Team A3 - LiftOff

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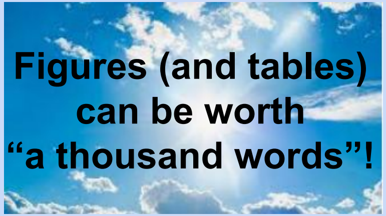
Add your 12 slides after this slide… [remember, 12 min talk + 3 min Q/A]



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Make sure to cover: (refer to the Final Presentation Guidance):

- Use Case / Application and Primary (Quantitative) Requirements (i.e. a reminder from prior presentations)
- Solution Approach – a reminder (include updates from Design Review presentation if changed)
  - E.g. block diagram(s), flow chart(s), schematic(s)
- System Implementation – your complete solution
  - E.g., pictures, screenshots, video (make sure that there is CMU access to play any media)
- Testing, Verification and Validation – with quantitative metrics and target values to compare with experiment
  - What tests did you run ? How many tests ? What were the results ?
  - Graphs, tables, quantitative results (compare with the metric targets & ultimately use-case requirements)
- Project Management – tasks, division of labor, and schedule
- Lessons Learned

Consider that this slide already works as a introduction slide so use your first slide wisely (i.e. feel free to delete guidance text)

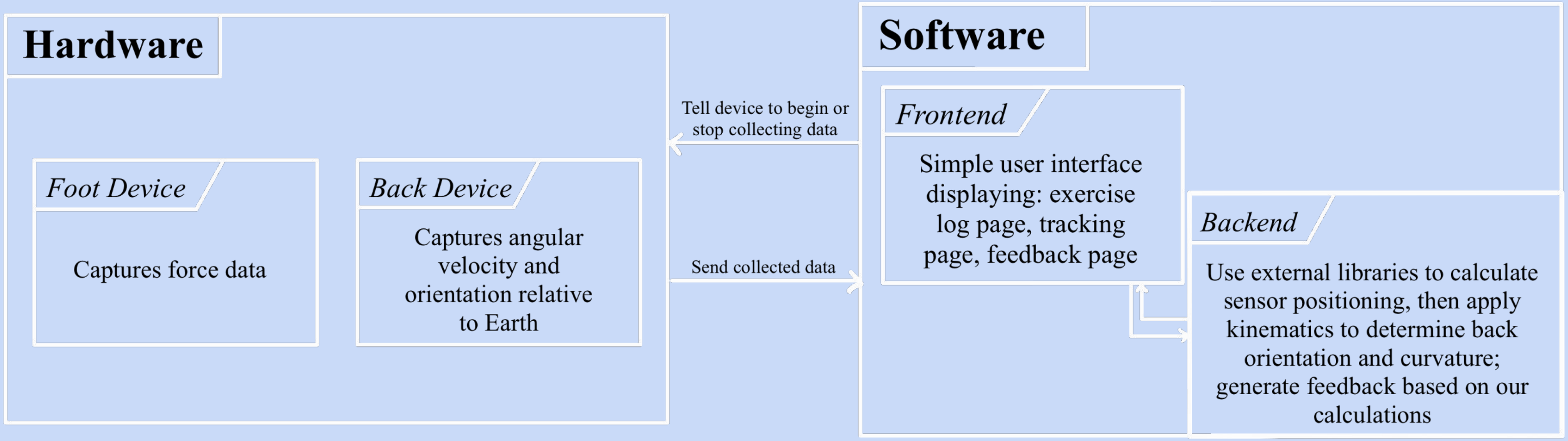
Use Case Requirements

Use Case Requirement	**Quantified Requirement**
Back orientation and arch detection	Classify back orientation via back angle relative to earth Classify presence of arch (yes or no) 90% classification accuracy
Pressure detection	Able to detect pressure changes and withstand up to 200 kgs
Easy/Simple Set up	< 2 minutes to set up
Light weight	< 2 pounds
Water/sweat resistant	Device must be water / sweat resistant
Battery Life/ Time between charging	At least 3 hour battery life
Informative / Actionable Feedback	Must give correct feedback
Data Tracking / Logging	Record amount of reps done and weight used (kg/lbs)

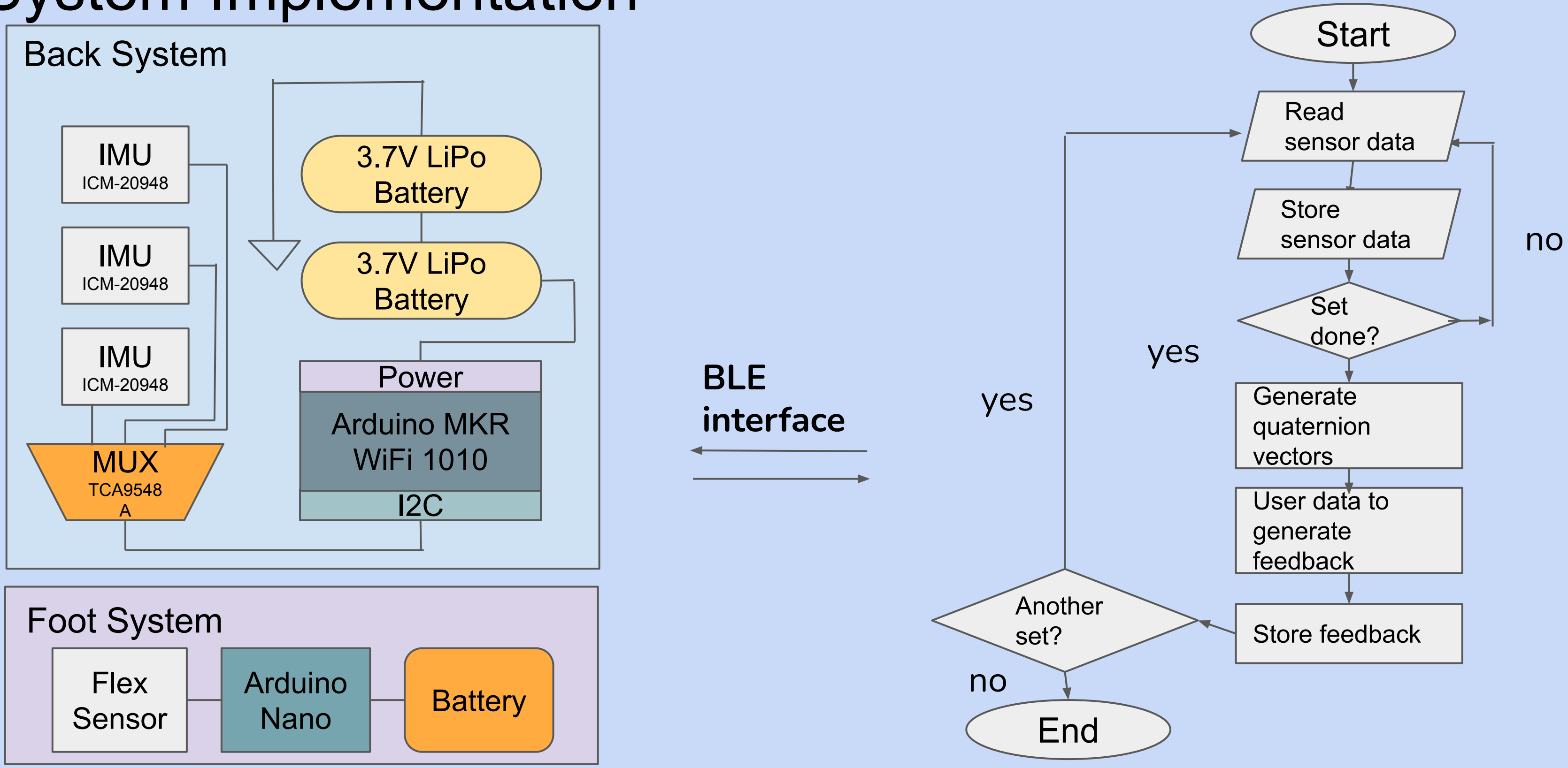
Solution Approach

- Wearable devices that connects to a web app
- The devices will:
  - Be worn over or without clothing
  - Track the user’s spine orientation and curvature
  - Determine the amount of pressure applied on the foot
  - Send data to the app
- On the web app, users can:
  - Learn how to do deadlifts and squats
  - Check if they did the movement correctly
  - Track and log their progress

System Specification



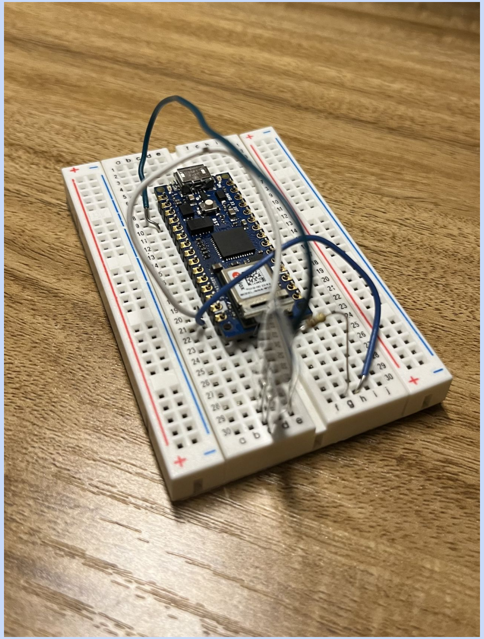
System Implementation



Hardware System

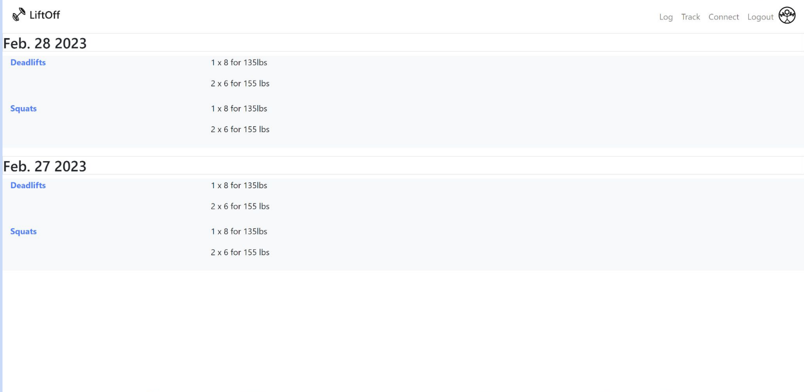
Software System

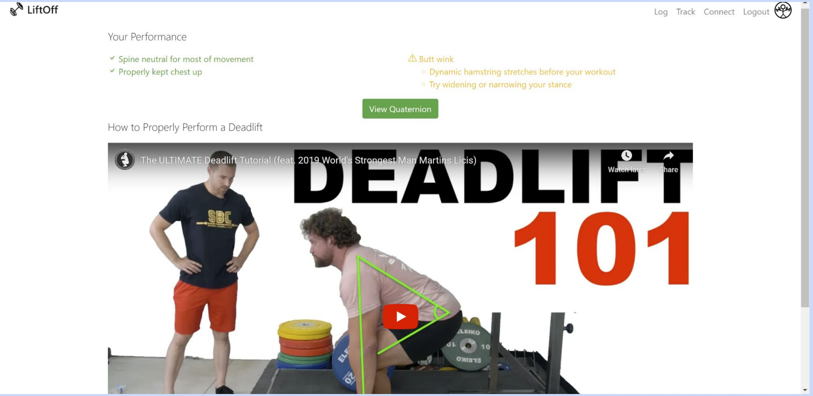
Realized Design

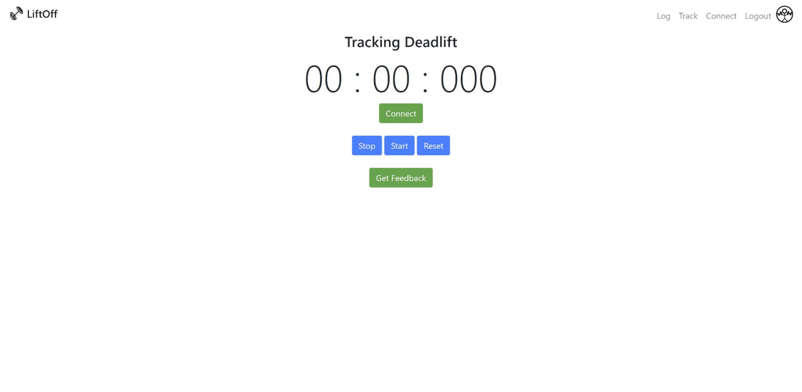


(To be placed on fabric)

Realized Design



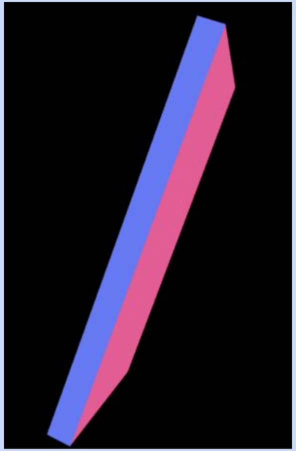




Testing, Verification, and Validation

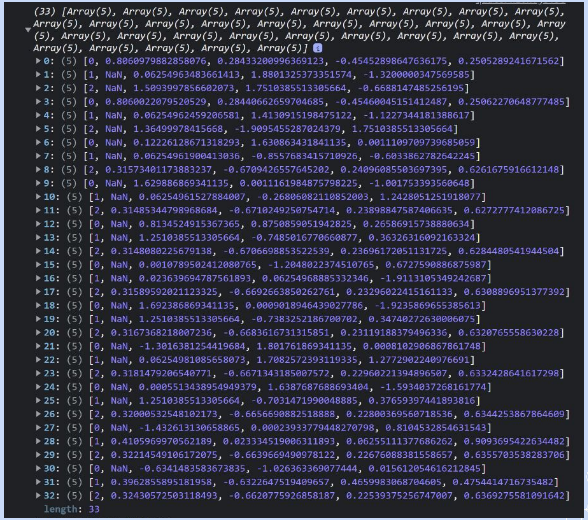
Use Case Requirement	**Quantified Requirement**	**Results**
Back orientation and arch detection	Classify back orientation via back angle relative to earth Classify presence of arch (yes or no) 90% classification accuracy	Using our observations over 10 trials, we do receive the correct orientation of the sensors.
Weight detection	Able to detect pressure changes and withstand up to 200 kgs	Current resistance ceiling is too low, need to do further testing
Easy/Simple Set up	< 2 minutes to set up	1 minute 22 seconds
Light weight	< 2 pounds	Our device weighs 0.6 pounds
Battery Life/ Time between charging	At least 3 hour battery life	We kept our device on for over 3 hours using the battery

Back Device: Testing, Verification, and Validation



We used an iterative testing process (repeated 8 times):

1. Read sensors' data via serial output
2. Verify data received by the web application is correct
3. Validate the data collected by ensuring the visualization per sensor matches the observed back position
4. In Progress: Combine data together for complete visualization
5. In Progress: Generate correct feedback based on the data collected



Foot Device: Testing, Verification, and Validation

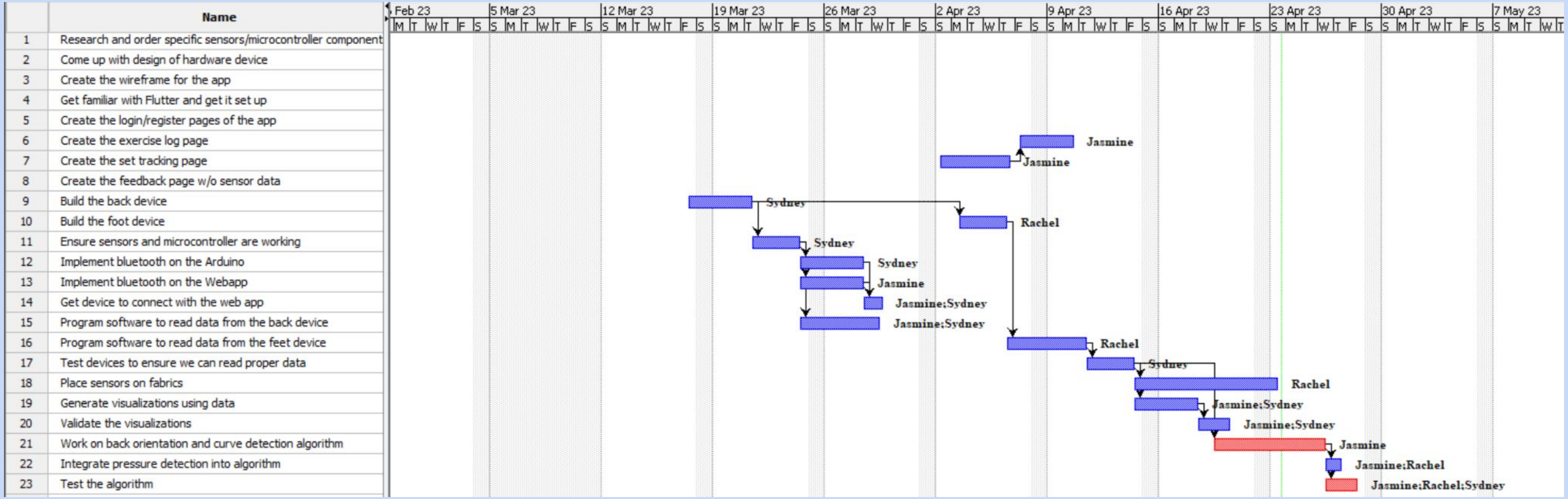
- Using different weights, we measured the average force sensitive resistance over 3 trials each
- Further testing is needed where we use both our foot devices and ensure the measured resistance is the same

Weight (lbs)	Force Sensor Resistance (kOhm)	Error/off by (weight-158-force)
0	158	0
5	162	1
20	174	4
30	184	4
140	203	95

Further Testing, Verification, and Validation

Use Case Requirement	Quantified Requirement	Testing Plan
Water/sweat resistant	Device must be water/sweat resistant	Out of scope with our current design
Informative / Actionable Feedback	Must give correct feedback	Do different types of squats and deadlifts: - Curved spine & neutral spine - Back bent backwards - Unbalanced pressure & balanced pressure - Bad squats & good squats - Bad deadlifts & good deadlifts
Data Tracking / Logging	Record amount of reps done and weight used (kg or lb)	Do sets of multiple reps: 0, 1, 5, 10 Ensure the reps recorded by the web app aligns with the reps done

Schedule



Sydney: Back device and visualizations

Rachel: Foot device and sewing

Jasmine: Web app and algorithms

Lessons Learned

- Integration is hard!
    - Communicating data between web pages is unexpectedly hard
- Designing wearable systems that require precise placement is difficult, as it is hard to incorporate into the design of the device the necessary placement.
- Creating your own algorithm is hard and you should carefully consider all possible use cases when designing.