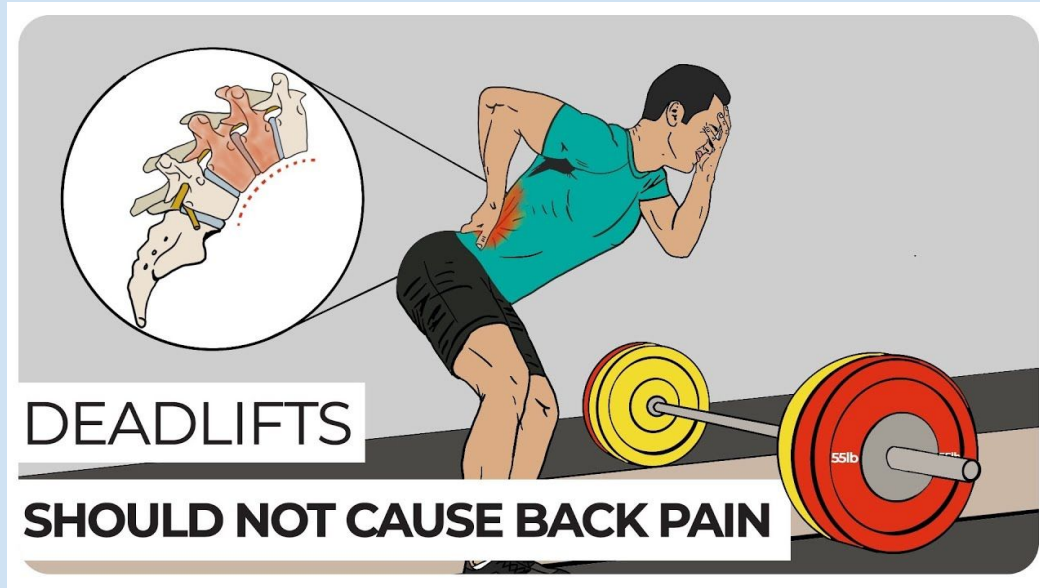


A03: LiftOff

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The Problem



Common gym lifts have high potential for back injury when done incorrectly. This creates a barrier to entry for people without gym experience.



Our System

- A wearable device that connects to a mobile app
- The device will:
 - Track the user's spine orientation and curvature
 - Send data to the app
- On the app, users can:
 - Learn how to do different exercises
 - Check if they did the movement correctly



Use-Case Requirements

Use Case Requirement	Quantified Requirement
Back orientation and arch detection	< 17s latency(~time it takes to perform 5 squat + 2s), 90% accurate
Easy/Simple Set up	< 2 minutes to set up
Small Form Factor For Primary Computer	< 2.5inches Fit on a weight lifting belt
Water/sweat resistant	Sensors placed on body / feet must be water / sweat resistant

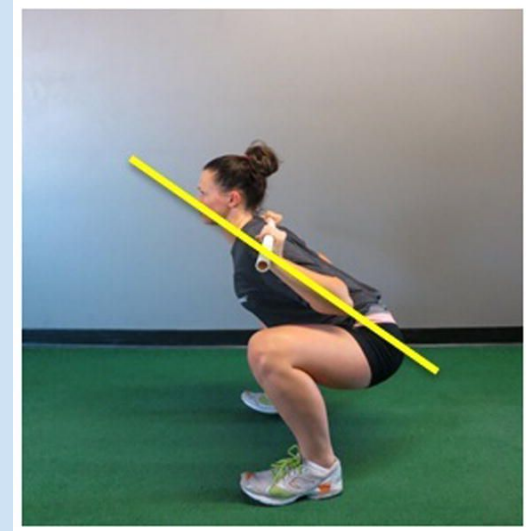


Use-Case Requirements Pt. 2

Use Case Requirement	Quantified Requirement
Battery Life/ Time between charging	At least 3 hour battery life
Informative / Actionable Feedback I.e. (detect the back moved forward too early, and inform the user that they should queue chest upwards)	The system must be correct 90% of the time. If bad form is detected, at least one piece of feedback must be provided. The feedback it provides must match the problem found.
Data Tracking / Logging	Count number of reps completed +/- 1 Record amount of weight used (kg or lb)

Technical Challenges

- Determining the lower back arch and back orientation
- Providing informative, appropriate feedback
- Creating a mobile app to log / report data
- Transmitting data between onboard sensors and mobile app

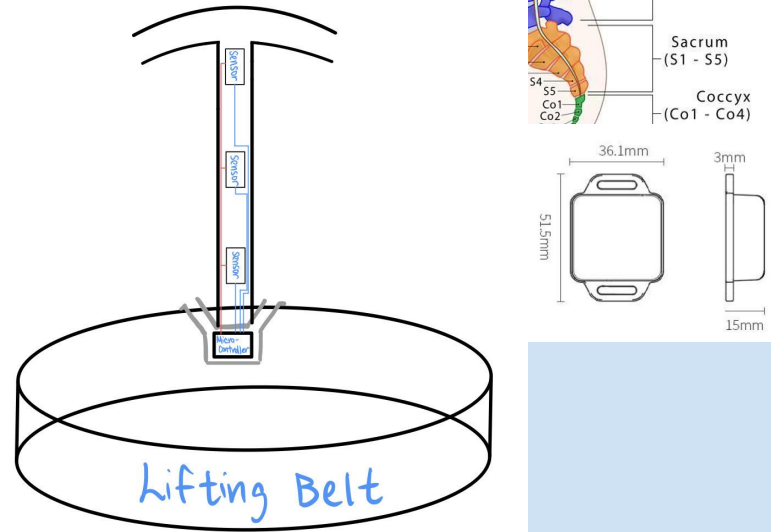
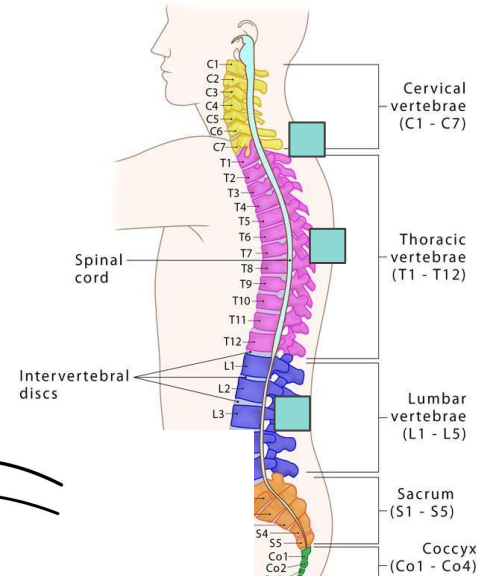


Determining Back Arch & Orientation

- Use 3 sensors placed at C-spine, T-spine, and L-spine
- Sensors must have both a gyroscope and accelerometer to help determine orientation
- Options : WITMOTION or MBIENTLab combined Accelerometer and Gyroscope

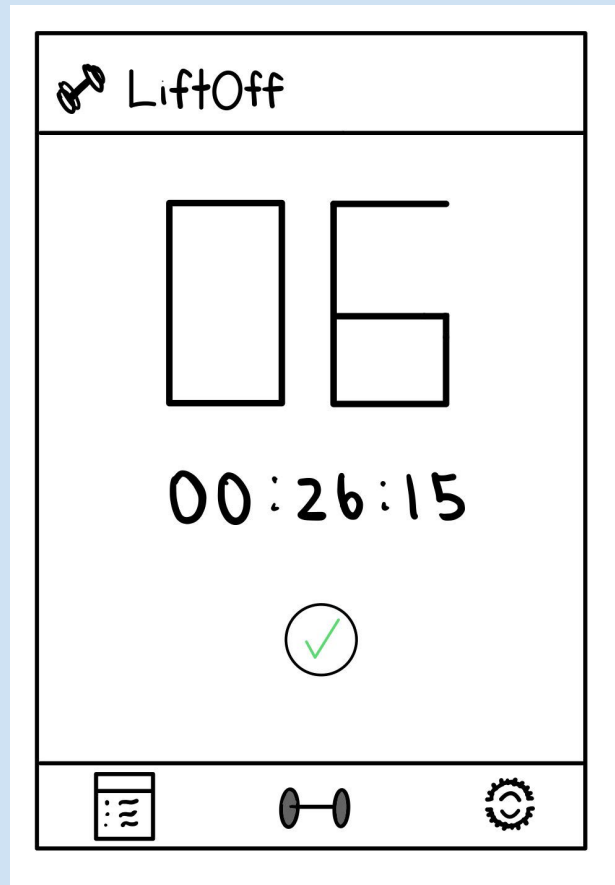
Vertebral Column

(Composed of 33 vertebrae)



Informative Easy to Use Mobile App

- Use Flutter to create a cross platform mobile application
- The app will:
 - Provide feedback on correct squat and deadlift form across one set
 - Have a data tracking page to inform users of their progress





Testing, Verification and Metrics

Use Case Requirement	Testing Plan
Back orientation and arch detection	Hold back in different positions and check data produced by sensors is consistent. Do this with various sensor placements on back, and with people of different heights.
Easy/Simple Set up	Have someone unfamiliar with our project follow set up instructions, time how long it takes.
Water/sweat resistant	Do research, buy sweat resistant sensors. Sweat with wearable on, check that readings stay consistent through same motions



Testing, Verification and Metrics Pt. 2

Use Case Requirement	Testing Plan
Battery Life/ Time between charging	Power our system on, and wait until it dies.
Informative / Actionable Feedback I.e. (detect the back moved forward too early, and inform the user that they should queue chest upwards)	Provide our own data to ensure conditional coverage such that feedback matches data received
Data Tracking / Logging	Use branch coverage to ensure that when we are counting reps or tracking time, everything is correctly updated

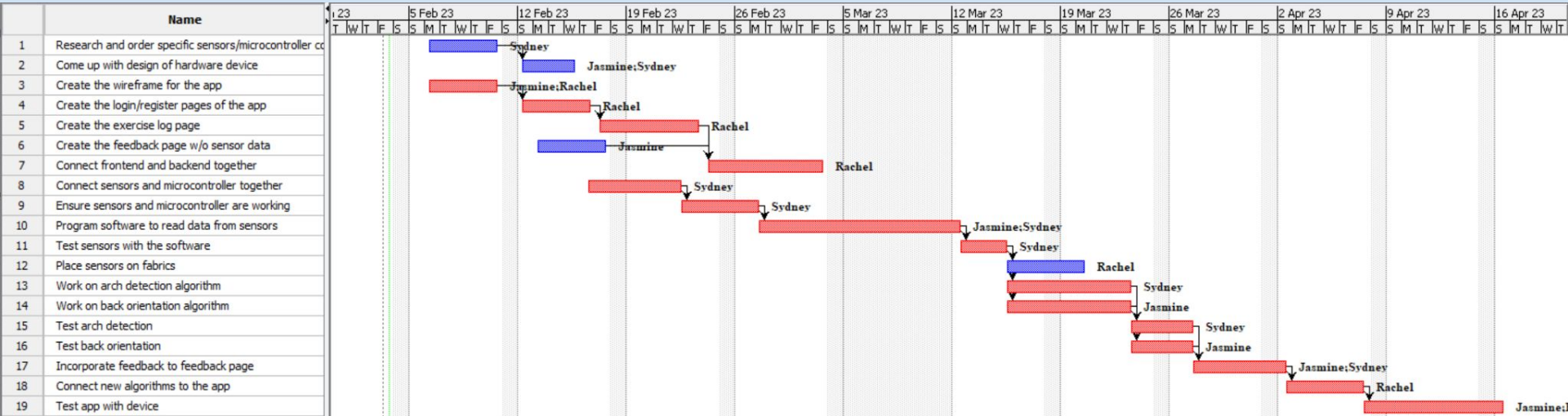


Tasks & Division of Labor

Sydney (Hardware/Sensors)	Jasmine (Detection Algorithm)	Rachel (App Interface)
Determine specific sensors/microcontroller to use that can work together	Create wireframe of the app	Attach sensors onto fabrics
Connect the sensors and microcontroller together	Create the feedback page	Create the login page and register page
Develop software that can read the data from the microcontroller	Work on back orientation algorithm	Create the exercise log page
Test sensor data collection	Test program with the device	Connect front and backend
Work on arch detection side of the algorithm	Map user feedback we will provide to data received	Test entire app to ensure everything works together



Schedule





Prospects

Our project is supposed to function like training wheels — it seamlessly guides people of any age and background into the world of lifting. Our goal is to make lifting more accessible, and to accurately provide user feedback just like a personal trainer.