Rowing biomechanics for lower extremities

Date: 3/14/2023

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

Team Leader: Neha Kulkarni (nnkulkarni@wisc.edu)

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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 met with Dr. Gruben to see his lab and how he applies both angular encoders and load cell off-axis load shielding to quantify force. Upon meeting with him, the team decided to move forward with a new design, using an angular encoder and pivoting footplate to

measure the degree of asymmetry during rowing. After deciding this, the team moved forward with fabricating a crude prototype using MDF and wood, to investigate the form factor, fabrication process, and efficacy of the design.

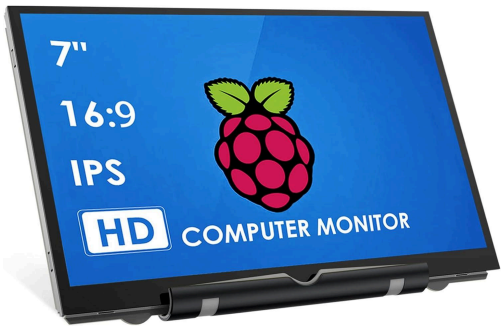
Difficulties / advice requests

We are still wondering which angular encoder to buy because the MA3 recommended by Dr. Gruben does not have the optimal resolution or output signal, but another encoder we are considering has a starting torque so may not be fully frictionless.

Current design

Prototype made for Show and Tell:

Display: Raspberry Pi + 7” LCD



Materials and expenses

Item	Description	Manufac-turer	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	
Raw Materials										
									$0.00	
									$0.00	
								TOTAL:	**$124.39**	

Major team goals for the next week

1. Finalize our footplate design with Dr. Gruben’s advice and our clients’ input.
2. Write a detailed fabrication plan for the footplate.
3. Order necessary materials for the footplate.

Next week’s individual goals

- Neha
  - Finalize fabrication plan, including materials
  - Begin fabrication
- Simmi
  - Finalize an angular encoder
  - Figure out angle amplification
- Allicia
  - Choose an angular encoder
  - Write code to incorporate encoder into the GUI
- Emily
  - Finalize fabrication plan
  - Fabricate LCD display case
- Colin

- Finalize fabrication plan and complete the base plate of the design

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							
Testings										x							
Deliverables																	
Progress Reports		x	x	x	x	X		x	x	x							
Prelim presentation							x										
Final Poster																	
Meetings																	
Client		x		X					x								
Advisor		x	x	X	X	x	x	x	x								
Website																	
Update		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:
  - Assisted in building show and tell prototype
  - Researched rotary encoders and how to process their signals
- Allicia:
  - Met with Dr. Gruben
  - Assisted in building show and tell prototype
- Emily:
  - Met with Dr. Gruben
  - Assisted in building show and tell prototype
- Colin:
  - Assisted in building show and tell prototype
- Simmi:
  - Met with Dr. Gruben
  - Assisted in building show and tell prototype
- Team previous goal:
  - Fabricate crude prototype
  - Refine and finalize angular encoder design

Activities

Name	Date	Activity	Time (h)	Week Total (h)	Sem. Total (h)
Neha Kulkarni	3/20	Prototype fabrication	3	3	31
Neha Kulkarni	3/21	Prototype fabrication	2	5	33
Emily Wadzinski	3/20-21	Prototype Fabrication	6	6	33
Simerjot Kaur	3/20-21	Prototype Fabrication	6	6	33
Colin Fessenden	3/20	Prototype Fabrication	3	3	25
Allicia Moeller	3/20	Prototype fabrication	4	4	45
Allicia Moeller	3/21	Prototype fabrication	4	8	49