Final Design and Testing Protocols

Problem Statement

- Johnson Health Tech uses Delsys Trigno sensors to collect acceleration data
  - One sensor at the sternum and two at the back of each heel
- JHT currently has no means of attaching the chest sensor and uses athletic tape to attach the sensors at the heels
- It is our goal to design and fabricate a sensor holder for both the chest and heels which is safer and more durable

Impact

A reliable and easy to use method for attaching Delsys Trigno sensors will result in easily obtained accelerometer data

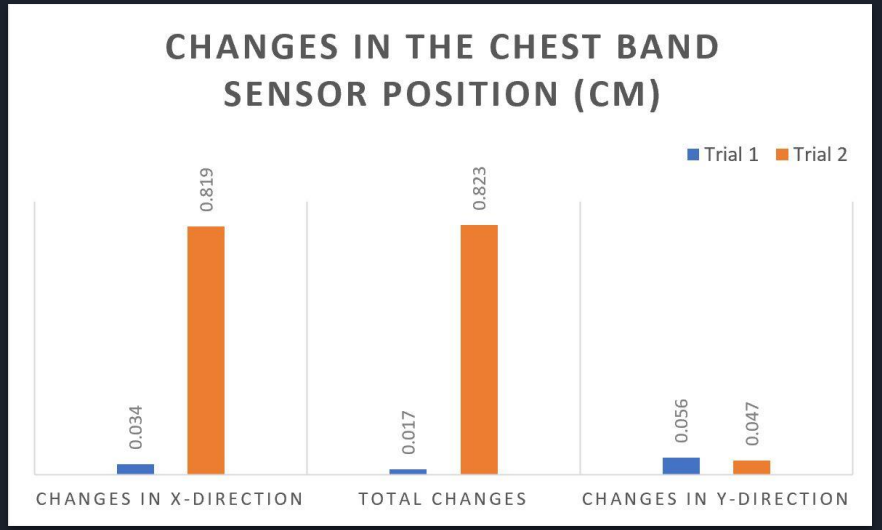
- Accelerometers can be used to determine:
  - Forces on the body
  - Step rate
  - Relative body segment velocities
- Eliminates the need for a force plate
- Accelerometer data gives JHT the ability to compare different exercise equipment
- This data can also be collected to better understand and possibly predict risk of injury

Chest Strap

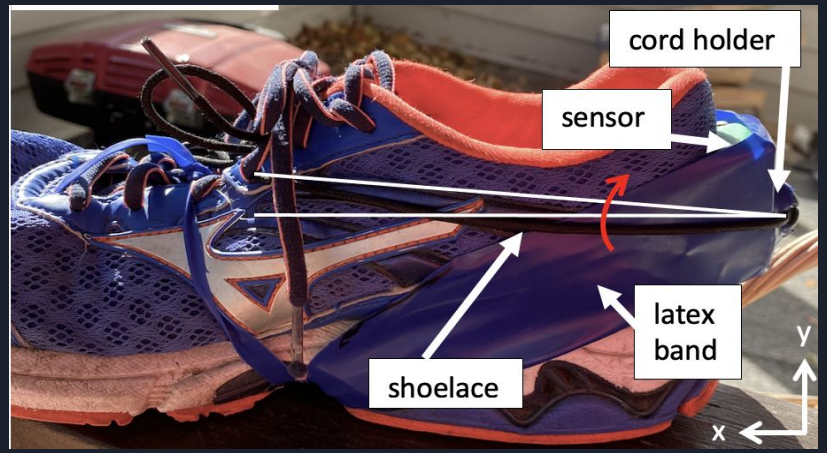
- Minimum length 63cm
- Maximum length unstretched 129 cm
- Maximum stretched length ~240 cm

Chest Strap Test Results

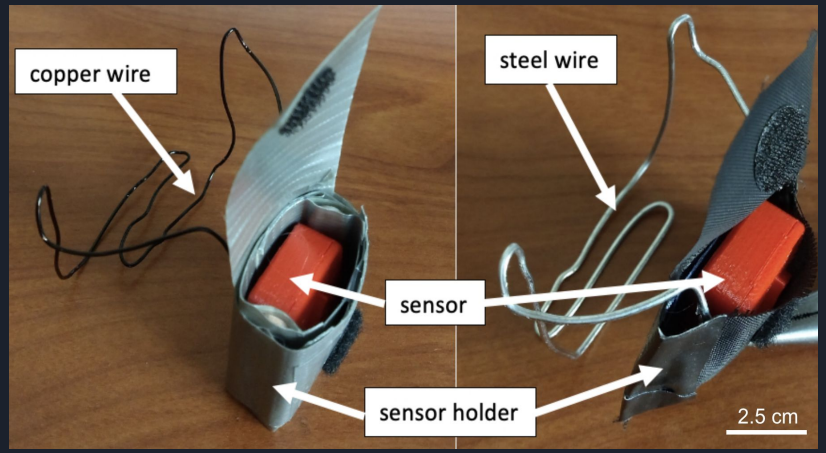
- Used Kinovea to measure movement
- One dot on the user's skin, one on the sensor
- Only tested over one type of material



Shoe Sensor Holders

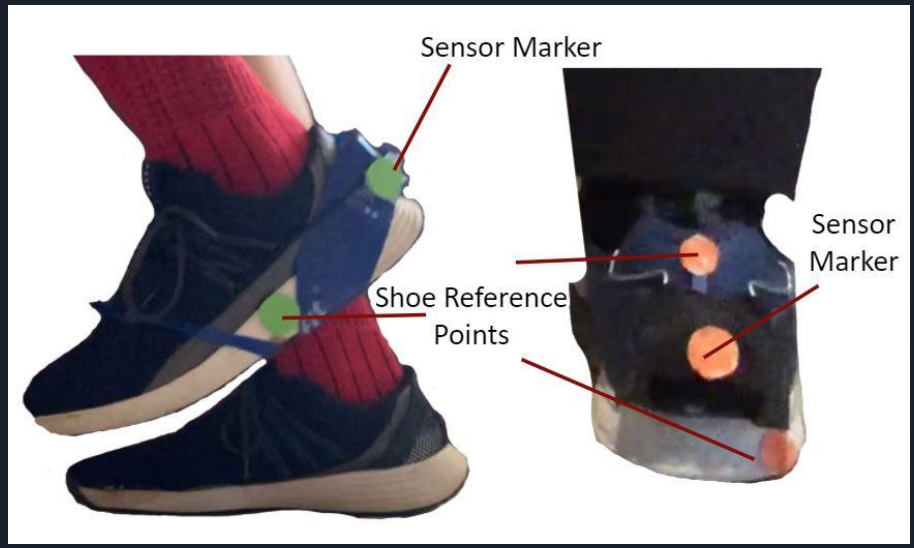


The Straps Design



The Clip Designs

Previous Testing Protocols

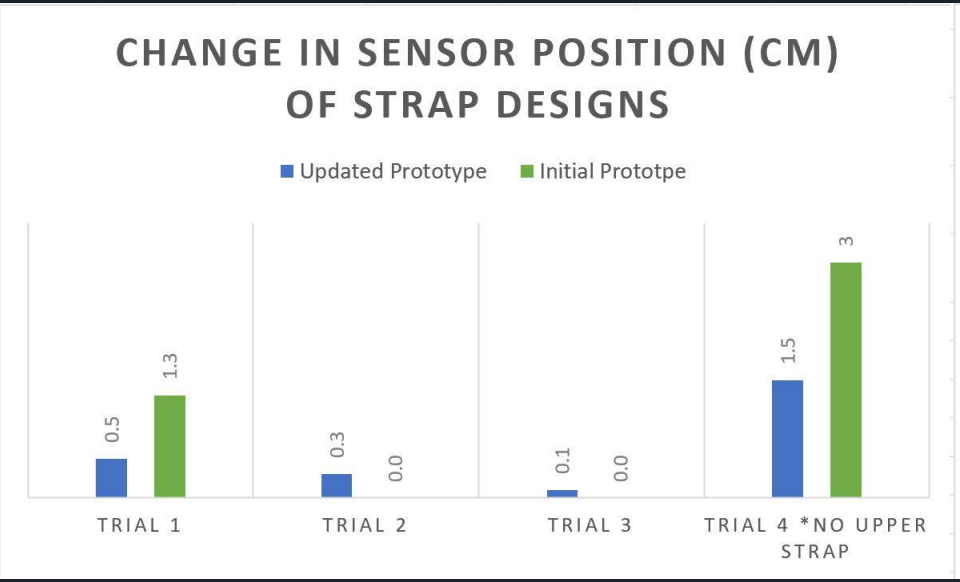


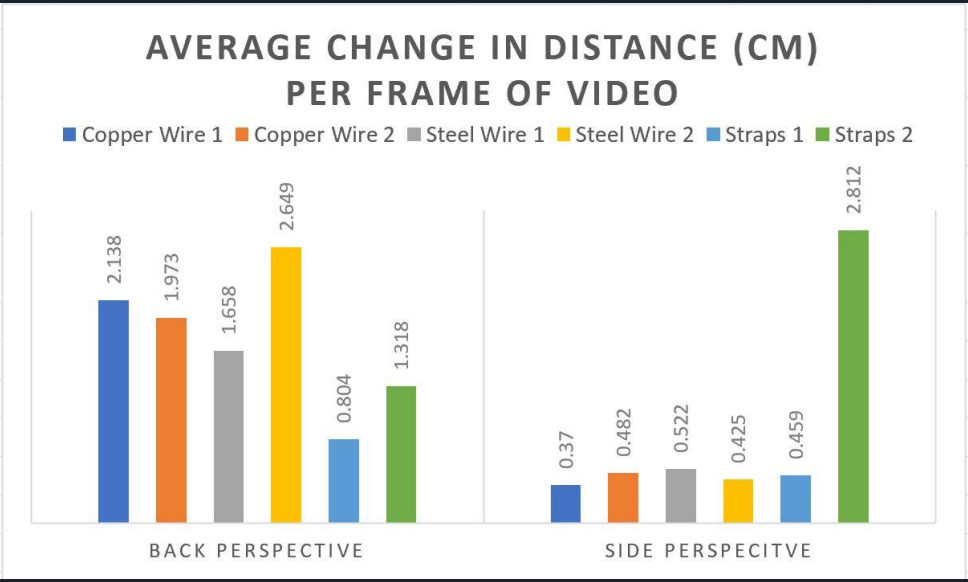
Phase 1- Straps Only

Ran and Marked Sensor Position

Phase 2- Both Designs

Motion Capture (kinovea) tracked movement





Shoe Sensor Holder Test Results

Phase 1-
Outlier of 1.3 cm for trial 1

Phase 2- Both Designs
First Straps = flat bottom
Second Straps = grooved bottom

	p-Value Back	p-Value Side
desired value	**1.0 cm**	**0.2 cm**
Copper 1	0.004	0.342
Copper 2	0.007	0.253
Steel 1	0.028	0.226
Steel 2	7.75×10^{-4}	0.296
Straps 1	0.250	0.270
Straps 2	0.141	5.87×10^{-4}

Improvements this Semester

- The Clip design will remain the same, but a new material will be used for the wire.
- The Straps design will get a pocket for the sensor and new material for the upper straps.

Timeline

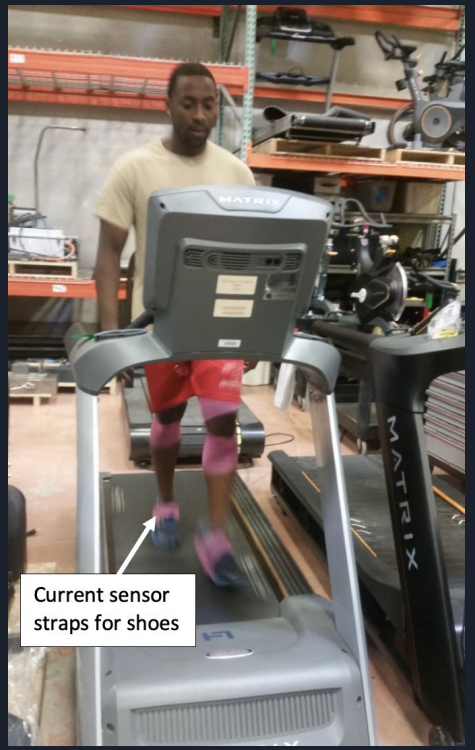
Project Goal	Deadline
Finalize Journal to Publish Project In	2/19/21
Determine Changes to Finalize Designs	2/19/21
Order Materials for Adjustments	2/19/21
Finalize Testing Plan	2/24/21
Test both Designs at Johnson Helath Tech Facility	2/26/21
Preliminary Deliverables	3/3/21
Analyze Testing Data	3/5/21
Make Adjustments Based off of Test Data	3/19/21
Final Deliverables	4/28/21

Testing Plan

- Johnson Health Tech - Trigno Sensors
- Gym/Treadmill - Motion Capture (Kinovea)
- Engineering Hall - Motion Capture

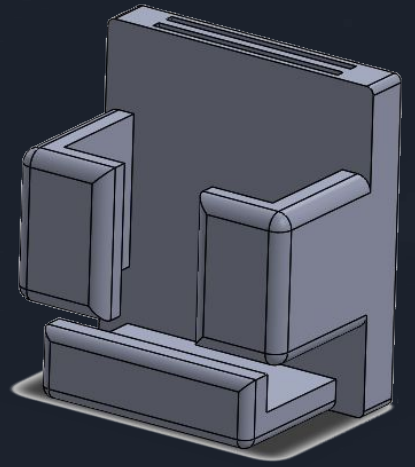
<u>Testing for Shoe and Chest Designs:</u>

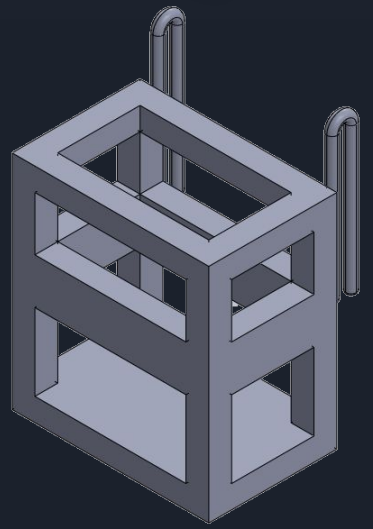
- Controls
  - Marker on the shoe/chest
  - Keep distance between test subject and camera the same
  - Use a tripod to keep camera height consistent
- Will test each design on multiple people



Other Materials

- Create a user manual
  - Step-by-step instructions on assembly/wear
  - Cleaning and general care
- Improve upon the SolidWorks imaging





Budget (Past)

Description	Total
Component 1	
1.5 in Elastic Strap (11 yards)	10.99
Component 2	
1.5 in Double Side Release Buckle	6.98
Component 3	
Cable Clips, ONME 6 Pack Cable Holder	4.99
Component 4	
Letsfit Resistance Latex Bands	5.09
Component 5	
18 Gauge Anezus Craft Wire	10.99
Component 6	
Adafruit LSM303AGR Accelerometer Magnetometer - STEMMA QT Qwiic	8.95
Component 7	
Adafruit LSM6DS33 + LIS3MDL - 9 DoF IMU with Accel / Gyro / Mag - STEMMA QT Qwiic	9.95
Component 8	
Adafruit ItsyBitsy nRF52840 Express - Bluetooth LE	17.95
	$91.28

Budget (Future)

Description	Total
Component 1	
20 Gauge stainless steel wire	$9.48