Weight Bearing Sensor

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Problem statement

Patients with, or in recovery from, many conditions have restrictions on how much weight they can safely put onto their legs without causing themselves further injury. While there are some ways to attempt to ensure this requirement is met, they are difficult to implement, do not work as well, or provide as much feedback as would be helpful to patients and those assisting them. The goal of this project is to design a low-profile, easy-to-use device to measure and record the amount of weight put onto the legs of a patient, and give feedback to the patient and care providers to ensure their safety precautions are being met.

Brief status update

- Brainstormed designs for the device
- Worked together to decide criteria to rank our device
- Completed our design matrix and decided on a preliminary design for our device.

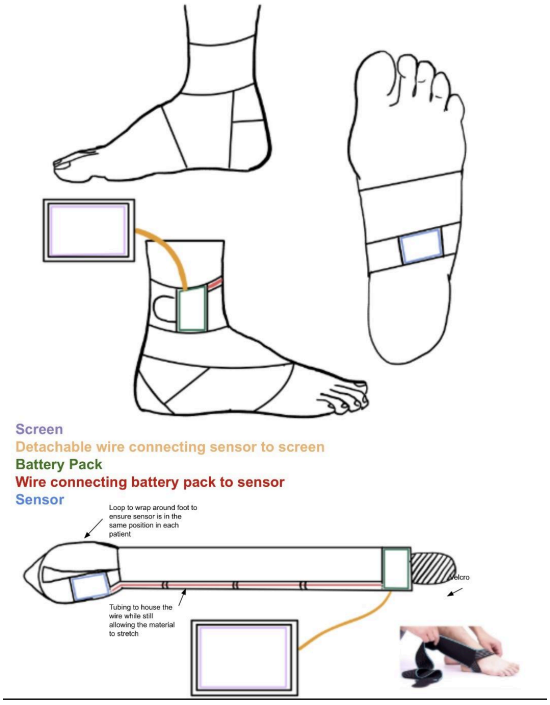
Difficulties/advice requests

Some clarification on the exact design desired by client, looking at an insole like design or a strap that could wrap around a patient's foot, looking for clarification from client to decide what would be more advantageous for them.

Current design

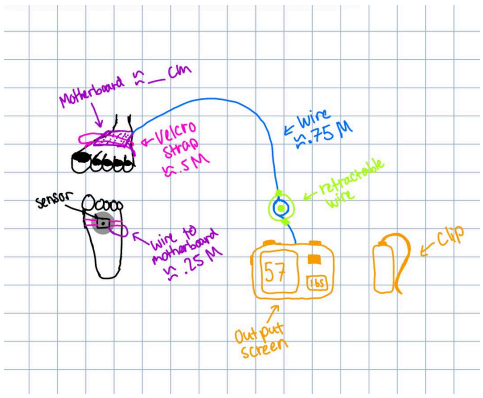
Designs:

Design 1: Built in Strap



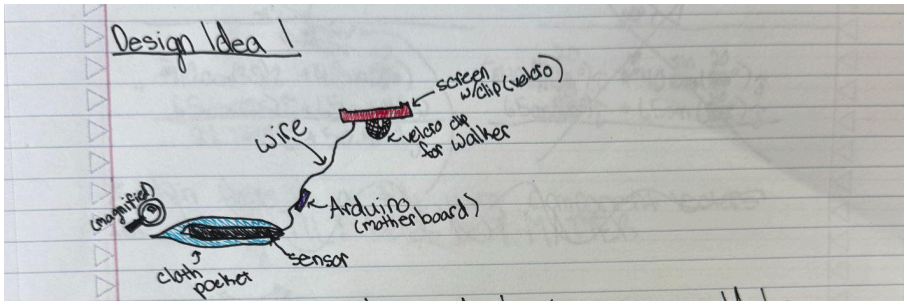
This device uses an ankle-brace like strip of elastic that can be adjusted to fit any patient. The loop at the end ensures that the sensor will sit in the same spot on each person's foot. The wiring will be fed through a tube of fabric to allow it to stay contained while the strap stretches. The battery pack will be fixed to the end of the strap, near the velcro strip. The wire connecting the battery pack/sensor to the readout will be detachable to prevent tangling when putting the device on.

Design 2:



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.

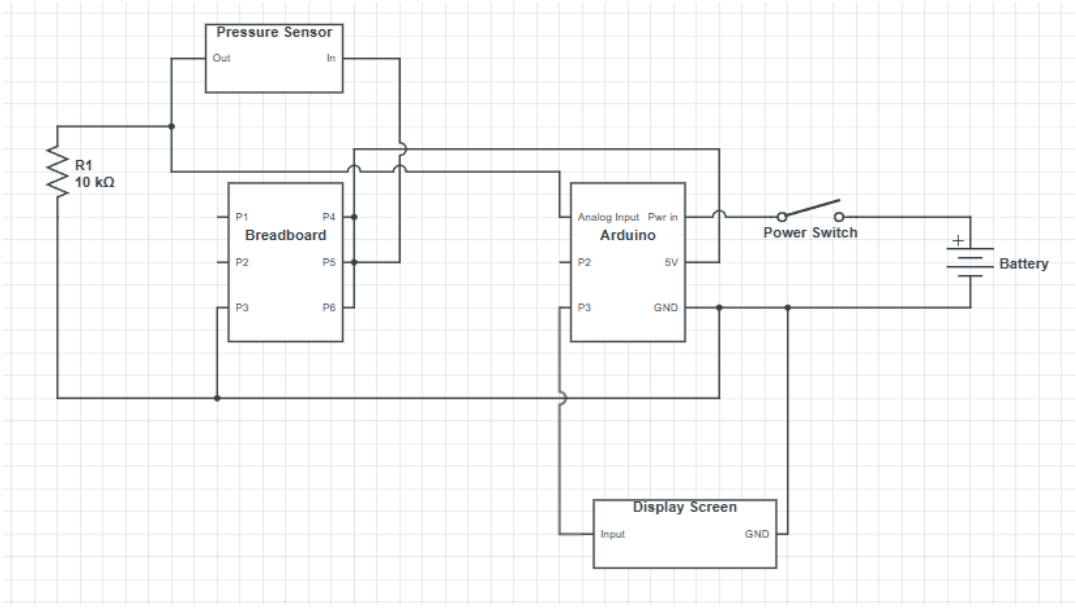
Design 3:



In this design, the weight bearing sensor would be resting in a cloth 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.

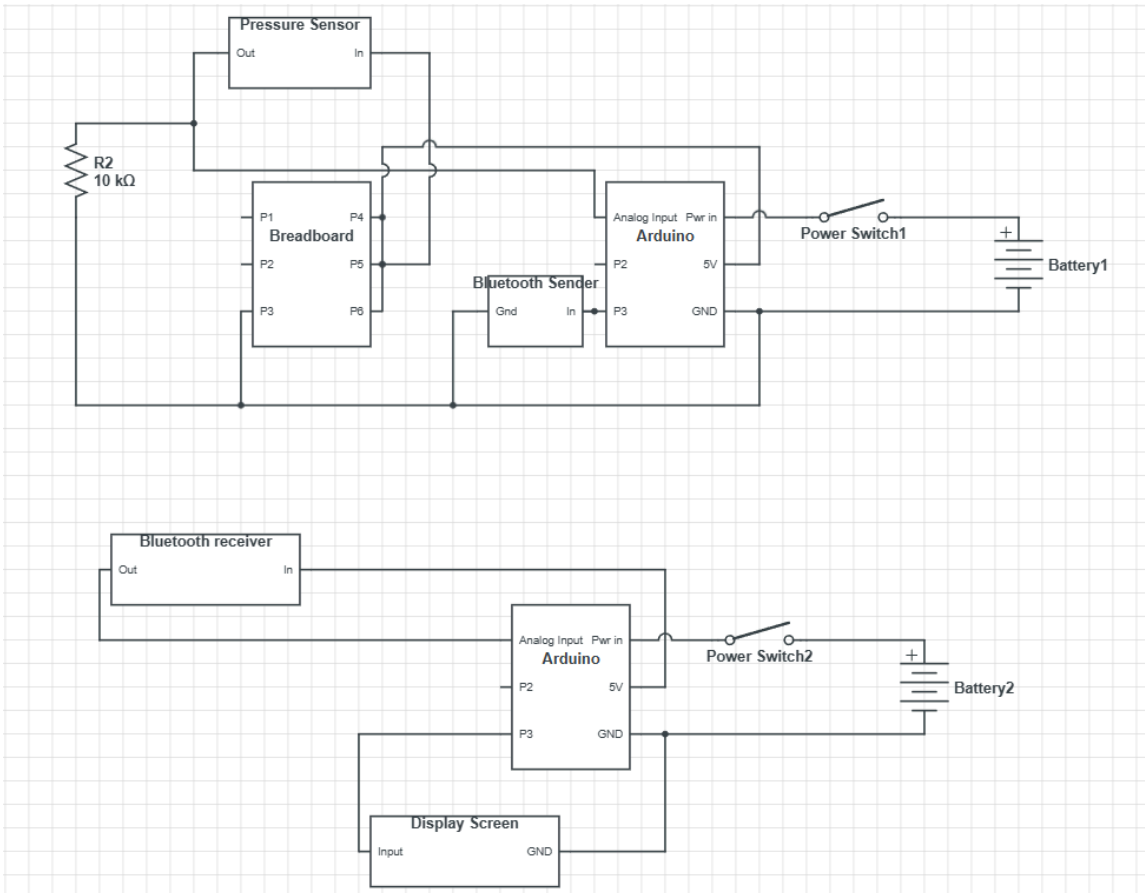
Circuits:

Design 1: Base circuit



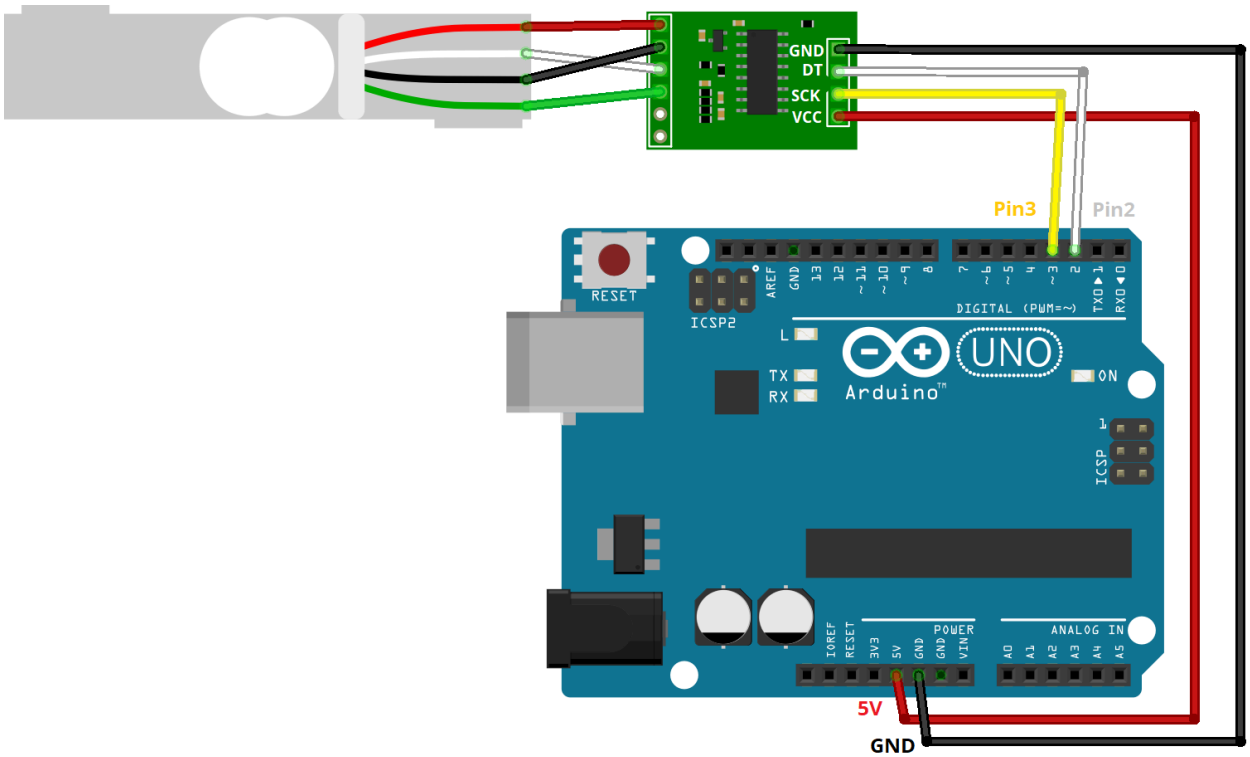
This circuit design involves as little extra material and pieces as possible, involving a battery to power an Arduino, and the Arduino powering the pressure sensor with only the breadboard as an intermediate. The feedback from the pressure sensor is split with a resistor in order to keep the results stable and level. The display is wired directly from the Arduino to ground. A power switch would act as an intermediary between the battery and the Arduino, to fully stop the flow of power when the device is off. This would help increase the battery life of the device and not be obtrusive, as no data needs to be saved between uses.

Design 2: Basic Circuit with Bluetooth



This circuit is 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. Both halves of the circuit include a switch between the battery and the arduino, to fully shut off the circuit when it is not in use.

Design 3: Circuit with Amplifier



This circuit is the basic design for a load cell using an Arduino. The Arduino microcontroller is powered by a battery and is connected to a HX711 amplifier, which is a breakout board that allows you to easily read load cells to measure weight. This amplifier would be connected to a load cell, which measures the weight, and the measured weight would then be sent to the display.

Materials and expenses

No materials or expenses at this time

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Category 1										
									$0.00	
									$0.00	
Category 2										
									$0.00	
									$0.00	
								TOTAL:	**$0.00**	

Major team goals from last week

1. Work on product design
2. Continue research on the device and the competition
3. Work with the client and advisor to narrow down product goals
4. Establish an official date for the next client meeting

Major team goals for the next week

1. Refine chosen design
2. Begin work on solidworks models of device, and initial stress and strain testing
3. Look into materials for the device, based on stress requirements and safety factors

Last week's individual goals

- Nikolai Hess:Continue brainstorming ideas, come up with initial sketches of ideas and circuits, and how to combine the two.
- Jetzu Thao: Look into circuits for design matrices, go over design ideas.
- Norah Greer: Continue brainstorming ideas, pick a few ideas to go in-depth on.
- Keira Ferrigan: Continue brainstorming ideas and communicating them with our team. Researching the sensors of existing designs
- Cassity Dechenne: Continue communicating with client and advisor, work on design ideas, continue researching.

Next week's individual goals

- Nikolai Hess: Look into more standards and codes related to materials. Brainstorm materials and look into what is used by insoles and similar products to come up with some ideas for material design.

- Jetzu Thao: Do more research into arduino circuit design and load cells, brainstorm designs for integration of circuits.
- Norah Greer: Look at all designs using the design matrix and decide on one we want to focus on. Move forward in researching how we can achieve that design
- Keira Ferrigan: Refine my drawings of the design, continue research on the sensor and screen.
- Cassity Dechenne: Continue communicating with client and advisor, improve and finalize design ideas

Timeline

https://docs.google.com/spreadsheets/d/1GoAuANy3F-ltP7vhI7g-B9dxuefjj8c50qzYs246SlE/edit?usp=sharing

Activities

Name	Date	Activity/Previous Week's Accomplishments	Time (h)	Week Total (h)	Sem. Total (h)
Nikolai Hess	9/23 9/25	Arduino bluetooth research Brainstorming and sketching for ideas Design matrix work	0.5 1 1.5	3	8
Jetzu Thao	9/25	Arduino load cell research Circuit design research Design matrix Brainstorming	3	3	5
Norah Greer	9/22	Sketched design ideas, researched some past attempts at this device.	2	2	5
Keira Ferrigan	9/25	Sketched ideas, design matrix, researched	2	2	5
Cassity Dechenne	9/25	Researched and formulated design ideas, brainstormed ways to improve designs, communicated with advisor/client	2	2	6