Rowing biomechanics for lower extremities

Date: 4/18/2023

Client: Jill Thein-Nissenbaum, Tricia DeSouza
Advisor: Dr. John Puccinelli
Team:

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Problem statement

Many college rowing athletes, particularly women, are susceptible to lifelong lower back or hip injuries due to disparate weight distributions on each leg while rowing. This issue can be addressed through gathering real-time data on athlete biomechanics, but this data is often difficult to obtain. Collection and analysis of biomechanical data will enable athletes to adapt their technique towards better performance, and will assist coaches and trainers in preventing injury. The client, Dr. Jill Thein-Nissenbaum, has tasked the team with creating a force plate system that can collect biomechanical data from rowers' lower extremities. The team's goal is to create a wireless sensor system in the rowboat that will capture load distribution during time of use and will assess lower extremity asymmetry to establish risk stratification. Additionally, the team aims to translate the force plate system into a user-friendly interface that will enable coaches and athletes to understand essential biofeedback information, thereby improving both performance and safeguarding against potential injuries.

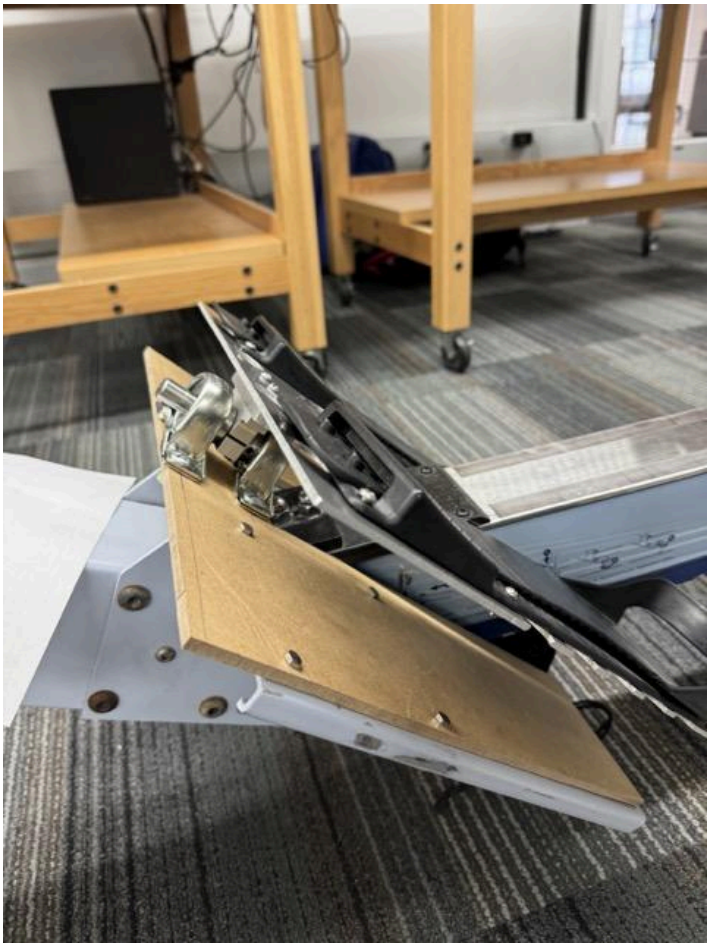
Brief status update

This week the team worked to fabricate and test the final prototype!

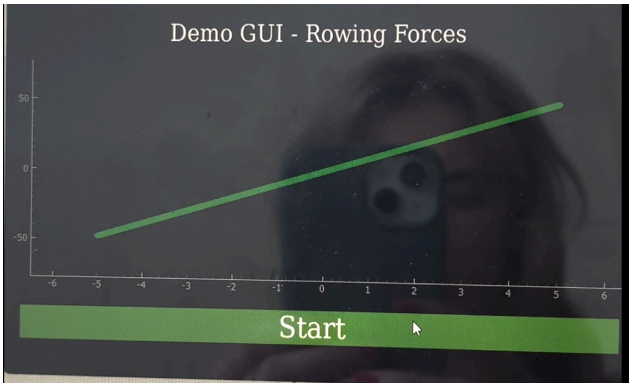
Difficulties / advice requests

The team is still considering different options for the springs and/or bumpers to place between the rotating plate and the baseplate. Whichever material we choose will have to provide good enough rotation to be picked up by the encoder while also being comfortable for the rower.

Current design



GUI:



Materials and expenses

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	#	Cost Each	Total	Link
Electronics										
Raspberry Pi	Microcontroller	Raspberry Pi		Sparkfun	DEV-15446	2/15	1	$45	$60.43	Link
Raspberry Pi	7” Display Screen	Raspberry Pi		Amazon		2/23	1	$33.99	$33.99	
Raspberry Pi	20W 5V 4A Power Supply	Raspberry Pi		Amazon		2/23	1`	$11.99	$11.99	
MicroSD Card	32GB 3D NAND High Speed MicroSD Card with Adapter	Silicon Power USA		Amazon		2/23	1	$8.99	$8.99	
HDMI Cable	4K Micro HDMI to HDMI Cable 1 FT Adapter 2.0	Szsea US		Amazon		2/23	1	$8.99	$8.99	
Display Case	7” Raspberry Pi Case Holder	Longruner		Amazon		3/18	1	$13.99	$13.99	Link
Undersized Rotary Shaft	1/2" diameter, 12" length	McMaster Carr	4149N15	McMaster Carr		4/05	1	$22.18	$22.18	Link
Aluminum Easy-Access Base-Mounted Shaft Support	Low-Profile T-Shaped, for 1/2" shaft dia.	McMaster Carr	1865K3	McMaster Carr		4/05	1	$28.20	$28.20	Link
Low-Profile Mounted Sealed Steel Ball Bearing	with Set Screw, for 1/2" shaft dia.	McMaster Carr	5913K6	McMaster Carr		4/05	2	$10.95	$21.90	Link
Aluminum Bolt-Together Framing	1-1/2" Square Rail, 6 ft length	McMaster Carr	8809T7-8809T21	McMaster Carr		4/05	1	$47.20	$47.20	Link
Marine-Grade Plywood Sheet	24" x 24" x 3/8"	McMaster Carr	1125T23	McMaster Carr		4/05	1	$33.71	$33.71	Link
Corner Surface Bracket		McMaster Carr	4931T221	McMaster Carr		4/05	8	$9.96	$79.68	Link
Load-Rated Threaded Bumpers	2" height	McMaster Carr	9377K23	McMaster Carr		4/05	2	$26.67	$53.34	Link
Compression Spring	352 max load	McMaster Carr	9657K695	McMaster Carr		4/05	8	$10.06	$80.48	Link

Compression Spring	124 max load	McMaster Carr	9657 K374	McMaster Carr		4/05	2	$25.92	$25.92	Link
Raw Materials										
Wood Scrap	TEAM Lab					3/23		$0.00	$0.00	
Aluminum Scrap	TEAM Lab					4/3		$0.00	$0.00	
8” Aluminum Rod	TEAM Lab					4/18		$8.27	$8.27	
								TOTAL:	**$138.38**	

Major team goals for the next week

1. Finish fabrication
2. Test prototype

Next week’s individual goals

- Neha
  - Assist with testing of prototype
  - Work on final poster and presentation
- Simmi
  - Assist with design testing and data collection
  - Work on final poster
- Allicia
  - Assist with testing on Monday
- Emily
  - Assist with testing on Monday
  - Complete poster
- Colin
  - Assist with testing on Monday
  - Finish Fabrication

Timeline

Task	Jan	Feb					March					April				May	
	26	2	9	16	23	29	1	8	15	22	29	5	12	19	26	3	10
Project R&D																	
Empathize	X	X	X														
Background	X	X	X	x													
Prototyping				x	x	X	x	x	x	x		x					
Testings										x		x	x				
Deliverables																	
Progress Reports		x	x	x	x	X		x	x	x		x	x	x			

Prelim presentation							x										
Final Poster																	
Meetings																	
Client		x		X					x			x		x			
Advisor		x	x	X	X	x	x	x	x			x	x	x			
Website																	
Update		x	x	x	X	X		x	x	x		x	x	x			

Filled boxes = projected timeline
X = task was worked on or completed

Previous week's goals and accomplishments

- Neha:
  - Finalized materials for footplate
  - Fabricated prototype with teammates
- Allicia:
  - Worked on angular encoder code
  - Fabricated prototype
- Emily:
  - Fabricated prototype
  - Worked on fabrication protocol
- Colin:
  - Fabricated prototype
- Simmi:
  - Fabricated prototype
  - Finished new testing protocol
- Team previous goal:
  - Receive materials and fabricate

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Neha Kulkarni	4/16	Fabrication	4	4	38
Neha Kulkarni	4/17	Fabrication	6	10	44
Colin Fessenden	4/16	Fabrication	4	10	40

Colin Fessenden	4/17	Fabrication	6	10	46
Colin Fessenden	4/18	Fabrication	4	14	50
Allicia Moeller	4/16	Fabrication	4	10	58
Allicia Moeller	4/17	Fabrication	6	10	64
Simerjot Kaur	4/16	Fabrication	4	10	41
Simerjot Kaur	4/17	Fabrication	6	10	47
Emily Wadzinski	4/16	Fabrication	5	5	42
Emily Wadzinski	4/17	Fabrication	6	11	48
Emily Wadzinski	4/18	Fabrication	4	15	52