of what you're doing, partially in order to keep the contact etc of people you meet, also to make sure you are following up as should be. Start early, and don't worry if it takes time to get an internship

- Tailor your resume to specific positions
- Create balance - show a full picture but don't get too bogged down in the details
- Show other jobs as well, even if not applicable, good to show holding a job
- When including projects, don't include dates as it messes with job experience programs

Send in resume for job fair resume book by Thursday night

- Cover letters should combine experiences in a more digestible way
- One page max for cover letters, be very concise
- Demonstrate knowledge of the employer, and also show applicable knowledge

Helpful, not always necessary. If they ask for it do it, if not don't

- identify purpose of an internship, more than just a job
- research the employer.
- Make sure to make clear why you would be adding value, and why you'd be adding value over another applicant

Stay concise, but choose your words carefully to show you have the right qualifications

When searching for jobs/internships don't pigeonhole yourself too badly, keep your options broad

Conclusions/action items:

Polish my resume, work on looking up some of the companies you are most interested in and what days they are there. Check for what days of resume review I can make and go to one, prepare a sort of elevator pitch for the career fair itself.

Lecture Notes 2 - 9/17

NIKOLAI HESS - Sep 17, 2025, 2:02 PM CDT

Title: Lecture notes 2

Date: 9/17

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Learn more about leadership roles and styles

Content:

Important properties of a leader:

- self awareness, important to know what you are doing, and what you need to do as a leader
- vision, someone with a good overview of what needs to be done, and who can keep track of what they and the team need to do
- transparency, someone that is transparent with decisions, in order to keep communication and decisions on an open and clear field
- communication, communicative, keeping everyone else up to date with what they and what everyone else is doing
- decision making, someone who is confident and competent in decision making, considering all aspects of a decision
- Empathy, someone who can empathize and be understanding with their teammates

Leadership styles:

- Power model, someone who is "in charge", traditional leadership role, "great man" theory
- Service leadership, decisions shared more so on an equal plane, sharing power, supporting others on the group
- Authentic leadership, being genuine will build trust and relationships, emotional and mutual relationships to help support others, importance on emotional intelligence

My leadership is probably somewhere between the last two, I try to keep other people on as much of the same level as possible, and to keep decisions on an open and clear level

We talked about how sometimes there is an importance for power leadership roles

People oriented leaders focus on building trust and an inclusive environment

Process oriented leaders set the pace for a team, and help get work done efficiently

Thought oriented leader sees the big picture and organizes for that ideal, and stays open to new and innovative approaches and ideas

Impact oriented leaders set high bars and lead by example, providing inspiration as much as support

Important to self assess, observe and reflect your own strengths, and get outside input

Personal goal for the semester: I would like to practice delegation and active teamwork, I think that I could distribute and work alongside tasks more evenly and keep more active tabs on those tasks. Some benchmarks for this goal will be to watch how people are doing in the deliverables and see how I can work alongside and assist them.

Interpersonal goals for the semester: I would like to help my whole team become more self sufficient and confident in the tasks they are doing, I want to support people to work self sufficiently, especially because they will need the skills again immediately in 201. Some benchmarks for this will be very similar, working with the other people in my group to ensure they are confident enough to do their tasks well, and not confused on what or how they should be doing them.

Conclusions/action items:

Polish my resume, work on looking up some of the companies you are most interested in and what days they are there. Check for what days of resume review I can make and go to one, prepare a sort of elevator pitch for the career fair itself.

Lecture Notes 3 - 9/24

NIKOLAI HESS - Sep 24, 2025, 1:47 PM CDT

Title: Lecture notes 3

Date: 9/24

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Learn more about peer mentoring

Content:

Reasons for peer mentoring:

- See one, do one, teach one philosophy, helps increase the learning we get from it ourselves
- We have the knowledge that they need, especially in such a difficult transition
- additional instruction and emotional support for new students
- we are much more approachable than professor and high profile people around
- Share experiences, research, coops, internships, etc
- Increases belonging in BME and helps build connections
- Mutual benefits: conferring knowledge onto younger students, and learning how to teach and convey knowledge, as well as learning where you have gaps

Transferrable skills from mentorship:

- Leadership
- Communication
- Active listening
- study practices
- self awareness
- interpersonal skills
- increased self esteem and confidence
- increased patience
- builds positive habits
- fosters personal growth
- gives a sense of accomplishment

what it means to be a good mentor:

- building trust
- psychological safety
- reliability
- support and enthusiasm
- availability
- transparency, humanizing challenges

how to listen effectively:

- get rid of distractions
- listen more than you speak (when applicable)
- at least act interested
- ensure you understand the main ideas
- ask questions
- react to ideas, not the person

- avoid judgement and quick decisions

Conclusions/action items:

Polish my resume, work on looking up some of the companies you are most interested in and what days they are there. Check for what days of resume review I can make and go to one, prepare a sort of elevator pitch for the career fair itself.

Lecture Notes 4 - 10/1

NIKOLAI HESS - Oct 01, 2025, 2:06 PM CDT

Title: Lecture notes 4

Date: 10/1

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Learn more about sustainable design

Content:

What is sustainability: to create and maintain conditions under which humans and nature can exist in productive harmony and support our own and future generations.

Circular economy: The idea of keeping all resources that are used in the economy stay in the economy (aluminum can recycling etc)

Some sustainable decisions can be made out of both sustainability and economic reasons (Ex: use of paper coverings in the doctor's office, getting rid of the paper both for sustainability and for cost reasons)

(Environmental) payback periods: how long and how many times you have to use something to make it either environmentally favorable, or economically favorable

Lifecycle assessment is a way to assess the uses you get out of something and compare it to the environmental output generated

Several cases in which the decision was made based on cost motivated partly by environmental reasons

Supply restrictions (eg during the pandemic)

How to use these tools in BME:

Analyze the starting materials, the sources of everything used, and how they processed, then look at how they are processed, whay goes into that process. Once the source is analyzed look at use, lifetime, cleaning and treatments etc.

Conclusions/action items:

Look at the lifetime and recycling vs reusable, look at the work needed to sterilize etc the devices

Look at the materials used and the requirements for the sourcing and manufacturing of the materials

Lecture Notes 5 - 10/8

NIKOLAI HESS - Oct 08, 2025, 2:06 PM CDT

Title: Lecture notes 5

Date: 10/8

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Learn more about licensing and patenting and WARF

Content:

Warf is a nonprofit entity intended to help protect research and help it come into a patent and go out into the market (this process is called technology transfer)

Examples of technology transfer: intellectual property licesnse, industry sponsored research, consulting arrangements, fees for service

IP is a huge part of the process. Four types of IP: Patents, copyrights, trademarks, trade secrets (Other IP: biomaterials, technique and know how (similar to trade secrets), data)

Copyrights: protections for creative expressions, expressed in a tangible medium (software, surveys etc.)

Trademarks: protection for names, marks, logos etc., requires use in commerce, source-identifying function (identifies the creator/company)

Trade secrets: can be used to protect anything of value, protection is good so long as the concept is not generally known

Patents: a property right granted by a governmental agency, no global patents. Patent holder has the right to exclude others from making, using, selling, or importing the claimed invention (not necessarily a product, can be a method etc.)

Three types of US patents: design (15 years, ornamental features), plant (exclusively for plants), utility (both provisional and official options, provisional 1 year, official 20 years)

Patents are issued for the invention of a new and useful process, machine, manufacture, or composition of matter. Often takes 2-5 years to issue after filing. Costs around $30k on average, mostly in attourney's fees.

Requirements to be patentable: must be eligible (cannot be a product of natuer, an abstract idea, or a natural phenomenon), must be novel (never done before), non-obvious (it cannot be simple modifications or combinations of existing concepts), enables and described (must provide enough detail to teach other how to make or use the invention)

Disclosing an invetion to WARF: disclosing: describes the innovation, identifies its advantageous and potential applications, names contributors, provides funding and public disclosure details

Meeting with WARF: discuss the innovation in more detail, ask questions about WARF and patenting process, discuss next steps

Warf deicdes based on two factors: IP considerations: Type of IP protection, potential breadth and strength of protection, public disclosure (past and planned), and stage of development

Licensing considerations: Applications, likelihood of identifying a commercial partner, likely return from licensing

Market analysis: Market status (established, emerging, new), size and type (large/growing market, medium and contracting, etc.), potential licensees (companies in the market)

License negotiations: type and terms (exclusive and field limited, sublicensing etc), considerations (upfront payments, royalties, reimbursements)

Ongoing: technology development, enforcement, amendment, termination

Benefits of licensing: reduced R&D costs, improved time to market, opportunity to enter new markets and expand quickly, new features or products provide additional revenue opportunities

Determining the value: technology application, key selling points/features/benefits, technology trends, market size, trends, competition, industry standards/historical deals

Conclusions/action items:

Think about what IP our project could have, and whether pursuing a patent of some kind could be feasible/viable/desirable.

Lecture Notes 6 - 10/15

NIKOLAI HESS - Oct 15, 2025, 2:09 PM CDT

Title: Lecture notes 6

Date: 10/15

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Learn more about patent law in BME

Content:

IP protection allows research to safely transfer into products, processes, and/or systems

legal career paths: technical advisor (does searches for other patents that you could be infringing on)

Patent agent (certified to talk with patent board, consults with both company and board)

Patent protection has many facets, can lead to damages and suing larger companies for the lost value

Patent discussion does not need to be combattive, can be both sides wokring together to meet on a task/project, can be well meaning and agreeable

How do engineers influence law and innovation:

Research: determines if an invention is truly new

Analytical reasoning: claim drafting and infringement analysis

Technical writing: translate complex technical concepts into clear, precise language

Communication: explaining tech to non-experts and patent examiners

Creativity: problem solving in patents and creating competitive products

Collaboration: cooperate with colleagues and external professionals

Project management: manage research, meet deadlines, and organize tasks

Intellectual property ownership: University will usually own IP, possible to get license opportunities

Companies will almost always own IP, part of employment and licensing agreement

Startup: patents will often be your own

Timing and publication: Ensure protections are in place because of risk of threat form other companies

Patent's important as they almost gurantee an almost monopolistic protection of the project

Conclusions/action items:

Think about what we would have to do to get a patent, and look into the time vs reward.

Lecture Notes 7 - 10/22

NIKOLAI HESS - Oct 22, 2025, 2:00 PM CDT

Title: Lecture notes 7

Date: 10/22

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Think about fall post-grad planning

Content:

Use your undergrad to "build your story", lower stakes than after, use this to your advantage

Research can be a good opportunity to do this or build this up

How to write your story for a cover letter etc: start with what you want to do (thesis statement etc, and how you can contribute and why)

Make a personal statement, show a reasonable idea of what you can and want to achieve, and potentially faculty there who are in your field of interest

Defend your plan with experiences, most recent first

Grad school options: masters: generally one year, med and phd programs, often industry focused, generally one year. Can let you rewrite story etc, give prep time to study for MCAT or apply to med schools, and as a stepping stone to a PhD program. mastsers will make you more desirable for both other programs and other positions. Can be very helpful for industry if paired with other industry experiences

Three different masters programs at uw: Research masters: 1.5-2 years often gotten by PhD programs, can be fully funded with some options, if working in a lab etc, and can get some amount of a stipend, thesis required, and must have a PI willing to sponsor thesis (not necessarily funding).

Accelerated programs: 1 year pure accelerated: coursework only, independent study allowed, BME innovation, design, and entrepreneurship: Project based (requires a project), partners with the business school

Apply online, and must have a PI to support your plan. Need 3 letters of reccomendation (for research masters, one must be from desired PI), deadline at 12/15, some spring entry allowed, special consideration given to BME undergrads, automatically admitted if you have a 3.0 GPA at least

PHD: good for people desiring to be independent researchers, write research grants, work in academia, lead projects in industry, startup, and consulting

networking and finding the area and location to work at important, build experience in research, network at conferences, look for locations with many people working in areas you are interested in (OMM, here, duke, tufts, U Penn, vanderbilt)

try to find external funding if possible, NSF-GRFP, workshops hosted

apply early and list names, have as good of a GPA as possible, generally a 3.5 and 75% quantitative GRE

Med school: prehealth advising very helpful, check requirements early as possible, requires Ochem 2 and ochem lab, physics requirements, and two semesters of english, requires ppsych 202 and soc studies, and biochem 501, all can be satisfied with BME credits

Research is very helpful, letter writers are vital, patient contact time is very important

Research is helpful to demonstrate skills outside of the classroom, list previous experience and as much experience as possible.

Conclusions/action items:

Think about where I could apply for PhD programs etc, look into the masters as a fallback potentially, think about when and what to apply to in terms of scholarships, think about retaking statistics

Lecture Notes 8 - 10/29

NIKOLAI HESS - Oct 29, 2025, 2:09 PM CDT

Title: Lecture notes 8

Date: 10/29

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Think about regulatory and FDA considerations

Content:

Three different FDA centers: One for devices, one for biologics, one for drugs

Three different classes of medical devices based on risks (class 1 low risk, class 2 medium, class 3 high)

several pathways to approval, for smaller markets with high risk, HDE (humanitarian device exemption) with lower requirements,

for average class 3 devices, and for class 2 devices with no prior similar approvals: PMA general study with most possible stringency

for class 2 devices: if something has similar priar approvals, 510k pathway to ease the approval process

If no prior similar approvals, and the device has a lower requirements, de novo study will sometimes be possible instead of a PMA

some of the first devices implanted were pacemakers, needed many many

"regulations are paid for in blood" many times the only things that bring about more stringent regulations are major, important events that cause somewhat shocking outcomes

Product recall study: Findings: firms face very very little punishment in terms of markets, very little repurcussions, partially because of media attention, partially because of inattention

Even huge firms and reecalls will sometimes be completely "invisible" because the recalls happen quietly and little attention was drawn to them

Misfolded proteins and alzheimers: Study showed that patients injected with growth hormone from a cadaver that had alzheimers wound up having alzheimers themselves very early, causality shown in study

Analysis of devices: failure mode and outcome analysis, looking at the ways a device can fail, and the outcomes, and showing some way to address or avoid them

Conclusions/action items:

Think about failure modes and outcomes for our device, think about all of the failure modes and outcomes, as well as any way to test the failure modes for them

Lecture Notes 9 - 11/5/2025

NIKOLAI HESS - Nov 05, 2025, 2:11 PM CST

Title: Lecture notes 9

Date: 11/5

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Think about regulatory and FDA considerations

Content:

From the three main departments of the FDA, device department (CDRH), drug (CDER), and biologics (CBER)

Have several main types of applications, CDRH (PMA, 510k, IDE), CDER (NDA, IND), CBER (BLA, IND)

several main genres of advanced therapeutics: genome editing, gene delivery, and cell therapy, most of these will go through CBER, though some through CDER

big paths for biologics: 351 and 361

361 is generally autologous, treated some way but not significantly. minimally manipulated, homologous use, not combined with other articles, and not dependent on significant metabolic activity in the cells

351 is anything not under this umberlla, 361 products require much less regulation, as 351 products have more risk associated

research versus "critical path"

Most research is not an actual product, showing proof of concept and demonstrating an ability to do something, vs making sure that a product is both viable and safe

TPP (target product profile) is an overview of all details of product, who will buy it and why, how and where and when it will be used, safety measures, efficacy, etc. everything needed to show an investor why they should invest in the device

Devices must be able to show manufacturing consistency, stability, characterization and potency before GMP (good manufacturing processes) studies, and demonstrate all of this together before a 151 approval.

One of the biggest, most important things in industry is quality control, and documentation for that is extremely important, every possible detail of a procedure down to lot and product numbers need to be recorded.

Conclusions/action items:

Think about quality systems and what would have to be done in our product to make it viable, if any of this is applicable to our product

Tong Distinguished lecture 11/7

NIKOLAI HESS - Nov 07, 2025, 12:47 PM CST

Title: Tong Distinguished Lecture series, building a career of impact

Date: 11/7/2025

Content by: Niko Hess

Content:

several "Chapters" of life, foundations, climbing the growth curve, making something.
Part of her growth was throwing herself into a role others didn't want, and used that to help advance herself and seize opportunities
Think of more than just a role and a company, how can you help make systemic change, what do you know and have you seen and where do you see gaps in the field
"You don't need to know you final destination, just follow hard problems and build skills that allow you to make an impact"
underlying challenges in healthcare: misaligned incentives, fragmented financing and regulation (federal, state, employer), data silos and legacy IT, inequities (10-15 year mortality gap)
system isn't broken, it was never designed to be consolidated to one system
parts needed to build a better care system: seamless exchange of clinical, claims, and social data across payers, providers, and patients, human centered design to build care around people and not processes or profits, aligned incentives and measurements meaning people are rewarded for outcomes not activity and transparency for all, connected care delivery platforms integrating virtual, in person, home, and community care
Seeking diverse exposure is important in growth, make sure that your experiences are not too much of a single theme
Know and protect your values, define what matters most, family/friends, health, career/impact, and make decisions that align
"run towards hard problems, they're the ones that change the world"

Conclusions/action items:

Think about how we can apply the ideas of systemic change and what to do with those ideas, think about the ways that I can think about when and what to do in the time we have.

Lecture Notes 10 - 11/12/2025

NIKOLAI HESS - Nov 12, 2025, 1:56 PM CST

Title: Lecture notes 10

Date: 11/12

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Think about the IRB and review process

Content:

Many examples of horrible and unethical experiments when researchers had no oversight

Several frameworks to help improve this:

nurembrug code: strong emphasis on voluntary consent

Declaration of Helsinki: focus on medical research

National Research Act: response to untrated syphilis study, prompted publication of the belmont report and creation of IRBs

Belmont report: focuses on respect for people and for autonomy, focus on beneficence (maximum benefits to minimal harm), focus on justice (reward should be evenly distributed), includes the "common rule", a criteria for approving research, protections for vulnerable groups, and requirements for IRB operations

IRB has a requirement of diversity (from racial, gender, and cultural backgrounds, diverse expertise)

IRB is intended to protect rights and welfare of people enrolled in research, reviews based on ethical, moral, and similar standards

All research must be reviewed by IRB if it includes human subjects, except for certain specific cases called IRB exempt

Definition of research is quite detailed, most things will be considered research, but certain things like quality improvements may not be and may not be subject ot review

System to submit and get protocols reviewed called arrow, will then be reviewed by scientific review board if necessary

Conclusions/action items:

Lecture notes 11 - 11/19

NIKOLAI HESS - Nov 19, 2025, 1:47 PM CST

Title: Lecture notes 11

Date: 11/19

Content by: Nikolai Hess

Present: Whole BME 300 class

Goals: Think about product development and medical device industry

Content:

product development in BME can be very expensive and highly competitive. Very resource intensive and very highly regulated

many companies have procedures and selection criteria to decide what devices to focus on because of this

overall corporate strategy > product portfolio review > project review > budgeting and resource delegation

Not every product/line is the same, small changes to a product are easy and minimally intensive, small upgrades are similar and still relatively low cost.

new to company products are nee products for the company but not for the industry

new to world products are fully new ideas and have not been done at all before, though they are the most time and resource intensive

Stage 0: ideation, as many ideas as possible

stage 1: exploration, digging into certain ideas, seeing what is currently out there, what gaps there are, talking to customers and seeing what exists and what customers need

stage 2: concept development, continuing to develop and form ideas of products while talking to customers and continuing research

Stage 3: design development, working on the idea that has been selected and what you can do with/about it, finalizing designs and starting the creation process

stage 4: design confirmation, testing and quality assurance as well as the continuation of design, iteration and refinement of idea

stage 5: design transfer and commercialization, advertisement and rollout of product, sales

more important to figure out and fully define the right question and right end goal for a problem versus just trying to throw solutions at a wall

design control: similar to risk management, the minutia of defining and developing your product production pipeline, as well as how you will test that and ensure accuracy.

Conclusions/action items:

think about how our device could be made for a bigger company and how it could be brought to market

The Measurement of Pressures under the Foot

Jetzu Thao - Dec 10, 2025, 8:27 PM CST

Title: The Measurement of Pressures under the Foot

Date: 9/12/25

Content by: Jetzu

Present:

Goals: Research most common pressure locations on foot

Content:

- The clinical application of the dynamic system is illustrated by the measurement of pressure/time curves encountered under the heel, the five metatarsal heads, and the great toe of a control group of feet and the feet of patients who had undergone metatarsophalangeal fusions, Keller arthroplasties, and Swanson arthroplasties.
- With this system, high spots of pressure can be readily recognized, and the actual pressure readings read off from the calibrated voltage comparator settings on the color interface. The actual values are of course to some extent dependent on body weight, and peak levels can be expressed in terms of body weight or as absolute values.
- There is a slight increase in peak pressures from childhood to adult life but the range is surprisingly small, when considered in relation to the large increase in body weight.
- It seems to be a characteristic of the foot that it functions in such a way that the loads are distributed to keep pressure within a relatively narrow limit.
- Since the normal foot, when standing, bears weight relatively evenly between hindfoot and forefoot, and between medial and lateral border, the first attempt to express the pressure distribution in mathematical terms utilized two ratios; first, that between the hind-foot and forefoot peak pressures, and secondly, by dividing the foot longitudinally down the center, the ratio between the medial and lateral peak pressures.
- Of the 42 feet studied, only 24 could be classed as normal on the lateral/medial ratio, and only 16 as normal on the heel/forefoot ratio. Only 10 feet were within normal limits on both ratios.
- To be of value to the busy clinician, a system for measuring the pressure distribution under the foot needs to be simple to use, convenient for the patient, reliable and accurate, and should present the data in a form which is readily understood and immediately available.

Conclusions/action items:

Foot is mainly around the toes, heel and outer sole of the foot. The device used in this article is able to provide a clear scan / interpretable data about this.

T. Duckworth, R. P. Betts, C. I. Franks, and J. Burke, “The Measurement of Pressures under the Foot,” Foot & Ankle, vol. 3, no. 3, pp. 130–141, Nov. 1982, doi: 10.1177/107110078200300303. Available: https://journals.sagepub.com/doi/10.1177/107110078200300303.

Jetzu Thao - Dec 10, 2025, 8:28 PM CST

The Measurement of Pressures under the Foot

Download

duckworth-et-al-1982-the-measurement-of-pressures-under-the-foot.pdf (1.3 MB)

Techniques for measuring weight bearing during standing and walking

Jetzu Thao - Dec 10, 2025, 8:33 PM CST

Title: Techniques for measuring weight bearing during standing and walking

Date: 9/30/25

Content by: Jetzu

Present:

Goals: Research weight bearing therapy

Content:

- To classify and assess techniques for measuring the amount of weight bearing during standing and walking.
- Weight bearing during standing leads to a force exerted by gravity on the subject. In a standing position the amount of this vertical ground reaction force under both feet equals the weight of the subject.
- It is evident that these forces under the foot during standing and walking generate forces and moments in other structures of the lower extremity, such as the hip
- In rehabilitation the amount of weight bearing during standing and walking is crucial in the healing period of orthopaedic patients with various pathologic conditions of the lower extremity,
- Different techniques are used to measure the amount of weight bearing, corresponding to their field of application. Two major fields of application can be distinguished. First, the field of training patients to learn and control partial weight bearing second, the field of evaluating postoperative weight bearing (research measurement).
- The clinical examination technique was used in a study by Gray et al. (1998) in which the physical therapist estimated what 60 pounds of force felt like when applied to the therapist's hand. They concluded that the amount of weight placed on the therapist's hand is subjective guesswork at best
-

Conclusions/action items:

Weight bearing techniques are used for therapy. Inaccurate tests have been used in the past, such as the therapist physcially feeling how much pressure the patient is putting on the limb and going off that, which has been inaccurate.

H. L. P. Hurkmans, J. B. J. Bussmann, E. Benda, J. A. N. Verhaar, and H. J. Stam, "Techniques for measuring weight bearing during standing and walking," Clinical Biomechanics, vol. 18, no. 7, pp. 576–589, Aug. 2003, doi: 10.1016/S0268-0033(03)00116-5.

Partial weight bearing after surgery for fractures of the lower extremity – is it achievable?

Jetzu Thao - Dec 10, 2025, 8:37 PM CST

Title: Partial weight bearing after surgery for fractures of the lower extremity – is it achievable?

Date: 10/1/25

Content by: Jetzu

Present:

Goals: Research

Content:

- Partial weight bearing is a generally accepted principle of rehabilitation following trauma or reconstructive surgery of the lower extremity
- This study implies that the conventional concept of postoperative partial weight bearing starting from 200 N and a stepwise increase of the load level until full weight bearing is not valid during clinical practice.
- The clear advantage of weight bearing versus postoperative immobilisation is that early mobilisation increases the bone turn over metabolism
- Weight bearing begins on the first postoperative day and increases stepwise until full weight bearing is achieved
- Immobilisation causes an increase of bone resorption whereas exercise training stimulates bone growth
- Early joint mobilisation and partial weight bearing represent accepted principles of postoperative treatment and previous studies have shown a clear advantage of immediate partial weight bearing versus immobilisation after surgery.

Conclusions/action items: (added late)

Partial weight bearing therapy is used for all ages of patients. Older patients struggle and frequently go over their weight bearing limit, while younger patients rarely have trouble staying under their limits.

A. Vasarhelyi, T. Baumert, C. Fritsch, W. Hopfenmüller, G. Gradl, and T. Mittlmeier, “Partial weight bearing after surgery for fractures of the lower extremity – is it achievable?,” Gait & Posture, vol. 23, no. 1, pp. 99–105, Jan. 2006, doi: 10.1016/j.gaitpost.2004.12.005

Circuit research

Jetzu Thao - Dec 10, 2025, 8:41 PM CST

Title: ESP32-S3 Research

Date: 10/17/25

Content by: Jetzu

Present:

Goals: Look into microcontroller for circuit

Content:

- ESP32 has bluetooth

- microcontroller able to connect over wifi and supports 2.4Ghz Wi-Fi

  - ESP32-S3-WROOM1 available on amazon
  - compatible with ardunio

Conclusions/action items:

Could use maybe, good option.

“ESP32-S3 Wi-Fi & BLE 5 SoC | Espressif Systems.” Available: https://www.espressif.com/en/products/socs/esp32-s3.

Arduino with Load Cell and HX711 Amplifier (Digital Scale)

Jetzu Thao - Dec 10, 2025, 8:44 PM CST

Title: Arduino with Load Cell and HX711 Amplifier (Digital Scale)

Date: 10/4/25

Content by: Jetzu

Present:

Goals: Follow guide to connect to Hx711 amplifier

Content:

- A load cell converts a force into an electrical signal that can be measured. The electrical signal changes proportionally to the force applied. There are different types of load cells: strain gauges, pneumatic, and hydraulic. In this tutorial, we'll cover strain gauge load cells.
- Strain gauge load cells are composed of a metal bar with attached strain gauges (under the white glue in the picture above). A strain gauge is an electrical sensor that measures force or strain on an object. The resistance of the strain gauges varies when an external force is applied to an object, which results in a deformation of the object's shape (in this case, the metal bar). The strain gauge resistance is proportional to the load applied, which allows us to calculate the weight of objects.
- The HX711 amplifier is a breakout board that allows you to easily read load cells to measure weight.
- The HX711 communicates with the microcontroller using two-wire interface (Clock and Data).
- Follow rest of coding instructions to calibrate amplifier and load cell.

Conclusions/action items:

Finish code for amplifier, connect to different load cell.

S. Santos, "Arduino with Load Cell and HX711 Amplifier (Digital Scale) | Random Nerd Tutorials," Apr. 27, 2022. Available: https://randomnerdtutorials.com/arduino-load-cell-hx711/.

Cheap Yellow Display coding

Jetzu Thao - Dec 10, 2025, 8:49 PM CST

Title: Cheap Yellow Display

Date: 11/11/25

Content by: Jetzu

Present:

Goals: Learn to use Cheap Yellow Display

Content:

- Board is compatbile with wifi and bluetooth
- able to do touchscreen
- The ESP32-2432S028R development board has become known in the maker community as the “Cheap Yellow Display” or CYD for short.
- Follow steps to code touchscreen on CYD
-

Conclusions/action items:

CYD tutorial done, touchscreen works. Unsure how to do bluetooth?

https://randomnerdtutorials.com/cheap-yellow-display-esp32-2432s028r/

R. Santos, “ESP32 Cheap Yellow Display Board (ESP32-2432S028R) | Random Nerd Tutorials,” Mar. 19, 2024

ESP32-S3 Pinouts

Jetzu Thao - Dec 10, 2025, 8:49 PM CST

Title: ESP32-S3 Pinout

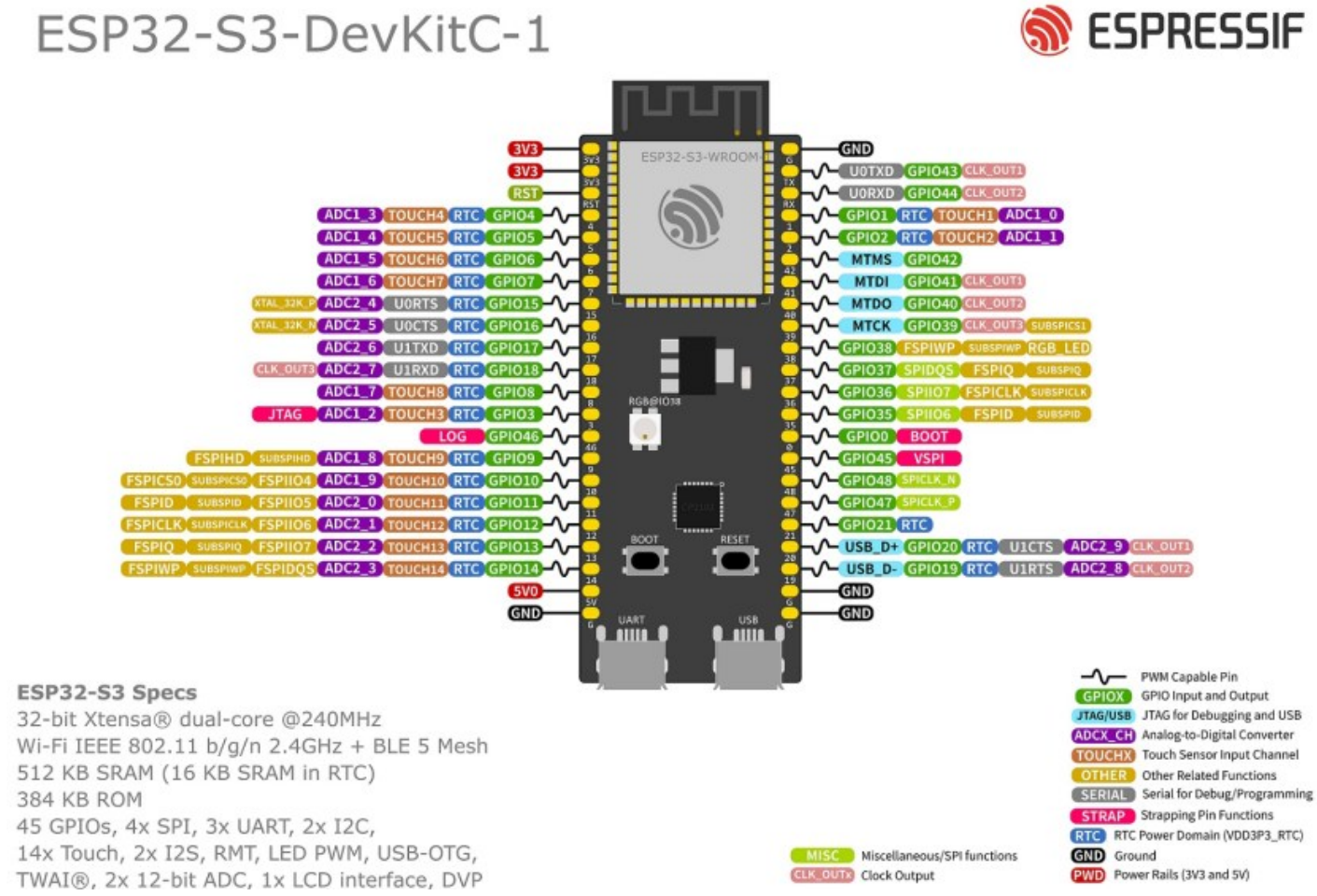
Date: 11/11/25

Content by: Jetzu

Present: Niko, Keira, Norah

Goals: Research how to connect microcontroller to Screen

Content:



Conclusions/action items:

Couldn't get it to work...

https://randomnerdtutorials.com/esp32-s3-devkitc-pinout-guide/

Bluetooth ESP32

Jetzu Thao - Dec 10, 2025, 8:52 PM CST

Title: ESP32 Bluetooth Classic with Arduino IDE – Getting Started

Date: 11/26/25

Content by: Jetzu

Present:

Goals: Try to connect ESP32-S3 to bluetooth

Content:

- At the moment, using Bluetooth Classic is much more simpler than Bluetooth Low Energy. If you've already programmed an Arduino with a Bluetooth module like the HC-06, this is very similar. It uses the standard serial protocol and functions.
- Code wasn't working
- Downloaded libraries in arduino IDE
- Code uploaded but couldn't connect or be seen

```
#include "BluetoothSerial.h"

#if !defined(CONFIG_BT_ENABLED) || !defined(CONFIG_BLUEDROID_ENABLED)
#error Bluetooth is not enabled! Please run `make menuconfig` to and enable it
#endif

BluetoothSerial SerialBT;

void setup() {
  Serial.begin(115200);
  SerialBT.begin("ESP32test"); //Bluetooth device name
  Serial.println("The device started, now you can pair it with bluetooth!");
}

void loop() {
  if (Serial.available()) {
    SerialBT.write(Serial.read());
  }
  if (SerialBT.available()) {
    Serial.write(SerialBT.read());
  }
  delay(20);
```

Conclusions/action items:
Couldn't figure out bluetooth connection, could be wiring issue?

https://randomnerdtutorials.com/esp32-bluetooth-classic-arduino-ide/

Human Subject Testing - Training

Jetzu Thao - Nov 14, 2025, 1:10 PM CST

Title: Human Subjects Testing

Date: (Completed 10/31/25)

Content by: Jetzu

Present

Goals: Complete the training module

Content:

Completed training module.

Conclusions/action items:

Jetzu Thao - Nov 14, 2025, 1:10 PM CST

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)
COMPLETION REPORT - PART 1 OF 2
COURSEWORK REQUIREMENTS*

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
UW-Madison Human Subjects Research Infrastructure (ID: 16302)	31-Oct-2025	No Quiz
Investigator Responsibilities (ID: 16391)	31-Oct-2025	4/4 (100%)
Defining Research with Human Subjects - SBE (ID: 491)	31-Oct-2025	8/8 (100%)
History and Ethical Principles - SBE (ID: 490)	31-Oct-2025	8/8 (100%)
Informed Consent - SBE (ID: 502)	31-Oct-2025	4/5 (80%)
Assessing Risk - SBE (ID: 503)	31-Oct-2025	5/5 (100%)
Populations in Research Requiring Additional Considerations and/or Protections (ID: 16680)	31-Oct-2025	5/5 (100%)
University of Wisconsin - Madison (ID: 12139)	31-Oct-2025	No Quiz
Consent with Subjects Who Do Not Speak English (ID: 17350)	31-Oct-2025	8/8 (100%)
Research with Children - SBE (ID: 501)	31-Oct-2025	5/5 (100%)

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Jetzu Thao - Nov 14, 2025, 1:10 PM CST

CITI PROGRAM

Completion Date: 31-Oct-2025
Expiration Date: 31-Oct-2028
Record ID: 73299425

This is to certify that:

Jetzu Thao

Has completed the following CITI Program course:

Basic/Refresher Course - Human Subjects Research
(Curriculum Group)
UW Human Subjects Protections Course
(Course Learner Group)
1 - Level 1
(Stage)

Under requirements set by:

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9/10/25 - Lecture

Jetzu Thao - Sep 10, 2025, 1:52 PM CDT

Title: Lecture - BME Career Prep

Date: 9/10/25

Content by: Jetzu

Present: Niko

Goals: Lecture Notes

Career Fair and Job searching

Content:

- Job Search tips
  - Keep track - ECS tracking sheet
- Quality of Source
  - Handshake, LinkedIn
- Connect BEFORE you are a candidate - use connections
- Applying is step 1, follow up is required (2-3 weeks)
- Think beyond title, focus on skills, industry, exposure
- Takes time, don't let perfect be the enemy of good.
- Resume Tips
  - Tailor resume to position - quick changes
  - Create balance - show full picture of experience
  - "Flawless" product - ATS proofed resume is do-able
    - MS word
    - No columns,charts,or colors
    - design projects WITHOUT years / semesters
    - Technical skills and coursework
    - Jobs - Org + Location, Position Title + Dates
  - Lots of ECS help available before the fair.
- Cover Letters
  - Based on job posting
  - Amplify greatest selling points
  - Clear and concise support
  - Demonstrate employer knowledge
  - Address to person
  - Recommended vs Required
  - Outline - basics
    - Intro: who you are, applying for, where you found it, and thesis statement.
      - "Based on my experience in A and B, I believe I would be able to make a difference in the X role at Y company."
      - Paragraph all about A
      - Paragraph all about B
      - Why employer/role + closing/next steps.
- Career Fair Advice
  - Identify purpose - more than internship
  - Look beyond obvious - overlap with other disciplines
  - Research employer - feedback from partners
  - Develop you "value added" statement - why you?
- Handshake posting problems
  - Look for wider variety than just the names

- System is not granular and precise
-

Conclusions/action items:

Get ready for career fair.

9/17/25 - Lecture 2

Jetzu Thao - Sep 17, 2025, 2:07 PM CDT

Title: Lecture 2 - Exploring Leadership and Style: Angela Kita

Date: 9/17/25

Content by: Jetzu

Present: Niko, Jetzu

Goals:

Leadership, Styles, Connect, Goal setting

Content:

- Qualities of Leader:
  - Communication, confidence, understanding / openminded, lifts others up
- Anatomy of a Leader:
  - Self-Awareness, Vision / Purpose, Transparent, Communication, Decision-making, Empathy
- Leadership at Variety of Levels
  - Organizational --> Team --> Interpersonal --> Personal
- Self-Awareness / Self-assessment
- Styles of Leadership
  - Power Model
    - Leadership = Power
    - "Someone has to take control, it should be me."
    - "Great Man Theory", Trait theory --> certain people are born to lead
    - Being in control is most important thing
    - Hierarchy, authority, command
  - Servant
    - Leadership = Mutual service
    - "not about me but about the needs of my followers is most important"
    - Being of service to others
    - sharing power
    - listening and understanding
    - empathetic, empowering, shared decision making
  - Authentic
    - Leadership = Authenticity
    - "Being my genuine self, I will gain and build trust."
    - building self esteem and self-awareness
    - emotional intelligence
    - creating authentic relationships
    - transparency, genuineness
  - People-Oriented
    - Glue that holds the team together; skilled at building trust and an inclusive environment
  - Process-Oriented
    - Sets pace for team, work alongside everyone, efficiency
  - Thought-Oriented
    - Sees big picture and anticipates future, new ideas and innovative approaches
  - Impact-Oriented
    - Set bar bar high and push for excellency, inspire people to follow your cause and mission
- Goals
  - Leadership doesn't require a particular job title
    - Leading others starts with yourself
    - Explore and define how you want to lead

        - Self assessment, observing, reflecting
        - Seek out feedback
    - Goal Setting
        - Personal Goals
            - I want to be more willing to go after what I want, I think I'm too complacent and I need to be willing to voice my opinions and embrace my own thoughts.
            - To achieve this goal, it's important that I understand the way I feel about certain topics, understand what I need to do to achieve these goals, and be willing to make myself uncomfortable by going into situations I don't usually find myself in.
            - I have a lot of goals for myself and it is also important to understand that I can't do it all at once, and I should be okay with going slowly and taking one step at a time.
        - Interpersonal / Team Goals
            - I want to lift others up when I can, give others opportunities to achieve their goals and I want to see others succeed.
            - To achieve these goals, it's important to be empathetic, to listen, to be willing to offer my opinion or withhold it depending on the situation, to enjoy other people's successes and to offer a hand when others may be knocked down.

Conclusions/action items:

Go after my goals.

9/24/25 - Lecture 3

Jetzu Thao - Sep 24, 2025, 1:50 PM CDT

Title: Lecture 3 - BME Mentorship

Date: 9/24/25

Content by: Jetzu

Present: Niko

Goals: Lecture ab Mentoring BME 200 students

Content:

- Mentoring BME 200 students
  - teaching them the ways
  - career development: team training / experience
  - leadership
  - emotional support
  - peer mentors are more approachable, mentees willing to ask more questions
  - sharing experiences
  - increases belonging
  - mutual benefits, transferrable skills
    - leadership
    - communication
    - active listening
    - study practices
    - self awareness
    - interpersonal skills
    - aka portable skills
  - increased self-esteem / confidence
  - increased patience
  - builds positive habits
  - foster personal growth
  - sense of accomplishment
- What does it mean to be a good mentor?
  - Building trust
  - psychological safety
  - reliability
  - support / enthusiasm
  - availability
  - humanize their challenges: be the coach
  - good listening
- Effectively Listening
  - Get rid of distractions
  - Stop talking
  - Act interested
  - Understand the main idea
  - Ask questions
  - react to ideas and not the person
  - avoid hasty judgement
- Mentor Map
  - Things I wish I knew:
    -

Conclusions/action items:

10/1/25 - Lecture 4

Jetzu Thao - Oct 01, 2025, 1:49 PM CDT

Title: Lec 4 - Sustainability

Date: 10/1/25

Content by: Jetzu

Present: Niko

Goals: Lecture

Content:

- Sustainability: everything we need for our survival and well-being depends, either directly or indirectly, on our natural environment.
  - This definition is mainly about resources
- Three pillars of sustainability
  - Social
  - Environment
  - Economic
- Sustainability in BME
- Circular economy
  - Worth to recycle or not?
- Carbon footprint
- Coffee - Pot vs Pod
- Plastic vs Stainless steel medical devices
- CO2 equivalent
- Engineering a more sustainable world
  - Look into process
  - Look at inputs / outputs / time commitments
  -

Conclusions/action items:

10/8/25 - Lecture 5

Jetzu Thao - Oct 08, 2025, 1:45 PM CDT

Title: Lecture 5

Date: 10/8/25

Content by: Jetzu

Present: Niko

Goals:

Content:

- Intro to WARF, IP, Disclosing and Licensing
- WARF - Nonprofit research
- Technology transfer
    - Intellectual property licenses
    - Industry sponsored search
    - consulting arrangements
    - fee for service
    - Moving research results from campus out into the market. WARF works at this interface to facilitate securing IP rights and commercial licenses
- IP Overview
    - 4 Types
        - Patents
        - Copyrights
        - Trademarks
        - Trade secrets
    - Other, WARF IP:
        - Biomaterials
        - Technique and know how
        - Data
- Non-patent IP
    - Copyrights: creative expressions in tangible mediums
        - Software
    - Trademarks: protection for names, marks, logos, dress, etc
        - Requires use in commerce
        - Source-identifying function
    - Trade Secrets: valuable, broad, recipes, contacts
        - can be used to protect anything of value
        - protection is good so long as the concept is not generally known
- Patents
    - Patent - property right granted by a governmental agency
    - Three types of US patents
        - Design (15 year long term, limited to ornamental features)
        - Plant (new variety, 20-year term, asexually reproducing, non-tuber)
        - Utility (Provisional,)
            - Utility (Non-provisional) patents
            - Issued for invention of a new and useful process, machine, manufacture, or composition of matter
            - Often takes 2-5 years to issue after filing (patent examination)
            - Costs ~$30k - mostly attorney fees
            - ~90% of patents issued by USPTO are non-provisional utility patents
            -

Conclusions/action items:

10/15/25 - Lecture 6

Jetzu Thao - Oct 15, 2025, 2:08 PM CDT

Title: Bioengineer It. Protect It.

Date: 10/15/25

Content by: Jetzu

Present: Niko

Goals:

- Intellectual Property for BME
  - Biomedical engineers create life-changing solutions
  - IP protection allows research to safely transfer into products, processes, and/or systems
    - Medical device --> patent filing --> marketplace
  - IP enables investment, partnerships, and ethical competition
  - Building IP knowledge:
    - Legal career paths for BMEs
    - protecting inventions and ownership
    - patent protection, searches and infringement
    - trademark, copyright, and trade secret protection
    - counterfeit products in the biomedical industry
  - Legal career paths for Engineers in IP
    - Technical Advisor - STEM degree (no law or patent bar)
    - Patent Agent - STEM degree + patent bar
    - Patent examiner - STEM degree (patent bar eventually)
    - patent attorney - Law degree + Patent bar
    - patent litigator - Law degree (STEM degree + patent bar optional)
    - IP license attorney - Law degree (STEM degree + patent bar)
    - Tech transfer manager - STEM degree preferred (law degree optional)
    - Engineer - STEM degree (work w/ IP lawyers to protect your inventions)
  - Skills from Engineering to IP
    - Research: determine if an invention is truly new
    - Analytical Reasoning: claim drafting / infringement analysis
    - Technical writing: translate complex technical concepts into clear, precise language
    - Communication: explaining tech to non-experts and Patent examiners
    - Creativity: problem-solving in patents / creating competitive products
    - Collaboration: cooperate with colleagues and external professionals
    - Project management: manage resources, meet deadlines, and organize tasks (patent creation process from concept to product launch)
  - IP ownership in BME
    - University: disclose before publishing; university usually owns IP, possible license opportunities
    - Company: employer typically owns inventions, trademarks, copyrights and open IPs
    - Self: careful
  - Timing and Publication
    - Disclose internally first
    - Publishing before filing and offers for sale = lost patent rights abroad and possible loss of rights in the US
    - Posters or abstracts can count as public disclosure
    - First to file system (not first to invent)
  - Invention Patentable
    - Novelty
    - Non-obviousness
    - Utility
  - Patent

- Creates monopoly / stops others
  - from making, using, selling, or importing invention
- two main types
  - Utility patents: protect how a product works or is made (20 years)
  - Design patents: protect the unique visual appearance of a product (15 years)
- Patents are critical in BME, where innovation drives competitive advantage
-

Content:

Conclusions/action items:

10/29/25 - Lecture 8

Jetzu Thao - Oct 29, 2025, 2:11 PM CDT

Title: Lecture 8 - Regulations

Date: 10/29/25

Content by: Jetzu

Present: Niko

Goals:

Content:

Dr. Kip Ludwig

- FDA Regulations
- 3 Major centers of FDA
  - CDRA - Center for Devices and Radiological Health
  - CBUR - Center for Biologics
  - CDUR - Center for Drugs
    -
- Regulatory Pathway - Welle / Krauthamer 2012
  - Class 1: Low risk
    - Example: Tongue depressor
  - Class 2: Moderate / Controlled risk
  - Class 3: High risk
  - 510k Pathway
    - Substantially equivalent to predicate
  - 510k De Novo
    - No Predicate
    - can become a 510k Predicate
  - Predicate design
- Post Market surveillance
  - FDA approval, post study for market approval
  - Special / General controls
- Medical Devices History
  - Regulations didn't start until 1976
  - FDA Modernization Act of 1997: Medical Device Provisions
    - "Regulations are Paid for in Blood"
  - Dalkon Shield
    - Implantable contraceptive
    - No oversight --> post market research proved it didn't stop pregnancy and caused complications
      - Maternal death, septic pregnancy, etc
  - FDA oversights
    - Inconsistency in regulations between devices
- Hypotheses for Regulations and Abnormalities
  - 1: Abnormal returns attributable to medical device recalls are negligible
  - 2: Abnormal returns attributable to recalls are less negative for firms with greater project scope
  - 3: Abnormal returns attributable to recalls are more negative for firms with high growth prospects
  - 4:
  - Key findings:
- Product Recall
  - Recalled products go under the radar
- FDA Guidance: Investigational Device Exemptions for Medical Device Clinical Studies Are Failure Mode Analysis Based

- Device FDA approval - online lists for everything needed for FDA regulations on models
- Look for most recent / similar devices and compare to their regulations
    - Use as template
-

Conclusions/action items:

11/5/25 - Lecture 9

Jetzu Thao - Nov 05, 2025, 2:11 PM CST

Title: Lecture 9: Framework Guiding Advanced Therapeutic Product Development

Date: 11/5/25

Content by: Jetzu

Present: Niko

Goals: Understanding regulatory practices

Content:

- FDA Structure and Advanced Therapeutics
  - Device
  - Drug
  - Biologic
- ---
  - Genome Editing
  - Gene Delivery
  - Cell Therapy
- FDA Framework: Developing CGT Products for Hemophilia
  - US Laws --> Regulations --> FDA Guidance
  - Clinical Design
- 351 vs 361
  - Human cells, tissues, and cellular and tissue-based products (HCT / Ps)
  - Homologous use: Using tissue for the same function
- Risks and Safety Concerns
- Product development life cycle:
  - Each stage of development cycle faces risks and challenges, and proper management of these risks is vital for successful commercialization
  - A target product profile TPP is your product vision
  - When? Why? How?
    - Core
    - Clinical Development Planning
    - CMC (qTPP, Quality TPP)
      - Product attributes
        - Purity
        - Degradants
        - Biocompatibility
- Considerations when developing a 351-Regulated CGT
  - Nonclinical
    - Non-GLP Nonclinical studies and pilot tax studies
    - Pivotal GLP tax studies GLP
  - Quality
    - CMC development
    - Demonstration of manufacturing consistency initiation of stability studies
    - GMP batches releases process and method validation
  - Clinical
    - Phase 1/2 trial --> Phase 3 Trial --> Filling and launch prep
    - Post marketing studies
  - Regulatory
    - TPP interact meeting
  - Time = Money

-

Conclusions/action items:

11/7/25 - Tong Lecture

Jetzu Thao - Nov 07, 2025, 12:44 PM CST

Title: Tong Lecture

Date: 11/7/25

Content by: Jetzu

Present:

Goals:

Content:

- **Speaker's Path**
  - Education, Work, MBA
    - 1st half of career, getting experience
  - Climbing Growth Curve
    - combine EQ with IQ to multiply impact and reach
    - Aetna --> Unified Women's Healthcare
      - Chief of staff to CEO President, Student Health President, Aetna
      - President and COO of United Women's Healthcare
  - Build and Transform
    - Drive system-level impact through innovation and scale
      - Hopscotch Health
        - Founder and CEO advanced primary care for rural communities
      - Blue Cross Blue Shield Association
        - Chief operating officer enable access, affordability
- **You don't need to know your final destination -- just follow hard problems and build skills that allow you to make an impact.**
- Healthcare System
  - Quadruple Aim
    - Improved Provider Experience
    - Improved Patient Outcomes
    - Lower Cost of Care
    - Improved Patient Experience
  - 50% of doctors would say that they maybe wouldn't want to go back and redo their studies
- How much do we spend on Healthcare in the US
  - $$ and % of GDP
  - 5.3 Trillion, 18% of GDP
- How much do we spend per person on healthcare
  - 2x
- How We Measure on outcomes, cost, quality and provider experience
  - US ranked last
  - Complicated due to outdated system
    - >900 insurers
  - Underlying challenges
    - Misaligned incentives
    - Fragmented financing and regulation
    - Data silos and legacy IT
    - Inequities (10-15yr gap between zip codes)
- Healthcare is broken because it was never properly designed
- What if we build an integrated system to enable health and wellness for all?
  - Future of healthcare is an integrated ecosystem of health and care
- What's required for building a better healthcare system
  - Design thinking

    - Interoperable data infrastructure
    - Human centered design
    - Aligned incentives and measurement
        - Clinicians should be rewarded for the outcome rather than the process
    - Connected Care delivery platforms
    - Simplified and automated infrastructure
    - Systems Thinking
    - Analytical Rigor
    - Design and Iteration
    - Process Optimization
    - Reliability and Safety
    - Healthcare needs better systems, and systems are what engineers are best at
- Integration is an Engineering Problem

1. Work Hard and build Range
    1. Take on the hardest projects, classes, and experiences you can find. Effort and rage are your foundation.
        1. Look for work in an office, especially in the modern hybrid times
        2. Things were easy after finding first professional job
2. Seek Diverse Exposure
    1. Explore different sectors, teams. and geographies. Gain perspective and learn how systems connect, not just how parts work
3. Choose your people wisely
4. Know your values and protect them
    1. Define what matters most- family/friends, health, career/impact, values - and make decisions that align.
5. Embrace Challenge and Keep Growing
    1. Run towards hard problems. Growth lives on the edge of discomfort - where big impact starts.

- Chase the hard problems and embrace curiosity.

Conclusions/action items:

11/12/25 - Lecture 10

Jetzu Thao - Nov 12, 2025, 1:50 PM CST

Title: IRB history/basics

Date: 11/12/25

Content by: Jetzu

Present: Niko

Goals:

Content:

- Research Opportunities
  - Ethical Research Frameworks
    - Nuremberg Code, 1947
  - Declaration of Helsinki, 1964
    - Focus on medical research
  - National Research Act, 1974
    - US response to US Public health service untreated syphilis study at tuskegee
- Belmont Report
  - Respect for Persons/Autonomy
    - Principle of respect for persons thus divides into two separate moral requirements: the requirement to acknowledge autonomy and the requirement to protect those with diminished autonomy
  - Beneficence
    - Maximize benefits and minimize harms
  - Justice
    - Who ought to receive the benefits of research and bear its burdens
  - Applying the Belmont principles
    - 1991 Department of Health and Human Services (DHHS) 45 CFR 46
      - Common Rule
        - Criteria for approving research
        - Protections for vulnerable groups
        - Requirements for IRB operations
    - 2018 Revised Common Rule
      - Modifications to reduce administrative burden
- IRB Composition
  - Diversity of membership required
    - Race, gender, cultural backgrounds
    - Scientific expertise
      - MD, PhD, MPH
      - Faculty, clinicians
    - Non-scientists
      - Community members
      - IRB staff
- Common Rule Criteria (45 CFR 46)
  - Risks, Benefits, Risk/Benefit Ratio, Equitable Selection of Subjects, Informed consent, privacy and confidentiality
- Rule Definitions
  - Research defined by common rule as: systematic investigation, including research development, testing
-

Conclusions/action items:

11/19/25 - Lecture 11

Jetzu Thao - Nov 19, 2025, 1:59 PM CST

Title: Development of Medical Devices

Date: 11/19/25

Content by: Jetzu

Present: Niko

Goals: Be able to explain how new product development works

Content:

- **NPD in medical device industry is**
- Highly regulated, Expensive, Resource Intensive, and Competitive
    - FDA and other regulatory bodies have a significant impact
    - Requirement for verification and validation is a cost multiplier
    - Resource intensive
- Selecting and prioritizing projects
    - Corporate business strategy
    - Product portfolio review
    - Project review
    - Budgeting and resource allocation
- Types of NPD Projects
    - Line extensions
        - Addition of additional sizes and configurations
    - Product improvements
        - Existing product change due to market feedback and/or new customer needs
    - New-to-company
        - Product line that is not new to market but is new for the company
    - New-to-world
        - innovative products that create completely new markets
- Managing NPD: Stage-Gate process
- Cloud --> Funnel --> Tunnel
    - Stage 0: Ideation
        - Brainstorming
    - Stage 1: Exploration
        - Narrow down ideas, primary / secondary market research
    - Stage 2: Concept development
        - Go / no-go decision
    - Stage 3: Design development
        - testing, development
    - Stage 4: Design confirmation
        - Verification, validation
    - Stage 5: Design transfer and commercialization
- Defining the problem
    - Defining the problem statement is the most important step of the design process
- Medical device development is expensive, complex, and highly-collaborative
- Having limited resources, most businesses have instituted processes like stage-gate to reduce risk and increase probability of success
- Good product design and development is necessary for commercial success but not sufficient

Conclusions/action items:

Advisor Meeting - 9/12/25 - Copy

Jetzu Thao - Sep 19, 2025, 12:16 PM CDT

Title: Advisor Meeting

Date: 9/12/25

Content by: Jetzu

Present: Jetzu, Niko, Norah, Keira, Cassity

Goals: Discuss project with advisor, overview progress, ideas, meeting with client

Content:

- Discussed group members, member's tracks, future plans,
- **FIND EACH PERSON'S PLACE IN PROJECT!**
  - **What can you contribute to the project?**
- Discuss progress:
  - Productive documentation
  - Creative documentation
- Meet with client before getting started
  - Find what they're looking for
  - Accessibility, Current device improvement
- Design specificity
  - Look into what you're interested in
  - Find what each person to contribute
- Future meetings - designated room
- What to ask client in meeting?
  - Go in open minded
  - Come with questions
  - Use time wisely
  - Don't tell them how they can help you, ask how you can help them
- Lab Notebook
  - Contact info
  - Document what happens
  - Data, Reports,
  - Have things in two places
  - Thoughts / Ideas
  - Open ended, be thorough and detailed with what we're doing
  -

Conclusions/action items:

Advisor Meeting 2 - 9/19/25 - Copy

Jetzu Thao - Sep 19, 2025, 1:05 PM CDT

Title: Advisor Meeting

Date: 9/19/25

Content by: Jetzu

Present: Niko, Keira, Norah. Jetzu

Goals: Discuss w/ Advisor

- Progress
  - PDS
- Goals
  - Design Matrix - Due Friday
    - Categories of Importance
    - Rubric for Design matrices
- Lab Archives
  - Grading
  - Expectations

Content:

- Progress
  - PDS complete
  - Budget - 500 dollars
  - Design specifications
- Meet with Advisor in office:
  - Conference room (2139)
  - In ECB - Engineering Centers Building
  - Dr. Dean will reach out for location
- Group Meeting times:
  - Tuesdays?
- Design Matrix - Due Friday
  - Work on it today, meet Tuesday, finalize design matrix on Friday before due.
  - Rough draft - Hand drawn designs, CAD needed for later reports
  - Need to go over categories
  - Matrix for Sensor pad
    - Possible use for sensor (arduino compatible - HX711 weight sensor)
  - Matrix for circuit
    - Battery Powered - Future design wireless?
  - Design Matrix Expectations:
    - Nobody is feeling unsure about what they're doing
    - Scores will be feedback for you --> highlighting involvement in project
- Reports
  - Preliminary report
    - requires data
    - shared folder for data --> get data into shared area ASAP
- **Ask Client about patient confidentiality / HIPPA (IMPORTANT)**
  - Clinical trials?
  - Client should feel safe that information is confidential
  - Client should be sure they're okay with what will be shared
  - How to handle data provided from patients? **Question that needs to be considered**
  - HIPPA training should be required and looked at
- Data collection / testing

- Gym weights for testing?
- Human data / testing
- Volunteers

Conclusions/action items:

Finish deliverables and get design matrices done.

Advisor Meeting 3 - 9/26/25

Jetzu Thao - Sep 26, 2025, 1:15 PM CDT

Title: Advisor Meeting

Date: 9/26/25

Content by: Jetzu

Present: Niko, Norah, Cassity, Keira

Goals: Overview designs

Content:

- Meeting with Prof. Dean, overviewing designs and discussing questions we may have.
- Questions for client in future
- Issues with current design ideas

Conclusions/action items:

Go over roles for preliminary report and presentation.

Advisor Meeting 5 - 10/24/25

Jetzu Thao - Oct 24, 2025, 12:55 PM CDT

Title: Advisor Meeting 5

Date: 10/24/25

Content by: Jetzu

Present: Niko, Norah, Cassity, Keira

Goals: Discuss plans / show progress

Content:

- **Progress**
  - Basic circuit, materials; strap, sensor, amplifier, LCD screen.
- Purchases from client
  - reimbursement
- Show and tell presentation
  - Show what we have so far
  - Flow of work
  - Flowchart for code
  - Assigned groups A or B?
    - Questioners and Presenters
    - One group at a time
    - 1 minute elevator pitch
    - Find out what client is looking for
  - Testing
    - Precision vs Accuracy
    - Testing standards
    - Technical specifications

Conclusions/action items:

Advisor Meeting - 11/7/25

Jetzu Thao - Nov 07, 2025, 1:32 PM CST

Title: Advisor Meeting

Date: 11/7/25

Content by: Jetzu

Present: Niko, Norah, Keira, Cassity.

Goals:

Content:

- Progress report makes sense
- Working in same directions but parallel
    - Need to put together materials for testing
- Meet with client ASAP to discuss the current
    - Discuss continuation of project- see if client wants to keep
- Testing protocol and ideas
- Final Report
    - Documentation for what we have
    - Include future planning and future work
- Breaking project down into milestones.

Conclusions/action items:

Advisor Meeting - 11/14/25

Jetzu Thao - Nov 14, 2025, 1:01 PM CST

Title: Advisor Meeting

Date: 11/14/25

Content by: Jetzu

Present:

Goals:

Content:

- Poster Session Prep
- Ask for anything we need right now (etc. power supplies, tables)
    - Request to Puccinelli
    - limited outlets, bring extension cord if need
- Power bank to power Arduino?
- Monitor size? - Display
- Printing Poster ($30)
    - Prices may vary
    - Cover the poster while transporting
        - Plastic sleeve, trash bag, paper cover, poster tube
- Font size: test sizes
- Less words is more, text can be bullets, include pictures
- References included
- Poster presentation after thanksgiving break
- Poster inclusions
    - Data: include design of test
        - Qualitative: should include reasoning
        - Quantitative: 5 minimum observations if we include
- Look at rubric beforehand
- Practice elevator pitch and practice what we are going to say
- Invite client
    - Allow them to come at any time and go
    - Posters will not be able to be distributed
- Peer evaluation
    - Form in canvas (Feedback Fruits)
- Notebook finalization
    - Lab notebook: don't go back
    - Summary: include what we did on project and what we impacted
    - Using notebook to record what happened
- Weekly Report
    - Testing coordination,
    - Difficulties with delivery
        - Contact Dr. Puccinelli
            - He has a stack of items
    - What time is left? Decide what are we going to leave with the client.
        - Leave the project or continue? Up to client to decide what he wants
        - Should give client more before knowing about continuation of project
        - Give client a timeline for the device's progress and possible ways to get to that point
    - Commenting on code
        - Pseudocode may be helpful for continuing project
- IP?
    - Not sure. Most likely not

    - Discoveries
    - Commercialization
        - Need to look more into it
    - Innovation
        - Bluetooth screen, adjustability, compatibility
    - Novelty
    - Patent
        - Should require everything, including user of product.

Conclusions/action items:

-

Advisor Meeting 3 - 11/21/2025

Jetzu Thao - Nov 21, 2025, 12:48 PM CST

Title: Advisor Meeting

Date: 11/21/25

Content by: Jetzu

Present: Niko, Keira, Norah, Cassity

Goals:

Content:

- Testing protocols?
  - Testing try to complete by next week
  - Testing durability
  - Control groups?
    - Zero value, baseline, calibration
    - Difference between dumbbells and anatomy
    - Test ourselves instead of needing outside ppl for testing
- Presentation
  - Show work that we've done
  - Show any testing
  - Show if testing / design was validated
  - What was left / created / what is needed for future work
  - Less words = better
  - What was gotten out of the project
  - Setup early - try to come an hour before
  -
  -

Conclusions/action items:

9/16/25 - Client Meeting - Copy

Jetzu Thao - Sep 19, 2025, 12:17 PM CDT

Title: First Client Meeting

Date: 9/15/25

Content by: Jetzu

Present: Jetzu, Niko, Keira, Cassity

Goals: Discuss project specifications and other details with client (Daniel Kutschera)

Content:

- Client wants device to be easily accessible and to work similar to a beeper boot
- Wants screen so it can easily be read how much weight patient is putting onto foot
- Wireless is desired, may be out of scope for this semester, potential future addition.
- Soft material to avoid irritation of skin
- Able to change sizes easily, one size fits all
- 500 dollar budget (can be increased if need be)

Conclusions/action items:

Work on PDS, contact Dan if we have quesitions

10/6/25 - Client Meeting 2 (copy)

Jetzu Thao - Nov 14, 2025, 1:11 PM CST

Title: Client Meeting 2

Date: 10/6/25

Content by: Jetzu

Present:

Goals:

Content:

- **Design Question:** Likes or dislikes?
  - Strap design preferred
  - 100kg load cell is fine
  - Weight display in pounds
  - Sanitization - easily wipeable by a mild sanitizer
  - Dan Kutschera, PT
  - Would prefer Venmo for payment
  - Send Dan schedule for presentations
  -

Conclusions/action items:

Get orders in by Friday-ish, start fabricating next week, try to get circuits done by today.

BSAC Meeting - 9/12/25

Jetzu Thao - Sep 12, 2025, 11:28 AM CDT

Title: BSAC Meeting

Date: 9/12/25

Content by: Jetzu

Present:

Goals:

Content:

Conclusions/action items:

BSAC Meeting 9/26/25

Jetzu Thao - Sep 26, 2025, 12:06 PM CDT

Title: BSAC Meeting 2

Date: 9/26/25

Content by: Jetzu

Present:

Goals:

Content:

- Notebook expectations
  - 4-6 hours of work
- Advisor meetings
  - Progress report goals
  - notebook will drive conversations
  - more / better documentation
  - notebook should show what influences you can have on the project
- Suggestion form for BME training
  - checkboxes for different tracks
  - do trainings early
  -

Conclusions/action items:

BSAC Meeting 10/24/25

Jetzu Thao - Oct 24, 2025, 11:30 AM CDT

Title: BSAC Meeting

Date: 10/24/25

Content by: Jetzu

Present:

Goals:

Content:

- Ideas coming from show and tell
  - Testing Protocols from others who are seeing your project for the first time
  - Use time wisely, 60 second pitch
- Talk to Alumni to find classes that were useful
- BME Advising Page
-

Conclusions/action items:

Type of strap

Norah Greer - Dec 06, 2025, 12:19 PM CST

Title: Type of strap to use

Date: 9/23/25

Content by: Norah

Present: Norah

Goals:

- Identify the best type of strap to attach our load cell to

Content:

- Strap must:
  - Prevent load cell from shifting to a different position on the foot
  - Not be super tight to avoid skewing load data from load cell
  - Be fairly easy to clean
- Possibilities:
  - Compression Sock
    - Would hold in place but could skew data about pressure on the foot
    - Is not very adjustable to multiple patients
  - Ace Bandage-type strap with loop on end
    - Loop goes around foot, able to reinforce location with remaining strap
  - Simple Velcro Strap
    - Would be very adjustable and hold sensor in place
    - Not very comfortable

Conclusions/action items: none

Materials and Bacteria

Norah Greer - Dec 06, 2025, 11:52 AM CST

Title: Materials and Bacteria

Date: 10/18/25

Content by: Norah

Present: Norah

Goals:

Determine which types of fabric absorb and transmit the lowest amounts of bacteria

Content:

[1]

- Bacteria is primarily transferred through friction (5% more than pressing fabric to surface)
  - Our product will likely move around a small amount during use, so friction is relevant
- Study found generally the order of fabrics from most to least likely to transfer bacteria were

1. Viscose
2. Polyester
3. Wool
4. Cotton
5. Blend
6. Silk
7. Polypropylene

[2]

- Second study looking at bacteria's tendency to survive of different fabrics
- Survival times:
  - Cotton: 26 days
  - Cotton-Polyester: 26.5 days
  - Silk: 28 days
  - Wool: 30

- Should most likely use some kind of wipeable/water resistant material to avoid bacteria growth, as it can last up to a month on the majority of tested materials
- Another option would be to make the electrical components removable and provide multiple washable straps to the client so that they could be switched out between patients.

Conclusions/action items: none

References:

[1] S. Varshney, P. Pandey, D. Gupta, and S. Sharma, “Role of fabric properties, moisture and friction in transfer of bacteria from fabric to fabric,” *Textile Research Journal*, p. 004051751986695, Aug. 2019, doi: https://doi.org/10.1177/0040517519866956.

[2] O. Koca, U. Altoparlak, A. Ayyildiz, and H. Kaynar, “Persistence of Nosocomial Pathogens on Various Fabrics,” *The Eurasian Journal of Medicine*, vol. 44, no. 1, pp. 28–31, Apr. 2012, doi: https://doi.org/10.5152/eajm.2012.06.

Materials to Avoid Slipping

Norah Greer - Dec 06, 2025, 11:57 AM CST

Title: Material options to avoid patient slipping

Date: 10/18/25

Content by: Norah

Present: Norah

Goals:

- Determine possible materials for the part of the device that makes contact with the floor to prevent patients from slipping during PT

Content:

- Floor surfaces tested:
  - Ceramic Tiles
  - Flagstone
  - Parquet
  - Parquet ceramics
  - Marble
  - Porcelain
  - Rubber
- Sock materials tested:
  - Wool
  - Polyacrylonitrile
  - Cotton
  - Polyester
  - Spandex
  - Silk
  - Polyamide
- Physical therapy would most likely occur on rubber tile flooring
- Desired materials are Polyester or Cotton due to their stretchy properties
  - These have low kinetic coefficients of friction on most likely materials, meaning slipping would be likely
- Possibility of adding grip patches/strips on bottom portion of the strap to combat this problem

Conclusions/action items: none

References:

[1] E. S. S, K. A. M, R. A. A, S. A. K, S. E. S, and A. W. Y, “PROPER SELECTION OF FOOT WEARING SOCKS TEXTILES BASED ON FRICTION COEFFICIENT DISPLAYED BY SLIDING AGAINST INDOOR FLOORS,” *Journal of the Egyptian Society of Tribology*, vol. 13, no. 2, pp. 15–24, Apr. 2016, doi: https://doi.org/10.21608/jest.2016.79629.

Weight Distribution of Foot (Walking)

Norah Greer - Dec 06, 2025, 10:57 AM CST

Title: Where weight is distributed throughout foot when walking

Date: 9/25/25

Content by: Norah

Present: Norah

Goals:

- Research where pressure is applied under the foot while walking
- Determine the best spot for the sensor to be on the foot for maximum accuracy.

Content:

https://www.researchgate.net/publication/369748138_WEIGHT_DISTRIBUTION_OF_HUMAN_FOOT_FOR_ERGONOMIC_DESIGN_OF_SHOE

- When walking, our weight goes from the heel, to the outside of the mid-foot, to the ball of the foot, and finally to the toes
- When standing, 57% of our weight is on our heel, and 43% on the forefoot and arch.
- For maximum accuracy, we should place the sensor on the part of the foot where the most pressure is applied.
    - Want sensor to be located on heel or ball of the foot
    - Middle is more fleshy and could cause an incorrect reading of pressure

Conclusions/action items: none

References:

[1] M. KUMAR, “WEIGHT DISTRIBUTION OF HUMAN FOOT FOR ERGONOMIC DESIGN OF SHOE,” vol. 02, no. 03, Mar. 2023, doi: https://doi.org/10.55041/isjem00165.

Weight Distribution of Foot (Standing)

Norah Greer - Dec 06, 2025, 10:58 AM CST

Title: Where weight is distributed on foot when stationary

Date: 9/25/25

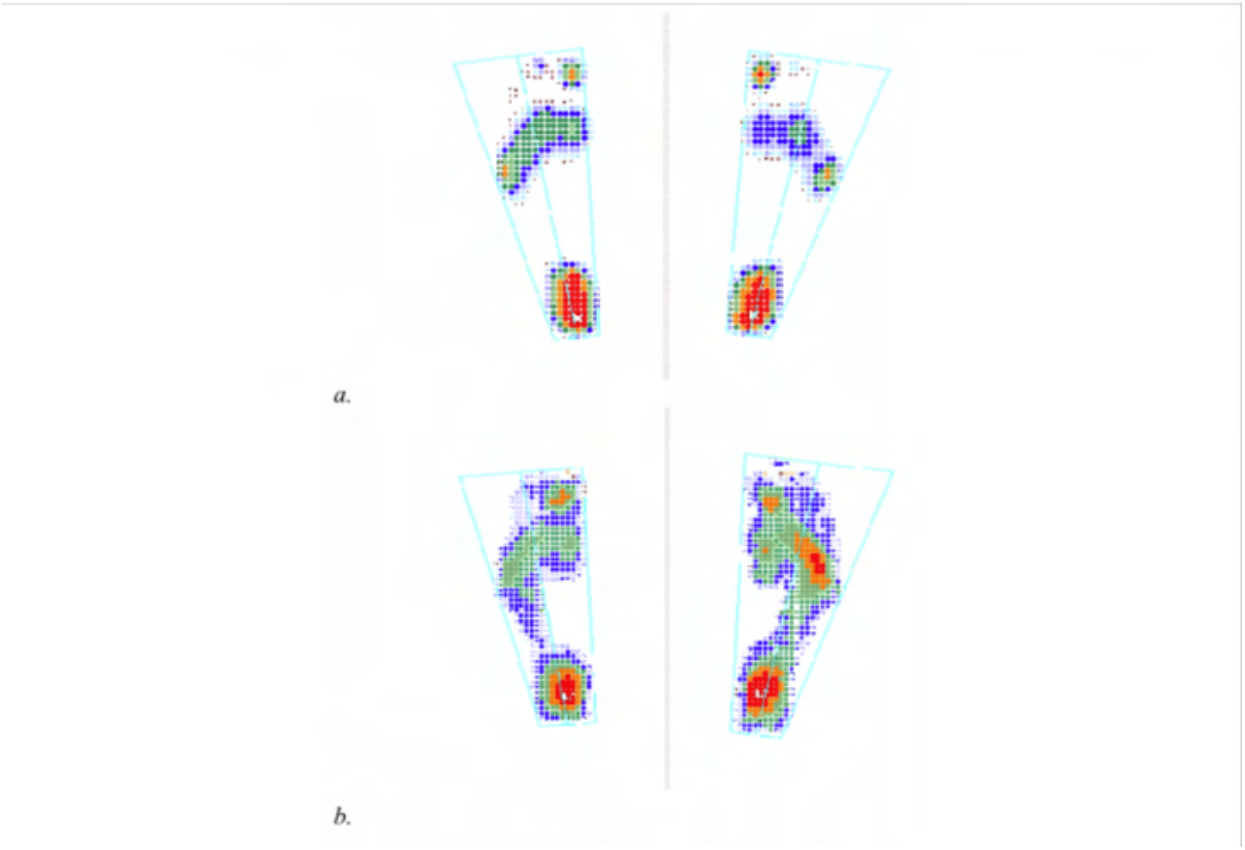
Content by: Norah

Present: Norah

Goals: Look into potential sensor placement based on the part of the foot that supports the largest amount of body weight

Content:

- The majority of body weight when standing is placed on the ball and heel of the foot, with the heel taking the larger portion of the weight
- The mid-foot takes little to none of the weight when standing
    - Should not place sensor here, will be highly inaccurate



- This information lines up with the information gathered from the article about weight distribution while walking
- Should place sensor on ball of foot or heel
    - Possibility for it to be adjusted to either?

Conclusions/action items:

none

References:

[1] V. Tsapenko, M. Tereshchenko, G. Tymchik, S. Matvienko, and V. Shevchenko, “Analysis of Dynamic Load on Human Foot,” pp. 400–404, Apr. 2020, doi: https://doi.org/10.1109/elnano50318.2020.9088788.

STAPPONE rehab

Norah Greer - Dec 06, 2025, 10:23 AM CST

Title: STAPPONE rehab

Date: 9/12/25

Content by: Norah

Present: Norah

Goals: Look into existing designs

Content:

https://www.stappone.com/en/products/partial-weight-bearing-management/stappone-rehab/

- STAPPONE rehab is an insole that tracks weight-bearing over time using sensor-imbedded insoles and an app.
- For use constantly throughout rehab period
- Priced at 499 (Euro)
- Spits out different data:
    - Time over weight-limit
    - Avg. Load
    - Max Load
    - Graphic representation of weight applied throughout session

UPDATE 9/16/25: Client wants something really adjustable to be used on all of his patients (kids to adults with very swollen feet). Mentioned many of his patients are unable to put shoes on so this product would be ineffective.

Conclusions/action items:

none

Novel loadpad

Norah Greer - Dec 06, 2025, 10:23 AM CST

Title: Novel Loadpad

Date: 9/12/25

Content by: Norah

Present: Norah

Goals: Look into existing products

Content:

https://www.novelusa.com/loadpad

- Novel Loadpad is a thin, flexible pad that can be placed between a soft and a hard surface (ex. foot and floor)
- Has electronic box that is matchbox-sized.
- Spits out data to an app via Bluetooth
- Many sizes available

Conclusions/action items:

none

Novel loadsol

Norah Greer - Dec 06, 2025, 10:22 AM CST

Title: Novel Loadsol

Date: 9/12/25

Content by: Norah

Present: Norah

Goals: Look into existing products

Content:

https://www.novelusa.com/loadsol

- Novel loadsol is similar to STAPPONE rehab in that it is a sensor-imbedded insole that spits out data to an app.
    - Not rehab specific, cannot set limit in app and can't get any type of live feedback
    - Has external electronics pack
    - Powered by coin batteries, only lasting for up to 24 hours

UPDATE 9/16/25: Similar to STAPPONE rehab, would not work for our client, as it is not adjustable to be used on multiple patients

Conclusions/action items:

none

ComeBack Mobility Smart Crutch Tips

Norah Greer - Dec 06, 2025, 10:22 AM CST

Title: ComeBack Mobility Smart Crutch Tips

Date: 9/12/25

Content by: Norah

Present: Norah

Goals: Look into existing products

Content:

https://comebackmobility.com/patient/

- Rather than measuring the amount of weight the patient puts on their limb, this product measures the amount of weight the patient puts on their crutches, and uses the patient's body weight to determine the weight on the foot
- Spits out data to an app
- A bit simpler as do not have to take into account comfort under the foot (size)

UPDATE 9/16/25: Not sure if this would work for client, he uses walkers in his facility, not crutches

Conclusions/action items:

none

OpenGo Sensor Insoles

Norah Greer - Dec 06, 2025, 10:22 AM CST

Title: OpenGo Sensor Insoles

Date: 9/12/25

Content by: Norah

Present: Norah

Goals: Look into existing products

Content:

https://moticon.com/opengo/sensor-insoles

- Very similar to other insole options
  - Embedded battery and sensors
  - Bluetooth connection
- Not specific to rehab so cannot set weight limit and get feedback when limit is exceeded.

Conclusions/action items: none

Preliminary Design Ideas

Norah Greer - Sep 26, 2025, 8:30 PM CDT

Title: Preliminary Design Ideas

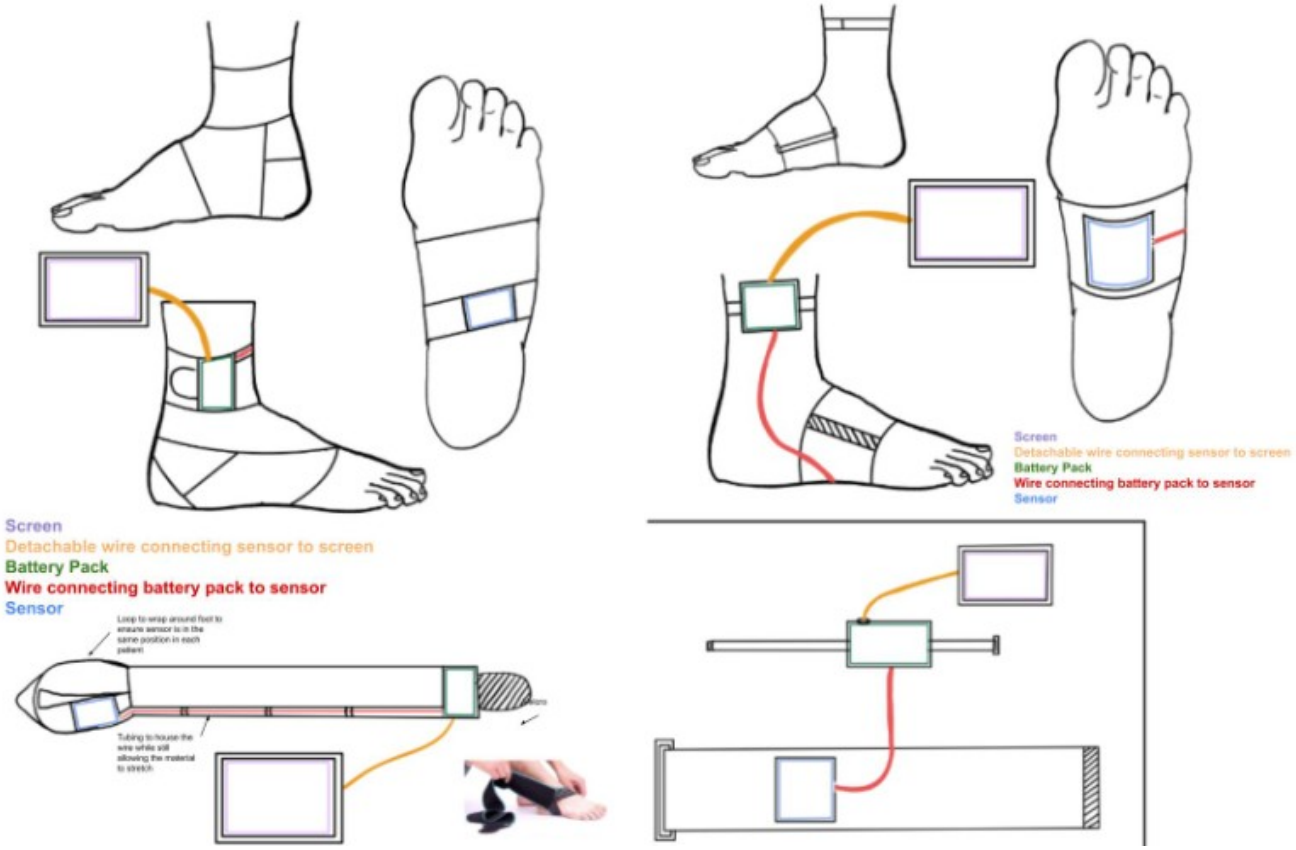
Date: 9/23/25

Content by: Norah

Present: Norah

Goals: Sketch Preliminary Design Ideas.

Content:



Conclusions/action items: Share sketches with the team and add them to the Design Matrix.

Load Cell Platform Design

Norah Greer - Dec 06, 2025, 9:01 AM CST

Title: CAD Model of Load Cell Platform Design

Date: 10/23/25

Content by: Norah

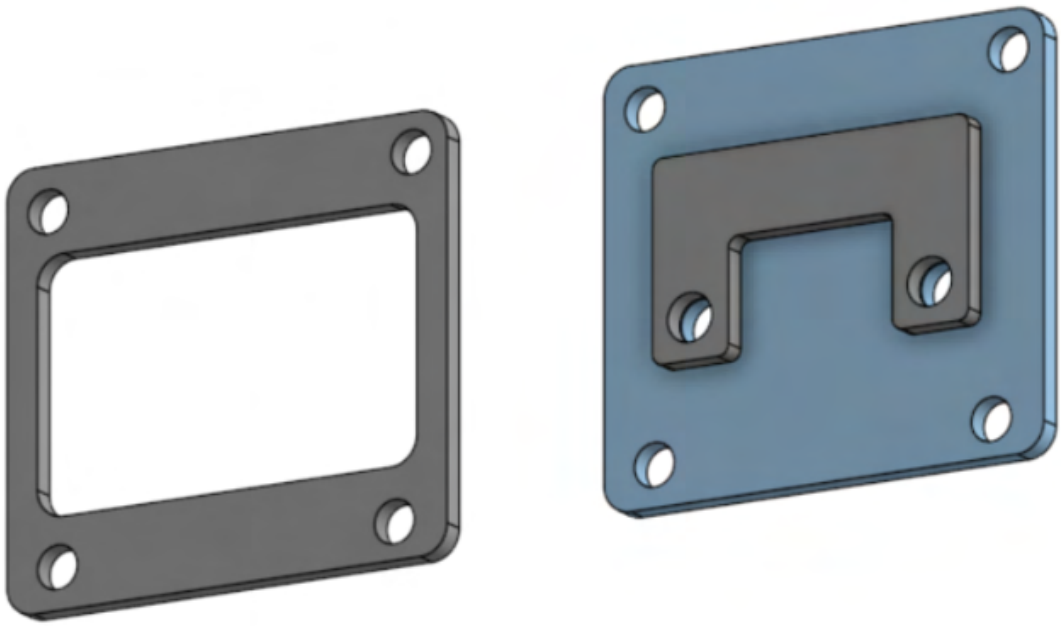
Present: Norah

Goals: Design something that could be attached to the load cell, allowing it to deflect

Content:

- Need something that protrudes on top and something with a cutout on the bottom. Top will push middle part of the loadcell down into the cutout.

Final Design:



- Fabrication Options:
  - Laser cut: Acrylic for strength, but it is thick
  - 3D printed: Would not be very strong
  - Cut out of metal: Has potential to be both thin and strong, unsure if we would be able to do this in makerspace
- To attach to load cell:
  - Top portion (blue): 2 pieces will be glued together. Middle gray piece will be fastened to middle portion of load cell using screws and nuts.
  - Bottom portion (gray): Will be glued to the bottom of the load cell

Conclusions/action items:

Machining Training

Title: Machining Training

Date: 10/31/25

Content by: Norah Greer

Content:

NORAH GREER

ID Number: 9086855773

Eligibility: CoE Students

Profile

My Memberships

Membership Type	Start Date	Expiry Date	Rer
Machining	Wed, Aug 20 2025	Permanent	Not
Shop Tools	Tue, Aug 20 2024	Thu, Jan 2 3000	Not
Laser Cutter	Tue, Aug 20 2024	Thu, Jan 2 3000	Not
Lab Orientation	Tue, Aug 20 2024	Wed, Dec 31 3000	Not
Shop Tools - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not
Laser Cutter - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not

Into to Shop Tools

Title: Intro to Shop Tools

Date: 10/31/25

Content by: Norah Greer

Content:

NORAH GREER

ID Number: 9086855773

Eligibility: CoE Students

Profile

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Lab Orientation	Tue, Aug 20 2024	Wed, Dec 31 3000	Not
Shop Tools - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not
Laser Cutter - Training Eligible	Tue, Aug 20 2024	Wed, Dec 31 3000	Not

Chemical Safety Training

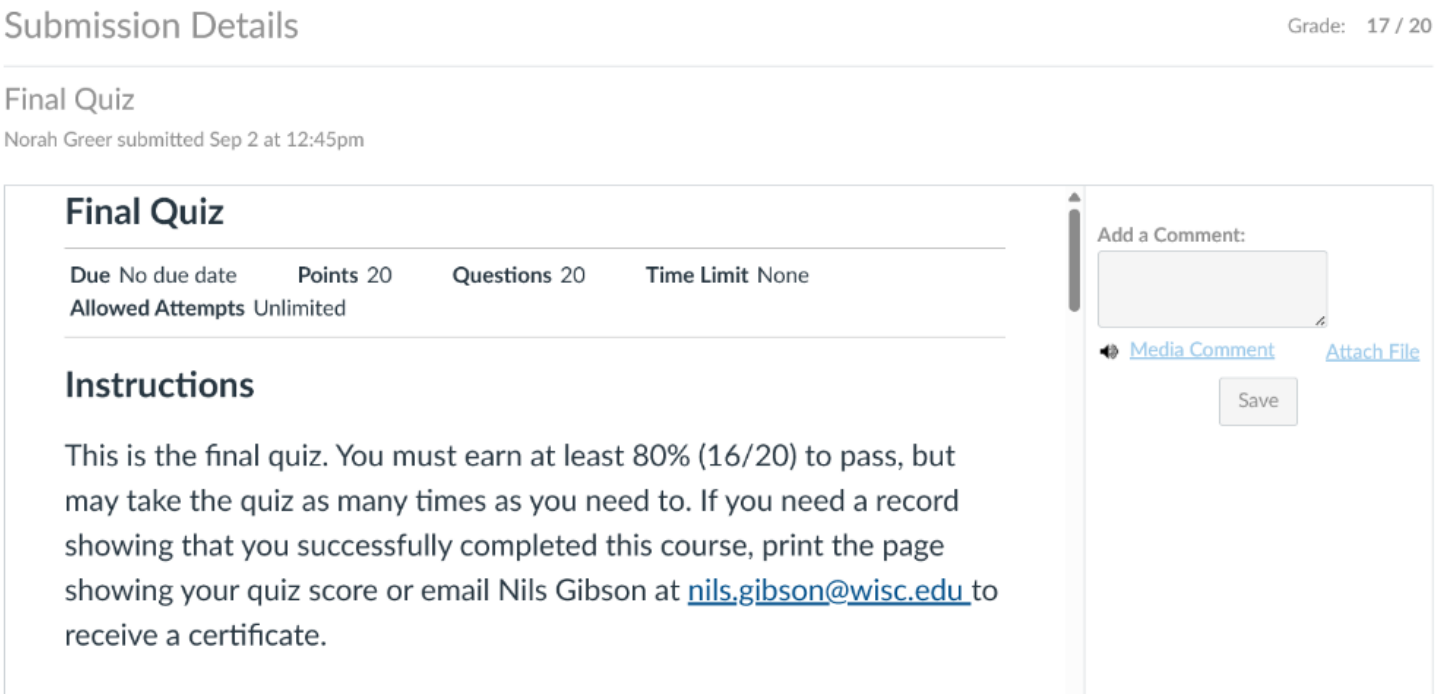
Norah Greer - Oct 31, 2025, 11:03 AM CDT

Title: Chemical Safety Training

Date: 10/31/25

Content by: Norah Greer

Content:



Biosafety Training

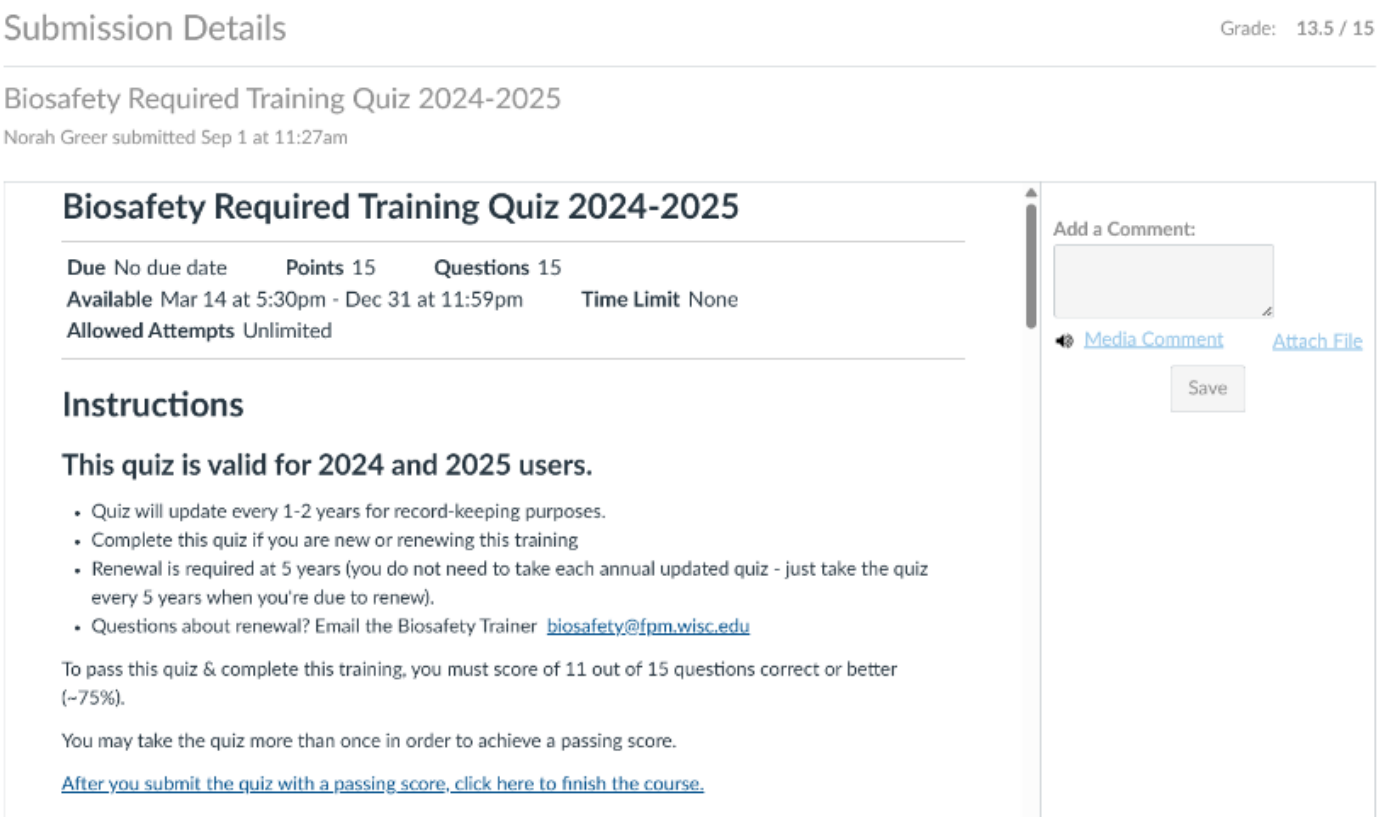
Norah Greer - Oct 31, 2025, 11:04 AM CDT

Title: Biosafety Training

Date: 10/31/25

Content by: Norah Greer

Content:



Submission Details

Grade: 13.5 / 15

Biosafety Required Training Quiz 2024-2025

Norah Greer submitted Sep 1 at 11:27am

Biosafety Required Training Quiz 2024-2025

Due No due date **Points** 15 **Questions** 15
Available Mar 14 at 5:30pm - Dec 31 at 11:59pm **Time Limit** None
Allowed Attempts Unlimited

Instructions

This quiz is valid for 2024 and 2025 users.

- Quiz will update every 1-2 years for record-keeping purposes.
- Complete this quiz if you are new or renewing this training
- Renewal is required at 5 years (you do not need to take each annual updated quiz - just take the quiz every 5 years when you're due to renew).
- Questions about renewal? Email the Biosafety Trainer biosafety@fpm.wisc.edu

To pass this quiz & complete this training, you must score of 11 out of 15 questions correct or better (~75%).

You may take the quiz more than once in order to achieve a passing score.

After you submit the quiz with a passing score, click here to finish the course.

Add a Comment:

Media Comment Attach File

Save

Team Meeting - 9/5/25

Norah Greer - Sep 26, 2025, 8:56 PM CDT

Title: Team Meeting 1

Date: 9/5/25

Content by: Norah

Present: Norah, Keira, Cassity, Jetzu, Niko

Goals: Get to know the team, assign roles, and talk about questions we may have during our first client meeting.

Content:

We set a time to meet each week with both our team and our advisor and exchanged contact information. We began our project by assigning roles to each group member, and starting our first progress report.

Conclusions/action items: Finish progress report 1, start brainstorming ideas

Team Meeting - 9/12/25

Norah Greer - Sep 26, 2025, 8:53 PM CDT

Title: Initial Team Meeting

Date: 9/5/25

Content by: Norah

Present: Norah, Keira, Cassity, Jetzu, Niko

Goals: Discuss questions we want to ask our client, start/assign sections for the PDS

Content:

We started the PDS, splitting up the sections among the group.

While starting the PDS, we realized there were multiple sections that we needed more information from the client to complete. We decided we need to ask the client to be more specific about how the device will interact with the patient (insole, strap, pad, etc.?)

Conclusions/action items: Fill out the PDS

Team Meeting - 9/19/25

Norah Greer - Sep 26, 2025, 9:07 PM CDT

Title: Team Meeting 3

Date: 9/19/25

Content by: Norah

Present: Norah, Keira, Cassity, Jetzu, Niko

Goals: Discuss PDS and possible design options, Talk about Design Matrix

Content:

We discussed the PDS and various different options for designs, keeping in mind our client's requests. We decided to divide the sketching work so Keira, Cassity, and I will draw the pad/strap designs, and Niko and Jetzu will work on the circuit designs. We also decided on the categories we will use for our design matrix and how each category should be weighted.

Conclusions/action items: Draw preliminary ideas, complete the design matrix

Team Meeting - 9/26/25

Norah Greer - Sep 26, 2025, 9:14 PM CDT

Title: Team Meeting 4

Date: 9/26/25

Content by: Norah

Present: Norah, Keira, Cassity, Jetzu, Niko

Goals: Discuss results of the Design Matrix, Start Preliminary Presentation.

Content:

We discussed the results of the design matrix and looked more into logistics of making the device (what sensor to buy/how the sensor will be implemented into the strap design). We also created our preliminary presentation and divided up the slides each person will fill out/present. We decided a time to meet over the weekend to complete the presentation and practice our presentation.

Conclusions/action items: Complete the Presentation, Practice Presenting.

Team Meeting - 10/2/25

Norah Greer - Nov 07, 2025, 12:06 PM CST

Title: Team Meeting 5

Date: 10/2/25

Content by: Norah

Present: Norah, Niko, Jetzu, Cassity, Keira

Goals: Finish Slides for Preliminary Presentation, Run through presentation to make sure we are within the allotted time.

Content:

Link to Slides

https://docs.google.com/presentation/d/1UVXUIwch1oEeVF5aNiHdch58zlNRdN-JLX6JX0nRzaE/edit?usp=sharing

Conclusions/action items: Continue practicing slides, present in class on Friday

Team Meeting - 10/3/25

Norah Greer - Dec 02, 2025, 9:17 PM CST

Title: Preliminary Presentation

Date: 10/3/25

Content by: Norah

Present: Norah, Cassity, Keira, Niko, Jetzu

Goals:

- Present our project to the other groups

- Listen to feedback/ideas

Content:

https://docs.google.com/presentation/d/1UVXUIwch1oEeVF5aNiHdch58zlNRdN-JLX6JX0nRzaE/edit?usp=sharing

Conclusions/action items:

Presentation went well. We took the allotted time, got through all slides. Got some ideas for testing (over time, sensor drift).

Team Meeting - 10/10/25

Norah Greer - Dec 05, 2025, 8:43 PM CST

Title: Weekly Meeting

Date: 10/10/25

Content by: Norah

Present: Norah, Keira, Cassity, Niko, Jetzu

Goals: Discuss a couple of specifics about our prototype

Content:

Fabric Ideas:

- Nylon: Super stretchy but will absorb sweat and bacteria
- Some water resistant fabric: Would avoid bacteria problem but wouldn't be stretchy and not very comfortable under the foot

Other things:

- Wires will be able to stretch with strap by being enclosed in a tube of fabric (leaving some slack in the wires)
- Battery pack, breadboard, amplifier, etc. will be housed in a box either attached to the end of the strap, or attached via a Velcro strap to the ankle.

Conclusions/action items: Start finalizing some design ideas and start ordering some materials.

Team Meeting - 10/17/25

Norah Greer - Dec 05, 2025, 8:56 PM CST

Title: Look at Materials

Date: 10/17/25

Content by: Norah

Present: Norah, Cassity, Keira, Niko

Goals: Look at our materials that have arrived

Content:

Load cell and amplifier arrived, need to make some kind of platform for the load cell to allow it to deflect.

Platform will consist of a top portion that protrudes and a bottom portion that is hollow to allow the load cell space to push downwards.

Conclusions/action items: Start designing platform, Niko will start working on the electrical components.

Team Meeting - 10/24/25

Norah Greer - Dec 02, 2025, 9:28 PM CST

Title: Discuss next steps

Date: 10/24/25

Content by: Norah

Present: Norah, Cassity, Keira, Niko, Jetzu

Goals:

- Figure out what needs to get done this work

- Divide up work for the next week

Content:

- My goals are to 3D model the strap

- Other group members are 3D modeling screen, coding, looking into more materials

UPDATE 10/31/25:

https://cad.onshape.com/documents/79dfe62d22aeda770eb79a26/w/b82f358d4a3bdc64a60883f5/e/5983340006ba845f72768724?renderMode=0&uiState=692fad720d2694ebb8144836

Conclusions/action items:

- Will start to work on strap design and have done for next Friday

- UPDATE 10/31/25: had some issues getting the drawing to look like fabric, took some trial and error but got it figured out.

Team Meeting - 10/31/25

Norah Greer - Dec 02, 2025, 9:40 PM CST

Title: Show and Tell

Date: 10/31/25

Content by: Norah

Present: Norah, Cassity, Keira, Niko, Jetzu

Goals:

- Present our progress to the rest of the groups

- Get some feedback/advice from other groups

Content:

Take Aways:

- Bluetooth tiny3 board, can replace Arduino and allow for Bluetooth

- Yellow screen will allow for Bluetooth as well, better quality

- Stretch on Wires?

- Test all parts of the circuit separately

Conclusions/action items:

- Look into the new components

- Start constructing prototype

Team Meeting - 11/2/25

Norah Greer - Dec 07, 2025, 1:17 PM CST

Title: Team Meeting 11/2/25

Date: 11/2/2025

Content by: Norah

Present: Norah, Niko, Jetzu, Keira, Cassity

Goals: Go Over Tasks to be completed before poster session

Content:

- Add some kind of foam to the load cell assembly, and sew wiring and load cell to the strap

- Give strap to Niko before leaving for Thanksgiving

- Cassity and Keira will start working on poster

- Niko/Jetzu will work on coding/bluetooth

Conclusions/action items:

9/12/25 - Advisor Meeting

Norah Greer - Dec 05, 2025, 9:18 PM CST

Title: Advisor Meeting 1

Date: 9/12/25

Content by: Norah

Present: Norah, Keira, Cassity, Niko, Jetzu

Goals: Introduce ourselves to our advisor, figure out what expectations are for the semester

Content:

- Introduced ourselves to our advisor, talked about research, paths in BME
- Discussed PDS and his expectations for completing it
- After meeting, discussed when would be the best time for us to meet as a team
    - During class period after weekly advisor meeting at 12:30 on Fridays

Conclusions/action items:

- Start brainstorming ideas for project, work on PDS

9/19/25 - Advisor Meeting

Norah Greer - Dec 05, 2025, 9:51 PM CST

Title: Advisor Meeting 2

Date: 9/19/25

Content by: Norah

Present: Norah, Cassity, Keira, Niko, Jetzu

Goals:

- Discuss program in PDS
- Ask about grading for notebook

Content:

- Next week we will shift to meetings in his office (2139 ECB)
- Design matrix due on Friday
    - Work on overall sketches --> can be rough hand drawn
    - Rank these using design matrix
        - Finalize categories
    - Also design circuit and make design matrix (Jetzu and Niko)
- Reports
    - Preliminary report due soon
        - Need data
- Testing
    - If tracking specific patient data, need to look into HIPPA --> don't think we will ever assign names to data, will only be real-time readout
    - Most likely will use gym weights for testing

Conclusions/action items:

Finish design matrix, start looking at prelim. report

10/6/25 - 2nd Client Meeting

Norah Greer - Dec 05, 2025, 9:03 PM CST

Title: Second Client Meeting

Date: 10/6/25

Content by: Norah

Present: Norah, Jetzu, Cassity

Goals:

- Discuss which of our designs the client likes the best
- Check if one, 100kg max load cell will be sufficient
- How he would like us to go about ordering materials

Content:

- Agrees strap design is best, secure and super adjustable
- 100kg load cell is good, clients are only putting partial weight so would never be going over ~200lbs
- Would prefer to just Venmo BPAG

Other things mentioned:

- Weight display should be in pounds
- Sanitization is important, final design should be able to be wiped clean by a mild sanitizer

Conclusions/action items:

Start fabricating when materials arrive.

Tong Lecture

Norah Greer - Nov 07, 2025, 12:45 PM CST

Title: Building Something That Matters - Why healthcare needs more engineers

Date: 11/7/25

Content by: Norah Greer

Present: Norah Greer

Goals: Listen to lecture and take away key points that can help in the future

Content:

3 Steps of Career

1. Education: Build Engineering Skills: Patents, Problem Solving

2. Climb Growth Curve: Combine EQ with IQ to multiply impact and reach

3. Build and Transform: Drive system-level impact through innovation and scare

Don't need to know final destination: Just follow next best decision/opportunity

Healthcare System:

- **Aims**: Improved Provider Experience, Improved Patient Outcomes, Lower Cost of Care, Improved Patient Experience

US spends 2x more per person on healthcare, but lower quality of care (ex. higher maternal mortality rate, higher provider burnout, etc.)

1. Hard Work and Build Range: Take on hardest projects, classes and experiences you can find. Effort and range are your foundation

2. Seek Diverse Exposure: Explore different sectors, teams, and geographies. Gain Perspective and learn how systems connect, not just how parts work.

3. Choose Your People Wisely: Surround yourself with curious, driven, high-integrity people. They will shape who you become.

4. Know Your Values & Protect Them: Define what matters most - Family/Friends, health, career/impact, values -- and make decisions that align.

5. Embrace Challenge and Keep Growing: **Run towards hard problems**. Growth live on the edge of discomfort -- where big impact starts.

Conclusions/action items:

Research - Weight distribution of foot

KEIRA FERRIGAN - Dec 10, 2025, 10:18 PM CST

Title: Weight distribution of foot

Date: 9/8/25

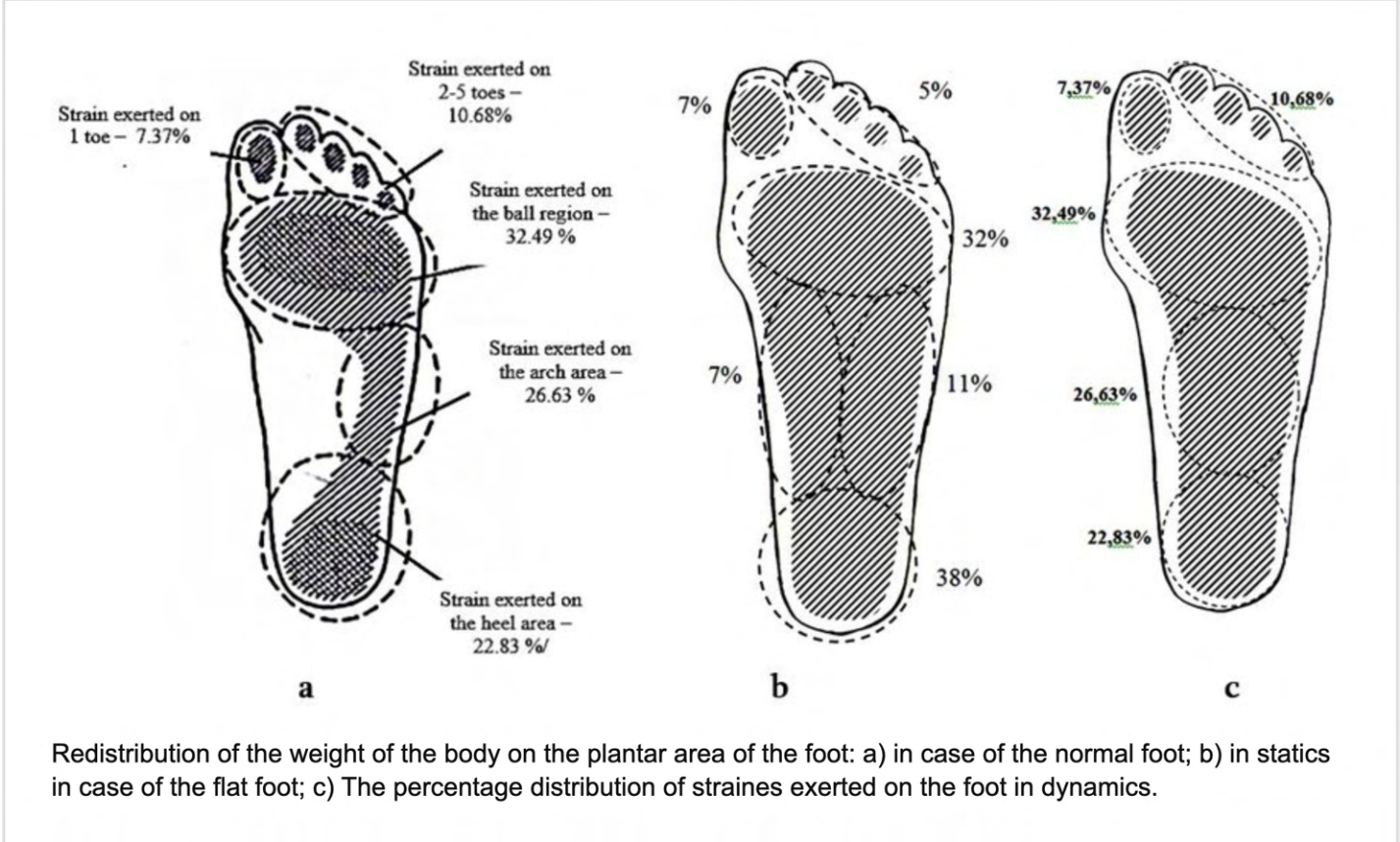
Content by: Keira

Content:

https://pmc.ncbi.nlm.nih.gov/articles/PMC11556619/#:~:text=Background:,balance%20and%20plantar%20pressure%20parameters.

- In a normal gait pattern, when the initial body weight is transferred to one of the lower extremities, the rearfoot and the forefoot are loaded in a balanced manner
- The weight distribution corresponds to 60% (rearfoot) to 40% (forefoot).
- In a study evaluating plantar pressure distributions in adolescent runners using a pressure-sensitive insole system, it was observed that high-speed running increases plantar pressure in the forefoot and midfoot regions
- there are many factors that can change the fore-rear foot weightbearing ratio, postural balance training, activation of foot flexor muscles, and even the use of insoles are some of these factors

https://www.researchgate.net/figure/Redistribution-of-the-weight-of-the-body-on-the-plantar-area-of-the-foot-a-in-case-of_fig1_325359275



Redistribution of the weight of the body on the plantar area of the foot: a) in case of the normal foot; b) in statics in case of the flat foot; c) The percentage distribution of straines exerted on the foot in dynamics.

Conclusions:

When thinking about what kind of design we would like to incorporate for our sensor, it's important to think about what weight is distributed on each part of the foot when walking/standing. As we can see from both articles, the ball of the foot and the heel of the foot have the greatest weight distribution. This means we should target the heel and/or the ball of the foot to get the most accurate

results for our client and his patients. That being said, if we do a sole type of idea, we would just put our pressure sensor at one of those areas.

Edit: Our client mentioned he wanted something adjustable and to be placed anywhere on the foot)

References:

[1] Figure 7. case of balanced distribution of body weight on the plantar..., https://www.researchgate.net/figure/Case-of-balanced-distribution-of-body-weight-on-the-plantar-surface-load-L-49-load-R_fig1_352034191 (accessed Dec. 10, 2025).

[2] S. Cerezci-Duygu, H. Sarak-Kucukosmanoglu, and A. Aytar, “The effect of weight distribution in the foot on balance and plantar pressure in female adolescent athletes,” Sports health, https://pmc.ncbi.nlm.nih.gov/articles/PMC11556619/#:~:text=Background:,balance%20and%20plantar%20pressure%20parameters. (accessed Dec. 10, 2025).

Research - Weight bearing restrictions

KEIRA FERRIGAN - Dec 10, 2025, 10:20 PM CST

Title: Weight bearing

Date: 9/15/25

Content by: Keira

Content:

https://www.orthofixacademy.com/magazine/bone-healing-the-role-of-weight-bearing-and-dynamization-1200

- If such forces remain too high during this period (inadequate stability), the result is a fibrous non-union. Therefore, external frames should be very stable in the early period to promote bone healing, but also to allow weight bearing as soon as possible.
- As the healing process advances, the bone can bear a greater load and less stability is required. But for a more flexible fixation to result in a successful response, there must be a remaining degree of intrafragmentary strain to stimulate the healing process.

Factors influencing the early bone healing process:

- Targeting the mechanical environment in fracture repair can intensify the healing response and accelerate callus formation, but bone healing is a well-orchestrated interaction between mechanical and biological components, requiring careful timing and attention.
- There are several factors influencing the time required for bone healing, including the type of fracture and frame used, bone-fixator distance, extent of fracture repair, other traumas in the same or the other limb, level of pain, and the patient’s physical and psychological condition, as well as their social conditions

Timeline of weight-bearing injuries:

- In the presence of a stable fracture, progressive loading should start 2 to 4 weeks after surgery – initially with 30% weight bearing, then 75%, and up to 100%. With unstable fractures, progressive loading should commence 5 to 8 weeks after surgery, with an initial 15% weight bearing, then 75% within two months after the operation, up to 100% over the following month, but only with radiological evidence of good callus formation. In any case, weight bearing, as tolerated by the patient, is at the surgeon's discretion.

Conclusions:

I was curious about what kinds of injuries caused these weight-bearing restrictions and why they are assigned. I was also curious about the process for weight-bearing restriction percentages during the recovery and rehabilitation processes. It's interesting to see the gradual increase in the amount of weight they are allowed to put on their foot after several weeks. I find it fascinating that it can be up to 100% weight-bearing from about two to three months after injury/surgery.

Edit: Our client said it would mainly go on the heel, but would like the ability to place anywhere on foot

References:

[1] “Bone healing: The role of weight bearing and dynamization,” Orthofix Academy, https://www.orthofixacademy.com/magazine/bone-healing-the-role-of-weight-bearing-and-dynamization-1200 (accessed Dec. 10, 2025).

Research - Types of 3D Printers

KEIRA FERRIGAN - Dec 06, 2025, 4:52 PM CST

Title: Types of 3D Printers

Date: 11/2/25

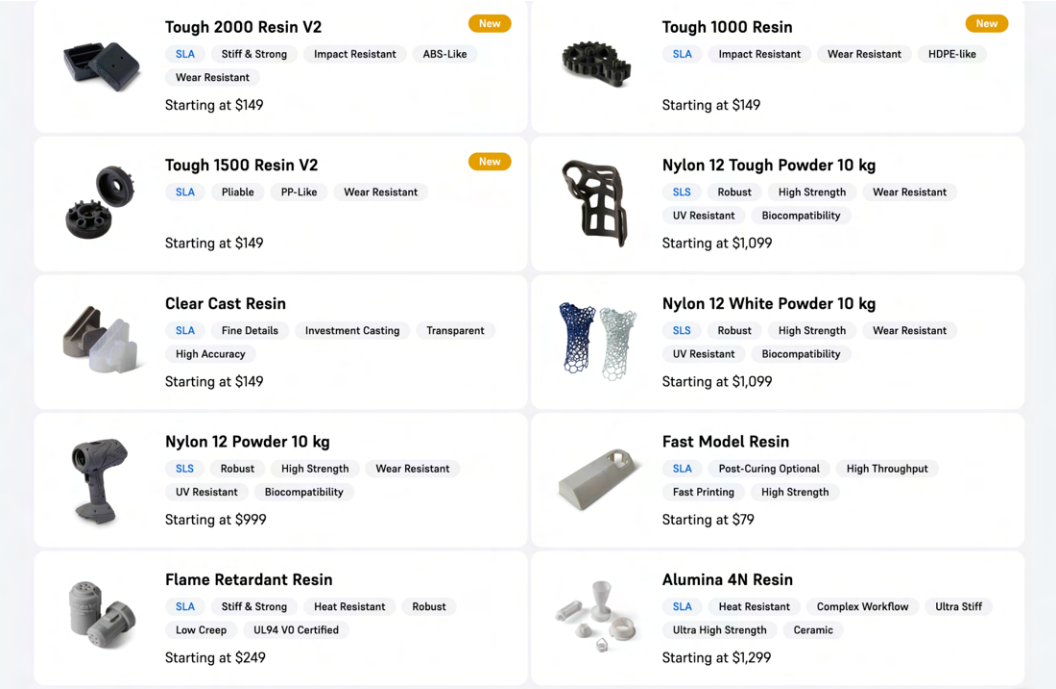
Content by: Keira

Content:

https://formlabs.com/3d-printers/?srsltid=AfmBOorfkcMFGGcDUNM6Svacp27fV5Mkr4ghqfsdXHPW6GvEo5H_bcIg

- Stereolithography (SLA)
  - great option for highly detailed prototypes requiring tight tolerances and smooth surfaces, such as molds, patterns, and functional parts.
    - Stereolithography is ideal for:
      - Rapid prototyping
      - Functional prototyping
      - Concept modeling
      - Short-run production
      - Dental applications
      - Jewelry prototyping and casting
- Selective Laser Sintering (SLS)
  - low cost per part, high productivity, and established materials
    - Selective laser sintering is ideal for:
      - Parts with flex
      - Functional prototyping
      - End-use parts
      - Short-run, bridge, or custom manufacturing
- Fused Deposition Modeling (FDM)
  - well-suited for basic proof-of-concept models, as well as quick and low-cost prototyping of simple parts
  - However, FDM has the lowest resolution and accuracy when compared to SLA or SLS and is not the best option for printing complex designs or parts with intricate features.
    - Fused deposition modeling is ideal for:
      - Basic proof-of-concept models
      - Simple prototyping

Examples of materials for 3D Printing (w/ cost):



https://making.engr.wisc.edu/equipment/3d-printers/
UW provides us with:

- Bambu Lab (FDM/FFF)
- Formlabs Form 2, 3, + 4 (SLA)
- Formlabs Fuse 1 (SLS)
- Stratasys F370 (FDM/FFF)
- Markforged

Conclusions/action items:

As I start to 3D model the boxes to enclose the wiring as an ankle band and a box to surround the display screen, it's important to know what 3D printer is best to use. After some research about the 3D printers that are easily accessible to us in the Makers Space and by cross referencing to the FormLabs website, I have concluded that I want to either use the FormLabs SLS printer or the FDM Bambu Lab printer. I have used a FDM printer before and feel that it could be very suitable for our project. However, after more research, the SLS printer could also be very suitable for our project because its low cost and flexible. Next steps are to complete my modeling for both boxes then use either printrer at the Makers Space to print them out.

References:

[1] “3D printers,” Grainger Engineering Design Innovation Lab, https://making.engr.wisc.edu/equipment/3d-printers/ (accessed Dec. 6, 2025).

[2] “3D printing guide: Types of 3D printers, materials, and applications,” Formlabs, https://formlabs.com/3d-printers/?srsltid=AfmBOorfkcMFGGcDUNM6Svacp27fV5Mkr4ghqfsdXHPW6GvEo5H_bcIg (accessed Dec. 6, 2025).

Research - cheap yellow displays

KEIRA FERRIGAN - Nov 21, 2025, 9:50 PM CST

Title: Researching Cheap Yellow Displays

Date: 11/13/25

Content by: Keira

Content:

Total Beginners Guide To Using A Cheap Yellow Display With ESPHome:

- Best to buy in bundle deal with the board and two other items
- Use ESPHome to code
- Can use arduino or idf
- Example of code:
    - esphome:
    - name: cyd
    -
    - esp32:
    - board: esp32dev
    -
    - logger:
    -
    - api:
    -
    - ota:
    - - platform: esphome
    -
    - wifi:
    - ssid: "xxxx"
    - password: "xxxx"
    -
    - font:
    - - file:
    - type: gfonts
    - family: Roboto
    - id: roboto_large
    - size: 40
    - bpp: 4
    -
    - globals:
    - - id: display_hello
    - type: bool
    - initial_value: 'true'
    -
    - output:
    - - platform: ledc
    - pin: GPIO21
    - id: backlight_pwm
    -
    - light:

```
  - platform: monochromatic
    output: backlight_pwm
    name: Display Backlight
    id: backlight
    restore_mode: ALWAYS_ON

spi:
  - id: tft
    clk_pin: GPIO14
    mosi_pin: GPIO13
    miso_pin: GPIO12
  - id: touch
    clk_pin: GPIO25
    mosi_pin: GPIO32
    miso_pin: GPIO39

display:
  - platform: ili9xxx
    model: ILI9341
    spi_id: tft
    cs_pin: GPIO15
    dc_pin: GPIO2
    auto_clear_enabled: true
    invert_colors: false
    color_palette: 8BIT
    rotation: 0
    dimensions:
      width: 320
      height: 240
    lambda: |-
      auto font = id(roboto_large);
      const char* text;

      if (id(display_hello)) {
        text = "Hello World!";
      } else {
        text = "Goodbye World!";
      }

      int x1, y1, text_width, text_height;

      it.get_text_bounds(0, 0, text, font, TextAlign::TOP_LEFT, &x1, &y1, &text_width,
&text_height);

      int x = (it.get_width() - text_width) / 2;
      int y = (it.get_height() - text_height) / 2;

      it.print(x, y, font, COLOR_WHITE, TextAlign::TOP_LEFT, text);

touchscreen:
  platform: xpt2046
  id: my_touchscreen
  spi_id: touch
  cs_pin: GPIO33
```

- interrupt_pin: GPIO36
- calibration:
- x_min: 208
- x_max: 3823
- y_min: 282
- y_max: 3835
- transform:
- swap_xy: true
- on_touch:
- lambda: |-
- id(display_hello) = !id(display_hello);

[Getting Started with ESP32 Cheap Yellow Display Board – CYD (ESP32-2432S028R)]:

- Gives a rundown of the setup for a windows pc
- Code for testing:
  - /* Rui Santos & Sara Santos - Random Nerd Tutorials
  - THIS EXAMPLE WAS TESTED WITH THE FOLLOWING HARDWARE:
  - 1) ESP32-2432S028R 2.8 inch 240×320 also known as the Cheap Yellow Display (CYD): https://makeradvisor.com/tools/cyd-cheap-yellow-display-esp32-2432s028r/
  - SET UP INSTRUCTIONS: https://RandomNerdTutorials.com/cyd/
  - 2) REGULAR ESP32 Dev Board + 2.8 inch 240x320 TFT Display: https://makeradvisor.com/tools/2-8-inch-ili9341-tft-240x320/ and https://makeradvisor.com/tools/esp32-dev-board-wi-fi-bluetooth/
  - SET UP INSTRUCTIONS: https://RandomNerdTutorials.com/esp32-tft/
  - Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files.
  - The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.
  - */
  -
  - #include <SPI.h>
  -
  - /* Install the "TFT_eSPI" library by Bodmer to interface with the TFT Display - https://github.com/Bodmer/TFT_eSPI
  - *** IMPORTANT: User_Setup.h available on the internet will probably NOT work with the examples available at Random Nerd Tutorials ***
  - *** YOU MUST USE THE User_Setup.h FILE PROVIDED IN THE LINK BELOW IN ORDER TO USE THE EXAMPLES FROM RANDOM NERD TUTORIALS ***
  - FULL INSTRUCTIONS AVAILABLE ON HOW CONFIGURE THE LIBRARY: https://RandomNerdTutorials.com/cyd/ or https://RandomNerdTutorials.com/esp32-tft/   */
  - #include <TFT_eSPI.h>
  -
  - // Install the "XPT2046_Touchscreen" library by Paul Stoffregen to use the Touchscreen - https://github.com/PaulStoffregen/XPT2046_Touchscreen
  - // Note: this library doesn't require further configuration
  - #include <XPT2046_Touchscreen.h>
  -
  - TFT_eSPI tft = TFT_eSPI();
  -
  - // Touchscreen pins
  - #define XPT2046_IRQ 36   // T_IRQ
  - #define XPT2046_MOSI 32 // T_DIN
  - #define XPT2046_MISO 39 // T_OUT
  - #define XPT2046_CLK 25   // T_CLK
  - #define XPT2046_CS 33   // T_CS
  -

```
SPIClass touchscreenSPI = SPIClass(VSPI);
XPT2046_Touchscreen touchscreen(XPT2046_CS, XPT2046_IRQ);

#define SCREEN_WIDTH 320
#define SCREEN_HEIGHT 240
#define FONT_SIZE 2

// Touchscreen coordinates: (x, y) and pressure (z)
int x, y, z;

// Print Touchscreen info about X, Y and Pressure (Z) on the Serial Monitor
void printTouchToSerial(int touchX, int touchY, int touchZ) {
  Serial.print("X = ");
  Serial.print(touchX);
  Serial.print(" | Y = ");
  Serial.print(touchY);
  Serial.print(" | Pressure = ");
  Serial.print(touchZ);
  Serial.println();
}

// Print Touchscreen info about X, Y and Pressure (Z) on the TFT Display
void printTouchToDisplay(int touchX, int touchY, int touchZ) {
  // Clear TFT screen
  tft.fillScreen(TFT_WHITE);
  tft.setTextColor(TFT_BLACK, TFT_WHITE);

  int centerX = SCREEN_WIDTH / 2;
  int textY = 80;

  String tempText = "X = " + String(touchX);
  tft.drawCentreString(tempText, centerX, textY, FONT_SIZE);

  textY += 20;
  tempText = "Y = " + String(touchY);
  tft.drawCentreString(tempText, centerX, textY, FONT_SIZE);

  textY += 20;
  tempText = "Pressure = " + String(touchZ);
  tft.drawCentreString(tempText, centerX, textY, FONT_SIZE);
}

void setup() {
  Serial.begin(115200);

  // Start the SPI for the touchscreen and init the touchscreen
  touchscreenSPI.begin(XPT2046_CLK, XPT2046_MISO, XPT2046_MOSI, XPT2046_CS);
  touchscreen.begin(touchscreenSPI);
  // Set the Touchscreen rotation in landscape mode
  // Note: in some displays, the touchscreen might be upside down, so you might need to set the rotation to 3: touchscreen.setRotation(3);
  touchscreen.setRotation(1);

  // Start the tft display
```

```
  tft.init();
  // Set the TFT display rotation in landscape mode
  tft.setRotation(1);

  // Clear the screen before writing to it
  tft.fillScreen(TFT_WHITE);
  tft.setTextColor(TFT_BLACK, TFT_WHITE);

  // Set X and Y coordinates for center of display
  int centerX = SCREEN_WIDTH / 2;
  int centerY = SCREEN_HEIGHT / 2;

  tft.drawCentreString("Hello, world!", centerX, 30, FONT_SIZE);
  tft.drawCentreString("Touch screen to test", centerX, centerY, FONT_SIZE);
}

void loop() {
  // Checks if Touchscreen was touched, and prints X, Y and Pressure (Z) info on the TFT display and Serial Monitor
  if (touchscreen.tirqTouched() && touchscreen.touched()) {
    // Get Touchscreen points
    TS_Point p = touchscreen.getPoint();
    // Calibrate Touchscreen points with map function to the correct width and height
    x = map(p.x, 200, 3700, 1, SCREEN_WIDTH);
    y = map(p.y, 240, 3800, 1, SCREEN_HEIGHT);
    z = p.z;

    printTouchToSerial(x, y, z);
    printTouchToDisplay(x, y, z);

    delay(100);
  }
}
```

Conclusions/action items:

From this research, I've learned that the most commonly used cheap yellow display is an ESP32-2432S028R.

A few options I have found:

Amazon - Option 1: This one is an ESP32-2432S028R, but has an acrylic casing around it, $21.98

Amazon - Option 2: This one is also an ESP32-2432S028R, but without the casing, $16.98

References:

[1] C. Ruhlman, “Esp32 cheap yellow display board (ESP32-2432S028R),” Random Nerd Tutorials, https://randomnerdtutorials.com/cheap-yellow-display-esp32-2432s028r/ (accessed Nov. 21, 2025).

[2] “Total beginners guide to using a cheap yellow display with ESPHome,” decryption’s blog, https://blog.decryption.net.au/posts/cyd-for-beginners.html (accessed Nov. 21, 2025).

Research - way to secure screen to walker

KEIRA FERRIGAN - Dec 06, 2025, 4:52 PM CST

Title: Way to secure the screen to a walker

Date: 11/21/25

Content by: Keira

Content:

Needs:

- Way to secure the display screen to a walker
- Has to be removable
- Cannot slip and rotate downward
- 1 inch diameter

Option 1 - Clip

Clip 1

The size of this clamp is approx. 2.4 inch in length and fits greenhouse frame tubing with an outside diameter of 1 inch, also ideal for other types of plastic stake or metal round tubes; Enough quantity to meet your daily use and greenhouse replacement needs

Clip 2

Durable Material: The pipe clamp is made of high quality PVC material, with tight structure and good toughness, not easy to deform and break, can fix and protect pipelines well, wear resistant and durable.

Clip 3

The u-hook pipe holder is made of high-quality ABS plastic material, it is not easy to break. Compared to metal clamps, plastic pipe support hangers do not rust and can be used for a long time.

Option 2 - Velcro

Velcro 1

Strong, reusable VELCRO® Brand ONE-WRAP® fasteners feature hook and loop laminated back to back without glue, so there’s no chemical residue. A variety of styles are available in 11 colors, making VELCRO® Brand ONE-WRAP® fasteners ideal for coding network and electrical wiring.

Velcro 2

VELCRO® BRAND REUSABLE ONE-WRAP® STRAP 1" X 5 FEET. Hooks are on one side, loop material is on the other. Front side mates with back side to create a secure closure.

Velcro 3

Hooks and loops are intertwined on the same side, just pass through the metal square buckle, and reverse the bonding, then cut to the appropriate length. 32ft straps with 50pcs buckles, you can make up to 50pcs buckle straps.

Conclusions/action items:

I ended up buying Clip 3 because it seemed like the best overall option. After contacting our client, he seemed to be a little skeptical of whether the velcro would wear or if it would end up slipping and rotating the display screen towards the ground. So we ruled out the velcro. Out of the 3 clips I found, this one seems easiest to install and connect to our display screen, durable, and still has a sleek design. It is also relatively cheap ($6.99, $7.37 with tax).

References:

N/A

Research - Overview of Competing Designs

KEIRA FERRIGAN - Dec 08, 2025, 4:37 PM CST

Title: Overview of Competing Designs

Date: 9/10/25

Content by: Keira

Content:

https://pmc.ncbi.nlm.nih.gov/articles/PMC12191147/

Sixty-two studies met the inclusion criteria. About 39% of studies used an insole-type device, which could be worn in a shoe or integrated into a removable boot. Other device types included step count or activity monitors (52%), force plates (18%), pressure film (2%) and external pedobarography systems (27%).

Device Metrics

Device/Model		Type	Force	Pressure	Step Count	Remote Tracking	Data Storage	Study	Source
Force plate	Bertec	Force plate	Yes	No	No	No	N/A	Dabke et al,[11] Bozkurt et al[12]	Dabke et al,[11] Bozkurt et al[12]
Force plate	Kistler	Force plate	Yes	No	No	No	N/A	Joslin et al,[13] Catani et al,[14] Kitaoka et al[15]	Joslin et al,[13] Catani et al,[14] Kitaoka et al[15]
Force plate	NS	Force plate	Yes	No	No	No	N/A	Kershaw et al[16]	Kershaw et al[16]
Force plate	NS	Force plate	Yes	No	No	No	N/A	van Hoeve et al[17]	van Hoeve et al[17]
Force plate	NS	Force plate	Yes	No	No	No	N/A	Wardlaw et al[18]	Wardlaw et al[18]
Force plate	AMTI	Force plate	Yes	No	No	No	N/A	Mittlmeier et al[19]	Mittlmeier et al[19]
Force plate	Custom	Force plate	Yes	No	No	No	N/A	Pratt et al[20]	Pratt et al,[20] Pratt et al[21]
RehaWalk Treadmill	Zebris	Multiple	Yes	Yes	No	No	N/A	Mendel et al[22]	Zebris[23]*
EMED	Novel	External pedobarography	Yes	Yes	No	No	N/A	Durr et al,[24] Mehlhorn et al,[25] Çolak et al,[26] Kosters et al,[27] Jansen et al,[28] Jansen et al,[29] Hirschmuller et al,[30] Becker et al,[31] Rosenbaum et al,[32] Mittlmeier et al,[33] Mittlmeier et al[19]	Novel[34]*
Footscan	Materialise (RSscan)	External pedobarography	No	Yes	No	No	N/A	Genc et al,[35] Zielinski et al,[36] Schepers et al,[37] Schepers et al[38]	Materialise[39]*

FootWork	Podoactivia	External pedobarography	Yes	Yes	No	No	N/A	Jordan-Palomar et al[40]	Jordan-Palomar et al,[40] Alfaro-Santafé et al[41]
Dynamic optical pedobarograph	NS	External pedobarography	No	Yes	No	No	N/A	Davies et al[42]	Davies et al[42]
GANGAS	Medilogic	Insole	No	Yes	No	No	N/A	Besch et al,[43] Follak & Merk[44]	Mediologic[45]*
Pedar	Novel	Insole	Yes	Yes	Yes	No	N/A	Hunt et al,[46] Hetsroni et al,[47] Kuschnaroff Contreras et al,[48] Vasarhelyi et al[49]	Novel[50]*, Novel[51]*
F-scan	Tekscan	Insole	Yes	Yes	Yes	Yes	2h**	Koval et al,[52] Teng et al,[53] Kuschnaroff Contreras et al[54]	Tekscan[55]*
SensiStep/FeetB@ck	Evalan	Insole	Yes	No	Yes	Yes	24h	Raaben et al,[56] Bakker et al[57]	Bakker et al,[57] Evalan[58]*
Custom	Custom	Insole	Yes	No	Yes	Yes	>24h**	Aranzulla et al[59]	Aranzulla et al[59]
SmartStep	Andante	Insole	Yes	No	Yes	Yes	NS	Hershko et al[60]	Isakov,[61] VirtualPoint[62]+
OpenGO	Moticon	Insole	Yes	Yes	Yes	Yes	~1-32h‡	Braun et al,[10] Braun et al[63]	Moticon[64]*
ReGO	Moticon	Insole	Yes	Yes	Yes	No	N/A	Eickhoff et al[65]	Moticon[66]*
Advanced Tibial Load Analysis System (ATLAS)	Custom	Insole	Yes	No	Yes	Yes	3m	North et al,[67] Lajevardi-Khosh et al,[68] Lajevardi-Khosh et al,[69] Lajevardi-Khosh et al,[70] North et al[71]	North et al,[72] Lajevardi-Khosh et al[70]
ParoTec	Paromed	Insole	No	Yes	No	No	NS	Dudkiewicz et al[73]	Paromed[74]*, Paromed[75]*
Fscan	Footlabs	Insole	Yes	Yes	No	NS	NS	Kinner et al[76]	Kinner et al[76]
NS	Penny andGiles	Insole	No	Yes	No	NS	NS	Follak & Merk[44]	Follak & Merk[44]
Pressure Sensitive Film	FujiFilm	Pressure film	Yes	Yes	No	No	N/A	Chiodo et al[9]	FujiFilm[77]*
Alta HR	Fitbit	Activity monitor	No	No	Yes	Yes	7d^	Reppas-Rindlisbacher et al[78]	FitBit[79]
Charge 4	Fitbit	Activity monitor	No	No	Yes	Yes	7d^	Hewage et al[80]	FitBit[81]
NS	Fitbit	Activity monitor	No	No	Yes	Yes	NS	Mendel et al[22]	Mendel et al[22]

StepWatch3	Modus Health	Activity monitor	No	No	Yes	Yes	>2m	Reider et al,[82] Kosters et al[27]	Cyma Tech[83]
Actibelt RCT2	Trium	Activity monitor	No	No	Yes	Yes	75d	Mueller et al[84]	Daumer (e-mail communication, March 9th, 2024)
Flex	Fitbit	Activity monitor	No	No	Yes	Yes	7d^	Schmal et al[85]	FitBit[86]
Shine	Misfit	Activity monitor	No	No	Yes	Yes	30d^	Schmal et al[85]	Misfit[87]
AX3	Axivity	Activity monitor	No	No	Yes	Yes	21d‡	Schmal et al,[85] Armitage et al[88]	Axivity[89]*
NS	ActiGraph	Activity monitor	No	No	Yes	Yes	180d	Resnick et al[90]	ActiGraph[91]++
ActivPAL professional	PAL	Activity monitor	No	No	Yes	Yes	NS	Taraldsen et al,[92] Taraldsen et al,[93] Taraldsen et al[94]	PAL[95]
PAM AM300	Pam Coach	Activity monitor	No	No	Yes	Yes	64d		

Conclusions/action items:

When thinking about what kind of weight-bearing sensor we want to make, it's important to know the competing designs that already exist out there. We can see that there are main categories that this study used to differentiate each existing design: the type, whether it uses force, pressure, counts steps, remotely tracks, has data storage, etc. This is also a great website to have come across because it shows all of the companies of our competing designs that we can look into as well as the pros and cons of designs similar or different than ours.

References:

[1] J. Robinson, A. W. T. Wang, and D. Stockton, “Weight-Bearing Monitoring Devices in Lower Extremity Fractures: A Scoping Review,” *Orthopedic Research and Reviews*, vol. Volume 17, pp. 257–267, Jun. 2025, doi: https://doi.org/10.2147/orr.s521013.

Research - STAPPONE Rehab

KEIRA FERRIGAN - Nov 29, 2025, 5:12 PM CST

Title: STAPPONE Rehab

Date: 9/29/25

Content by: Keira

Content:

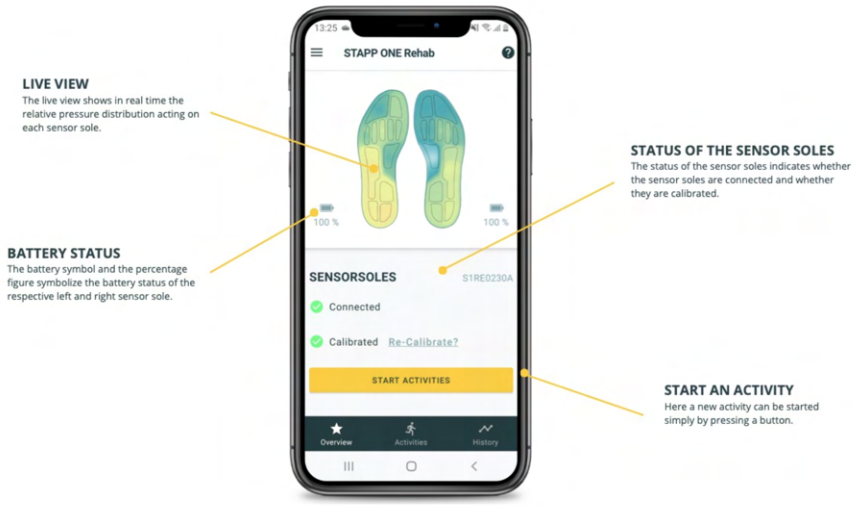
https://www.stappone.com/en/products/partial-weight-bearing-management/stappone-rehab/

Overview of product:

STAPPONE Rehab is the innovative solution for maintaining prescribed partial weight-bearing load limits in rehabilitation. The product consists of our unique, durable textile sensor insole and the corresponding app. The sensor insole connects via Bluetooth to a smartphone and can be operated in a user-friendly manner via the STAPPONE Rehab app. The sensor insoles are simply inserted into the patient’s comfortable shoes (e.g. sports shoes).

Special Features:

- Bluetooth
- Connects to an App
- Sensors throughout the whole sole
- Live Feedback
- Notification if too much weight applied
- App sends data directly to medical treating staff
- Many other quantitative data



Technology specifics:
Stappone sensor insoles have a worldwide unique sensor technology. The textile pressure sensor technology, which is integrated over the entire surface, is unrivalled when it comes to durability. All electronic components are fully integrated into the sensor sole. Together with a memory capacity of 256 MB, gyroscope, magnetometer and accelerometers, it provides incomparable added value in load management and rehabilitation.

Conclusions/action items:

Stappone is a very well thought-out and intricate design of a weight-bearing sensor. I really like the feature of it being connected to an app that can notify or vibrate when too much weight is being put on the sole. This is a very clever and technologically advanced feature that they added. However, I think that the device that our client wants is a little different, with some different features. For example, he wants the weight-bearing sensor to only be used during his PT session; therefore, it needs to be very versatile and easily used/reused. Therefore, our design doesn't need to be as technologically advanced, but needs to be more versatile for different-sized feet, and different amounts of swelling (ex: if a patient is not able to wear shoes). Overall, this is a very well designed product and is great for inspiration for our designs.

References:

[5]“STAPPONE Rehab,” *stappone*, May 10, 2023. Available: https://www.stappone.com/en/products/partial-weight-bearing-management/stappone-rehab/

Research - Weight-Bearing Force Plate

KEIRA FERRIGAN - Nov 29, 2025, 5:36 PM CST

Title: Weight-Bearing Force Plate

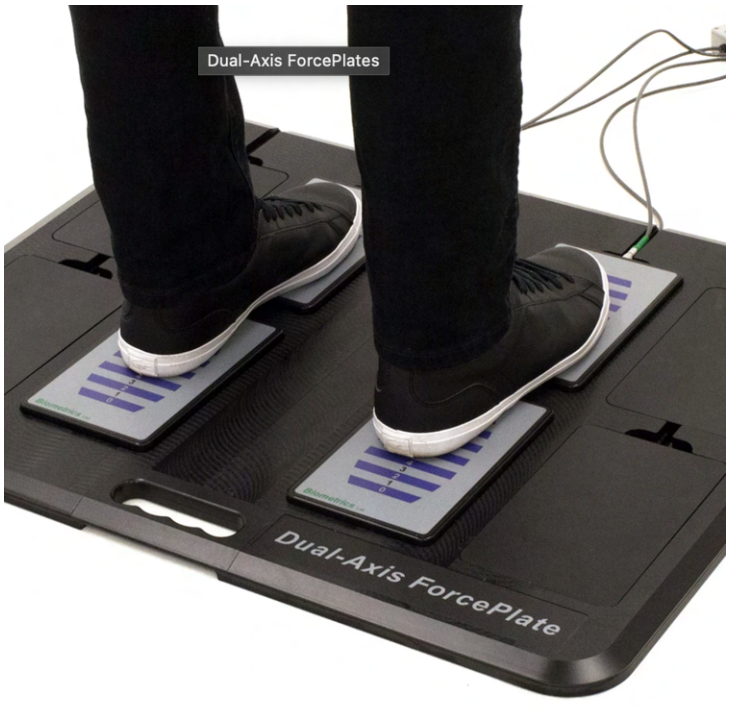
Date: 10/05/25

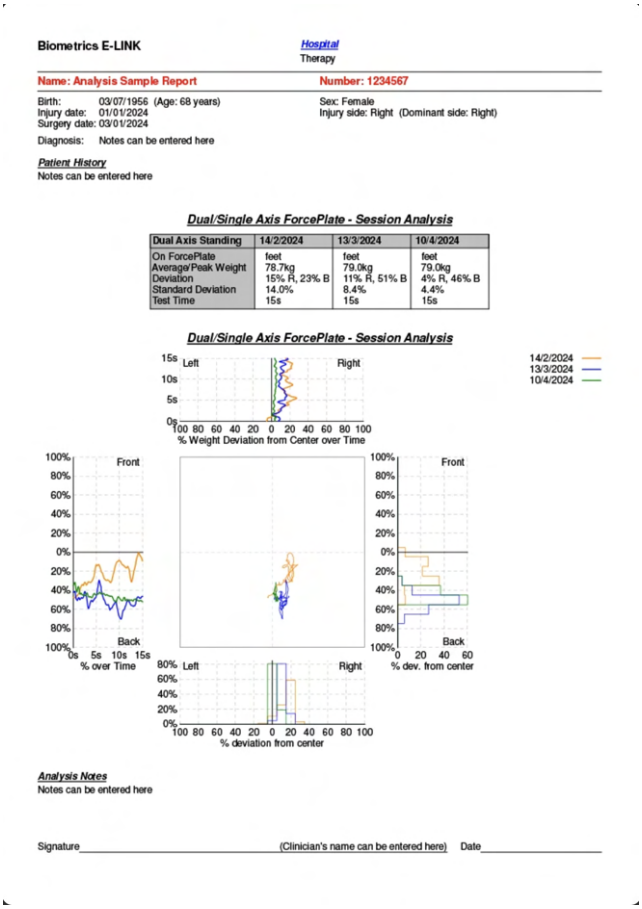
Content by: Keira

Content:

https://biometricselink.com/weight-bearing-forceplates/
Technology:
Four ForcePlates are used for simultaneous evaluation of right/left AND front/back weight-bearing balance. They offer both single-axis and dual-axis exercise for upper and lower extremities in standing or seated positions.
Features:

- Primarily provides weight-bearing standing balance evaluation and exercise
- Designed to accurately and objectively assess a patient's ability to maintain postural stability on a static surface
- Measures fluctuations in the weight distributed over the ForcePlates
- Results are displayed both in text and graph format for immediate feedback and analysis
- Evaluates progress over time as an outcome measure
- Through the innovative integration of computer based Activities the ForcePlates can also be used for interactive exercise
- Help towards muscle strengthening, neuromuscular re-education and balance co-ordination
- Also accommodate evaluation and weight bearing exercise of the upper extremities and for seated balance
- Ideal for light touch/short duration exercise in pain management programmes through to full weight loading for strengthening joints and encouraging specific movement patterns




Biometrics E-LINK
Hospital
Therapy

Name: Analysis Sample Report
Number: 1234567

Birth: 03/07/1956 (Age: 68 years)
Injury date: 01/01/2024
Surgery date: 03/01/2024
Sex: Female
Injury side: Right (Dominant side: Right)

Diagnosis: Notes can be entered here

Patient History
Notes can be entered here

Dual/Single Axis ForcePlate - Session Analysis

Dual Axis Standing	14/2/2024	13/3/2024	10/4/2024
On ForcePlate	feet	feet	feet
Average Peak Weight	78.7kg	79.0kg	79.0kg
Deviation	15% R, 23% B	11% R, 51% B	4% R, 46% B
Standard Deviation	14.0%	8.4%	4.4%
Test Time	15s	15s	15s

Dual/Single Axis ForcePlate - Session Analysis

Analysis Notes
Notes can be entered here

Signature _____ (Clinician's name can be entered here) Date _____

Conclusions/action items:

This product might not directly be a competing design, but it uses weight sensors just as we plan to use. The purpose of this product is to help patients gain balance through fun and engaging games, then give back a full report of the percent weight distribution/deviation. Ours product has a different motive, but yet can still potentially use similar technology to this product. Their "Force Plate" can sense how much weight/percent weight is being put on different parts of each foot, where we need a more portable but similar plate-like sensor where we are able to get a readout of weight bearing or percent weight bearing. It's interesting to see the different pressure sensors that are used for various things in the rehabilitation world.

References:

[6]“ForcePlates – Weight-Bearing Therapy,” *E-LINK*, 2024. Available: https://biometricselink.com/weight-bearing-forceplates/. [Accessed: Nov. 29, 2025]

Research - Beeper Boot

KEIRA FERRIGAN -

Title: Types of 3D Printers

Date: 10/10/25

Content by: Keira

Content:

https://scholarexchange.furman.edu/scjas/2020/all/263/#:~:text=This%20project%20addresses%20complications%20with,the%20arduino%20online%20pr

- Goals include: test subjects are able to comply with weight bearing restrictions, the buzzer triggers when weight bearing is exceeded. Uniquely, the insert instantaneous feedback. Inserts will prevent patients from reinjuring themselves after injury, also helping patients follow the given guidelines.
- Inserts are made out of an arduino board, a bread board, a buzzer, a multimeter, and the arduino online programming system.
- Polat discovered that although patients were able to adjust to and remember the weight bearing protocol in early stages, patients forgot or disregarded the was relieved.

Conclusions/action items:

This "beeper boot" is what our client uses currently and does like many aspects of it. 1) its very bulky and hard to transport 2) it does not give an actual num readout 3) not very versatile for patients with a lot of swelling, which he deals with a lot. However, this website is very good for knowing the technology that boot as inspiration for our weight bearing product. Our client explained to us that many PT clinics are using this product right now and it has a lot of negative

References:

[1] J. Kochert, “Pressure-sensitive shoe insert to provide instantaneous feedback to individuals with weight bearing restrictions,” Furman University Scholar https://scholarexchange.furman.edu/scjas/2020/all/263/#:~:text=This%20project%20addresses%20complications%20with,the%20arduino%20online% stem. (accessed Dec. 7, 2025).

Research - Background of Standards

KEIRA FERRIGAN - Nov 29, 2025, 3:31 PM CST

Title: Background of Standards

Date: 9/19/25

Content by: Keira

Content:

What's a Standard?
https://www.iso.org/standards.html
A standard is a document that provides requirements, specifications, guidelines or characteristics that can be used consistently to ensure that materials, products, processes and services are fit for their purpose.

Who Creates Standards?
https://guides.lib.utexas.edu/c.php?g=554840&p=3812748
Standards are created by a wide variety of organizations. The most common are:
Professional societies, such as the IEEE
Industrial or manufacturing associations, such as the American Wire Rope Manufacturers
Governmental agencies or bodies, such as the U.S. Department of Defense
Companies, such as General Motors [Company standards are often proprietary and therefore are available only to approved subcontractors.]
International bodies, such as the International Organization for Standardization (ISO)
The ISO is a non-governmental organization that both creates and approves international standards. ISO deals with all subject areas except electrical and electrotechnical matters; these are handled by the International Electrotechnical Association (IEC).
Many countries also have national standardization organizations. Country standards are in the language of the country. English translations are not typically available.

Standards in Engineering:
https://guides.library.uab.edu/bme/standards
Standards are particularly important in the field of engineering in order to protect people and ensure quality product development and production. Standards exist about a wide variety of topics - everything from the composition and properties of materials to the requirements for health care services. As shown in the figure below, standards can *(and should)* be used in every part of the design process.
This website contains information about how to find standards and what kind of places to look for standards for engineering specifically.
ANSI, AMSE, and IEEE seem like a good place to start

Standards in Medicine:
https://www.ncbi.nlm.nih.gov/books/NBK225181/
Background:
The development and availability of standards for patient safety can serve several purposes. They can either establish minimum levels of performance or can establish consistency or uniformity across multiple individuals and organizations. Another purpose for standards is that they set expectations. The process of developing standards can set expectations for the organizations and health professionals affected by the standards.
RECOMMENDATION 7.1 Performance standards and expectations for heath care organizations should focus greater attention on patient safety.

- Regulators and accreditors should require health care organizations to implement meaningful patient safety programs with defined executive responsibility.

- Public and private purchasers should provide incentives to health care organizations to demonstrate continuous improvement in patient safety.

RECOMMENDATION 7.2 Performance standards and expectations for health professionals should focus greater attention on patient safety.

Health professional licensing bodies should

- implement periodic reexaminations and relicensing of doctors, nurses, and other key providers, based on both competence and knowledge of safety practices; and
- work with certifying and credentialing organizations to develop more effective methods to identify unsafe providers and take action.

Professional societies should make a visible commitment to patient safety by establishing a permanent committee dedicated to safety improvement. This committee should

- develop a curriculum on patient safety and encourage its adoption into training and certification requirements;
- disseminate information on patient safety to members at special sessions at annual conferences, journal articles and editorials, newsletters, publications and websites on a regular basis;
- recognize patient safety considerations in practice guidelines and in standards related to the introduction and diffusion of new technologies, therapies, and drugs;
- work with the Center for Patient Safety to develop community-based, collaborative initiatives for error reporting and analysis and implementation of patient safety improvements; and
- collaborate with other professional societies and disciplines in a national summit on the professional's role in patient safety.

Conclusions/action items:

As of right now, I don't feel that I know much about standards/what they are/what they do. So I wanted to use my first research notebook to gain a background on what a standard is and how to find them. I looked into what standards are, who creates them, and why they are important. I also wanted to know how they apply to biomedical engineering. So I found a website that relates standards to engineering and a website that relates standards to medicine. Now I have a better understanding of standards and can start looking into different types of standards that could apply to our project.

References:

[1]ISO, “Standards,” *ISO*. Available: https://www.iso.org/standards.html

[2]L. Dallas, “LibGuides: Standards, Codes, & Specifications: What is a standard?,” *guides.lib.utexas.edu*. Available: https://guides.lib.utexas.edu/c.php?g=554840&p=3812748

[3]A. McNeill, “Research Guides: Biomedical Engineering: Codes, Specifications, and Standards,” *guides.library.uab.edu*. Available: https://guides.library.uab.edu/bme/standards

[4]L. T. Kohn, J. M. Corrigan, and M. S. Donaldson, “Setting Performance Standards and Expectations for Patient Safety,” *Nih.gov*, 2020. Available: https://www.ncbi.nlm.nih.gov/books/NBK225181/

Research - Overall Scope of Important Standards for our Project

KEIRA FERRIGAN - Nov 29, 2025, 3:06 PM CST

Title: Overall Scope of Important Standards for our Project

Date: 9/22/25

Content by: Keira

Content:

Medical Devices:
Association for the Advancement of Medical Instrumentation
Acronym:
AAMI
Contact:
Matthew Williams
Title:
Vice President, Standards
Date Accredited:
7/22/1977
Address:
901 N. Glebe Road, Suite 300
Arlington, VA 22203
Phone:
703.215.8479
E-mail:
MWilliams@aami.org
WWW URL:
www.aami.org
Scope
Medical device standards, including electromedical devices and recommended practices in the area of sterilization technology

Sensors:
National Emergency Number Association
Acronym:
NENA
Contact:
Sandy Dyre, ENP, CPM
Title:
Director, Committee Resource Management
Date Accredited:
4/19/2013
Address:
1700 Diagonal Road, Suite 500
Alexandria, VA 22314
Phone:
202.618.4401
E-mail:
crm@nena.org
WWW URL:

www.nena.org
Scope
The National Emergency Number Association (NENA) develops requirements, standards, specifications, recommended procedures, and information documents through the NENA Development Group (NDG) and its related committees and working groups. NENA also sponsors interoperability verification testing. This work supports 9-1-1 emergency call routing and data management. 9-1-1 service systems are comprised of transport networks, hardware, software, data, and, personnel, and operational policies and procedures that:
A. enable processing of emergency calls from originating services including but not limited to providers of voice telephony, text messaging, data transmission, and multimedia transmission or streaming;
B. provide standardized interfaces to originating service providers and/or network providers to support emergency communications; acquire and integrate emergency call data (including but not limited to caller location) useful to call routing and handling;
C. deliver emergency calls, video, and data to the appropriate public safety answering point and/or other appropriate emergency entities; and
D. answer, process, and support emergency calls.
Parts of NENA's development work concern standards, procedures, and practices for the management of databases which control software functions, procedures for overall system management, and guidelines for the maintenance and evolution of systems intended to ensure emergency service quality and consistency.
NENA's interest in ANSI accreditation is specific to 9-1-1 service systems and their design, deployment, maintenance, operation, and upgrade. NENA's ANSI standards scope starts at the point an originating service provider interfaces to the 9-1-1 system, encompasses the above areas, and ends at the point where the call, message, and/or data has been interpreted and processed by public safety call taking functions, and/or interconnected to other emergency entities (such as trauma centers, hospitals, sensor monitoring centers, etc.).

Sanitation:
3-A Sanitary Standards, Inc.
Acronym:
3-A
Contact:
Eric Schweitzer
Title:
Director, Standards and Certification
Date Accredited:
2/10/2004
Address:
1250 H Street NW, Suite 903-A
Washington, DC 20005
Phone:
703.790.0295
E-mail:
erics@3-a.org
WWW URL:
www.3-a.org
Scope
3-A Sanitary Standards, Inc. seeks to formulate voluntary consensus sanitary standards and accepted practices for equipment and systems used to produce, process, and package food, beverages and pharmaceutical products. Over a history of more than 80 years, the list of 3-A Standards has grown to nearly 70 individual standards for products, components and systems and nine Accepted Practices

Conclusions/action items:

To begin my research on standards, I figured I would start by looking through the American National Standards website and see what could potentially apply to our project. These seem to be overarching groups of standards, not so much so very specific standards. But I have a good base of what is important to look into for our project: Medical Device standards, Sensor standards, and Sanitary standards.

References:

[1] “Listing of ANSI-accredited standards developers,” ANSI, https://www.ansi.org/american-national-standards/info-for-standards-developers/accredited-standards-developers#sort=%40titlecomputed%20ascending (accessed Nov. 29, 2025).

9/25/25 - Brainstorm Drawings

KEIRA FERRIGAN - Sep 25, 2025, 10:06 PM CDT

Title: Brainstorm Drawings

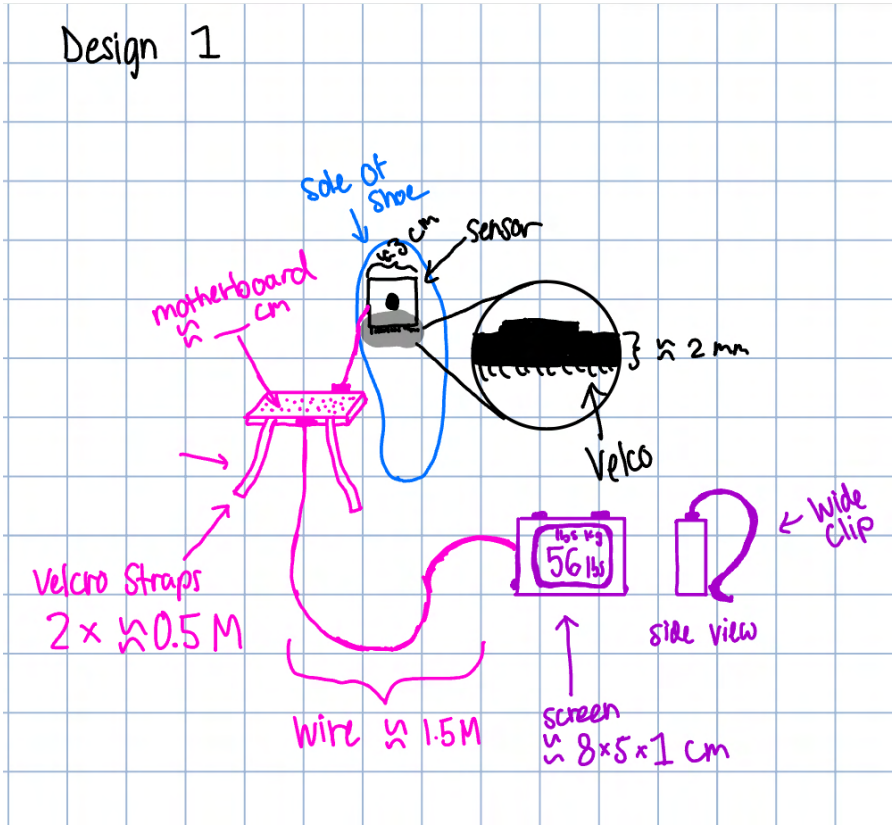
Date: 9/25/25

Content by: Keira Ferrigan

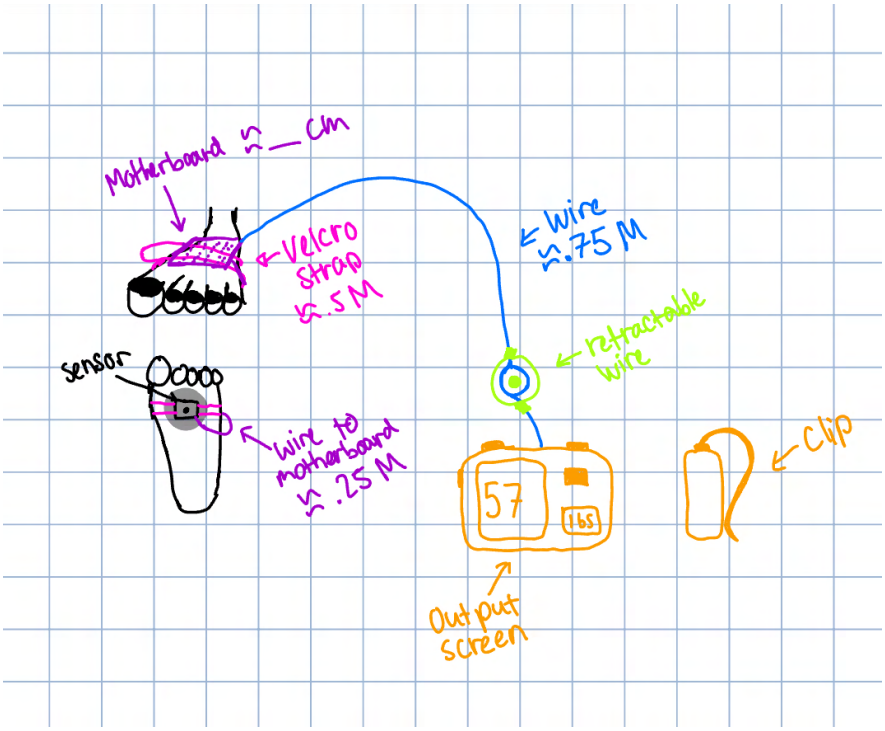
Present: Keira

Goals: Create 2 designs

Content:



This device adds a velcro patch to the bottom of the sensor. The velcro will ber able to stick to any part of the sole of the shoe so that the weight bearing can be read from different parts of the food. In addition, I added a sort of ankle band that will hold the motherboard and wiring close to the sensor. I used long velcro straps for this to be adjustable to accommodate different ankle sizing and swelling. A wire will then run from the ankle band up to the screen where the weight is displayed. This screen will have a wide clip on the back so that it can easily be clipped onto a walker for the patient.



This device incorporates the sensor being placed at the bottom of a foot and for it to be strapped around the foot itself. The straps will be velcro to accommodate the different sized and shaped feet. This device also has the motherboard strapped to the top of the foot so that it can stay near the sensor and still out of the way of the patient's gait. A wire will then be run from the motherboard to the display screen, however the wire will be retractable so that no excess wire will be in the way of the physical therapist of the patient. This display screen will also have a clip on it so that it can be easily read by the patient and the pt while it is attached to the walker.

Conclusions/action items:

I created two designs and tried to make them as different as I could while keeping the criteria of our client. Next, we need to show each other our ideas and rank them based on the design matrix. The design matrix will help us determine the best route and best design for this project.

11/2/25 - 1st 3D Modeling of LCD Box

KEIRA FERRIGAN - Nov 21, 2025, 9:26 PM CST

Title: Brainstorm Drawings

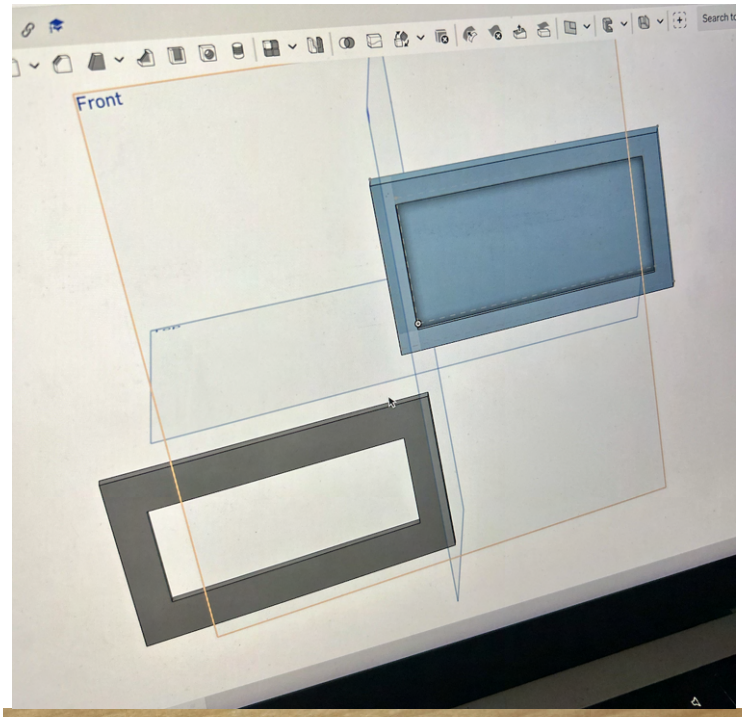
Date: 11/2/25

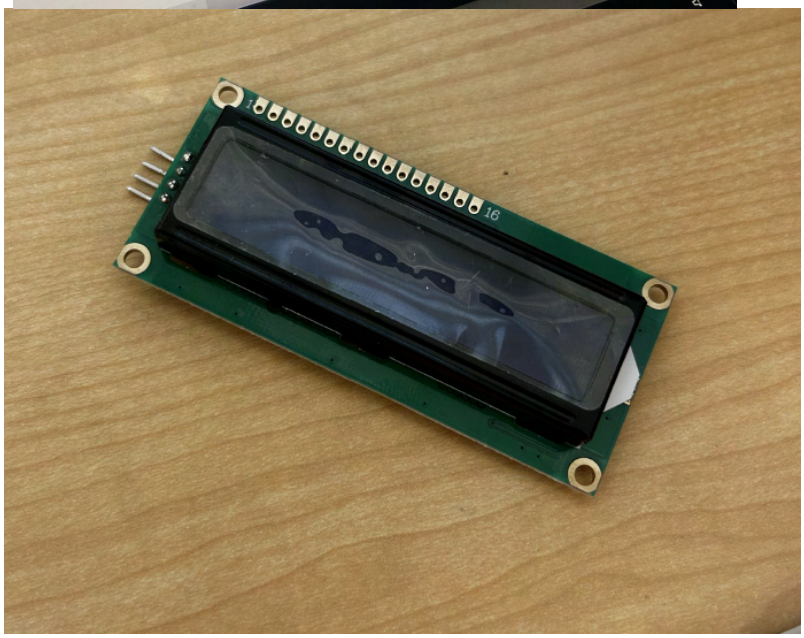
Content by: Keira Ferrigan

Present: Keira

Goals: Create a 3D Model of the LCD Box

Content:





The picture on the left is my first attempt at making a box for the LCD screen. I wanted the overall design to very simple and sleek. The purpose of this box it to protect the LCD screen and its components. The right is a photo of the LDC screen for reference.

Conclusions/action items:

This is a very rough draft, I don't have dimensions yet so I need to add those when I get them. I also plan to fillet the sides to make it more sleek and have less sharp edges for the final design.

11/11/25 - 2nd 3D Modeling of LCD Box

KEIRA FERRIGAN - Nov 21, 2025, 9:42 PM CST

Title: 2nd 3D Modeling of LCD Box

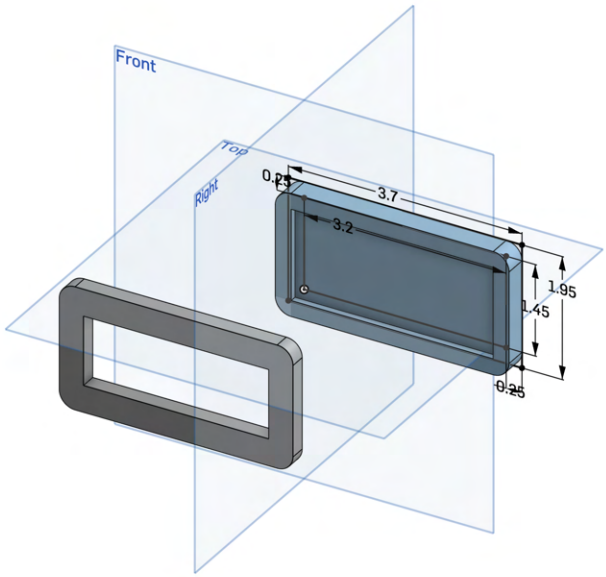
Date: 11/11/25

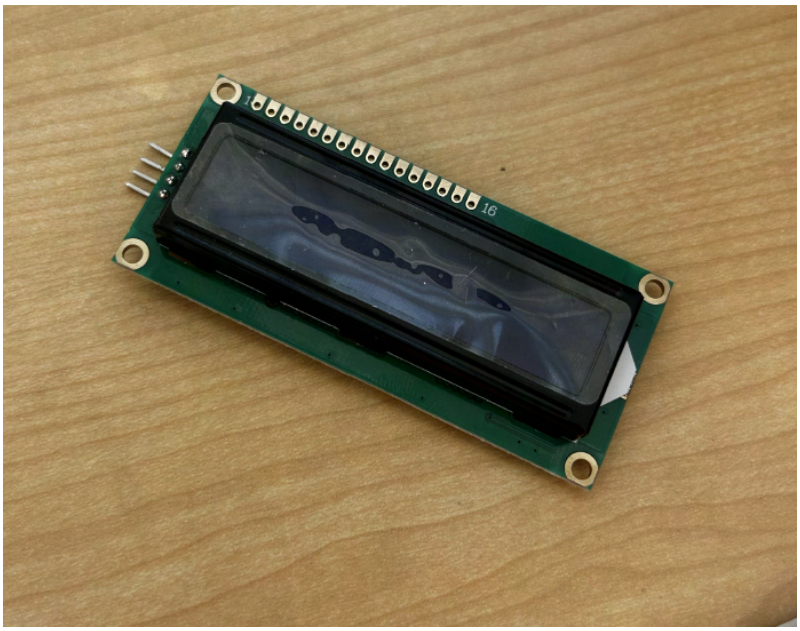
Content by: Keira Ferrigan

Present: Keira

Goals: Refine the 3D Model of the LCD Box

Content:





The picture on the left is my refined version of the box. As you can see, I got the measurements to dimension my box, and I filleted the edges to make it have a sleeker look. The right is a photo of the LDC screen for reference.

Conclusions/action items:

Here is my second draft of the box. However, I am going to wait to 3D print this box until we know for sure we are going to use this screen. We have not yet gotten it to work and display anything with our circuit, so we are uncertain if we will continue using the screen.

(Edited Nov 21: We ended up swapping out this display for a cheap yellow display, so I will re-dimension the box.)

11/21/25 - 1st 3D Modeling of Ankle Strap Box

KEIRA FERRIGAN - Nov 21, 2025, 9:41 PM CST

Title: 1st 3D Modeling of Ankle Strap Box

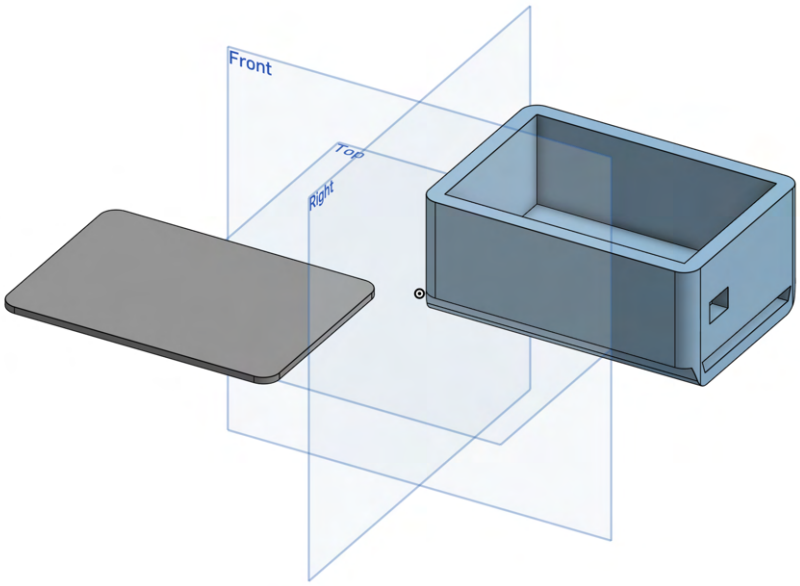
Date: 11/21/25

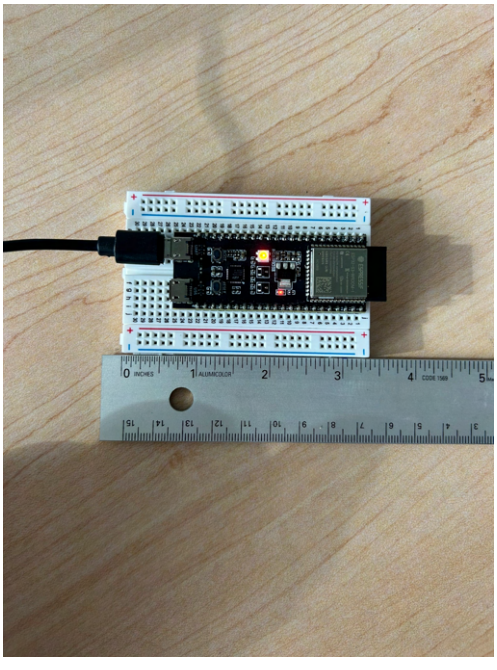
Content by: Keira Ferrigan

Present: Keira

Goals: Create a box for breadboard and microcontroller

Content:





On the left is the box I created. I added a slot at the bottom to potentially feed the velcro through that will be used as an ankle strap. The whole at the right side of the box is for the usbc cord shown on the right picture. Then I made a lid that we will most likely be screwing to the box to hold it shut. The picture on the right shows the breadboard and microcontroller, but not the battery pack that will also need to fit in the box. I also filleted the sides for a sleek look.

Conclusions/action items:

Here is my draft of a box meant to hold the breadboard, a battery pack, and the microcontroller. We are still deciding if we want to add it to an ankle strap or to the ankle wrap directly. So for that reason, I am going to hold off on 3D printing it for right now. I might also need to refine depending on the kind of battery/battery pack that we decide on, but for right now we are powering our circuit through the battery in our computers.

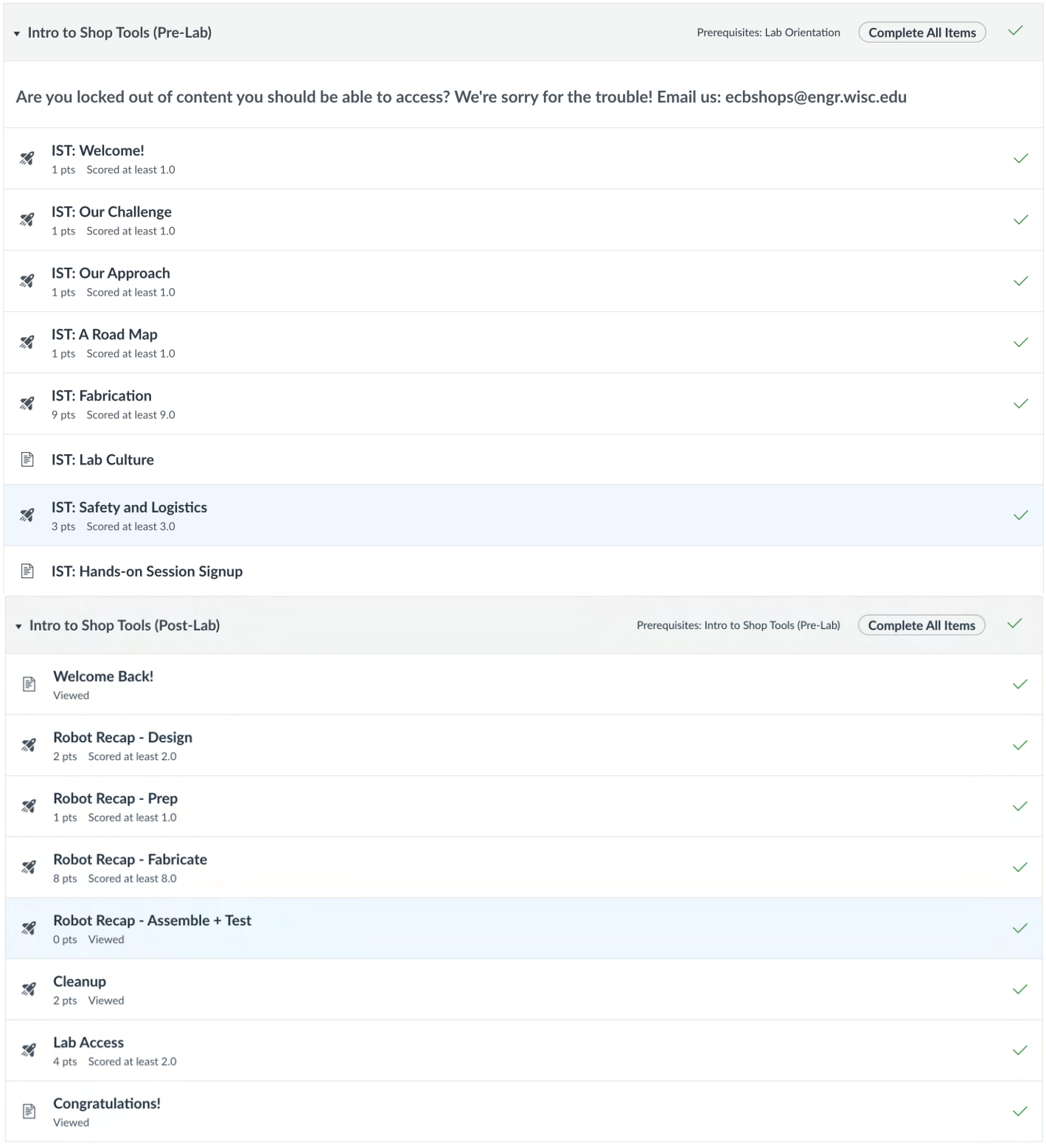
Intro to Shop Tools Training

KEIRA FERRIGAN - Oct 15, 2025, 2:59 PM CDT

Title: Intro to Shop Tools

Content by: Keira

Content:



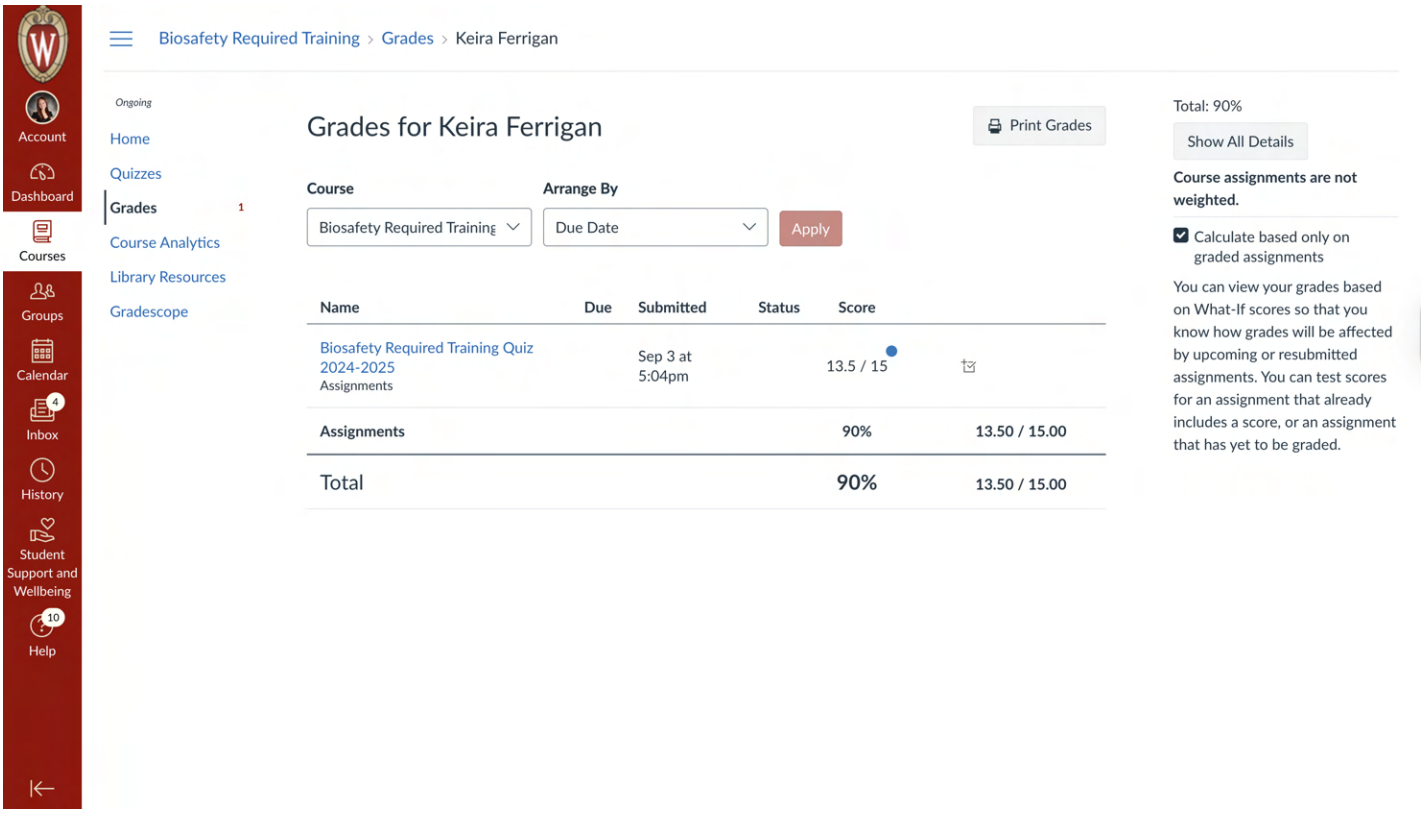
Biosafety Training

KEIRA FERRIGAN - Oct 15, 2025, 3:01 PM CDT

Title: Biosafety Training

Content by: Keira Ferrigan

Content:



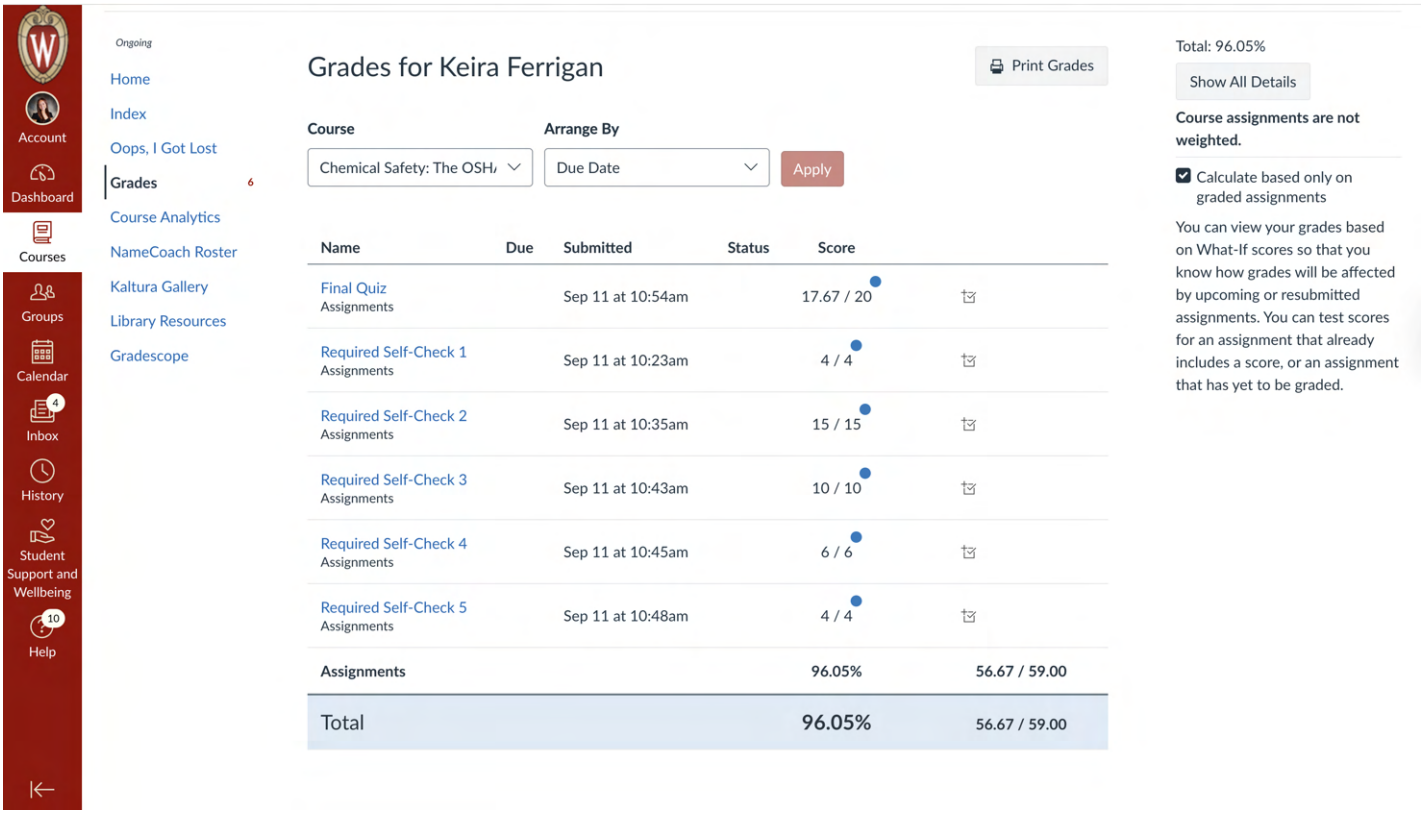
Chemical Safety Training

KEIRA FERRIGAN - Oct 15, 2025, 3:03 PM CDT

Title: Chemical Safety Training

Content by: Keira Ferrigan

Content:



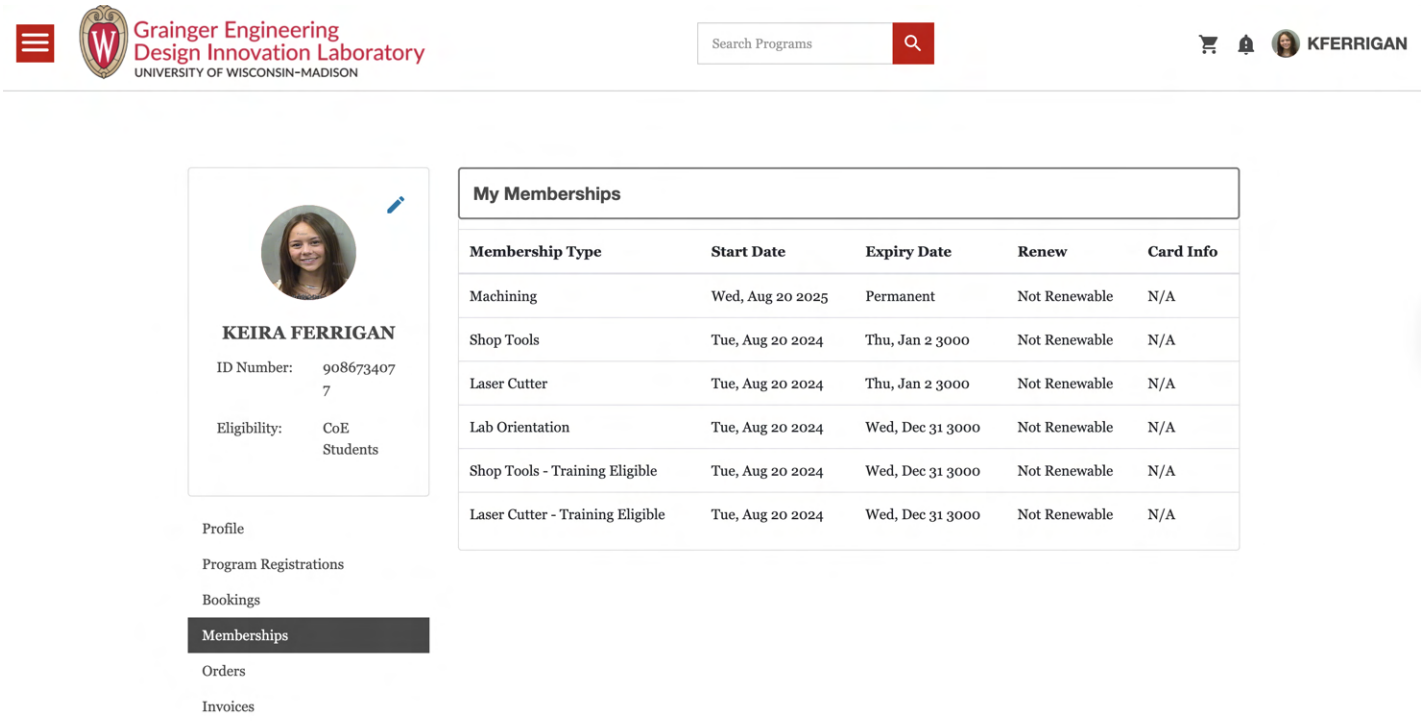
Machining Training

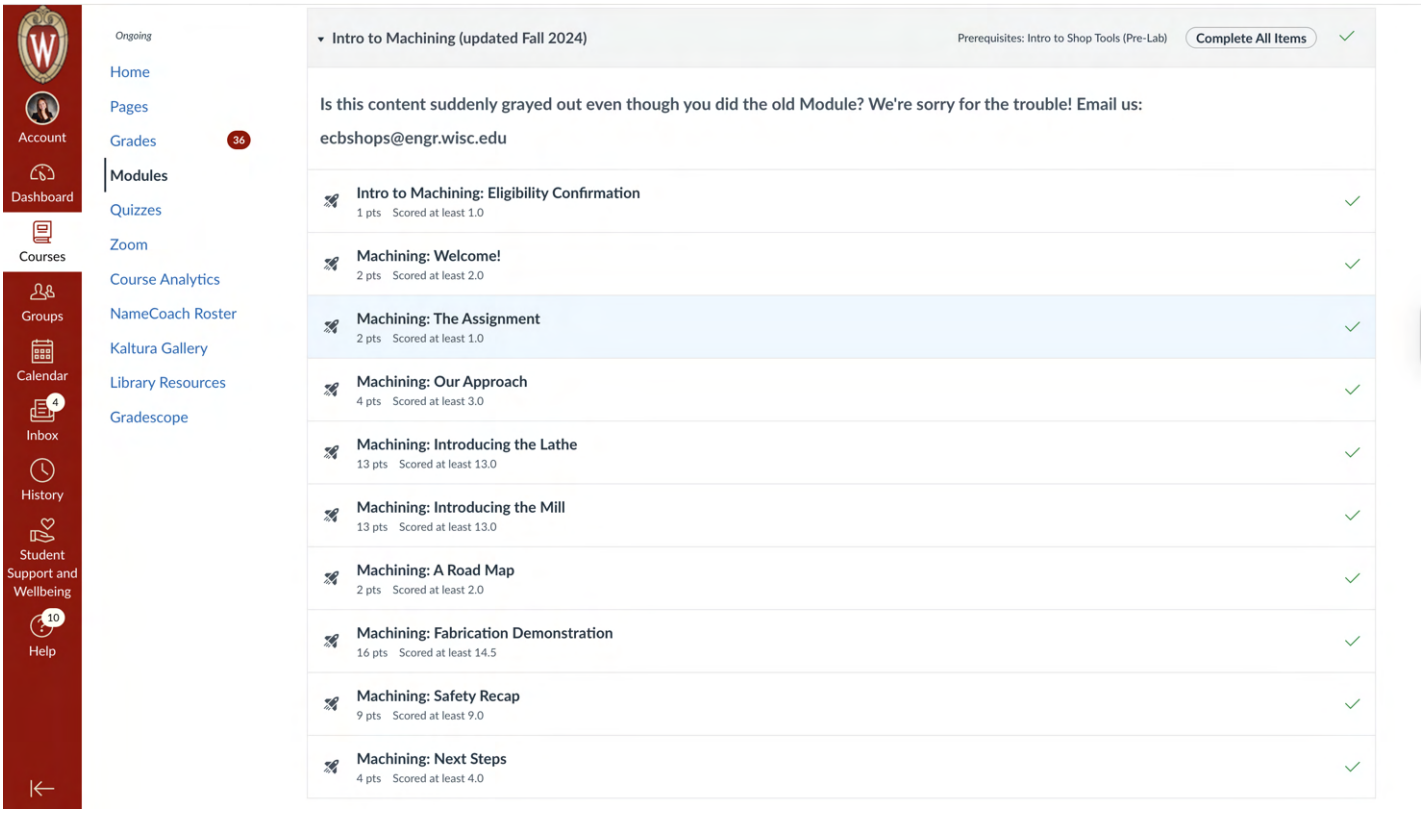
KEIRA FERRIGAN - Nov 02, 2025, 3:52 PM CST

Title: Machining Training

Content by: Keira Ferrigan

Content:




Account
Dashboard
Courses
Groups
Calendar
Inbox
History
Student Support and Wellbeing
Help
Ongoing
Home
Pages
Grades
Modules
Quizzes
Zoom
Course Analytics
NameCoach Roster
Kaltura Gallery
Library Resources
Gradescope
Intro to Machining (updated Fall 2024)
Prerequisites: Intro to Shop Tools (Pre-Lab)
Complete All Items
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Intro to Machining: Eligibility Confirmation
1 pts Scored at least 1.0
Machining: Welcome!
2 pts Scored at least 2.0
Machining: The Assignment
2 pts Scored at least 1.0
Machining: Our Approach
4 pts Scored at least 3.0
Machining: Introducing the Lathe
13 pts Scored at least 13.0
Machining: Introducing the Mill
13 pts Scored at least 13.0
Machining: A Road Map
2 pts Scored at least 2.0
Machining: Fabrication Demonstration
16 pts Scored at least 14.5
Machining: Safety Recap
9 pts Scored at least 9.0
Machining: Next Steps
4 pts Scored at least 4.0

9/5/25 - chose a project / met my team

KEIRA FERRIGAN - Nov 13, 2025, 10:55 AM CST

Title: Chose Project / first team meeting

Date: 9/22/25

Content by: Keira

Present: Jetsu, Cassity, Norah, Niko

Goals: Decide on roles, take a group picture, introduce ourselves

Content:

Our Website:

https://bmedesign.engr.wisc.edu/public/projects/f25/weight_bearing

Our Group Photo:

Conclusions/action items:

I ended up going with the weight-bearing sensor project. It piqued my interest because the client is a physical therapist, and so is my mom. I also liked the idea and feel that it could have been beneficial for me when I had various injuries from sports in high school. I am very excited to see the ideas that our group comes up with, with the help of our client and advisor, and looking forward to working with them all!

9/12/25 - first advisor meeing

KEIRA FERRIGAN - Nov 13, 2025, 11:46 AM CST

Title: First advisor meeting

Date: 9/12/25

Content by: Keira

Present: Jetsu, Cassity, Norah, Niko

Goals: Meet our advisor

Content:

N/A

Conclusions/action items:

It was very great to meet our advisor and get some background on him. He seems to be very knowledgeable about BME, and even though he just moved to UW-Madison from Ohio State that he has a good idea of what our BME projects are like at Wisconsin. With a background at a different college, he can also have even broader ideas because of his different experiences. I look forward to continuing to work with him, and we plan to meet every Friday at 12:30 pm.

9/22/25 - finish pds

KEIRA FERRIGAN - Sep 28, 2025, 8:31 PM CDT

Title: Finalize PDS

Date: 9/22/25

Content by: Keira

Present: Jetsu, Cassity, Norah, Niko

Goals: Discuss final PDS, start brainstorming ideas

Content:

Final PDS:

https://docs.google.com/document/d/1GAIgH2sKXw39V8cirnX1bvdHSoEvaKfPxQzbspRgSBY/edit?tab=t.0#heading=h.mnfzsp6av563

Conclusions/action items:

We had already completed our PDS prior to this meeting. However, we used this meeting to ask and answer any questions we have about the PDS and the content on the PDS. After this, we started discussing and brainstorming designs for both the circuit and the physical design for this project. It was beneficial for me to discuss the ideas we have already thought of and discussed before I started sketching out my ideas. When sketching my designs, I tried to make them as unique and different from each other as possible so that it would be easier to rank them based on our 5 different categories. Next, we need to show our different ideas and discuss the ratings we give each design.

9/26/25 - discussed design matrix

KEIRA FERRIGAN - Sep 28, 2025, 8:32 PM CDT

Title: discussion of design matrix

Date: 9/26/25

Content by: Keira

Present: Cassity, Norah, Niko, Jetsu

Goals: Meet with advisor, discuss designs

Content:

Final design matrix:

https://docs.google.com/document/d/1kzd4p568kkgEUX7pJgpsIITkPb9B17wHp6AK7elswyg/edit?tab=t.0

Conclusions/action items:

Our meeting with our advisor was very helpful and thoughtful. We concluded that we should meet again with our client to share the design ideas we have and see if he has any input or recommendations. We also discussed some potential areas of our design where we need clarity in which we will ask our client. However, it was very beneficial just discussing our designs and how they will work with my team because we were able to bounce ideas off each other and ensure that we are all on the same page.

10/2/25 - finished slides

KEIRA FERRIGAN - Dec 08, 2025, 4:20 PM CST

Title: meeting - finished slides for presentation

Date: 10/2/25

Content by: Keira

Present: Niko, Jetsu, Cassity, Norah

Goals: finish slides for presentation

Content:

Our final preliminary slides:

https://docs.google.com/presentation/d/1UVXUIwch1oEeVF5aNiHdch58zlNRdN-JLX6JX0nRzaE/edit?usp=sharing

Conclusions/action items:

We discussed what should be on each slide and overall finalized our slides during this meeting, We also ran through our presentation as practice for the actual presentation, and to ensure that our presentation does not exceed 10 minutes. Next, I want to practice running through my slides alone just so I know roughly what I want to include. Then we give our final presentation tomorrow!

10/3/25 - preliminary presentation

KEIRA FERRIGAN - Oct 15, 2025, 2:43 PM CDT

Title: Preliminary presentation x meeting

Date: 10/3/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: Give a presentation, plan our next week

Content:

N/A

Conclusions/action items:

We gave our presentation and did well! I was very nervous going into this presentation because public speaking can be nerve-racking for me. However, I tried to remain calm and tried not to overthink it too much, and this approach often helps me. Though I stuttered a few times during the presentation, I am still happy with my performance and felt that I said everything I needed to say. In our quick meeting at the end, we talked about getting a start on the report and planned accordingly based off the due date.

10/10/25 - order materials

KEIRA FERRIGAN - Oct 15, 2025, 3:10 PM CDT

Title: Ordering Materials

Date: 10/10/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: Order Materials

Content:

Name of Material	Number/amount	Cost per unit	Total Cost	Link
Velcro strap for arduino	1 (2" x 16')	10.99	10.99	https://www.amazon.com/Fastening-Buckles-Reusable-Storage-Organization/dp/B0DDPVJMYN/ref=sr_1_5_sspa?crid=39B57UXZ2WOWX&dib=eyJ2IjoiMSJ9.zwD8EBmxedRdJZUxe33qYGnJhJK4TwI0IkGgbnki9ypEVomHSImxHu_dMP3a1tgwn_IQ9l0H2fCFxwmJCRM78v3PqAlcGjuBSFlkR9szByS0q63590ovb4GnvRsOhvaPk2eyOPb9y5bySXlFNSYcs9-YFP7I2Z88ZG3qf5sk6T6nZpq9rI1SPMEUKcpmeCLJMNFLxAUcHBApGHVRXF_oJoIE7dY-4fot5orJQ4RAS7g.kDF0AXDGk4o00kBDgDqDuPSulxYdhe-gKB3PM_Ta6TE&dib_tag=se&keywords=wide%2Bvelcro%2Bstrap%2B2%27%27%2B4%27&qid=1760118792&sprefix=wide%2Bvelcro%2Bstrap%2B2%27%27%2B4%27%2Caps%2C138&sr=8-5-spons&sp_csd=d2lkZ2V0TmFtZT1zcF9tdGY&th=1

Ankle strap	1	7.59	7.59	https://www.amazon.com/gp/product/B06XBN24L2/ref=ewc_pr_img_1?smid=A19K0OZLY7K6B4&th=1
Uxcell 100kg 42mm x 38mm x 3mm Electronic Scale Body Load Cell Weighing Sensor	1 (42mm x 38mm x 3mm/1.7" x 1.5" x 0.12)	8.12	13.11	https://www.harfington.com/products/p-1195929?currency=USD&variant=44083328450809&utm_source=google&utm_medium=cpc&utm_campaign=Google%20Shopping&stkn=f8e35277684b&utm_source=Google&utm_medium=cpc&utm_campaign=250930-us-pmax-hw&utm_term=250930-us-pmax-hw&utm_content=ywh&gad_source=1&gad_campaignid=23062083306&gbraid=0AAAAAoTFl2TfCjzEBpUEw7XHG6ebe3o4a&gclid=Cj0KCQjw3aLHBhDTARIsAIRij5_JPKsvrpFBkBtvUimTwDcAZss_tkmsQJb64CVgRnJFO8_c0DodLqkaAu8CEALw_wcB
Uxcell HX711 Module Weighing Sensor Pressure Sensor AD Module	1 (34 x 21 x 3mm)	6.39	$11.38	https://www.harfington.com/products/p-1195929?currency=USD&variant=44083328450809&utm_source=google&utm_medium=cpc&utm_campaign=Google%20Shopping&stkn=f8e35277684b&utm_source=Google&utm_medium=cpc&utm_campaign=250930-us-pmax-hw&utm_term=250930-us-pmax-hw&utm_content=ywh&gad_source=1&gad_campaignid=23062083306&gbraid=0AAAAAoTFl2TfCjzEBpUEw7XHG6ebe3o4a&gclid=Cj0KCQjw3aLHBhDTARIsAIRij5_JPKsvrpFBkBtvUimTwDcAZss_tk

				msQJb64CVgRnJFO8_c0DodLqkaAu8CEALw_wcB

Conclusions/action items:

As BPAG, I ordered all of the materials. During our last client meeting, we agreed that I would order materials and our client would reimburse me. Now that I have ordered the materials, we must wait for them to arrive. I will also email our client with confirmation of the ordered materials and discuss what form of payment is best for him.

10/24/25 - advisor meeting x discussion on future

KEIRA FERRIGAN - Nov 13, 2025, 11:51 AM CST

Title: advisor meeting x discussion

Date: 10/24/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: meet with our advisor, get clarity on standards, divide up roles

Content:

N/A

Conclusions/action items:

Our advisor meeting was very helpful and gave us good insight into our testing and the standards that we will have to look into for our design. We want to look further into medical device standards and the pressure sensor standards. We also started discussing and dividing up the work that we will work on individually. For example, my role is to 3D model two boxes, one that holds the Arduino and one that holds the display screen. I have some previous background from high school and last semester on 3D modeling so that will help me a lot to accomplish this role.

10/31/25 - Show&Tell

KEIRA FERRIGAN - Nov 21, 2025, 9:50 PM CST

Title: Ordering Materials

Date: 10/31/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: Get peer reviews and ideas from other BMEs

Content:

Our Groups' Takeaways from Show&Tell:

- Subtract the weight of the circuit and straps
- Could use a better screen (tiny yellow screen oled esp32)
- Maybe use memory foam in the sensor pocket for comfortability
- Look into different sensors
- Test all parts of the circuit separately
- Look at the battery pack and whether it would give negative voltage, and if we need negative voltage
- look at the smaller Bluetooth Arduino board, tiny 3 board
- think about how much pull we need to withstand for the wires
- Can look into PCB board to make it smaller and more compact

Conclusions/action items:

This was overall a great and needed process for our group as a whole. Not only did we gain good talking and elevator pitch skills, but we also received great feedback. Everyone that we talked to had different backgrounds and had different and very helpful feedback for us. It was also very intriguing to see and hear the progress that other groups have made on their projects. The next steps include using everyone's feedback to keep trying to troubleshoot and fix our circuit and to hopefully start testing our design in the next week.

11/2/25 - troubleshooting/testing meeting

KEIRA FERRIGAN - Nov 02, 2025, 3:34 PM CST

Title: Show&Tell

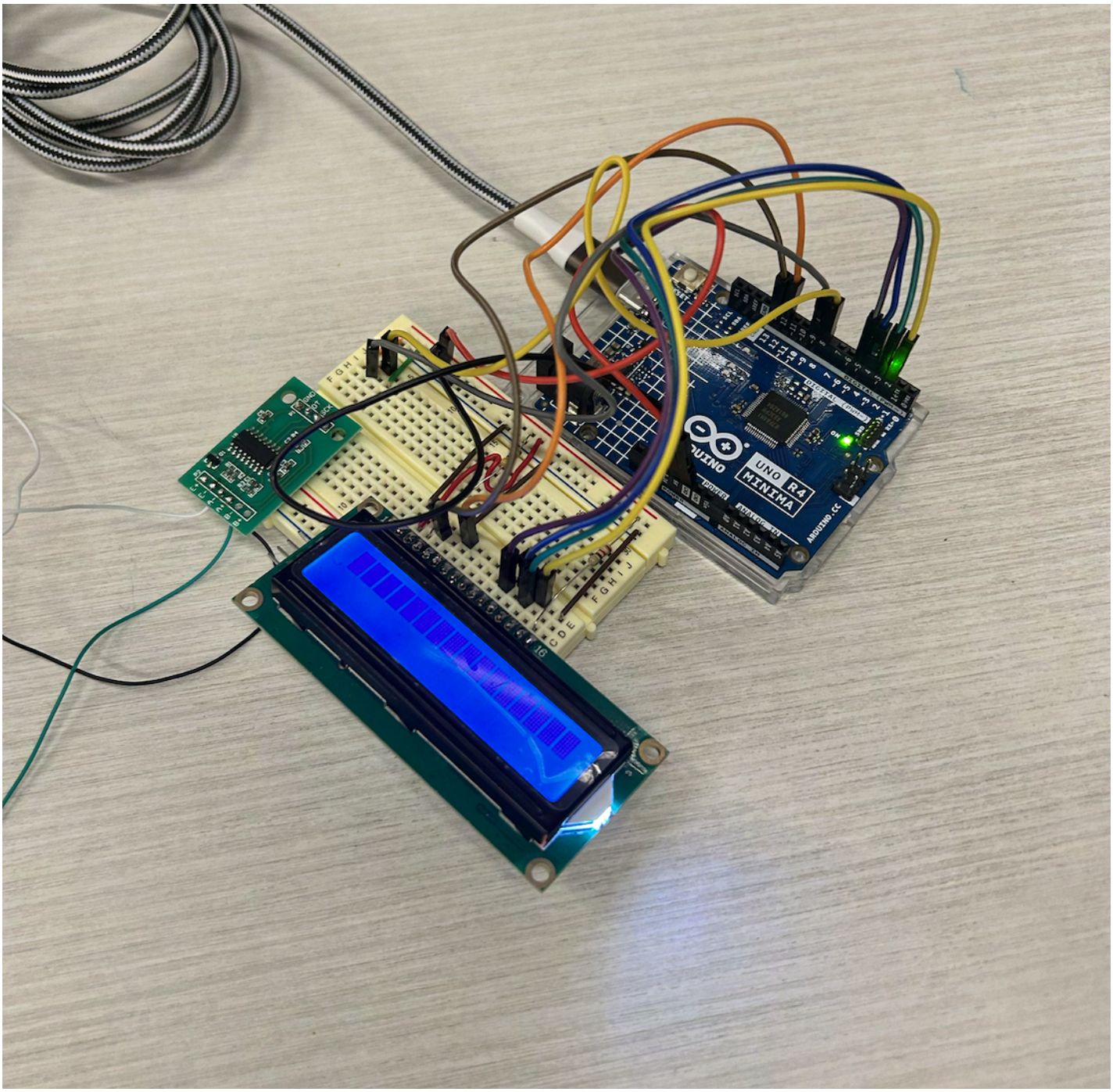
Date: 11/2/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: Work out the bugs in our circuit

Content:



Conclusions/action items:

We met today with the purpose of talking about testing and maybe starting testing. However, there were a few errors in our circuit/code that caused it to not be able to run. So we will have to continue working on that and continue troubleshooting so that we get a readout on our screen before we are able to test. We plan to go to the Wendt makerspace sometime this week to see if anyone would be able to assist us. Then we plan to start testing, and we can do so by meeting at the Nic.

11/7/25 - tong lecture and advisor meeting

KEIRA FERRIGAN - Nov 13, 2025, 11:47 AM CST

Title: Tong lecture and advisor meeting

Date: 11/2/25

Content by: Keira

Goals: learn about

Content:

Tong lecture notes - Kristin Myers

- run towards hard problems because those are the ones that change the world

Chapter 1:

- had many jobs in college, some school-related and some not

- 4 internships to gain experience in different aspects of bme

- took role leading obgyns right before the pandemic, huge challenge during pandemic

- UW undergrad and Harvard for grad school

Chapter 2:

- worked at Aetna

- opened cycling business

- flew to florida and texas to meet with them to explain importance of masks

Chapter 3:

- worked at hopscotch health was founder and ceo

-worked at (and currently works at) Blue Cross Blue Shield

More on Healthcare:

-50% of doctors said that they wouldn't go back and do all of the education again

-We spend $5T on healthcare in the US

- $1.2T in healthcare that goes to medical waste

- underlying challenges: misaligned incentives, fragmented financing, data silos and legacy IT, inequities (10 to 15 yr gap between zip codes)

- Healthcare is a very complex and broken system

- Telehealth is a big solution, but very hard to get a strong enough wifi connection in rural areas (rural and cities differ a lot)

5 Takeaways:

1) Work Hard and Build Range: use challenges to grow and strengthen your skills, work in offices with other people, move around and work in different places

2) Seek Diverse Exposure: explore different teams, sectors, and geographies, learn how systems connect

3) Choose your People Wisely: surround yourself with curious and motivated people, positive people are very important, these people will shape who you become

4) Know your Values and Protect Them: define what matters most to you, family, friends, career, health, and make decisions that align, prioritize sleep

5) Embrace Challenge and Keep Growing: run towards hard problems, growth lives on the edge of discomfort, don't fear not being good enough, operate from curiosity and take on big things, be proud of yourself and how much you've done

Q and A:

biggest tip to avoid burnout?

energy flows and times of the day when we are supposed to do different things, take breaks, say no to things (plans, going out, etc), create priorities and devote your time to them

why is the healthcare system broken, and how can we fix?

many systems exist within the healthcare system and it wastes a lot of money, hopefully we will have data connecting and data flowing of medical data, wage gap is big problem for healthcare, working towards medical care at a lower cost for patients

Conclusions/action items:

The Tong lecture was very informative and inspiring for all of us. It's great to see a person who was once in our position has accomplished so much in her life so far. It is also very valuable for us to hear her tips and tricks throughout her life on how she got into the position she is in today. I will remember her and her advice as I move through my BME career. The advisor meeting was very helpful regarding timing. We should plan to meet with our client soon and get some more materials approved and ordered for our final design.

11/13/25 - Client Meeting

KEIRA FERRIGAN - Nov 14, 2025, 1:06 PM CST

Title: advisor meeting

Date: 11/13/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: Get our final product approved, get more ordered parts approved

Content:

Parts to order:

Cheap Yellow Display - Approved

Clip - Approved

Conclusions/action items:

We met with our advisor, and he was very helpful in telling us what is coming up. We have the poster presentation coming up, and we have to start thinking about what we want to put on the poster. We also need to think about what pictures we want on our poster and the size/font of the text to make it easily readable and understandable. We

11/14/25 - Advisor Meeting

KEIRA FERRIGAN - Nov 14, 2025, 1:09 PM CST

Title: Advisor Meeting

Date: 11/13/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: Meet with our advisor, update him on our progress

Content:

N/A

Conclusions/action items:

We met with our advisor, and he was very helpful in telling us what is coming up. We have the poster presentation coming up, and we have to start thinking about what we want to put on the poster. We also need to think about what pictures we want on our poster and the size/font of the text to make it easily readable and understandable. We also need to start thinking about if we would consider patenting any part of our design, which is a good thing to think about and talk about as a group. Next, I need to order two more parts for our final and start fabricating our final product. We also need to email Puccinelli to request a table for our poster presentation.

11/20/25 - Meeting to Fabricate

KEIRA FERRIGAN - Nov 21, 2025, 9:56 PM CST

Title: Meeting to Fabricate

Date: 11/20/25

Content by: Keira

Present: Jetsu, Niko, Norah

Goals: Meet in Wendt to test our new screen/microcontroller, and buy screws for our sensor

Content:

N/A

Conclusions/action items:

We met to try to make progress on fabrication before Thanksgiving break. I handed over the new cheap yellow display and microcontroller we ordered to have Jetsu start to work on testing out the new circuit with our new parts. Norah and I looked into potential different screws/nuts to use to hold together the laser-cut pieces of our sensor so that it is able to deflect and give out a reading. We ended up getting 6 mini screws and 6 nuts to hold it together. The issue we are running into is that the load sensor is very thick right now with the laser-cut acrylic pieces. So we need to look into how to thin that out to maximize comfort and ergonomics for our client and his patients.

11/21/25 - Advisor Meeting

KEIRA FERRIGAN - Nov 21, 2025, 10:00 PM CST

Title: Advisor Meeting

Date: 11/21/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: Meet with our advisor, update him on our progress, and plan work for the next 2 weeks

Content:

N/A

Conclusions/action items:

We met with our advisor, and he was helpful in giving us further insight into our testing and what it should look like. We agreed that it would be okay to test with dumbbells and then test with our group members to get that human aspect into our testing. We also met as a group after our advisor meeting to think about future steps and work that needs to be done before our poster presentation. We agreed that Niko and Jetsu will work on the circuit, Norah will start sewing a pocket onto our strap, I will look into battery packs and continue our 3D modeling of the boxes, and Cassity will get started on the final poster. We also all agreed to work on the poster and hopefully get it printed by the end of Thanksgiving break.

12/6/25 - Poster Presentation

KEIRA FERRIGAN - Dec 06, 2025, 1:04 PM CST

Title: Poster Presentation

Date: 12/6/25

Content by: Keira

Present: Jetsu, Niko, Norah, Cassity

Goals: Give our poster presentation to our client and advisor, learn about other groups' projects

Content:

Weight-Bearing Sensor

Team: Niko Hess (Lead), Jetzu Thao (BSAC), Norah Greer (BWIG),
Keira Ferrigan (BPAG), Cassity DeChenne (Communicator)
Advisor: Professor David Dean Client: Daniel Kutschera, PT

Introduction

Motivation:

Create an accurate, adjustable, and comfortable sensor, able to be worn throughout a physical therapy session.

- Increase accuracy in applying prescribed weights
- Fit all patients regardless of foot size or swelling

Fig. 1 STAPPONE rehab, an insole that tracks weight-bearing over time. Allows users to set weight-bearing limit in an app and receive visual, haptic, and acoustic feedback in case of under or overloading. Specific to one shoe size. Priced at €499 [1]

Background:

During rehabilitation after a lower limb injury or surgery, percent weight bearing refers to the amount of body weight a patient is allowed to place on the affected limb while standing or walking.

In physical therapy sessions, patients are led through stages such as:

- Non-weight bearing (0%)
- Partial weight bearing (25–50%)
- Full weight bearing (100%) [2]

Gradually increasing these percents helps restore strength, balance, and mobility while minimizing the risk of re-injury or delayed healing. [3] However, these percents are often applied inaccurately due to a lack of an adjustable, accurate method of measuring them.

Design Specifications

- Accurately measure the weight applied within 1-2 lbs for every 100 lbs
- Battery must last for up to 2 hours
- Function in warm and humid conditions, in temperatures from 37-40°C
- Adjustable for any size foot
- Comfortable to use, not altering the patient's natural gait
- All electrical components enclosed in the strap, not to come into contact with patient skin
- Durable, ideally lasting for several years of use
- Manufacturing costs must be under $500
- Device should be as invasive as possible, including minimizing wiring

Modeling and Testing

Modeling and Ergonomics:

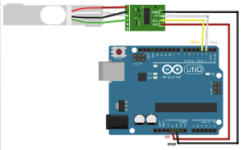


Fig. 2 Final design of the microcontroller circuit

The microcontroller will serve to record and analyze the output from the load cell using the HX711 amplifier

- Amplifier necessary due to low levels of voltage from load cell
- Microcontroller will analyze the signal and interpret to convert to usable info
- Built in low energy bluetooth function will project to screen

The ESP32 screen will receive data via bluetooth from the microcontroller-load cell circuit and use this data to print the weight values in real time

- Built in bluetooth functionality and microcontroller in the screen
- Screen will clip onto walker or sit on a surface and allow for live readings

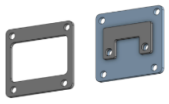


Fig. 3 Solidworks assembly of platform for load cell to allow for deflection

This platform is used on either side of the load cell, with the hollow and protruding sides allowing it to deflect when weight is applied.

The design includes:

- Rounded edges and corners for comfort
- A shape and size closely matching that of the load cell to minimize material under the foot.
- Made of acrylic to minimize profile while retaining strength.

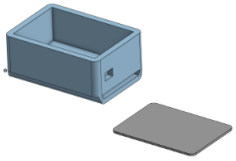


Fig. 4 Solidworks assembly of 3D printed ankle band box with a lid

This enclosure will hold the contents of the microcontroller and arduino. It also has a slit at the bottom to weave through a velcro strap to wrap around the patient's ankle.

This design includes:

- Filleted edges to give a sleek look
- Hole for the wiring
- Lid to be screwed shut
- 3D printed with an SLS printer for durability

Testing Protocol:

Testing was performed using barbells and weights in at 3 set weights

- 45 pounds, 65 pounds, 110 pounds
- Additional control measurement with zero weight
- Set measurements were used to ensure accuracy
- Lower weights were used to mimic low weight bearing requirements where device is most useful

Testing Results:

While the measurements were not perfect, the main adjustment will be simple code alterations, and the level . These measurements are promising but could be greatly improved upon with more testing.

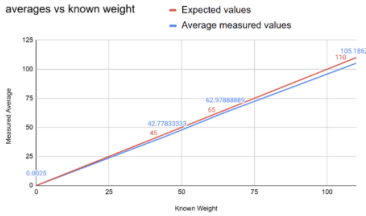


Fig. 5 A graph depicting a comparison of known weights applied vs. the average listed on the readout.

Final Prototype

The final prototype of the device includes a strap to hold the sensor and the circuitry running it, and a separate display screen. While the bluetooth functionality is not implemented, the sensor can read weights and provide output to a computer.

- Fully assembled strap
- Working screen and sensor circuit
- Sensor can output data to a computer
- Bluetooth not yet integrated

Fig. 6 Picture of final prototype

The individual pieces of the prototype are all working independently of each other, and have shown efficacy in function, simply needing work towards integration.

Future Work & Discussion

The prototype design includes most of the desired functions, thought not connected to each other. Refinement and combination of parts will be the focus of next steps.

- Screen adjustments
- Bluetooth integration
- Box enclosures around screen and circuit
- Incorporate sanitary precautions
- Power circuit by alkaline batteries

Future work on our design would center around improving our product's maneuverability and ease of use. Switching out wiring for Bluetooth, lessening our design's bulk, and changing the power source to portable batteries would be key priorities.

Acknowledgements

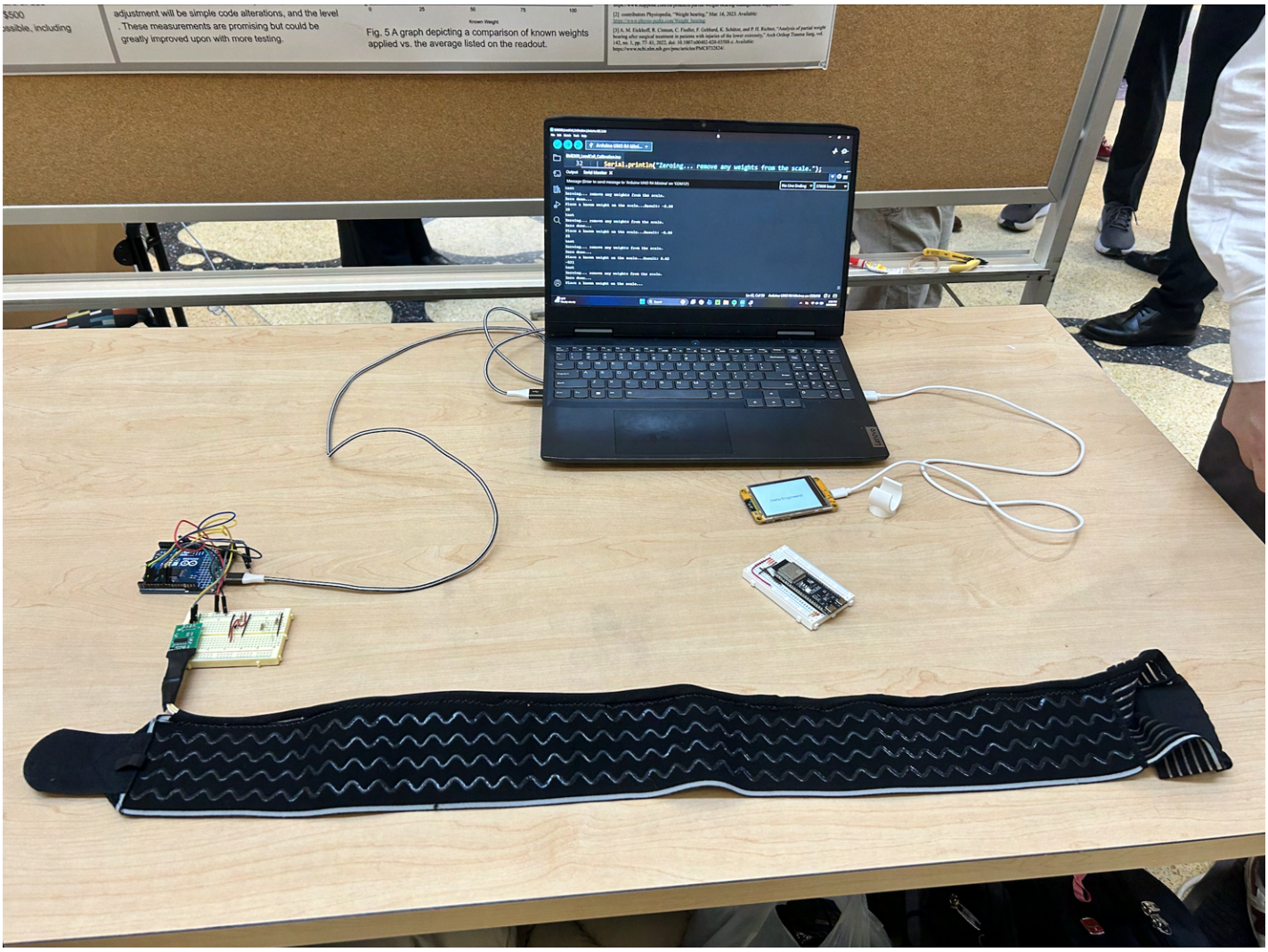
- Dr. John Puccinelli
- BME Faculty
- Workshop Staff
- Dr. David Dean
- Daniel Kutschera, PT

References

[1] "STAPPONE Rehab," stappone. Available: https://www.stappone.com/en/products/partial-weight-bearing-management/stappone-rehab/.

[2] contributors Physiopedia, "Weight bearing," Mar. 16, 2023. Available: https://www.physio-pedia.com/Weight_bearing

[3] A. M. Eickhoff, R. Cintean, C. Fiedler, F. Gebhard, K. Schütze, and P. H. Richter, "Analysis of partial weight bearing after surgical treatment in patients with injuries of the lower extremity," Arch Orthop Trauma Surg, vol. 142, no. 1, pp. 77–81, 2022, doi: 10.1007/s00402-020-03588-z. Available: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC9732824/.



Conclusions/action items:

We had a great time giving our presentation and sharing our process, along with everything we have learned to our fellow BMEs and peers. We are very proud of what we have accomplished this semester and the prototype that we have created. While it isn't perfect, we still do believe that we have a really solid start that we can then pass on to future groups (or for the juniors in our group to continue). We had a great time learning about and seeing everyone's progress that they have made on their own projects and see the overall impact that this class makes as a whole. Next, I will send an email to our client thanking him for coming to our poster presentation and sending him the final materials I ordered, as well as the cost ($65.87) for reimbursement. We will divide and conquer the final report and will get started on that as soon as possible!

12/4/25 - Weight Distribution on Feet

Cassity DeChenne - Dec 04, 2025, 8:47 PM CST

Cassity DeChenne - Dec 04, 2025, 8:35 PM CST

Title: Weight Distribution on Feet

Date: 12/4/25

Content by: Cassity DeChenne

Content: This article explored the weight distribution that a group of people had on different areas of their feet. One of their findings most relevant to our project was this: "There was higher load on the rearfoot (left 54.14%; right 55.09%) than on the forefoot (left 45.49%; right 44.26%)." This is important to know for placement of our weight bearing sensor on the underside of the foot. Our client wanted to be able to adjust the placement of the sensor in between uses as well, so it is important to know that there are different weight distributions on the two main areas of the foot that the sensor could be placed. This study also found that there was a correlation between increasing age and increasing weight placed on the forefoot. In addition, they found a correlation between increasing BMI and increasing weight placed on the rearfoot.

	Mean value/Median	Tolerance range Lower limit	Tolerence range Upper limit	Confidence interval Left limit	Confidence interval Right limit
Weight distribution (%)					
Balance left	50.07	27.72	77.82	49.12	51.03
Balance right	50.12	22.24	72.89	49.14	51.09
Forefoot left	*45.49*	19.78	*81.07*	*42.81*	*46.60*
Forefoot right	*44.26*	17.40	*78.21*	*43.61*	*47.05*
Rearfoot left	54.14	22.89	82.75	52.64	55.64
Rearfoot right	*55.09*	*21.75*	*82.50*	*53.37*	*56.94*
Pressure parameter (N/cm^2)					
Maximum pressure	*12.5*	*7.00*	*21.35*	*12.00*	*13.00*
Left	*11.05*	*5.25*	*19.19*	*10.50*	*11.60*
Right	*11.00*	*6.34*	*19.38*	*10.60*	*11.50*
Forefoot left	8.23	3.00	16.81	7.83	8.59
Forefoot right	8.59	3.54	16.50	8.22	8.96
Rearfoot left	*9.60*	*3.54*	*18.20*	*9.00*	*10.00*
Rearfoot right	9.51	3.50	17.76	9.12	9.89

	p value	Rho-value	*p* value	Rho-value
		Age		BMI
Weight distribution (%)				
Balance left	0.99	0.01[1]	0.39	0.04[1]
Balance right	1.00	0.01[1]	0.38	− 0.04[1]
Forefoot left	**0.01**	0.13[1]	***0.001***	*− 0.16*[1]
Forefoot right	*0.30*	*0.05*[1]	***0.001***	*− 0.19*[1]
Rearfoot left	**0.02**	− 0.11[1]	**0.001**	0.17[1]
Rearfoot right	*0.48*	*− 0.03*[1]	***0.001***	*0.17*[1]
Pressure parameter (N/cm^2)				
Maximum pressure	*0.81*	*0.01*[1]	***0.001***	*0.31*[2]
Left	*1.00*	*0.001*[1]	***0.001***	*0.30*[2]
Right	*0.61*	*0.03*[1]	***0.001***	*0.29*[2]
Forefoot left	**0.01**	0.20[2]	***0.03***	*0.11*[1]
Forefoot right	**0.02**	0.12[1]	***0.001***	*0.35*[2]
Rearfoot left	***0.03***	*− 0.11*[1]	***0.001***	*0.41*[3]
Rearfoot right	0.71	− 0.02[1]	**0.001**	0.41[3]

References: D. Ohlendorf, K. Kerth, W. Osiander, F. Holzgreve, L. Fraeulin, H. Ackermann, and D. A. Groneberg, “Standard reference values of weight and maximum pressure distribution in healthy adults aged 18–65 years in Germany,” *J. Physiol. Anthropol.*, vol. 39, no. 1, p. 39, Nov.

2020, doi: 10.1186/s40101-020-00246-6. https://pmc.ncbi.nlm.nih.gov/articles/PMC7706280/

12/4/25 - Dangers of Wearing an Ankle Brace

Cassity DeChenne - Dec 04, 2025, 8:39 PM CST

Title: Dangers of Wearing an Ankle Brace

Date: 12/4/25

Content by: Cassity DeChenne

Content: From this webpage's explanation, most of the discomfort and danger coming from wearing an ankle brace appears to result from long-term usage. This is useful to know because our product uses an ankle brace to secure our weight bearing sensor, but only for short wear periods. The dangers were primarily reliance on the brace that could cause ankle muscle regression and skin irritation. While the patient using our design definitely would not wear it long enough for muscle regression, skin irritation is slightly possible. To reduce this risk, it is important that we recommend wearing socks/shoes in between our product and the skin.

References:

Nevada Orthopedic & Spine Center, “Pros and Cons of Having Your Young Athlete Wear an Ankle Brace,” *Nevada Orthopedic*, Jun. 01, 2023. https://www.nevadaorthopedic.com/post/pros-and-cons-of-having-your-young-athlete-wear-an-ankle-brace

12/7/25 - Ankle Brace Altering Gait

Cassity DeChenne - Dec 07, 2025, 7:39 PM CST

Title: Ankle Brace Altering Gait

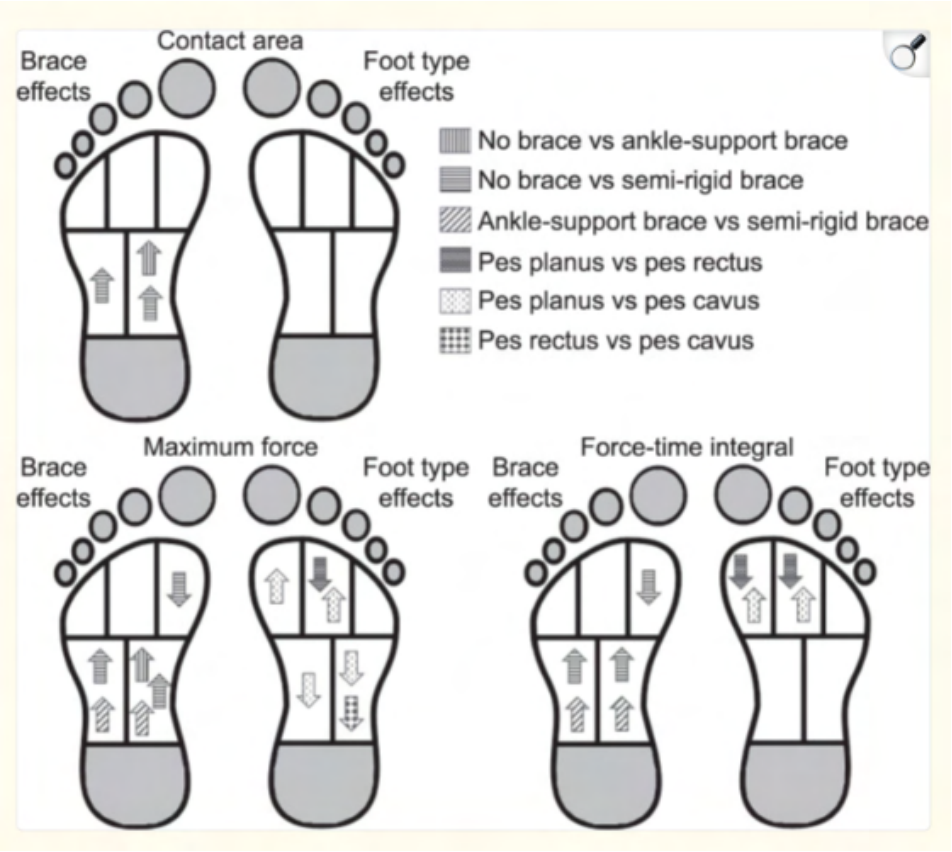
Date: 12/7/25

Content by: Cassity DeChenne

Content: This article discussed a study in which weight distribution on the foot was altered with different types of ankle braces. This study was conducted by assessing the weight that fell on different points of the foot as the participants completed different activities. It is also important to note that foot type/shape was found to impact weight distribution independent of the ankle brace. They ultimately found that the use of an ankle brace did alter weight distribution on the midfoot and forefoot, and this redistribution did not depend on foot type. The study also found that different types of braces altered weight distribution in different ways. This highlights the importance of looking into the weight distribution of the particular brace used in weight-bearing sensor designs. This would be needed in order to accurately assess the weight that should be targeted when using the sensor for weight-bearing restriction monitoring.

Effects of Brace Condition and Foot Type on the Contact Area, Maximum Force, and Force-Time Integral in the 5 Regions of Interest During the Cutting Task

Variable	Foot Type, Mean ± SD								
	Pes Planus			Pes Rectus			Pes Cavus		
	No Brace	Ankle-Support Brace	Semirigid Brace	No Brace	Ankle-Support Brace	Semirigid Brace	No Brace	Ankle-Support Brace	Semiri Brace
Contact area, normalized insole contact area									
Medial midfoot[a,b]	0.153 ± 0.012	0.155 ± 0.005	0.160 ± 0.005	0.154 ± 0.007	0.156 ± 0.008	0.158 ± 0.003	0.154 ± 0.007	0.155 ± 0.004	0.157 0.003
Lateral midfoot[b]	0.161 ± 0.005	0.160 ± 0.002	0.163 ± 0.005	0.158 ± 0.005	0.156 ± 0.013	0.161 ± 0.002	0.159 ± 0.002	0.158 ± 0.003	0.160 0.003
Medial forefoot	0.076 ± 0.006	0.077 ± 0.003	0.073 ± 0.009	0.077 ± 0.002	0.077 ± 0.004	0.076 ± 0.004	0.077 ± 0.002	0.076 ± 0.004	0.077 0.002
Middle forefoot	0.092 ± 0.004	0.092 ± 0.002	0.093 ± 0.004	0.091 ± 0.002	0.092 ± 0.003	0.091 ± 0.001	0.092 ± 0.002	0.092 ± 0.003	0.092 0.002
Lateral forefoot	0.085 ± 0.002	0.084 ± 0.001	0.086 ± 0.003	0.083 ± 0.004	0.082 ± 0.008	0.084 ± 0.003	0.084 ± 0.002	0.085 ± 0.002	0.084 0.002



References:

Dickerson, L. C. and Queen, R. M., “Foot posture and plantar loading with ankle bracing,” *Journal of Athletic Training*, vol. 56, no. 5, pp. 461–472, May 2021. doi:10.4085/1062-6050-164-20.

11/24/25 - Competing Design 1

Cassity DeChenne - Dec 04, 2025, 8:34 PM CST

Title: Competing Design 1

Date: 11/24/25

Content by: Cassity DeChenne

Content: The Engineering Rehabilitation nCounters company has a weight bearing sensor for $599. This product uses a piece of cloth that covers the whole bottom of a foot, with two sensors placed at the ball and the heel of the foot. This is a bit more size-restricting than our design, where a strap can stretch and wrap to accommodate different foot sizes. The design does use a similar screen to ours, just a bit more bulky and detailed. Another detail of this design that slightly differs from ours is that feedback on weight distribution is given through a speaker or headphones, rather than solely by looking at the screen.

References:

P. Barrett. (2024, June 17). *Portable Limb Load Monitor_Touch (PLLM_Touch) – How it Works* NCounters Engineering Biofeedback Rehabilitation Products, https://ncountersonline.com/portable-limb-load-monitor?srsltid=AfmBOorgs17z_IRzwpqhIDLDVsmhdjpraP52KHlSWBttH-hSM0nHljNG.

11/24/25 - Competing Design 2

Cassity DeChenne - Dec 03, 2025, 2:39 PM CST

Title: Competing Design 2

Date: 11/24/25

Content by: Cassity DeChenne

Content: This design is mainly for cane users, but the methods/technology used are helpful to look through. It is also important to note that one of the client's main concerns was for the sensor screen to be able to clip to a walker, which is similar in shape to the cane and could therefore have significant sensor design crossover. This design is intended for more long-term use than ours. The sensor straps onto the cane in this design, monitoring the weight that the patient leans on the cane. It can support weights of up to 111 kg, very similar to our design. The weight data would all be sent to a mobile phone, and it appears to give more of a continuous weight load graph, rather than instantaneous weight load feedback. In all, this design would not be sufficient for our client's needs, but it is useful to reference.

References:

J. Ballesteros, A. Tudela, J. R. Caro-Romero, and C. Urdiales, “Weight-bearing estimation for CANE users by using onboard sensors,” MDPI, https://www.mdpi.com/1424-8220/19/3/509 (accessed Dec. 3, 2025).

12/3/25 - Competing Design 3

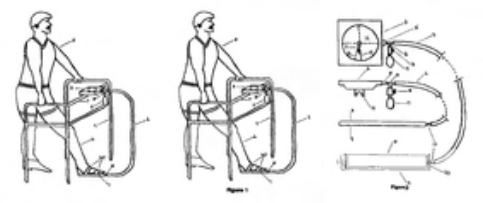
Cassity DeChenne - Dec 03, 2025, 2:55 PM CST

Title: Competing Design 3

Date: 12/3/25

Content by: Cassity DeChenne

Content: This source mainly discussed the weight bearing sensor designed and the patents needed to claim ownership of the design. This sensor utilized a "bladder" that would fill up with liquid/air, placed around a patient's foot in order to gauge the amount of pressure put on said patient's afflicted leg. Like our design, the weight put on the limb in question would be available to see in real-time. However, due to the nature of the design and it's possibility for bacteria transfer, it is only recommended for single-patient use. Also, more similar to our design, the output screen would attach directly to a walker/crutch.



References:

F. A. Ward, “Visual warning device for weight bearing,” U.S. Patent US 8915132B1, Dec. 23, 2014.
https://patents.google.com/patent/US8915132B1/en

12/3/25 - Competing Design 4

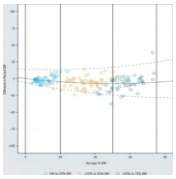
Cassity DeChenne - Dec 03, 2025, 3:22 PM CST

Title: Competing Design 4

Date: 12/3/25

Content by: Cassity DeChenne

Content: This article compared three different weight bearing sensors: the OpenGo, the SmartStep, and the SensiStep. The OpenGo has wireless sensor insoles that measure weight data. This design also has a temperature sensor. The way it relays the weight data can be by audio or haptics, depending on the preference of the user. The SmartStep also has an insole design, except it uses air pockets in the insoles to capture weight data. Finally, the SensiStep consists of an insole design with the pressure sensor placed in the back of the heel, with the feedback unit placed on a wrist or belt. These three were compared to monitor their agreement in weight data against a control (an AMTI force plate used as the "gold standard"). The final conclusion was this: "Agreement with the gold standard was substantial for the SmartStep, moderate for OpenGo science, and slight for SensiStep."



References:

R. van Lieshout, M.J. Stukstette, R.A. de Bie, B. Vanwanseele, and M.F. Pisters, “Biofeedback in Partial Weight Bearing: Validity of 3 Different Devices,” *J. Orthop. Sports Phys. Ther.*, vol. 46, no. 11, pp. 993–1001, Nov. 2016. https://doi.org/10.2519/jospt.2016.6625

12/7/25 - "Beeper Boot"

Cassity DeChenne - Dec 07, 2025, 11:40 AM CST

Title: "Beeper Boot"

Date: 12/7/25

Content by: Cassity DeChenne

Content: In this article, a study was performed in which the weight that participants of a study group put on their legs were assessed. They were assigned target weights that they would allow on their limbs of interest, and the amount that they surpassed said weights was compared using the "beeper boot" versus a regular scale. The boot consisted of a weight-bearing sensor placed inside a foot brace, in which there would be a "sensereader" that the sensor would send the weight data to. This reader would then generate an "audiovisual signal," or a beep, depending on the weight that the user put on the boot. The end result of this study was that they found that using a bathroom scale for weight-bearing restrictions would not be accurate enough to warrant use. They also found that using the boot offered significant improvement in accuracy.

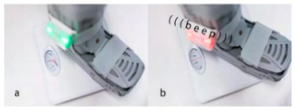


Figure 1. The device outputs loads under 20 kg with a green light (**a**) and loads over 20 kg with a red light (**b**), accompanied by an audible alarm sound. The removable sensereader is located on the outside of the orthosis. This makes it easy to see and ensures that it does not get in the way while walking.

Second Cycle Treatment Group (n = 42)	Underload <15 kg	Target Zone 15–30 kg	Overload >30 kg
Level Ground	22.0% (11.0 SD 8.9) [a]	71.4% (39.8 SD 18.8) [b]	6.6% (3.3 SD 4.3) [c]
			(a) $p = 0.017$; (b) $p < 0.001$; (c) $p < 0.001$
Upstairs	19.4% (4.4 SD 4.1) [a]	72.2% (16.7 SD 5.7) [b]	8.4% (1.9 SD 2.4) [c]
			(a) $p = 0.091$; (b) $p = 0.008$; (c) $p < 0.001$
Downstairs	26.6% (6.0 SD 4.2) [a]	69.2% (15.6 SD 4.5) [b]	4.2% (1.0 SD 1.3) [c]
			(a) $p = 0.022$; (b) $p = 0.028$; (b) $p < 0.001$

Table 1. The first cycle included all participants without biofeedback. All loads were divided into three categories: underload (<15 kg), target zone (15–30 kg), and overload (>30 kg). The sum of the steps per load zone is given in %. The mean step count and its standard deviation are presented in parentheses.

First Cycle n = 84	Underload <15 kg	Target Zone 15–30 kg	Overload >30 kg
Level ground	12.4% (5.7 SD 8.6)	42.5% (20.1 SD 12.8)	45.1% (22.6 SD 18.3)
Upstairs	12.4% (2.8 SD 3.9)	51.6% (12.1 SD 7.2)	36.0% (8.4 SD 7.6)
Downstairs	15.6% (3.5 SD 3.8)	52.4% (12.1 SD 6.2)	32.0% (7.4 SD 6.9)

References:

T. P. Merkle, N. Hofmann, C. Knop and T. Da Silva, “Is an Ambulatory Biofeedback Device More Effective than Instructing Partial Weight-Bearing Using a Bathroom Scale? Results of a Randomized Controlled Trial with Healthy Subjects,” Sensors, vol. 24, no. 19, Art. no. 6443, Oct. 2024, doi: 10.3390/s24196443.

12/3/25 - Fabric for Wire Pocket/Sensor Pocket

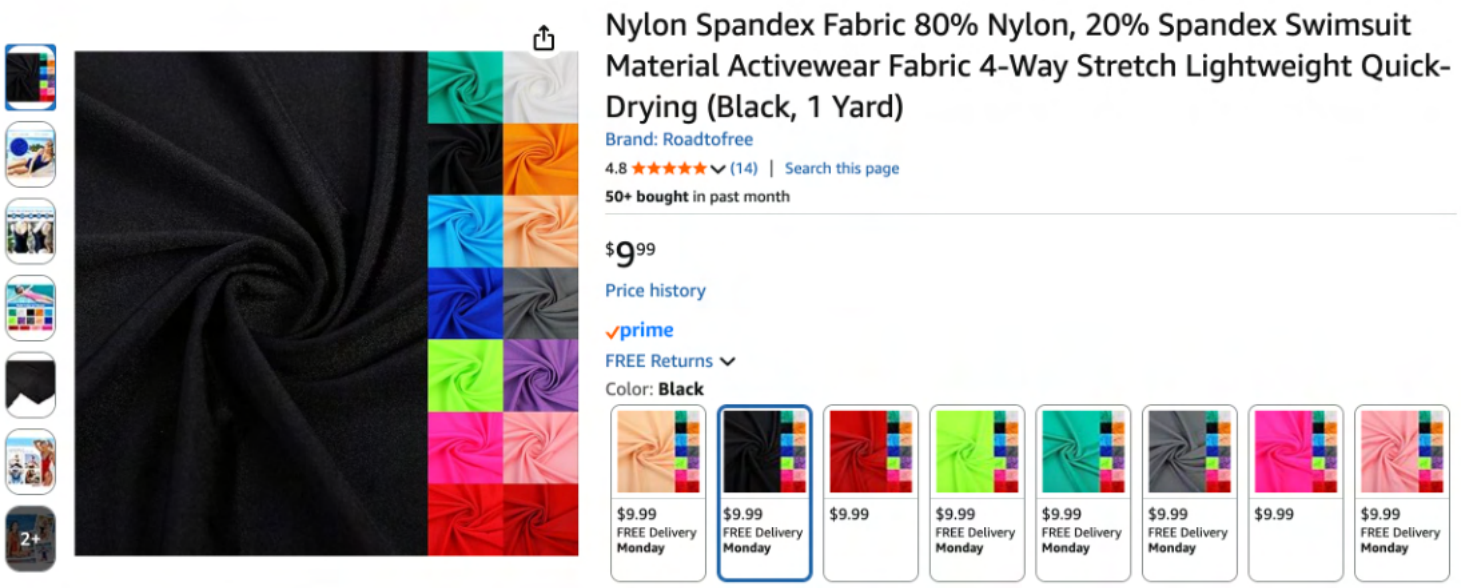
Cassity DeChenne - Dec 03, 2025, 3:49 PM CST

Title: Fabric for Wire Pocket/Sensor Pocket

Date: 12/3/25

Content by: Cassity DeChenne

Content: We needed to find a fabric that was stretchy so that, when it was sewn onto the strap, it wouldn't tear as the strap stretched around patients. We also needed it to be durable, as it would be stretched and used repeatedly. In addition, we needed to find something inexpensive with small shipping costs so that it would fit within our budget. We also needed it to ship fast and in small swaths (arguable the hardest part because most fabric we found would only ship in large loads). Finally, we settled on a fabric that was able to meet all these criteria.



https://a.co/d/5oGyeLG

12/7/25 - Strap to Keep Sensor Secured

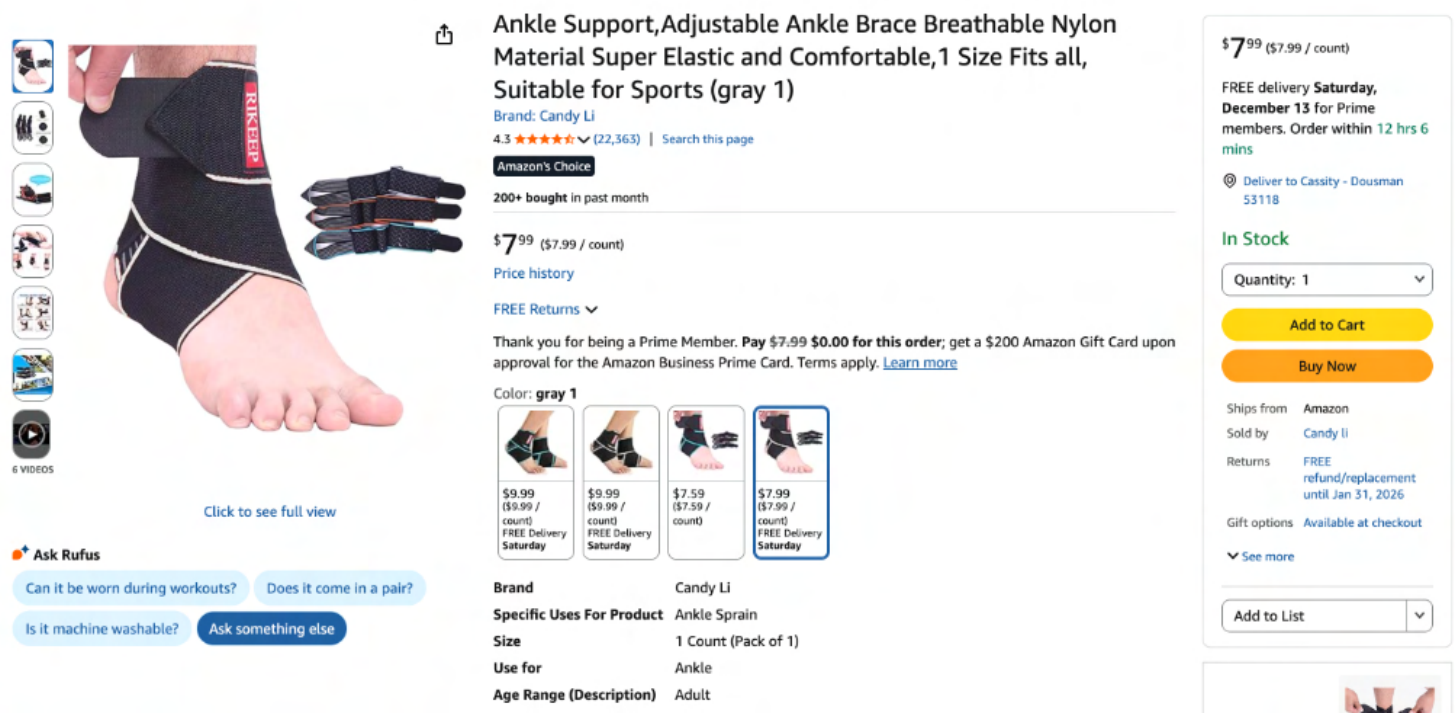
Cassity DeChenne - Dec 07, 2025, 11:59 AM CST

Title: Strap to Keep Sensor Secured

Date: 12/7/25

Content by: Cassity DeChenne

Content: We considered multiple ways to keep the sensor secured. We thought about using a compression sock, but we didn't want the added pressure to skew weight data. Our client did specify that he wanted something adjustable, so while an insole design crossed our minds, we ultimately dismissed it because that would not work for patients with many differing sizes of feet. Also, if patients' feet were too swollen to fit in shoes, an insole design would not work, and our client said that this was the case for many of his patients. We ended up going with this ankle support brace that we modified to work with our intended design.



12/7/25 - Weight Bearing Rehab After Surgery

Cassity DeChenne - Dec 07, 2025, 12:45 PM CST

Title: Weight Bearing Rehab After Surgery

Date: 12/7/25

Content by: Cassity DeChenne

Content: This article ran through why and how weight bearing restrictions might be used after lower-extremity surgery. An important point they made was this: "This restriction is necessary to provide adequate time for proper bone or tissue healing to occur. It also allows for any hardware that was placed during the surgical procedure to remain in the proper position." If someone were to go full weight-bearing on their afflicted limb after surgery, it could damage the healing tissues or shift whatever things were placed on/in the leg during surgery. This is why weight-bearing restrictions are so important and why it is critical that the methods used to measure the weight put on the afflicted limb are accurate and reliable. This article also runs through some helpful definitions of partial weight-bearing, toe-touch weight bearing (only the toes can touch the ground and bear weight), full weight-bearing, and more relevant terms.

References:

L. Inverarity, “Weight-Bearing Restrictions and Activity After Surgery,” *Verywell Health*, Nov. 17, 2025. https://www.verywellhealth.com/weight-bearing-restrictions-2696668

12/7/25 - Patient Compliance with Weight Bearing Restrictions

Cassity DeChenne - Dec 07, 2025, 1:02 PM CST

Title: Patient Compliance with Weight Bearing restrictions

Date: 12/7/25

Content by: Cassity DeChenne

Content: This article went over a study in which the target group was assessed for how likely they would be to comply to weight bearing restrictions as time progressed. This study utilized an weight-bearing insole that would be continuously utilized throughout the entirety of the study. This meant that patients would be assessed on their weight bearing continuously for 5-42 days, whenever they put on the insole (whenever they put on shoes). They found that patients weren't very reliable with adhering to the weight-bearing restricting restrictions that they were assigned, and even less as time went on. This is a critical observation to highlight the importance of physical therapist- monitored weight bearing restriction sessions.

Fig. 1 OpenGO Insole (Moticon GmbH; Munich, Germany)

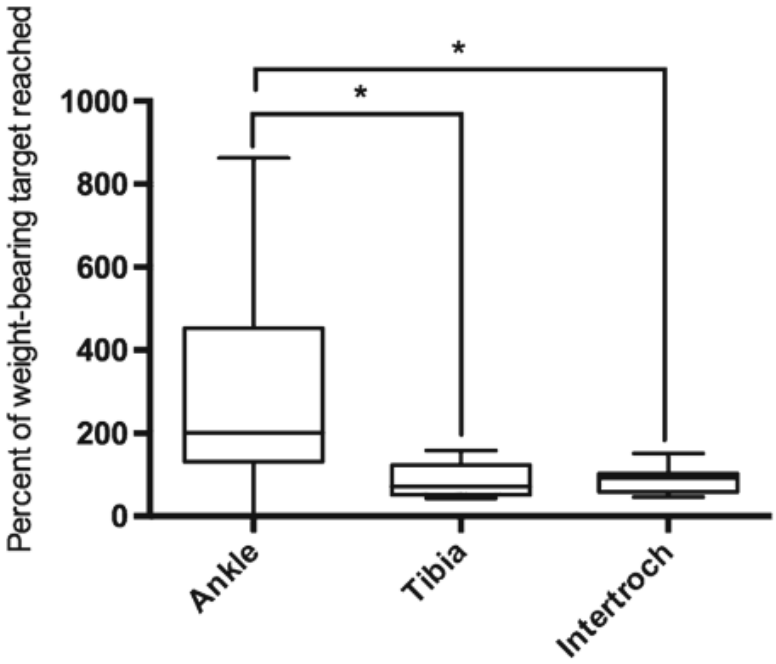


Fig. 2 Box plots show the deviation from the recommended weight-bearing limit (100%) for all three fracture types included in the study. *Boxes* show median, as well as 1st and 3rd quartiles, Tukey whiskers. *$p < 0.05$

References:

B. J. Braun, N. T. Veith, M. Rollmann, M. Orth, T. Fritz, S. C. Herath, J. H. Holstein and T. Pohlemann, “Weight-bearing recommendations after operative fracture treatment — fact or fiction? Gait results with and feasibility of a dynamic, continuous pedobarography insole,” *International Orthopaedics*, vol. 41, no. 8, pp. 1507–1512, 2017, doi: 10.1007/s00264-017-3481-7.

12/7/25 - Sample Weight Bearing Plan: Hip Surgery

Cassity DeChenne - Dec 07, 2025, 1:16 PM CST

Title: Sample Weight Bearing Plan: Hip Surgery

Date: 12/7/25

Content by: Cassity DeChenne

Content: This article gave a sample plan for rehab following hip surgery. It is mainly meant to be used by physical therapists as a sample general outline for hip surgery patients that can be modified depending on patient pain, recovery speed, etc. There were many recommendations and specifications on a wide range of recovery methods, but I'll focus specifically on the weight-bearing portions. This article recommends that the patient have 20 lb weight bearing on their afflicted limb for 4 weeks. If the surgery was more extensive, they may extend this recommendation to 6 weeks. The article also recommends that physical therapists keep patients weight-bearing restricted at their discretion, altering the target weight and duration of the restrictions according to the patient.

References:

M. B. Ellman and E. Groff, *Scope and Glute Repair PT Protocol (11-23)*, Panorama Orthopedics & Spine Center, Feb. 2015. Available: https://www.panoramaortho.com/wp-content/uploads/2015/02/Scope-and-Glute-Repair-PT-Protocol-11-23.pdf

12/7/25 - Weight Bearing Reasons

Cassity DeChenne - Dec 07, 2025, 1:27 PM CST

Title: Weight Bearing Reasons

Date: 12/7/25

Content by: Cassity DeChenne

Content: This article went over what weight bearing is, the types, why a patient might be recommended to have a weight bearing restriction, and the benefits of the practice. One especially interesting thing they mentioned is this: "Some significant issues when it comes to weight-bearing are obesity, limited mobility due to disease, or bearing weight too early following a fracture or orthopedic surgery. When circumstances limit the ability to ambulate and bear weight, the risk of obtaining osteoarthritis or osteoporosis increases." This highlights some reasons why restrictions may need to be placed. However, it also highlights some possible dangers of keeping a patient weight-bearing restricted at a lower weight than they need to be. This is a possible danger that could arise from incorrect measurement of weight in some rehab practices. Also, this danger could arise from keeping a patient non-weight bearing when they could be participating in partially weight-bearing exercises. This again highlights the importance of accurate, reliable weight-bearing sensors that allow physical therapists to comfortable and confidently allow patients to engage in partial weight-bearing exercises at exactly the weight they want them to use.

References:

T. B. Anderson and H. Duong, “Weight Bearing,” in *StatPearls [Internet]*, Treasure Island, FL: StatPearls Publishing, 2023. https://www.ncbi.nlm.nih.gov/books/NBK551573/

9/26/25 - My Initial Design

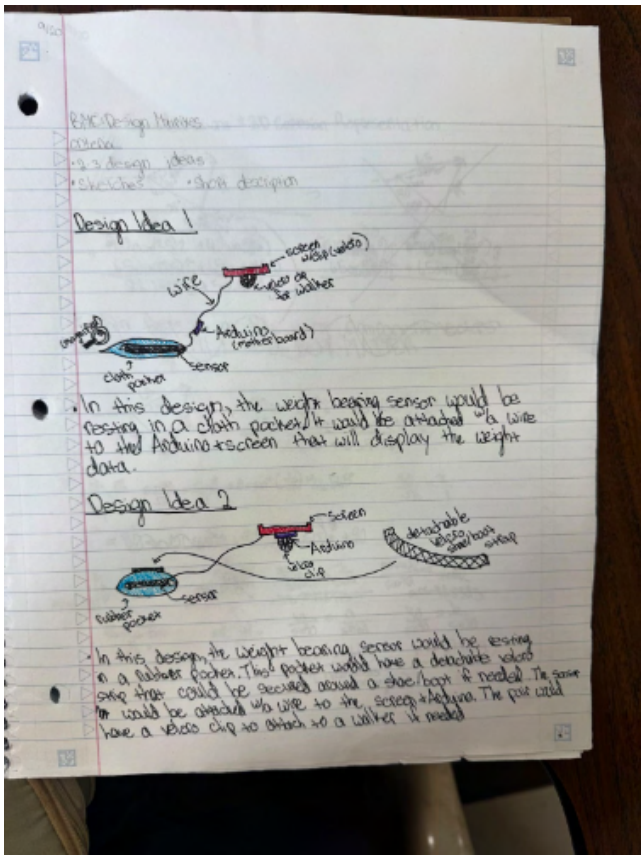
Cassity DeChenne - Nov 02, 2025, 4:58 PM CST

Title: Initial Design Ideas

Date: 9/26/25

Content by: Cassity DeChenne

Content:



In these designs, the weight bearing sensor would be resting in a pocket. This would be placed under the client's foot. It would be attached with a wire to the Arduino circuit, which could rest in the shoe/boot. This wire would also attach to the screen that would display the weight data. This screen would be able to clip onto a patient walker if needed with a velcro strap.

Link to design matrix: https://docs.google.com/document/d/1kzd4p568kkgEUX7pJgpsIITkPb9B17wHp6AK7elswyg/edit?usp=sharing

9/26/25 - All Initial Designs

Cassity DeChenne - Dec 03, 2025, 3:37 PM CST

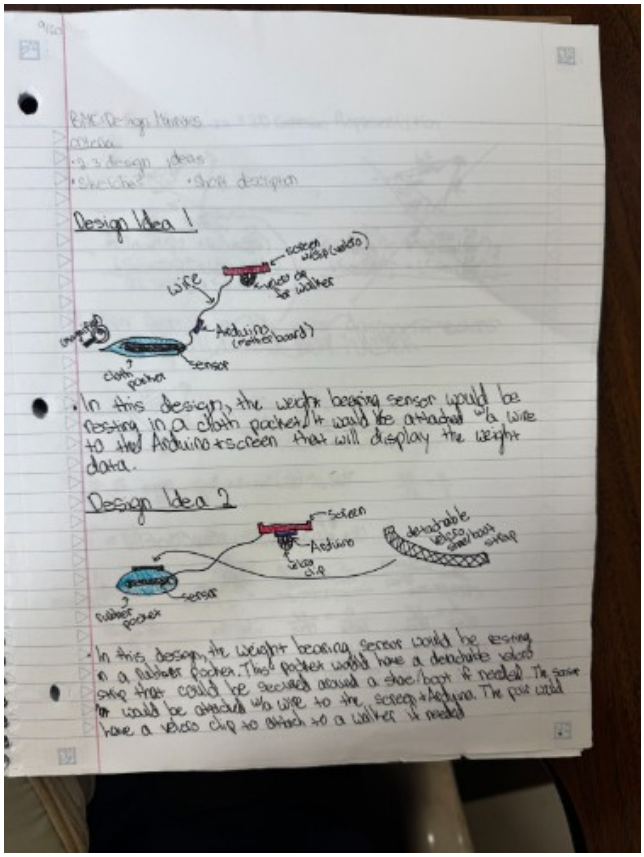
Title: All Initial Designs

Date: 9/26/25

Content by: Cassity DeChenne

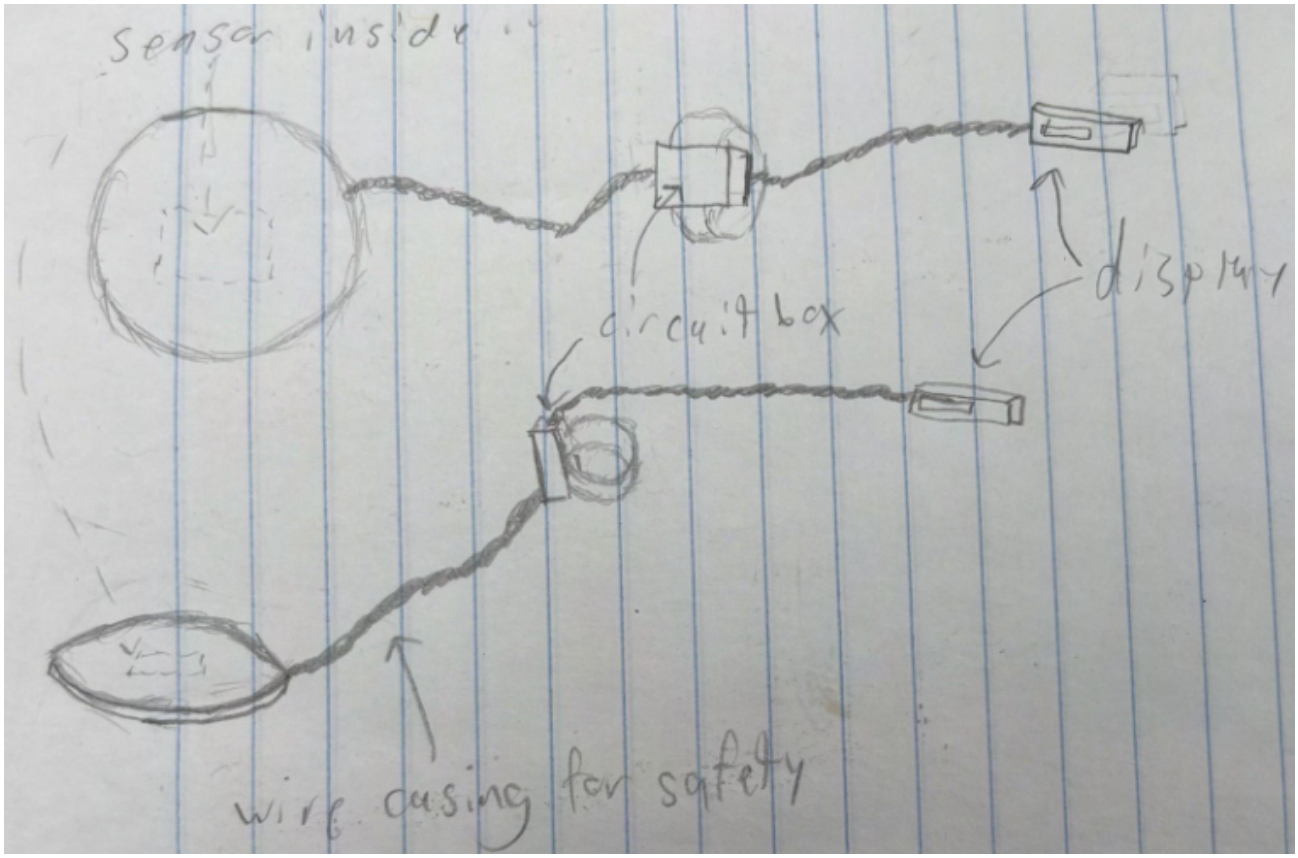
Content:

Cassity's Designs



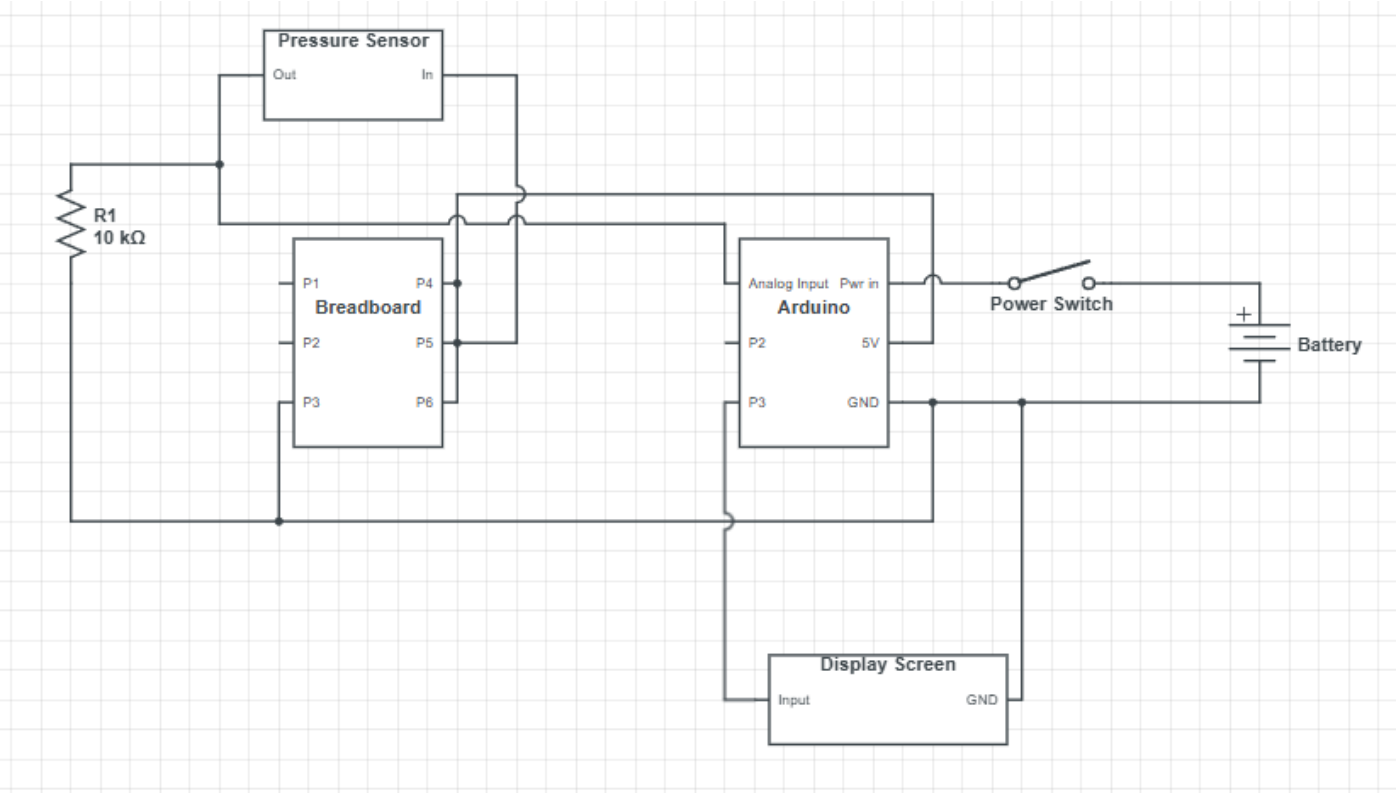
Niko's Designs:

Firm mini pad:



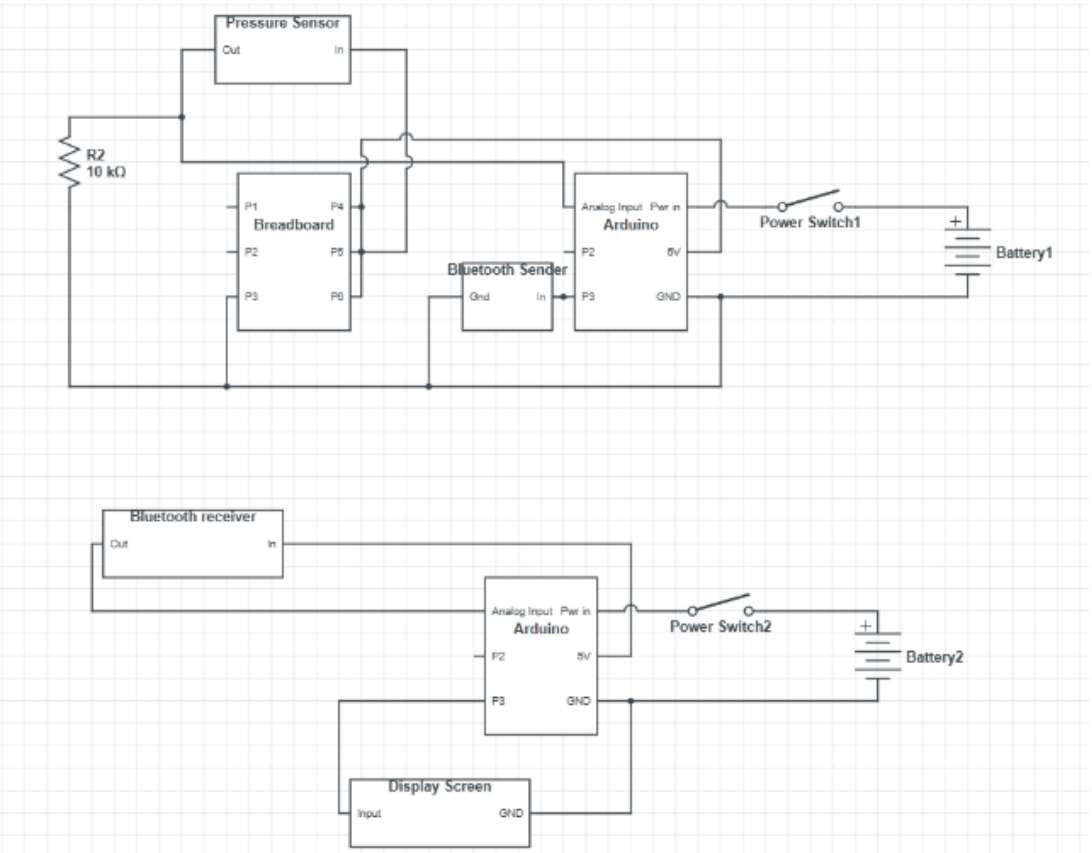
The design uses a small, thin, circular pad with a sensor embedded inside. The pad would be quite small and fit in the sole of a shoe, as well as under the pad or ball of a foot. The top of the pad is made of a very soft, cushioned material, and the bottom attached to the pad is made of a slightly firm, but flexible material to provide better support and hopefully more consistent results. This bottom would have a velcro section on the back and include both a flat pad that could attach to avoid damaging shoes, as well as a strap that could attach to the velcro and hold the design to the foot of a patient. The wires feed out from one end of the pad, and connect to an anklet with the circuitry attached. The wiring to the display would feed out of the other side of the anklet. All wiring would be encased in a flexible, knitted fiber sleeve to protect both the wiring and the patient.

Basic circuit:



This circuit design involves as little extra material and pieces as possible, involving a battery to power the arduino, and the arduino powering the pressure sensor with only the breadboard as an intermediate. The feedback from the pressure sensor is split with a resistor in order to keep the results stable and level. The display is wired directly from the arduino to ground.

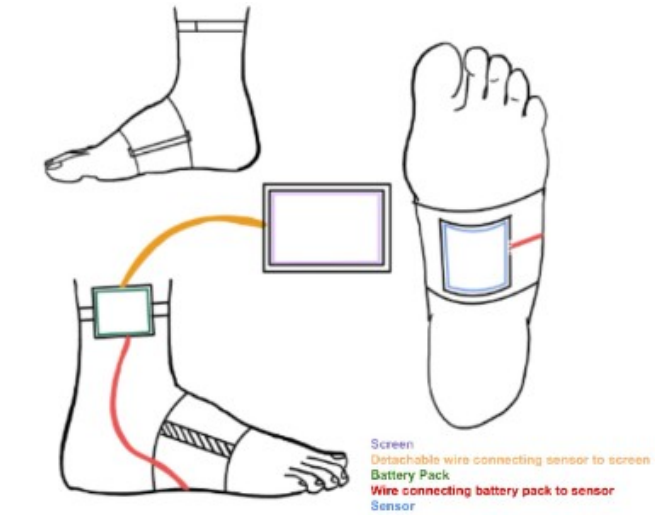
Basic circuit with bluetooth:

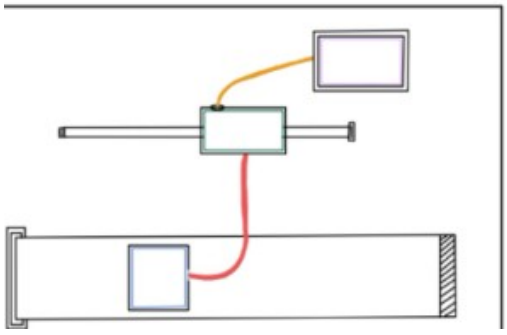


This circuit remains almost as basic as possible, with the Arduino powered by the battery, and the sensor powered by the Arduino through the breadboard. The feedback is split by a resistor to ground for signal stability, and then fed to the arduino, which sends the signal for the display to a bluetooth device. The second half of the circuit includes an identical battery and arduino setup with a breadboard, connected to a bluetooth receiver to receive signal from the other Arduino. The second Arduino processes the input and projects it to the display, which then wires directly to ground

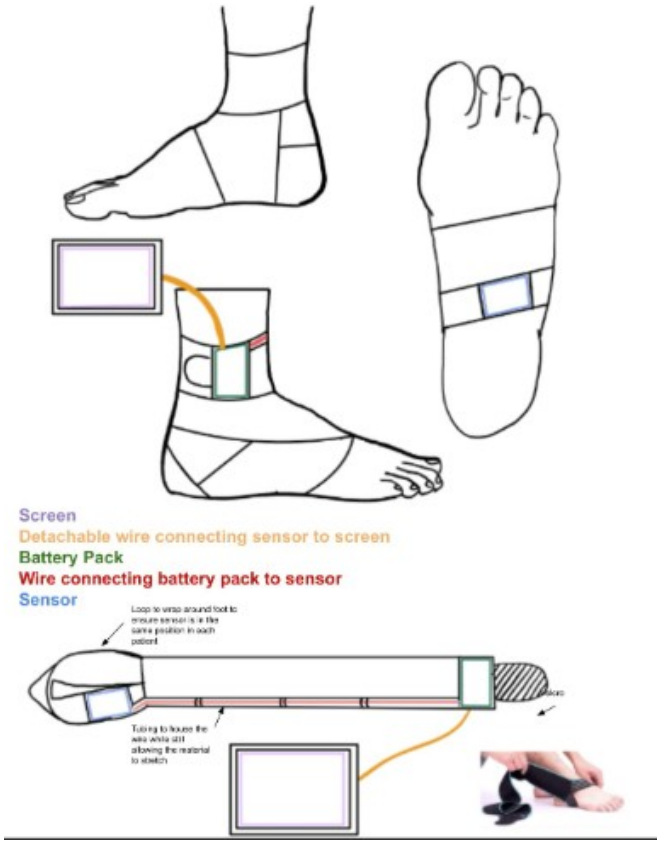
.

This design uses an adjustable velcro strap similar in design and material to that on a blood pressure cuff. The sensor is embedded in the cuff with an opening to allow the wire to connect to the battery pack. The battery pack will also be located on an adjustable velcro strap. The screen will be attached via a disconnectable wire to prevent tangling and increase the ease of use.

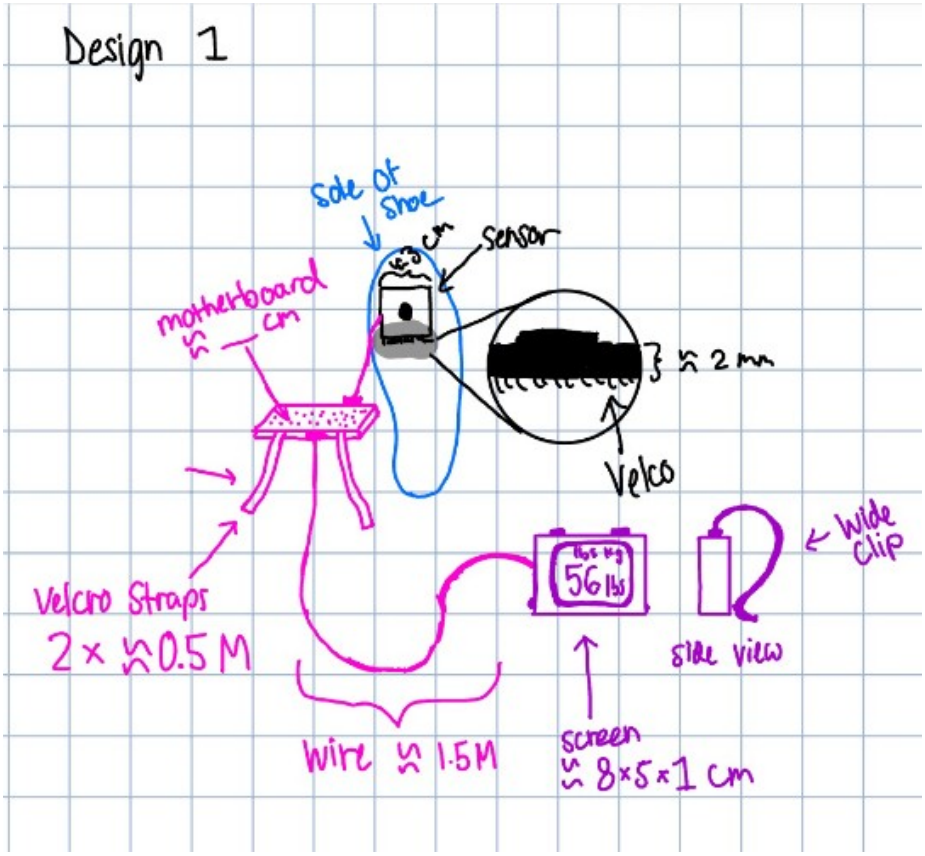




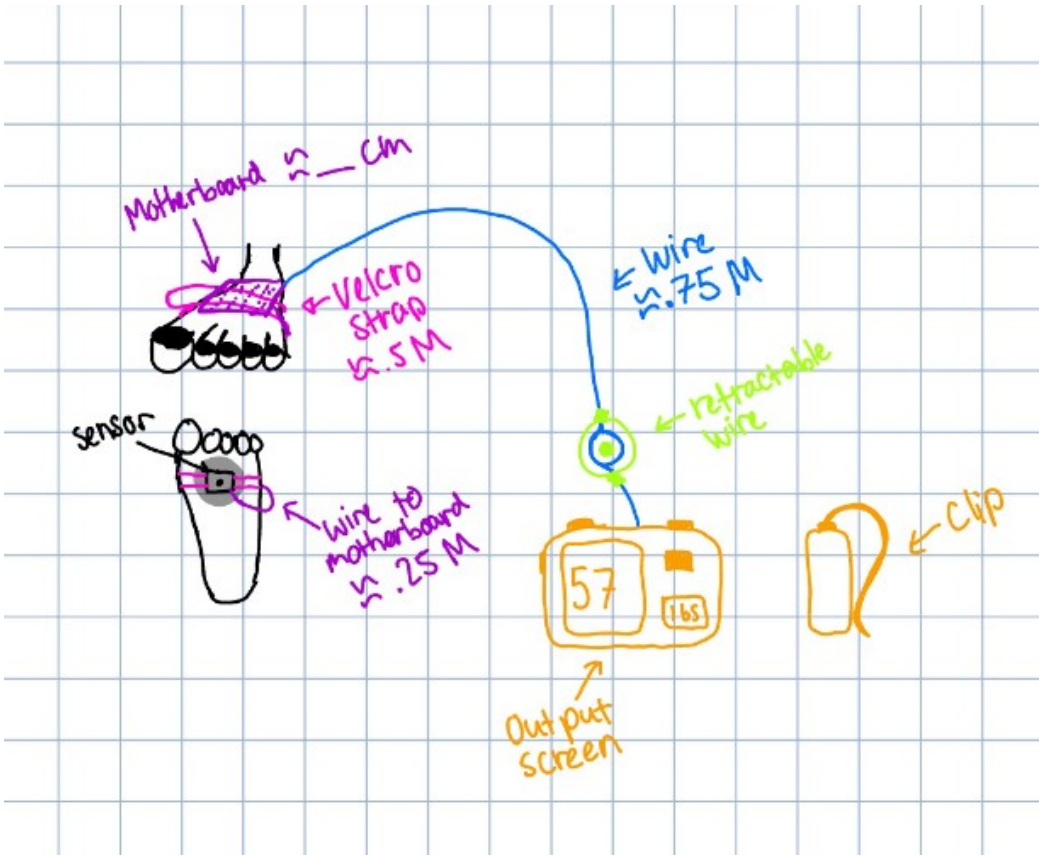
This device uses an ankle-brace like strip of elastic that can be adjusted to fit any patient. The loop at the end ensures that the sensor will sit in the same spot on each person's foot. The wiring will be fed through a tube of fabric to allow it to stay contained while the strap stretches. The battery pack will be attached to the velcro end of the strap



Keira’s Designs



This device adds a velcro patch to the bottom of the sensor. The velcro will ber able to stick to any part of the sole of the shoe so that the weight bearing can be read from different parts of the food. In addition, I added a sort of ankle band that will hold the motherboard and wiring close to the sensor. I used long velcro straps for this to be adjustable to accommodate different ankle sizing and swelling. A wire will then run from the ankle band up to the screen where the weight is displayed. This screen will have a wide clip on the back so that it can easily be clipped onto a walker for the patient.



This device incorporates the sensor being placed at the bottom of a foot and for it to be strapped around the foot itself. The straps will be velcro to accommodate the different sized and shaped feet. This device also has the motherboard strapped to the top of the foot so that it can stay near the sensor and still out of the way of the patient's gait. A wire will then be run from the motherboard to the display screen, however the wire will be retractable so that no excess wire will be in the way of the physical therapist of the patient. This display screen will also have a clip on it so that it can be easily read by the patient and the pt while it is attached to the walker.

11/2/25 - Parts Testing Plan

Cassity DeChenne - Dec 03, 2025, 3:35 PM CST

Title: Parts Testing Plan

Date: 11/2/25

Content by: Cassity DeChenne

Content:

Sensor

Testing:

- Set sensor on platform on flat ground, attach to screen and circuit.
- Set a small, flat block on top of the sensor.
- Set a variety of different weights on the block and assess the sensor readout for difference from expected weight. Make sure to account for block weight.

Data analysis:

- Record each expected weight and actual weight readout in a spreadsheet.
- Add up the difference of each weight and divide by the number of tests to get the average weight deviancy.
- Calibrate sensor accordingly.

Strap

Testing:

- Wrap strap around foot and mark with an erasable marker on the strap where the last wrap around the sole of the foot ends.
- Wear the strap around for some time, then mark on the strap where the last wrap around the sole of the foot ends now.
- Unwrap strap and measure the distance between the two marks.
- Repeat these steps with varying times of wear.

Data analysis:

- Record each mark distance in a spreadsheet that includes length of wear time.
- Add up the mark distances and divide by the number of tests to get the average strap movement.
- Make a plot of wear time and strap movement.

11/2/25 - Design Criteria

Cassity DeChenne - Dec 03, 2025, 3:41 PM CST

Title: Design Criteria

Date: 11/2/25

Content by: Cassity DeChenne

Content:

(**Design 1: The Built in Strap, Design 2: The Wrap-Around, Design 3: The Cloth Pocket)**

Sensor Pad Design Matrix

			Design 1		**Design 2**		**Design 3**
Criteria	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Safety	35	4.5	31.5	4	28	4	28
Ergonomics	25	5	25	4	20	4	20
Versatility	20	4	16	5	20	5	20
Ease of use	15	4	12	3	12	4	12
Cost	5	3	3	4	4	4.5	4.5
Total	100	**Sum**	**87.5**	**Sum**	**84**	**Sum**	**84.5**

		Basic Circuit		**Basic Circuit with bluetooth**		**Circuit with amplifier**	
Criteria	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Safety	30	4.5	27	5	30	4.5	27
Accuracy	25	4	20	4	20	5	25
Compactness	20	4	16	4.5	18	4	16
Simplicity	10	5	10	3	6	4.5	9
Cost	5	4.5	4.5	3.5	3.5	4	4
Total	100	**Sum**	**77.5**	**Sum**	**77.5**	**Sum**	**81**

11/14/25 - Ideas for Wire Tunnel/Cloth Pocket

Title: Ideas for Wire Tunnel/Cloth Pocket

Date: 11/14/25

Content by: Cassity DeChenne

Content:

How to attach wire:

- Use section of stretchy cloth
  - Ideas:
  - Stretchy mesh fabric: https://zelouffabrics.com/products/stretch-power-mesh-fabric-by-the-yard?variant=43898932232422&country=US&currency=USD&utm_medium=product_sync&utm_source=google&utm_content=sag_organic&utm_campaign=sag_organic&_YR59q&gclid=CjwKCAiAw9vIBhBBEiwAraSATmOd8Y5Bw6lxNCqMjcE5QF0dW7kAXSYfCYErccSDgMd8O_QetWXkMhoCvyQQAvD_BwE
  - Stretchy spandex fabric: https://fashionfabricsclub.com/products/blue-poly-stretch-spandex-jersey-knit-fabric-101029?variant=46873660293368&utm_source=google&utm_medium=organic&utm_campaign=shopping&utm_term=101029&gad_source=1&gad_campaignid=2189060159E6KSTfXJmhoCgYMQAvD_BwE
- Sew stretchy cloth onto long corner of strap to make a tunnel for wire to run through
- Run wire through tunnel

How to make pocket

- Use a swath of the same cloth to sew stretchy pocket onto strap

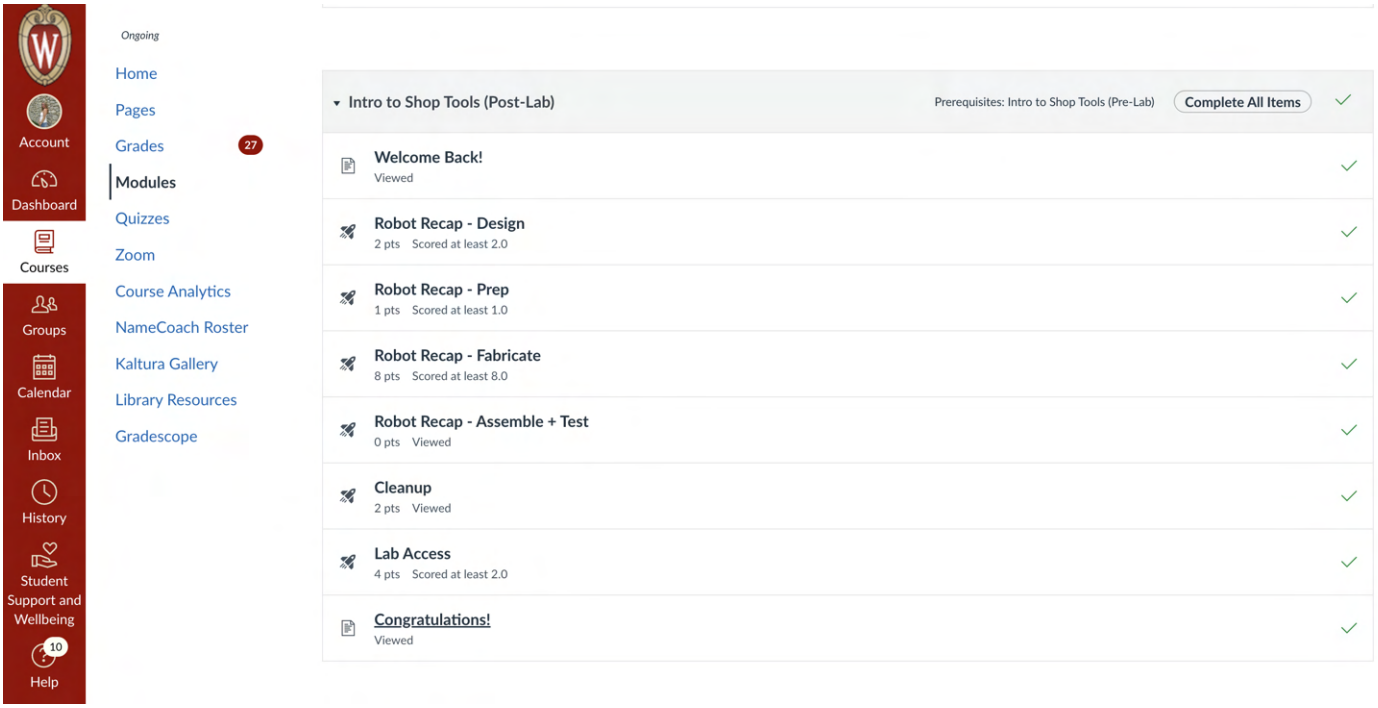
Intro to Shop Tools Training

Cassity DeChenne - Oct 21, 2025, 7:47 PM CDT

Title: Intro to Shop Tools

Content by: Cassity

Content:



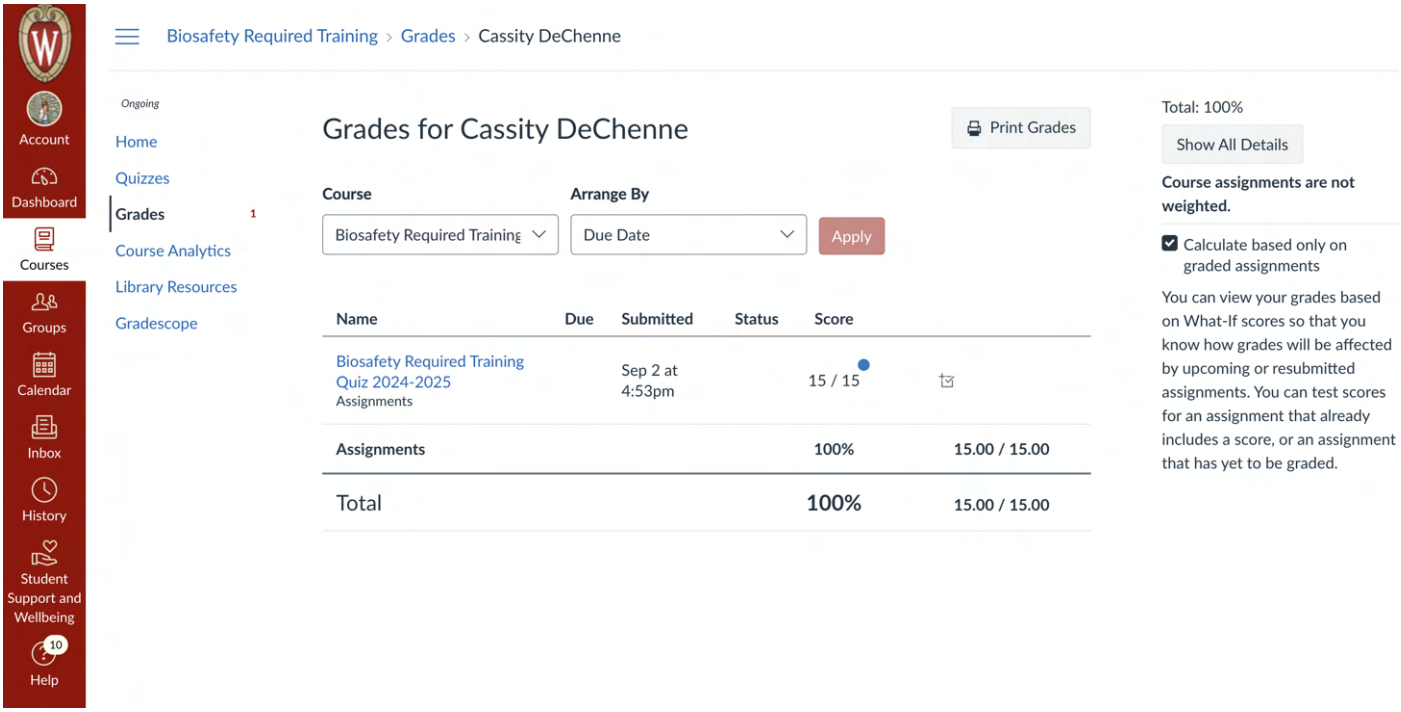
Biosafety Training

Cassity DeChenne - Oct 21, 2025, 8:15 PM CDT

Title: Biosafety Training

Content by: Cassity

Content:



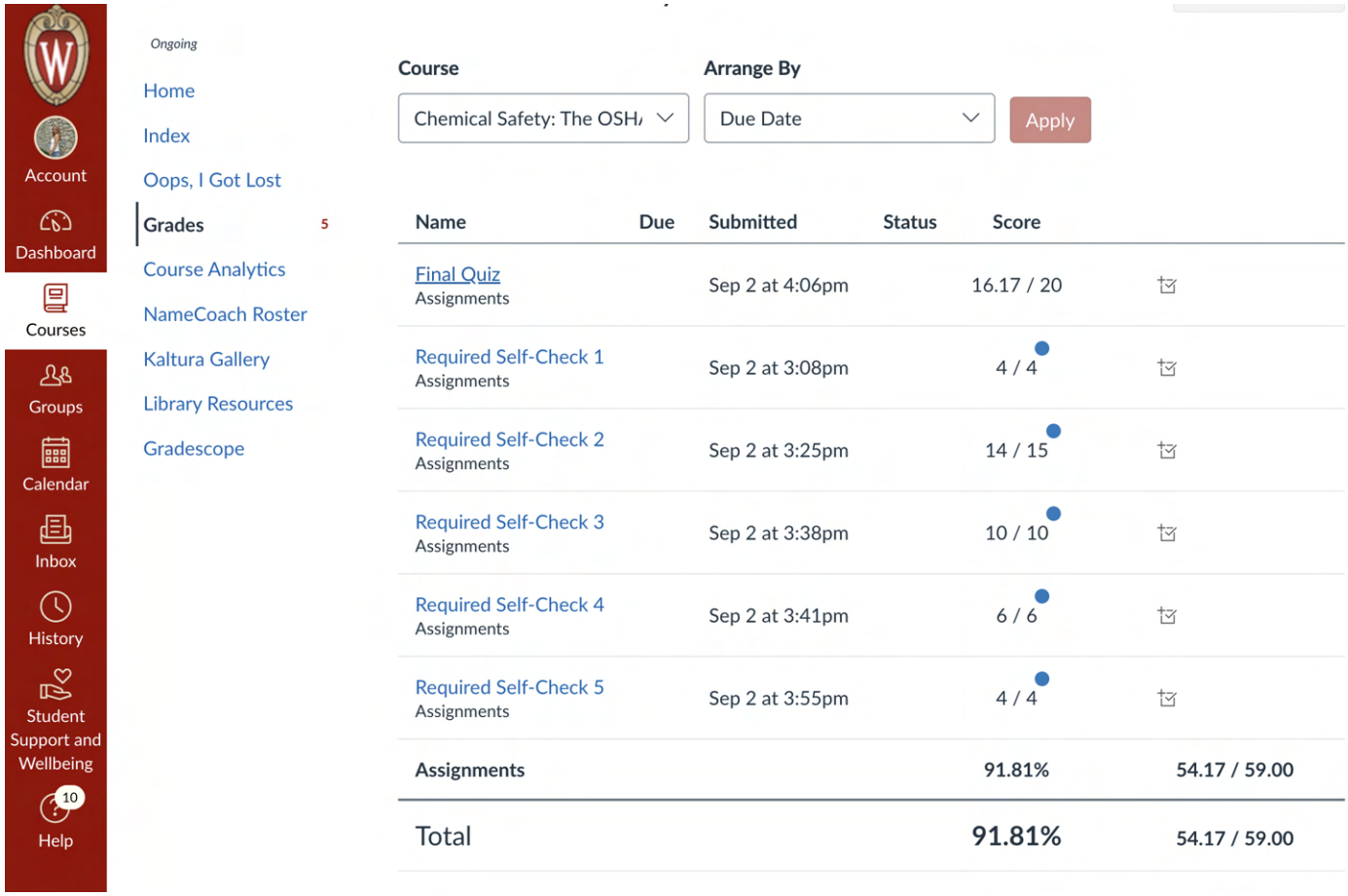
Chemical Safety Training

Cassity DeChenne - Oct 21, 2025, 8:17 PM CDT

Title: Chemical Safety Training

Content by: Cassity

Content:



Cassity DeChenne - Oct 21, 2025, 8:22 PM CDT

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cdchenne.pdf (114 kB)

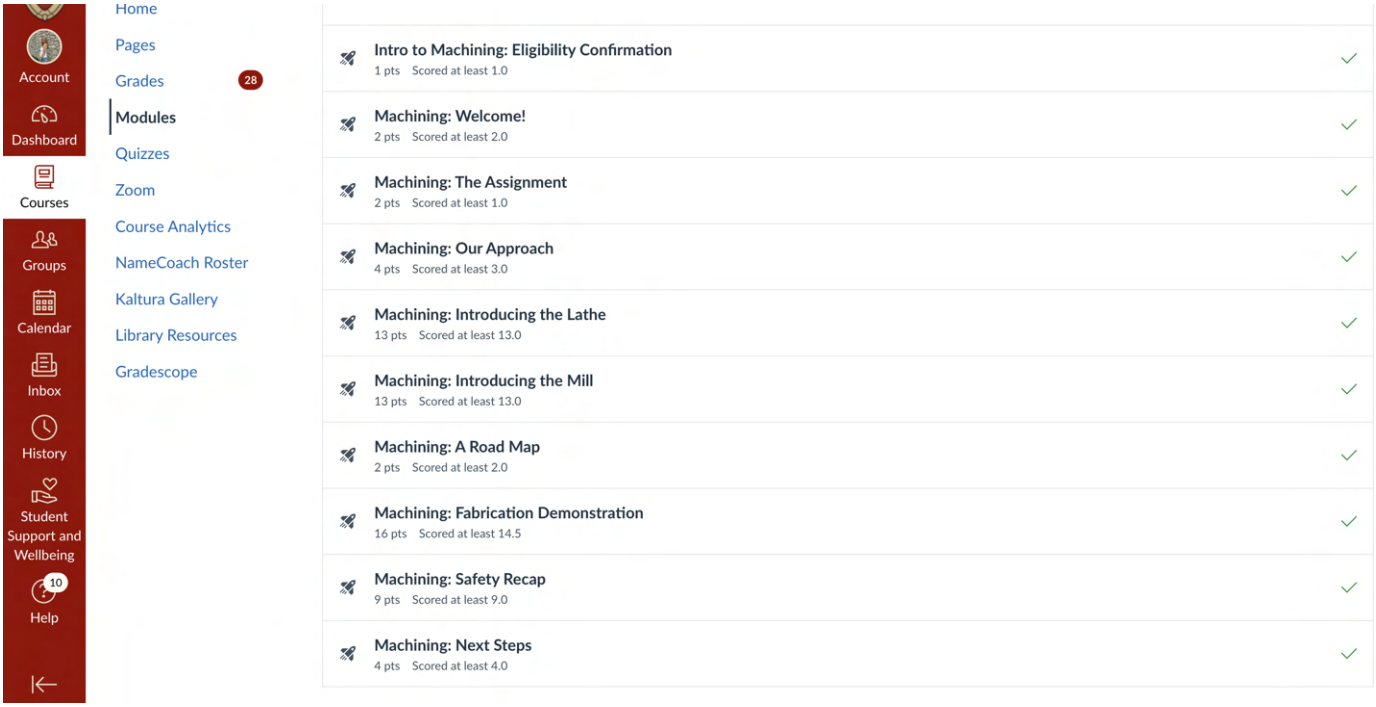
Intro to Machining Training

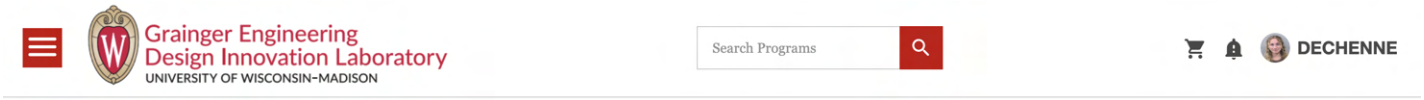
Cassity DeChenne - Nov 02, 2025, 3:56 PM CST

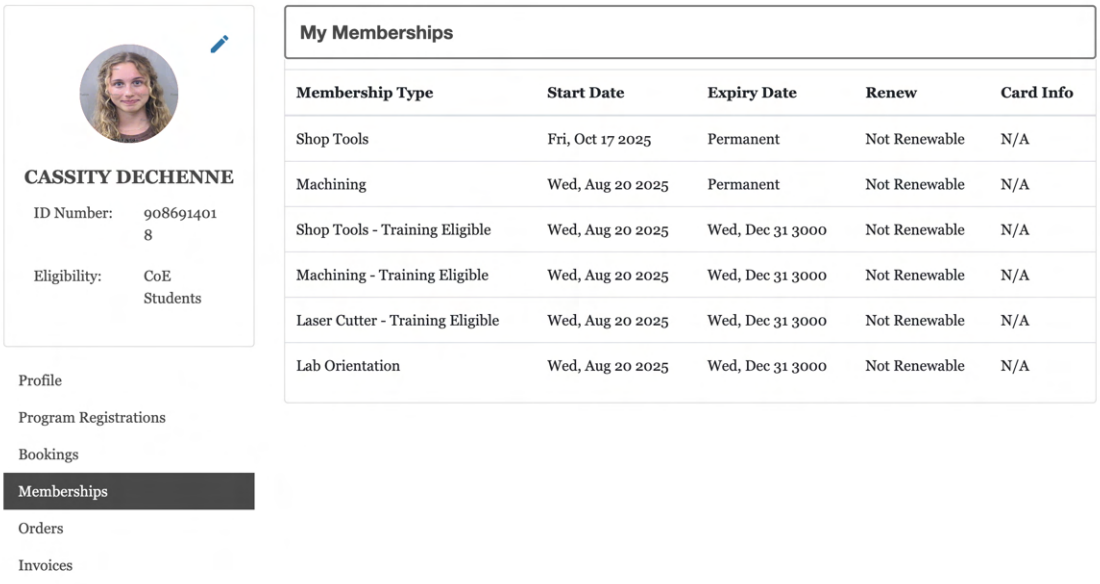
Title: Intro to Machining

Content by: Cassity

Content:







9/5/25 - Team Meeting 1

Cassity DeChenne - Sep 05, 2025, 3:41 PM CDT

Title: Team Meeting 1

Date: 9/5/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Establish group meeting times and roles.

Content: We met and figured out our individual roles, then walked through a bit of what would be expected with our project and this class. We then tentatively worked out when we would meet with each other and when we would request to meet with our advisor, and took our group picture.

Conclusions/action items: We all need have our courses swapped to our correct advisor and have our notebook entry in by next meeting. I specifically as the communicator need to send emails to our client and advisor by next meeting, and the rest of the group needs to complete some other initial tasks as required by their role.

9/12/25 - First Advisor Team Meeting

Cassity DeChenne - Sep 14, 2025, 2:17 PM CDT

Title: Team Meeting 2

Date: 9/12/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Meet with advisor and establish actionable tasks.

Content: Attended zoom meeting with advisor and introduced ourselves and our project. We discussed expectations for this project and our individual roles throughout the meeting. After the meeting, we started working on our PDS and further discussed what we would need to do before we next met

Conclusions/action items: We will research weight bearing sensors further and work on filling out aspects of our PDS.

9/16/25 - Client Team Meeting

Cassity DeChenne - Sep 18, 2025, 4:15 PM CDT

Title: Client Meeting 1

Date: 9/16/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Establish Client Needs and Product Specifications.

Content: We met with our client over zoom and discussed what he wanted from us and what he wanted from our product. We introduced ourselves and then talked about cost, design, functionality, and materials.

Conclusions/action items: Our client informed us that he wants a sensor that can be easily worn in a shoe/boot and primarily used in a rehabilitation center. He gave us a budget of $500 and told us to email if we ever had more questions. We will do more research and design work before we meet with our client again.

9/19/25 - Advisor Team Meeting

Cassity DeChenne - Dec 07, 2025, 8:20 PM CST

Title: Advisor Team Meeting

Date: 9/19/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Discuss PDS, confirm expectations, and figure out what we need to do next.

Content: We talked about our PDS and what needed to be in it to ensure that we completed the document as intended. We also discussed possible initial design ideas and our plan for working on our design matrices that are due next Friday.

Conclusions/action items: We will all come up with possible design ideas and sketches to be included in our design matrices. We will compare them and decide on our top designs based on what our client has specified that he wants in said designs.

9/26/25 - Advisor Team Meeting

Cassity DeChenne - Sep 26, 2025, 3:29 PM CDT

Title: In person Advisor Team meeting

Date: 9/26/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Go over expectations and design ideas with advisor, along with the plan going into next week.

Content: We talked out our design ideas and got our advisor's input on the top ones. We also discussed what our plan would be after our client got back to us on his design preferences, and made a plan to ask for another client meeting. Then, we lightly touched on our plan to make and practice our preliminary presentation that we are presenting next Friday.

Conclusions/action items: We will start working on our preliminary presentation this weekend and meet up sometime on Sunday to finish up our slides and practice presenting. Then, we will continue editing and finalizing our slides throughout the week and meet up one more time to run through our presentation and time it out to around 10 minutes. I will also let our client know the day/time of the presentation if he wants to watch.

10/2/25 - Team Meeting

Cassity DeChenne - Oct 08, 2025, 10:00 AM CDT

Title: In person Advisor Team meeting

Date: 10/2/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Solidify content and timing or preliminary presentation.

Content: We all discussed our slide content and how it should be changed before the presentation on Friday. We also practiced going through the presentation in whole, making sure the content flowed, the speaker transitions sounded nice, and the presentation timed in at around but under ten minutes.

10/7/25 - Client Meeting

Cassity DeChenne - Oct 08, 2025, 10:09 AM CDT

Title: In person Advisor Team meeting

Date: 10/7/25

Content by: Cassity DeChenne

Present: Jetzu Thao, Norah Greer, Cassity DeChenne

Goals: Figure out client design preferences and cost logistics.

Content: We met with the client through Zoom and asked him a lot of questions about different parts of the design and how we should order parts. The client also noted that he would like to watch our future presentations and requested that the dates be sent to him.

Conclusions/action items: For ordering parts, the client wanted us to order them with personal money and then send him the exact cost of our purchases, after which he would Venmo the buyer that exact amount. The client also clarified on what parts of the design matched up with his idea of the product and what we might need to alter. I sent an email to the client on the dates/locations of our future presentations.

10/10/25 - Advisor Team Meeting

Cassity DeChenne - Dec 07, 2025, 7:54 PM CST

Title: Advisor Team Meeting

Date: 10/10/25

Content by: Cassity

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Update advisor on current progress and discuss what we need to do to further our design.

Content: We discussed some standards that we may need to meet in order to let our product be used in a physical therapy setting. We also went over what we still need to do to get going on testing individual parts and get our prototype working. After our advisor, we met as a group to discuss individual roles. We figured out that we need to buy some stretchy fabric in order to connect our sensor seamlessly to our Arduino and also connect our sensor to the ankle brace.

Conclusions/action items: We need to order a battery pack and decide on a type of stretchy fabric to buy as well. We also need to continue working on the code and circuit in order to get our weight bearing sensor to send information to the Arduino and then to the screen without problems.

10/24/25 - Advisor Team Meeting

Cassity DeChenne - Oct 25, 2025, 9:57 PM CDT

Title: In person Advisor Team meeting

Date: 10/24/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Make sure we're on track and work on assembling our product.

Content: We met with our advisor and discussed our plan for the next week. We figured out what would be expected of us in the Show and Tell next week, and started to prepare for it.

Conclusions/action items: We will work together to formulate a 60-second elevator pitch to use during Show and Tell. We will start testingwhat products we can, and we will start figuring out methods to process the data we produce from testing our sensor/strap.

11/2/25 - Team Meeting

Cassity DeChenne - Nov 14, 2025, 1:05 PM CST

Title: In person team meeting

Date: 11/2/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Trouble shoot with new Arduino, reassemble product and start parts testing.

Content: We switched out our current Arduino for a better-functioning one and discussed our next steps.

Conclusions/action items: We will finalize our code for our display screen and get started on testing for the different parts. I will work on the code and help with the CAD design of our sensor pocket.

11/7/25 - Advisor Team Meeting

Cassity DeChenne - Nov 14, 2025, 1:18 PM CST

Title: In person team meeting

Date: 11/7/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Clarify timeline with advisor, update advisor on our course of action.

Content: We talked with our advisor about the issues we've been having with our project (aligning schedules, debugging circuit code), and discussed ways we could move forward with our design.

Conclusions/action items: Our first order of business is debugging the code because we can't test the sensor until the circuit works and the code outputs a weight on the screen. After that, we will begin testing our sensor with weights and calibrate it to the readout we want to have. Then, we can order the final parts that we need (stretchy fabric, different screen, microcontroller, etc.)

11/14/25 - Advisor Team Meeting

Cassity DeChenne - Dec 03, 2025, 4:10 PM CST

Title: In person team meeting

Date: 11/14/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Update advisor on group progress, get feedback on where we should be.

Content: We talked to our advisor about what we have been doing over the past week. He suggested that we look at what patents we might need and we told him about what we learned from the client meeting yesterday. Our advisor suggested that in a future client meeting, we should also clarify whether our client wants another BME Design group to work on the product further or if he will take the design as is.

Conclusions/action items: We will continue work and testing on our design. We will also request our client to order the materials we still need and the products that we need to switch out on our current design.

11/21/25 - Advisor Team Meeting

Cassity DeChenne - Dec 03, 2025, 4:18 PM CST

Title: In person team meeting

Date: 11/21/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Meet with advisor and team to share progress and evaluate the next steps we should take.

Content: We shared with our advisor how we are improving our design to have a more advanced final product. He shared what he had learned about our final poster presentation and advised us on a timeline for getting everything done without having to cram at the end of the semester. After the meeting, we delegated tasks throughout our group.

Conclusions/action items:

We will start working on our poster presentation. We will also start working on getting our final parts all together. We need to sew fabric onto our foot strap for the wire attaching the circuit and sensor to run through. We also need to sew more fabric with padding onto the strap in order to make a little pocket for the sensor to go in. Both of these alterations will make our design less abrasive on the skin that it touches.

10/3/25 - Preliminary Presentation

Cassity DeChenne - Nov 02, 2025, 3:36 PM CST

Title: Preliminary Presentations

Date: 10/3/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne

Goals: Give a ten-minute presentation on our design, get feedback on it, and listen to peer presentations.

Content: We gave our presentation to a classroom of other BME Design groups and answered their followup questions on different aspects of our project plan and product designs. We also listened and learned from our peers from their presentations. We especially got to learn from and compare to our peers that were working on pressure and temperature sensors in casts.

Link to presentation: https://docs.google.com/presentation/d/1UVXUIwch1oEeVF5aNiHdch58zlNRdN-JLX6JX0nRzaE/edit?usp=sharing

Conclusions/action items: We will apply the feedback that we got and the presentations of the other design groups to our next project steps.

10/31/25 - Show and Tell

Cassity DeChenne - Nov 02, 2025, 4:57 PM CST

Title: Show and Tell

Date: 10/31/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne

Goals: Give updated and shortened presentations to small groups and give and receive feedback.

Content: We split our design group into two sections, with both sections taking turns presenting to peers and listening to peer presentations. This was more interactive than the preliminary presentations, and we were able to get some really helpful advice from one peer that works in the MakerSpace.

Elevator pitch script: https://docs.google.com/document/d/1Q8gbzU5eH3FvHdkLNs3rjZPk_ItQkhTUaPQm05izSig/edit?usp=sharing

Conclusions/action items: We will apply the advice we heard to our design. We plan to switch out the current cord and switch our current screen to a different type that is on the market. We will also test each remaining part individually to pinpoint where our data output error is coming from.

11/7/25 - Tong Lecture

Cassity DeChenne - Nov 07, 2025, 12:58 PM CST

Title: Tong Lecture: Building a Career of Impact

Date: 11/7/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Listen and learn from Kristin Myers on building a career of impact.

Content:

- Advice: run towards the hard problems.
- Kristin majored in BME at UW Madison, then worked for five years at Medtronic, got her MBA at Harvard, then worked at Skyline Ventures and Arboretum Ventures after that.
- For her Climbing the Growth Curve chapter, she worked at Aetna managing around a 350-person team, then she worked at Unified Women's Healthcare, which is right around the time COVID hit.
- Sourcing healthcare for her aging mom has been hard even with all of the healthcare connections she has built
- Advice: take the next step, even if you don't know your final destination.
- Only around 50% of people with a medical degree would work towards that same degree if they had a do-over
- Stat: 25% of adults skip care due to cost
- Some underlying challenges in the medical system: misaligned incentives, fragmented financing, unreliable internet in rural areas, etc.
- How to build a better healthcare system:
    - Connect healthcare data better across systems
    - Simplified admin tasks
    - Building care around people
- Takeaway points
    - Work hard and build range: take on the hardest experiences, it will benefit you greatly. Also, get some range with your experiences; work in different geographical locations, types of businesses.
    - Seek Diverse Exposure: explore different types of work, eg. more solitary work, more team-centered work, gain perspective and learn how systems connect, not just how individual parts work.
    - Choose your people wisely: surround yourself with people that will help you along your path because they will shape who you are.
    - Know your values and protect them: know what matters most to you and make decisions that align with those values.
    - Embrace challenge and keep growing: run towards hard problems, grow by going outside of your comfort zone.
- Avoiding burnout: know the time of day you are most able to put in work and effort and energy. Manage your time well, say yes to the things you want to do, and don't say yes to the things you don't want to do.
- Comprehensive medical records don't really exist yet, most specialist records just contain some parts of a person's whole medical record

Conclusions/action items: N/A

12/5/25 - Final Poster Presentation

Cassity DeChenne - Dec 07, 2025, 7:44 PM CST

Title: Final Poster Presentation

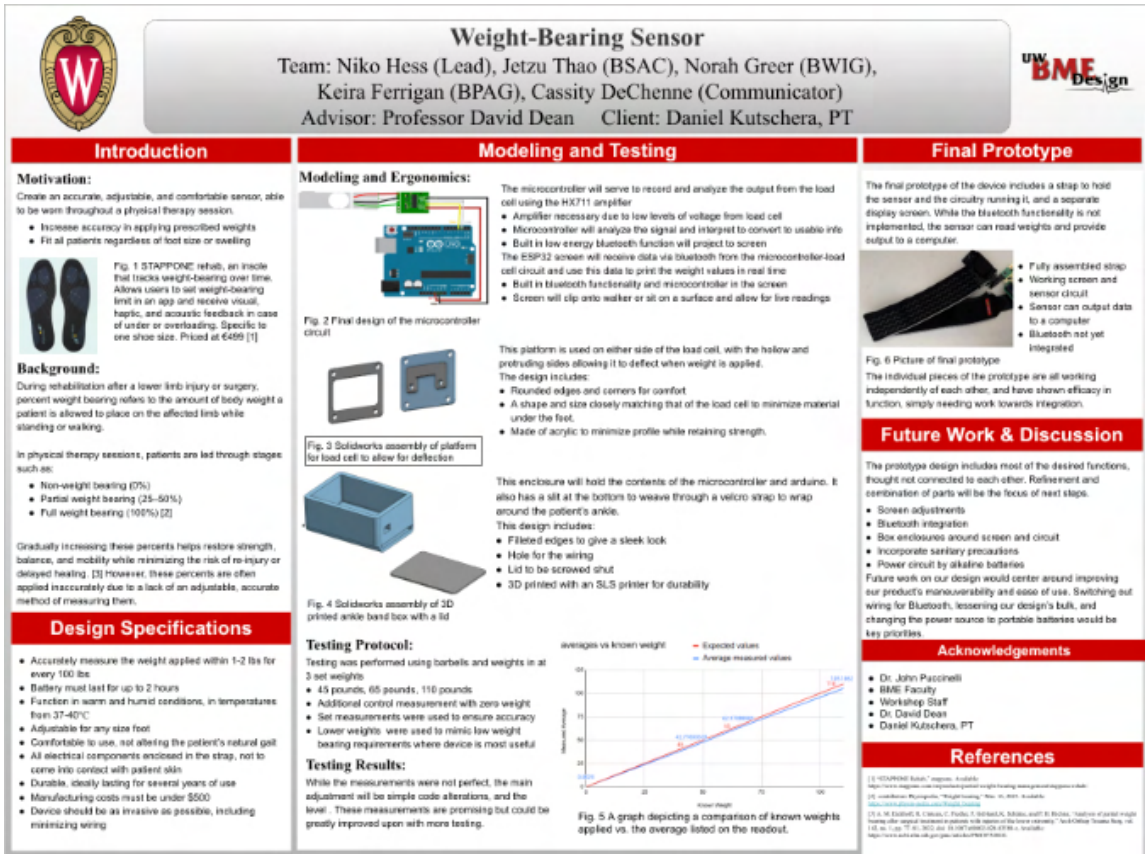
Date: 12/5/25

Content by: Cassity DeChenne

Present: Entire project group (Nikolai Hess, Jetzu Thao, Norah Greer, Keira Ferrigan, Cassity DeChenne)

Goals: Present our group's findings and learn from other BME Design poster presentations.

Content:



Conclusions/action items:

We were able to explore many peer presentations and learn about the different projects that had been going on this semester. We were also able to get a lot of presentation practice in front of an assortment of peers, our advisors, and our client. Our peers gave us some very useful advice - like to alter our poster design in a way that would even out text spacing and to increase the number of photos on our poster - and we were able to give some useful advice too.

2014/11/03-Entry guidelines

John Puccinelli - Sep 05, 2016, 1:18 PM CDT

Use this as a guide for every entry

- Every text entry of your notebook should have the **bold titles** below.
- Every page/entry should be **named starting with the date** of the entry's first creation/activity, subsequent material from future dates can be added later.

You can create a copy of the blank template by first opening the desired folder, clicking on "New", selecting "Copy Existing Page...", and then select "2014/11/03-Template")

Title: Descriptive title (i.e. Client Meeting)

Date: 9/5/2016

Content by: The one person who wrote the content

Present: Names of those present if more than just you (not necessary for individual work)

Goals: Establish clear goals for all text entries (meetings, individual work, etc.).

Content:

Contains clear and organized notes (also includes any references used)

Conclusions/action items:

Recap only the most significant findings and/or action items resulting from the entry.

2014/11/03-Template

John Puccinelli - Nov 03, 2014, 3:20 PM CST

Title:

Date:

Content by:

Present:

Goals:

Content:

Conclusions/action items: