Johnson Health Tech: EMG Sensor Holder

Cassie Geddes, Quinton Heney, Emily Johnson, Ian Schirtzinger, Kiley Smith

Client: Arrington Pollman & Staci Quam

Advisor: John Puccinelli

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Problem Statement

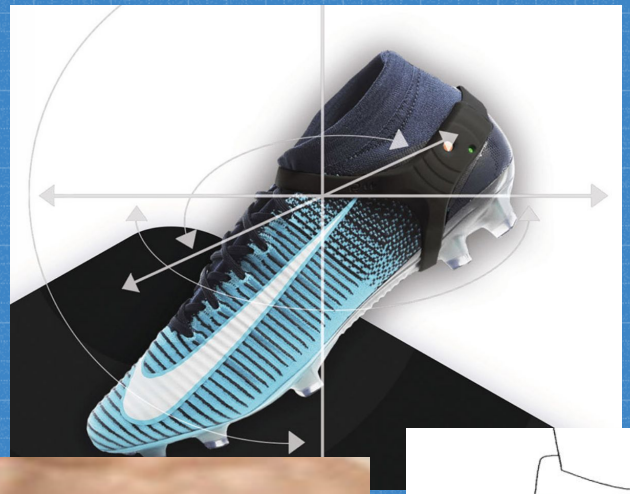
- Johnson Health Tech uses Delsys Trigno™ EMG and Accelerometer sensors to measure acceleration and center of mass
- Their current method of an athletic tape wrap cause the sensors to slip and possibly alter the runner's gait
- Tape can bunch up and become burdensome
- Create two sets of sensor holders

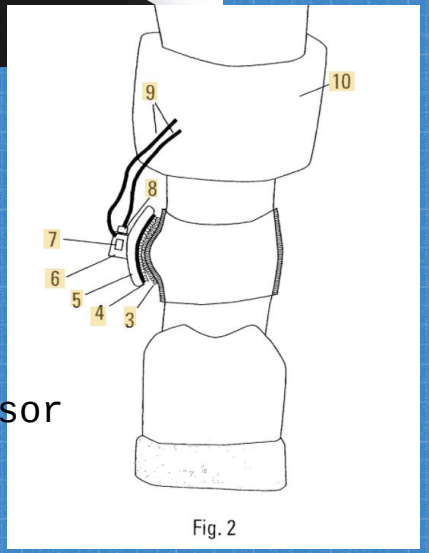
Background Material

- The Delsys Trigno sensors are used by Johnson Health tech to determine forces on and velocities of body segments
- Data analysis is done in MATLAB to determine ground reaction force (heel) and total body movement measurements like step rate (chest)
- Sensors can also be put at other areas of interest like the tibia or head

Competing Designs

- Strap system for 6-axis Motion Smart Sensor by Playermaker [1]
- 3D acceleration sensor that strapped on ankle using elastic fleece strap and a cuff (US7912672B2) [2]
- Heart Rate Sensor by Polar





Product Design Specifications

- Two sets of sensor holders
  - 1 chest strap and 2 shoe straps per set
- Compatible with women’s size 6 to men’s size 12 running shoes and chest circumferences of 32in-46in [3]
- Withstand around 2.28 kN to 2.64 kN of force [3][4]
- Minimal alteration to user’s gait/movement and < 0.10in displacement of sensor relative to the user’s shoe/chest

Chest Holder- Design One

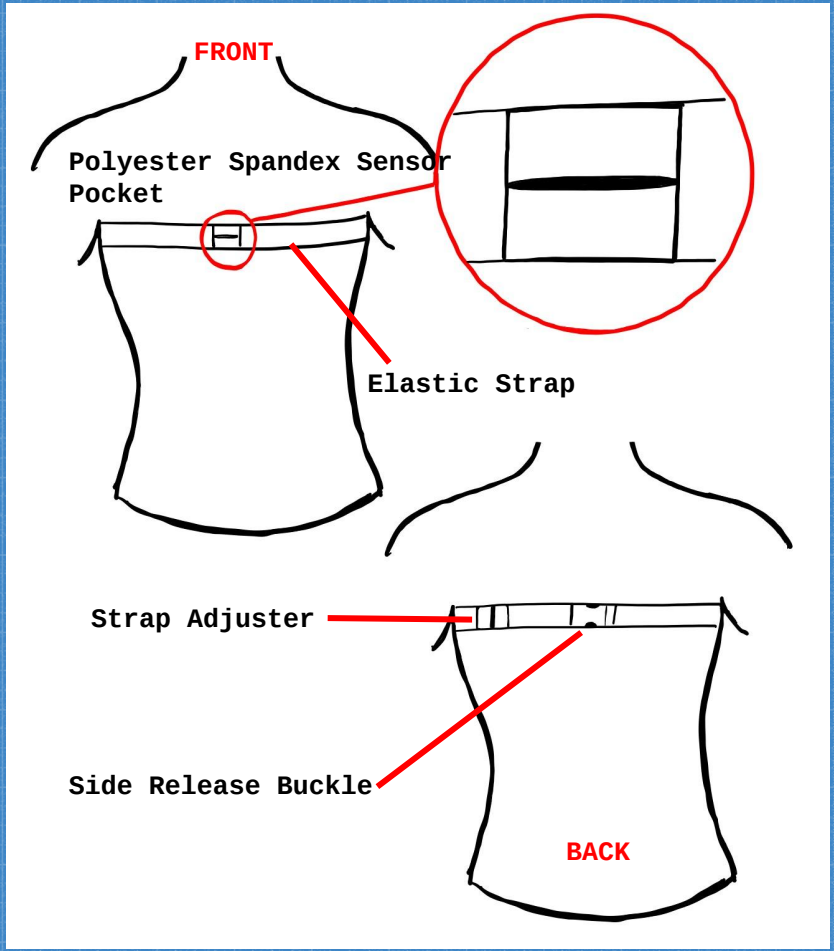
The Fanny Pack

Fanny Pack

- Small Polyester Spandex Pocket
- Comfort from Singular Strap

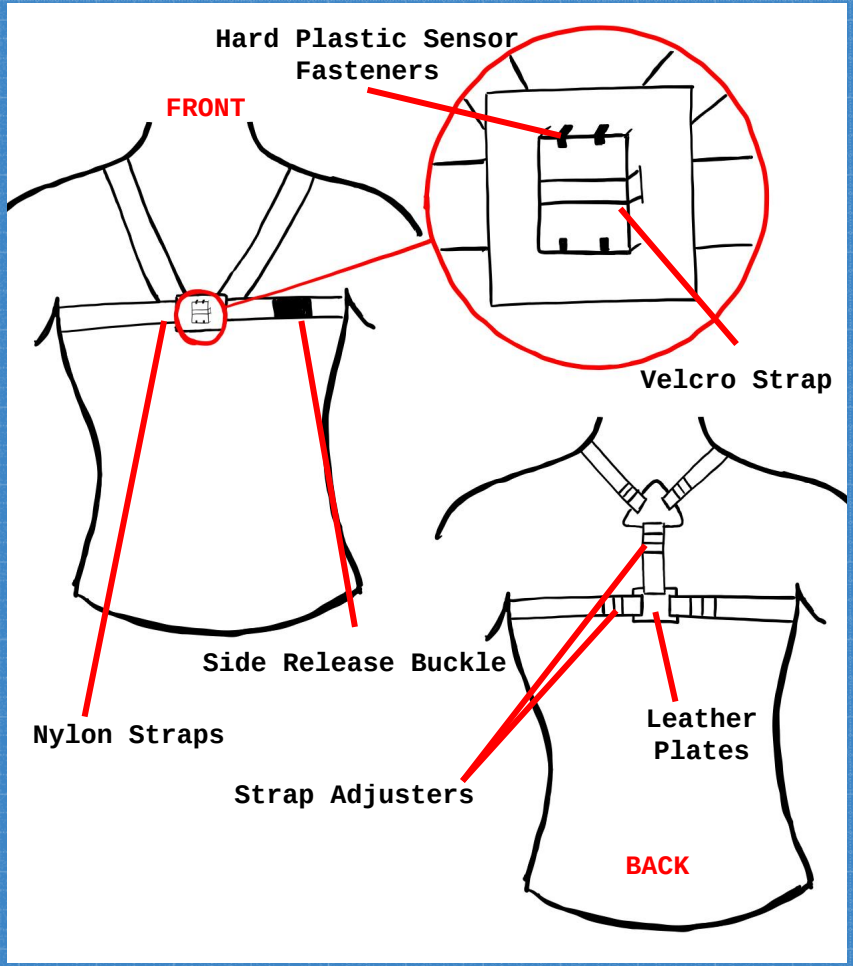
Disadvantages

- Deformation in the Pocket
- Possible Vertical Movement



Chest Holder- Design Two

The Mounted Harness



Mounted Harness

- Multiple Adjusters
- Secure Vertically and Horizontally

Disadvantages

- Discomfort around the Neck
- Excess Material for Smaller Users

Chest Holder- Design Three

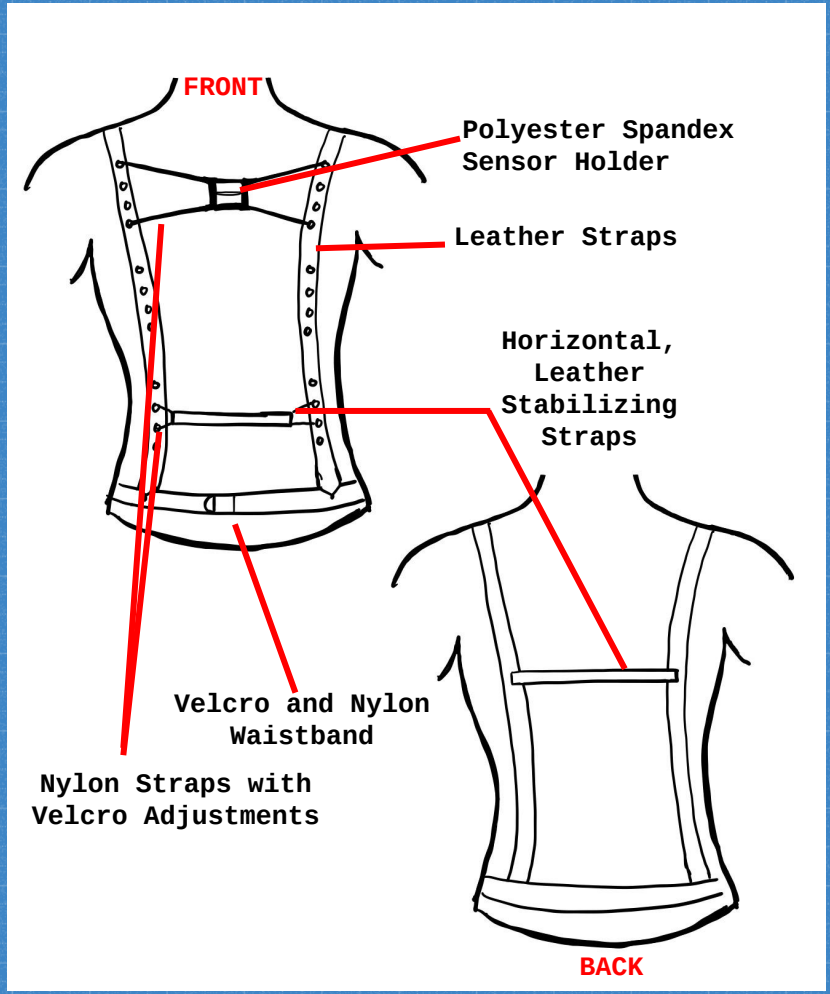
Lederhosen

Lederhosen

- Vertical Sensor Adjustment
- Stabilization

Disadvantages

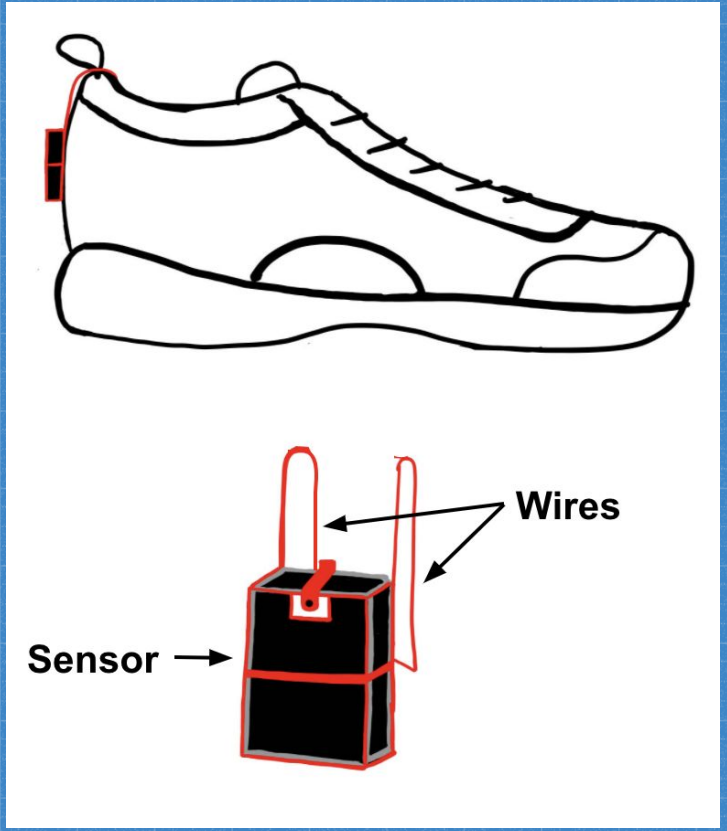
- Maintaining Waistband Position
- One Size for Vertical Length
- Leather Material



Design One

The Clip

The Clip



Pros

- Lightweight
- Minimally cumbersome
- “One-size-fits-all”

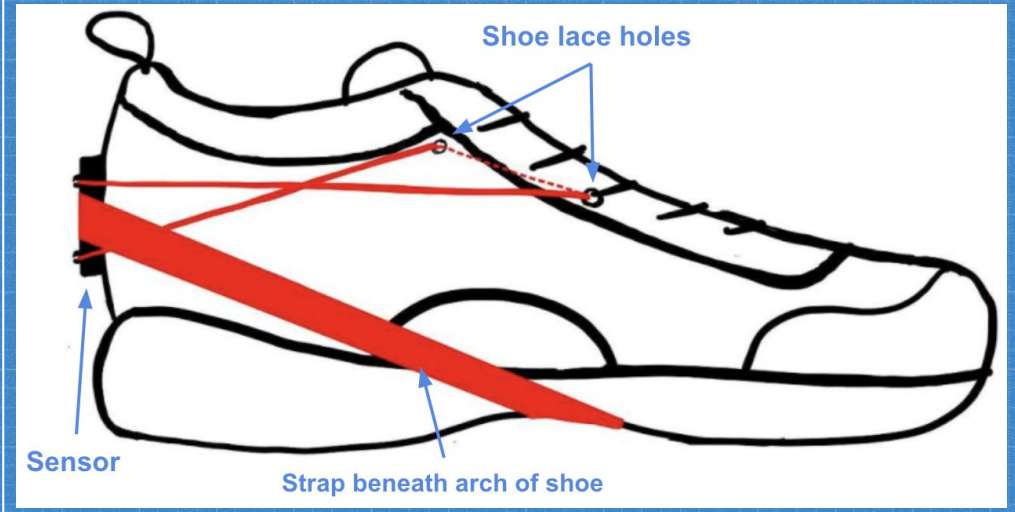
Cons

- Stability uncertain
- Longevity

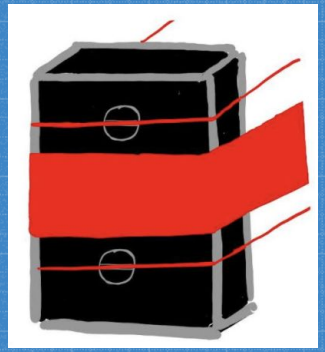
Design Two

The Straps

The Straps



Sensor View



Pros

- Adjustable straps
- Lightweight

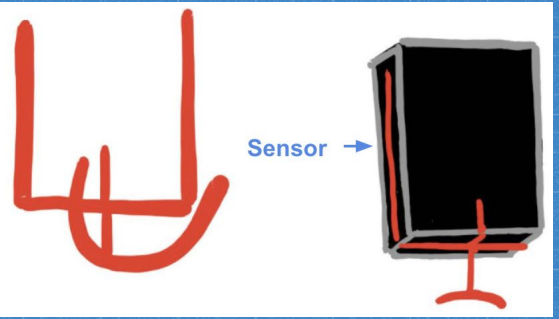
Cons

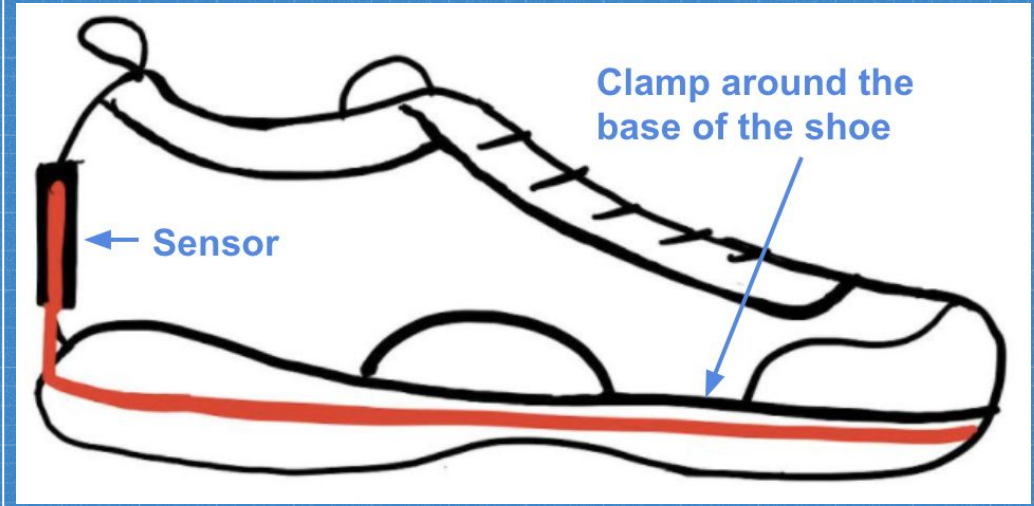
- Requires two laces loops
- Stability uncertain

Design Three

The Goal Post

The Goal Post





Pros

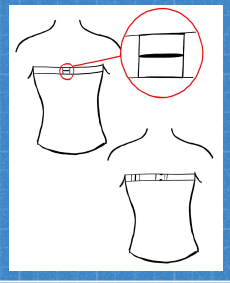
- Minimally cumbersome
- Likely stable

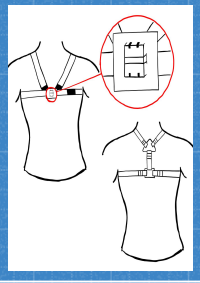
Cons

- Not compatible for multiple shoe sizes

Design Matrix (Chest Strap)

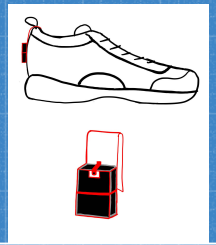
		The Fanny Pack		The Mounted Harness		Lederhosen	
	Weight	**Score Out of 5**	**Weighted Score**	**Score Out of 5**	**Weighted Score**	**Score Out of 5**	**Weighted Score**
Predicted Stability	25	3.5	17.5	4.5	22.5	4.5	22.5
Comfort	20	4.5	18	4	16	3.5	14
Lack of Hinderance	20	5	20	3.5	14	3.5	14
Ease of Fabrication	15	5	15	4	12	2.5	7.5
Cost	10	4.5	9	4.5	9	3.5	7
Ease of Use	10	5	10	4.5	9	3	6
Total			89.5		82.5		71

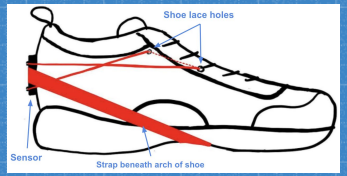




Design Matrix (Shoe Holder)

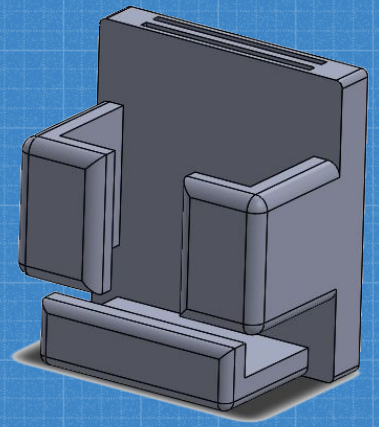
		The Clip		The Straps		The Goal Post	
	Weight	**Score Out of 5**	**Weighted Score**	**Score Out of 5**	**Weighted Score**	**Score Out of 5**	**Weighted Score**
Predicted Stability	20	4	16	2.5	10	1	4
Comfort	15	2.5	7.5	3.5	10.5	5	15
Lack of Hinderance	15	4	12	4	12	4.5	13.5
Ease of Fabrication	12.5	3.5	8.75	4	10	4	10
Safety	12.5	4	10	3	7.5	4.5	11.25
Cost	10	2	4	4.5	9	4.5	9
Ease of Use	10	4.5	9	3	6	3	6
Total			67.25		65		68.75





Future Work

- Fabricate all designs
- Collect force and acceleration data using current methods
- Collect force and acceleration data using new designs
- Compare data to see improvements
- Pick most stable design
- Improve best design



References

[1] Playermaker, “Play Smart. Connect Your Game. ,” *Playermaker*. [Online]. Available: https://playermaker.com/#:~:text=Playermaker%20is%20the%20game%20changer,on%20team%20and%20player%20performance. [Accessed: 17-Sep-2020].

[2] Method and Device for Evaluating Displacement Signals, by R. Feichtinger and J. Löschinger. (2011, Mar. 22). *Patent US 7912672B2.* Accessed on: Sept. 17, 202. [Online]. Available: Google Patents.

[3] C.D. Fryar, M.S.P.H., D. Kruszon-Moran, Sc.M., Q. Gu, M.D., and C.L. Odgen, Ph.D., “Mean Body Weight, Height, Waist Circumference, and Body Mass Index Among Adults: United States, 1999-2000 Through 2015-2016,” CDC, United States, Rep. 122, 2018.

[4] “Biomechanical Differences Between Different Foot Strikes,” Harvard University, Cambridge, MA, United States.