



BaselineTech - Design Review

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Product Requirements

1. This product shall accurately simulate the movements of snowboarding.
2. This product shall have 2 rotational degrees of freedom, with the roll being able to tilt up to 30-40 degrees.
3. This product shall be able to have snowboards of varying sizes be mounted to it.
4. This product shall have safety features for if the user loses their balance.
5. This product shall function with users that weigh up to 150 lbs.
6. This product shall collect and send usable data of snowboards movement to a PC, via
7. bluetooth, in real time.
8. The main electrical components will be hidden from the user, ensuring a user-friendly experience.

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Milestones Achieved

Milestone 1: Research and Ideation

ECE:

- Determine subsystems (block diagrams, etc.).
 - Power management, Roll, Yaw, Microcontroller
- Divide subsystems, assign to individual members (based on technical skills/capabilities, interests).
- Brainstorm the sensors and electronics needed for sensing the roll and yaw of the board.
- Select a microcontroller that can send information to a PC via wifi/Bluetooth.

ME:

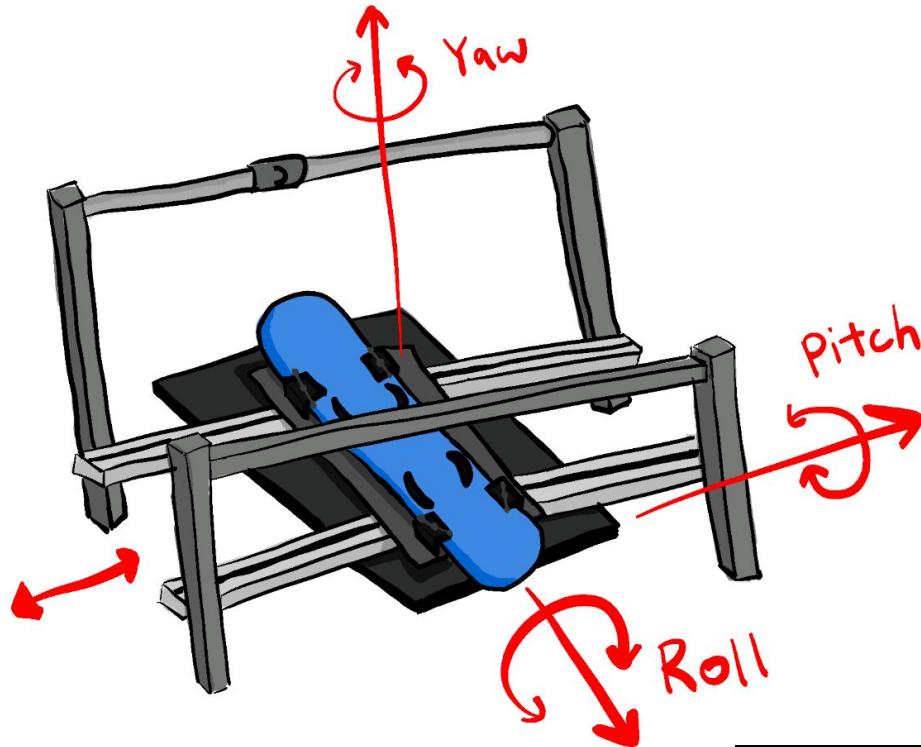
- Research into subsystems, ideate potential solutions.
 - Pitch, linear rails, roll, yaw, board mount, safety
- Divide subsystems, assign to individual members (based on technical skills/capabilities, interests).
- Safety feature methods and designs have been discussed and some CAD has been made.

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Full Mechanical Architecture

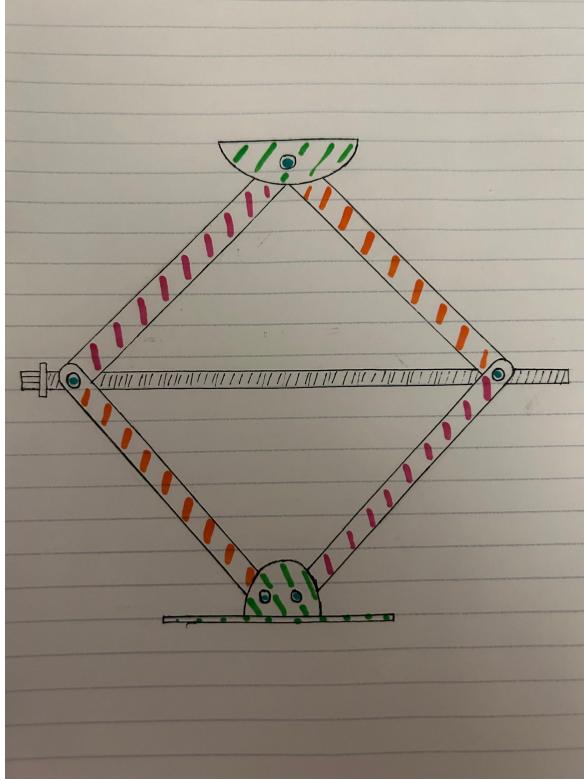
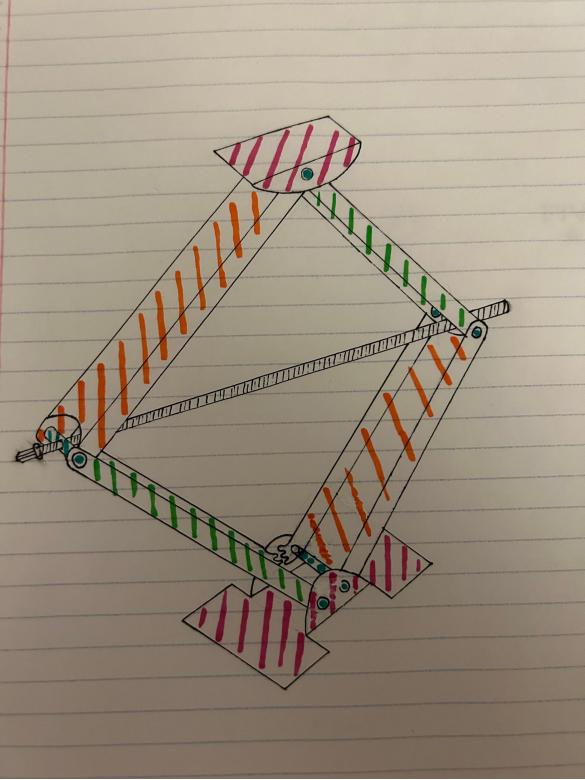
Subsystems:

- Roll
- Pitch
- Yaw
- Linear Movement
- Board mounting
- Safety/harness



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Pitch



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Pitch



.1" 5052 H2
Stainless
Steel

Parts List McMaster

- Lead Screw \$20
- Cap nut? \$5
- Hex nut \$5
- Clevis Pin w/ cotter 5x \$100

Total:
\$330

Amazon

- Trunnion 2x? \$25

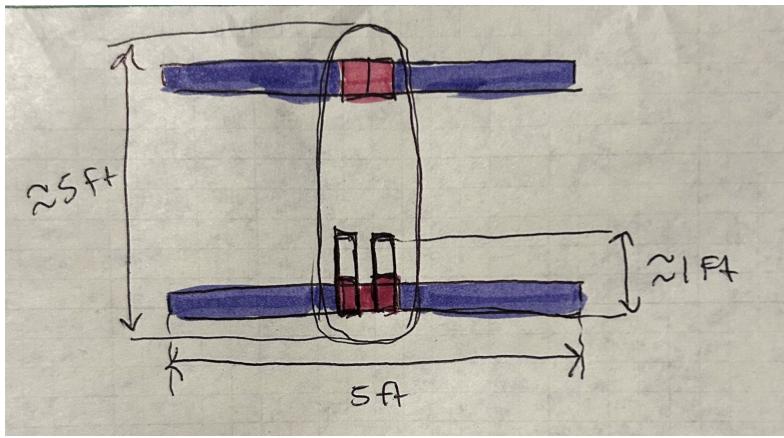
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- Members 4x \$120
- Bottom Plate \$30
- Top Hinge \$25

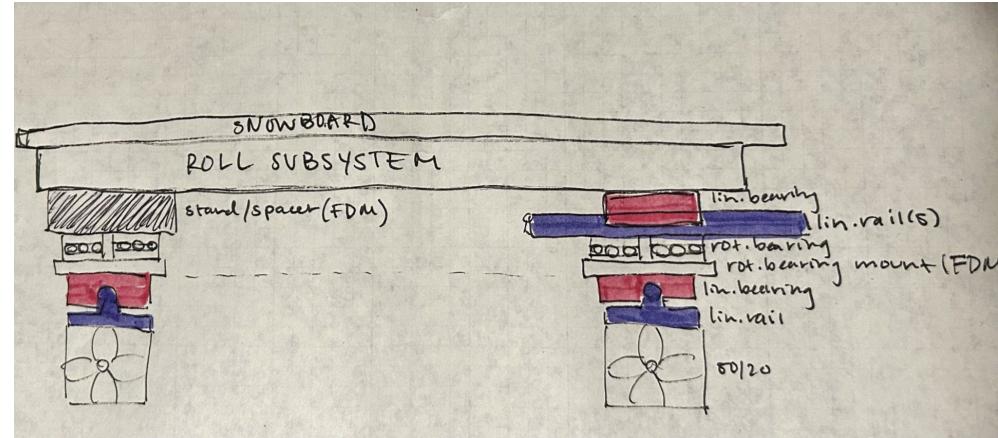
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Linear Rails

Top-down view



Side view



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Linear Rail



Rails:

- 5 ft: \$78
- 2 ft: \$36

Linear bearings: 198 lbs dynamic load capacity (comes with the rails)

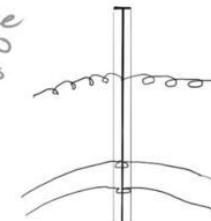
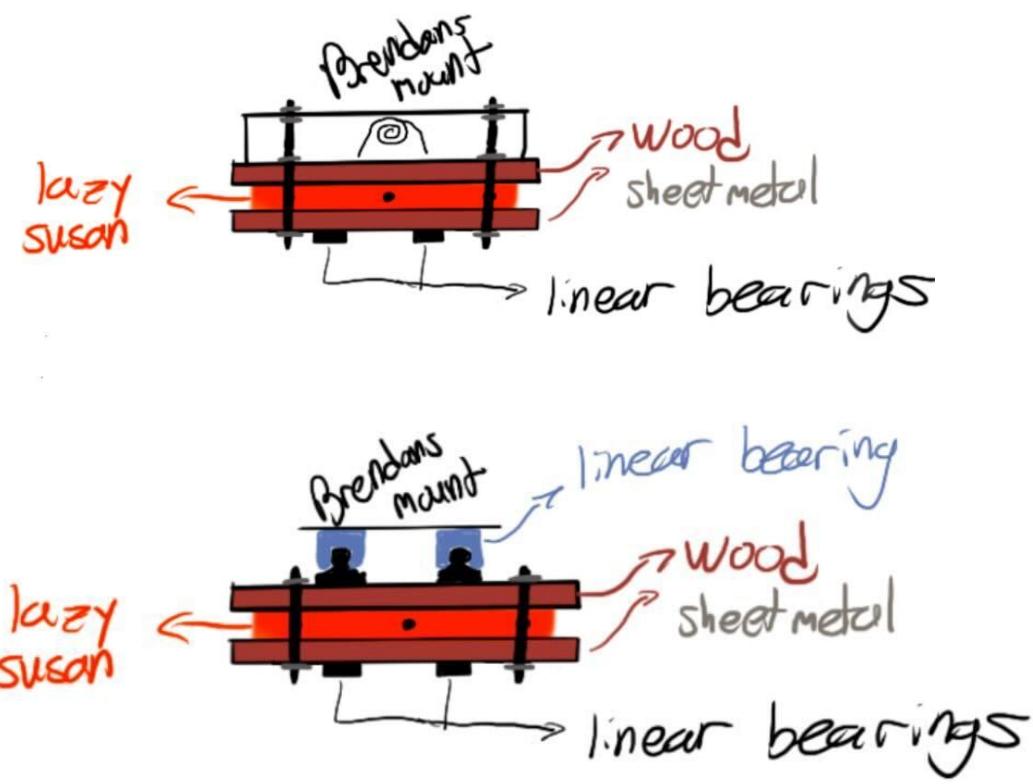
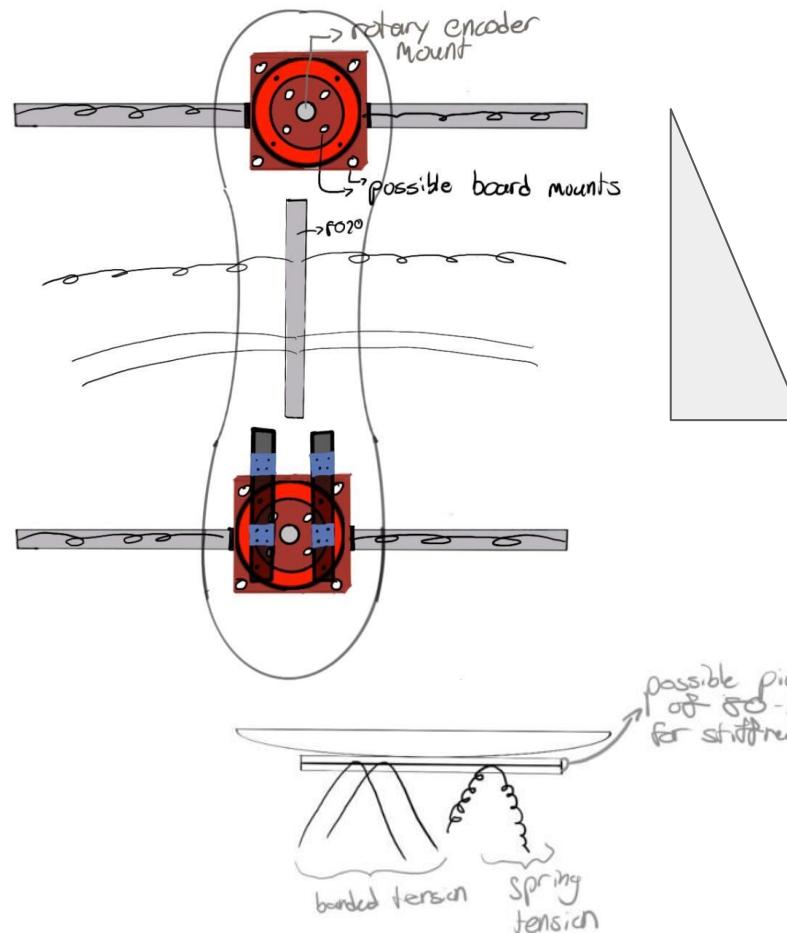
- Extra bearings: \$19

1.5" 80/20 for support - 11 ft total: \$90

Total: \$230

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Yaw

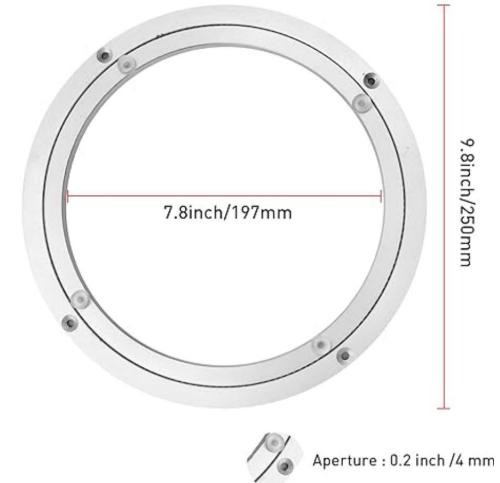


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Yaw

Parts:

- Two 8in to 12in aluminum Lazy Susans (\$30-50 for both)
 - 130 lb load capacity (10 in)
- Two small linear rails
 - 200-300mm (around \$30)
- Need M6 screws for connections
- Two mounting plates:
 - Made out of wood or sheet metal
 - Can be cut on cnc under ruggles with wood
- Use threaded ro
- Possible tensions:
 - 40lb torsion spring in front (\$4)
 - Extension springs, 30lbs?
 - Some tension “rope”



1.493" 1.125" 0.135" 4"

5.17

0.878"

43.88

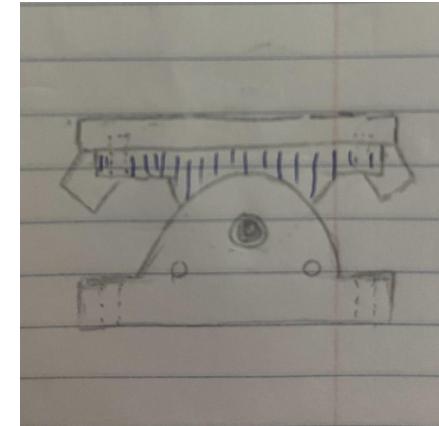
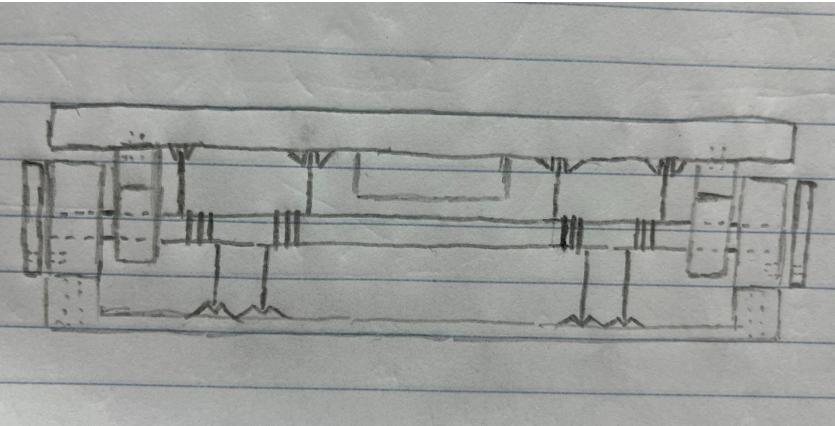
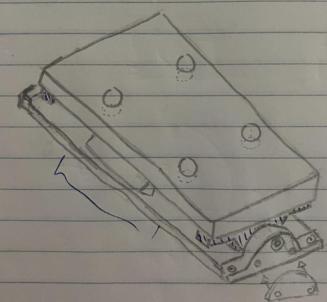
Music-Wire Steel 1

9271K959

4.23

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Roll

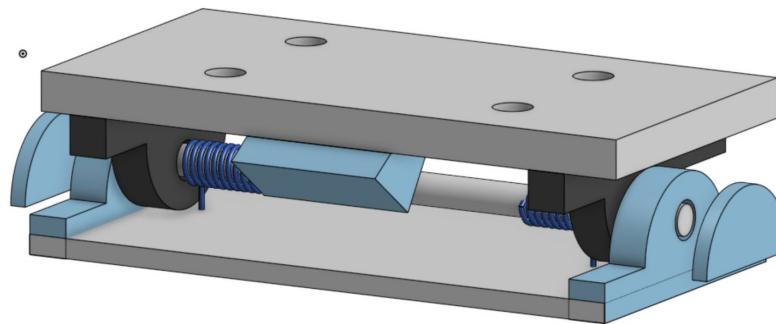
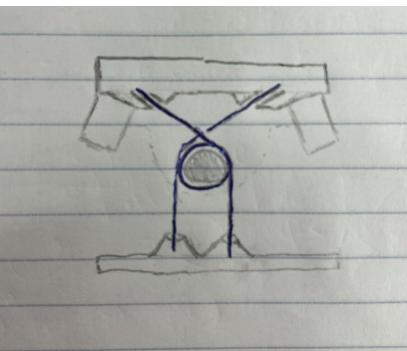


Top plate: 1ft x 4ft

Base: Similar, depends
on size on yaw system

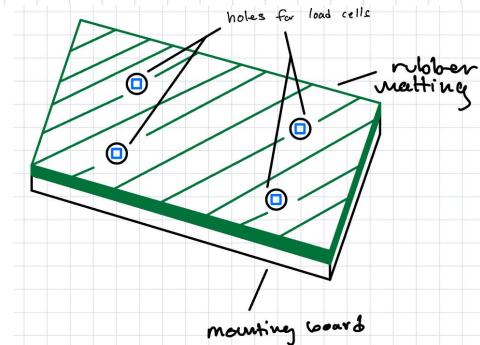
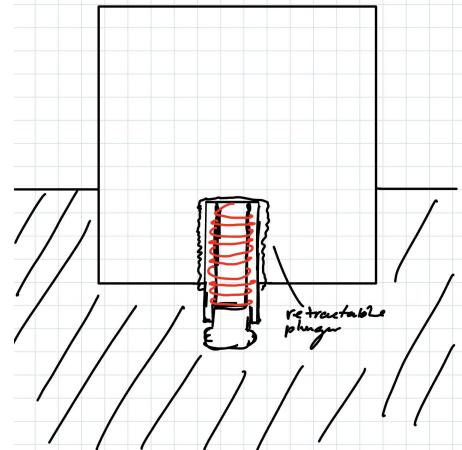
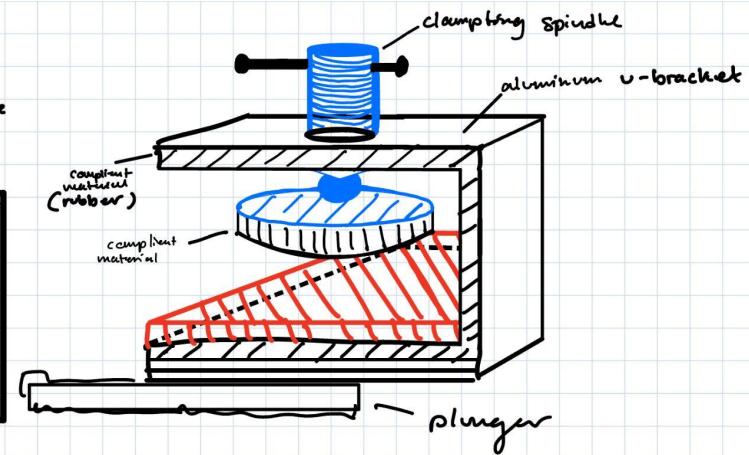
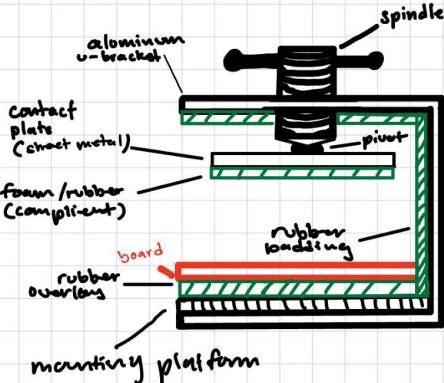
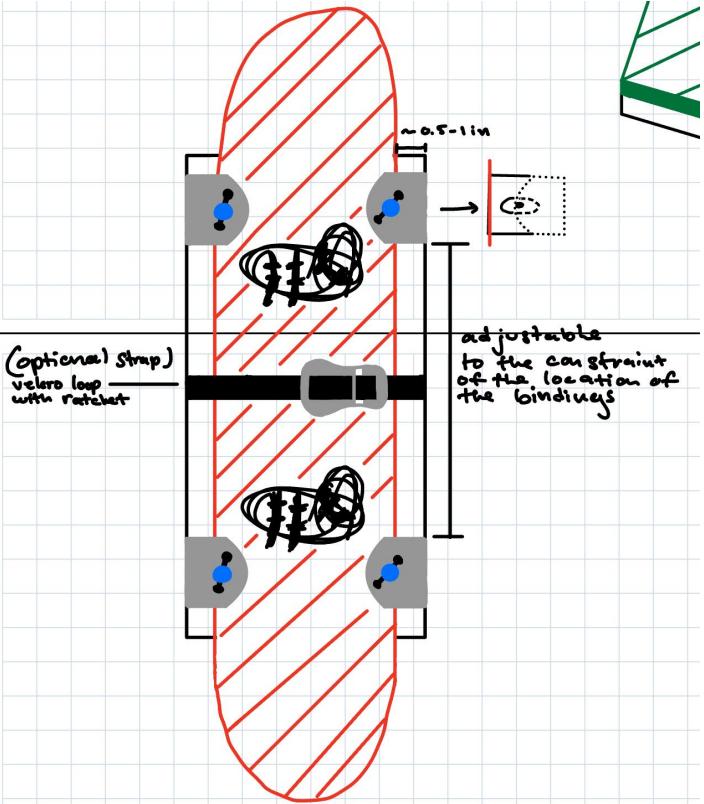
Max board angle of 43.5°

Hardstop prevents
over-rotation, springs help
return to initial position.



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Board Mount (Sachin)



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Board Mount (Sachin)

Parts List:

McMaster

- Clamping spindle (x4)
 - Toggle spindle customization
 - Cheap and fits sizing
- Steel Retractable Spring Plunger with Pull Ring, 10-32 Thread Size (x4)
- Sheet metal?

Abacus surfaces:

- Rubber matting POWERStock® Home Gym Floor Mats
- Other compliant material?

Online Metals:

- Aluminum Channel 6061-T6-Extruded Aluminum Association

Slotting and UE?

- How to handle UE
 - Effectiveness and customization of fully detachable
 - Slotting will allow for efficiency and ease but adds weight to the mounting platform

Other?

- Should I just do heavy duty straps and winch
- Adding chair that fits the constraint of the array? (leave for end)

Total: \$175 ~ \$120

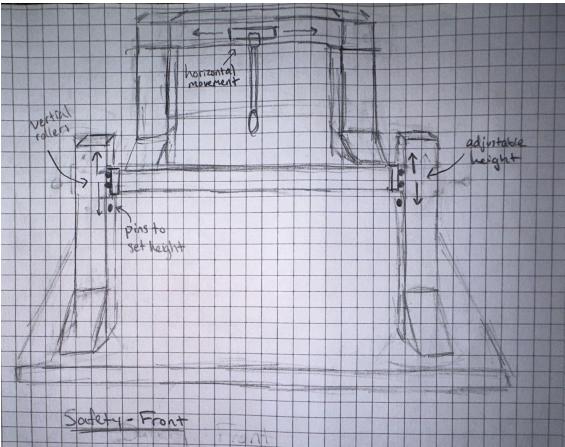
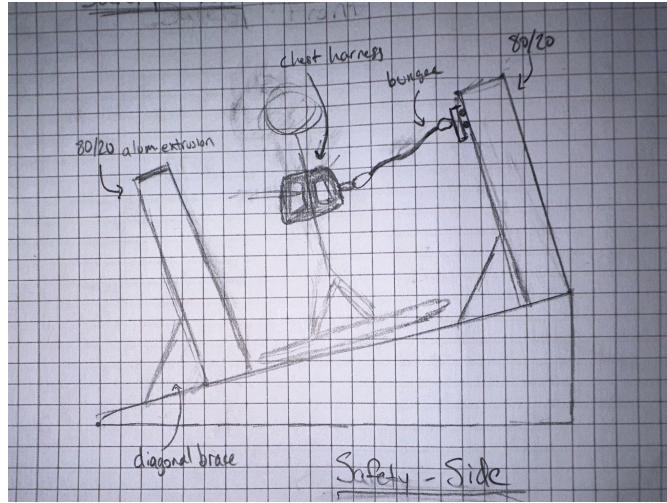
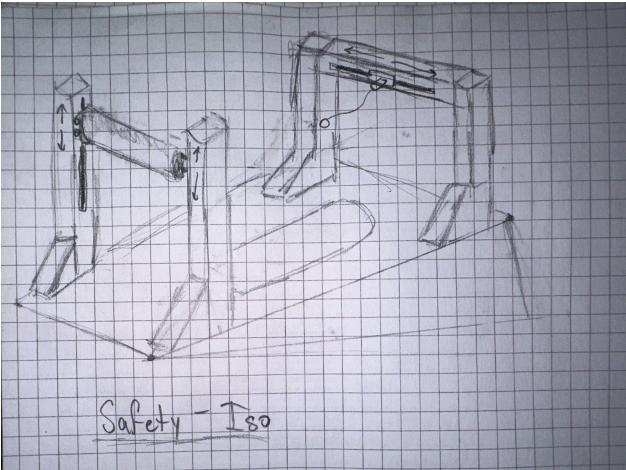
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Safety Research (Eli)



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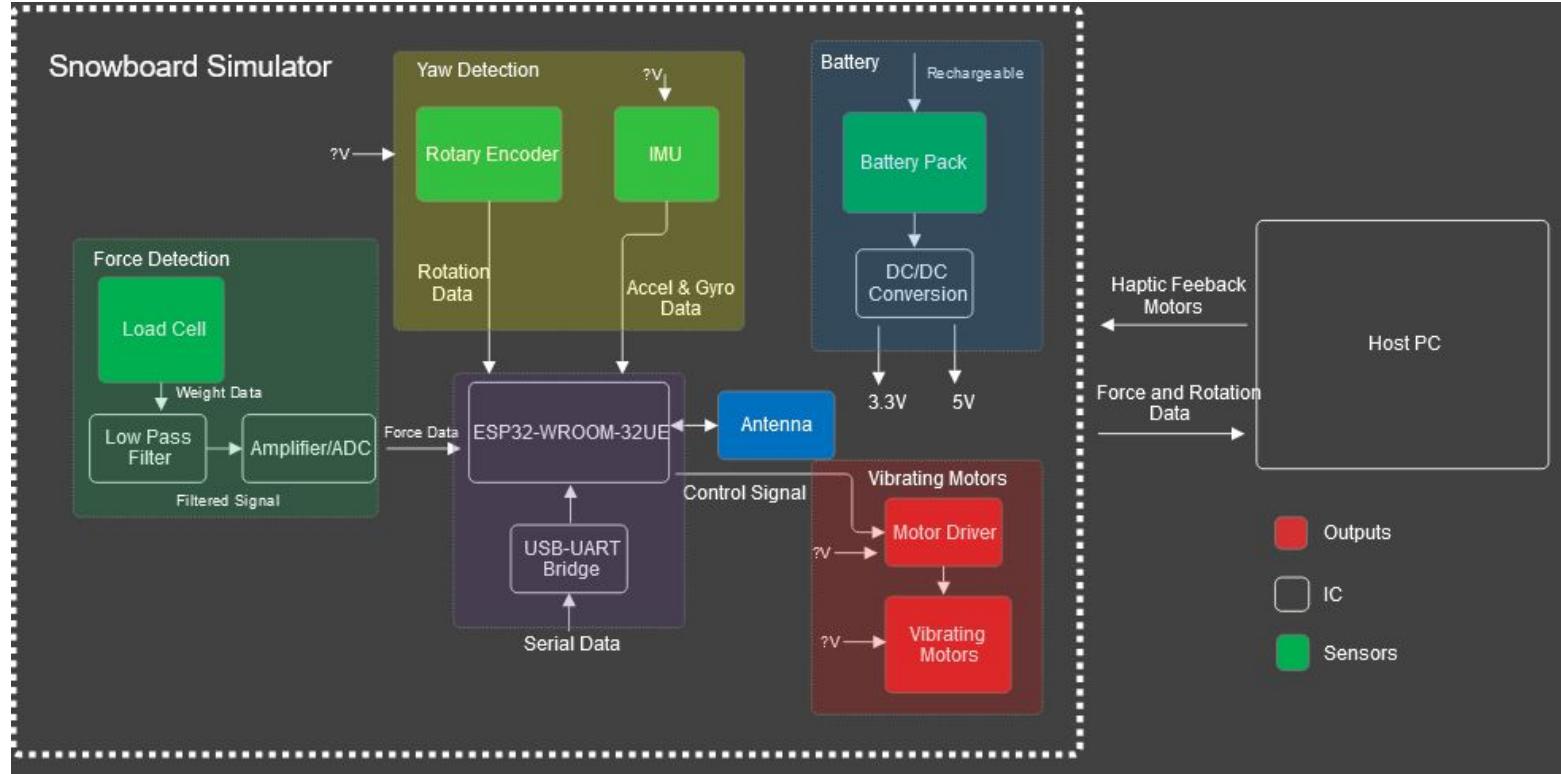
Safety Sketches (Eli)



Rough cost ~ \$100

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Full Electrical Architecture (Cat)



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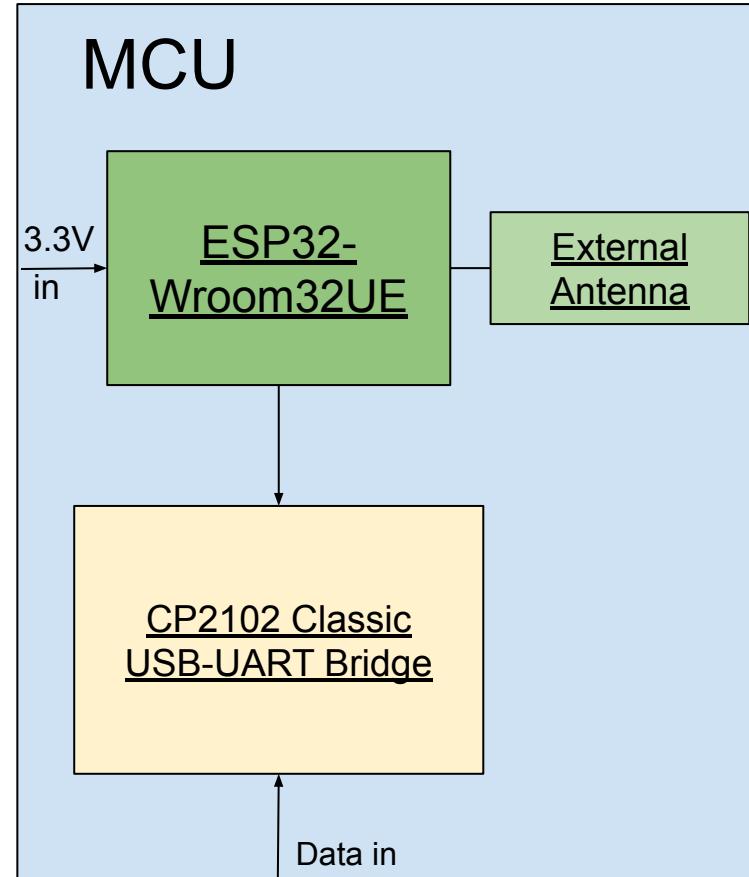
Microcontroller (Jani)

ESP32:

- 2.4GHz
- 3.3V supply
- Bluetooth/WiFi
- 536kB SRAM
- 26 GPIOs
- SD card, I2C, SPI, UART, ADC, DAC, etc

Antenna 2.4-WRT-CCC

- 2.4 GHz
- Omni directional
- Size: h= 10.0 mm
d= 19.0 mm
- Efficiency = 66%
- Range ~300 feet



USB-UART Bridge:
CP2102

- Standard
(previously used at Generate)

Data in/out:

- 4 load cells
- IMU
- Motor driver
- Rotary encoder
- More to come

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Power Management System (Jani, Ava)

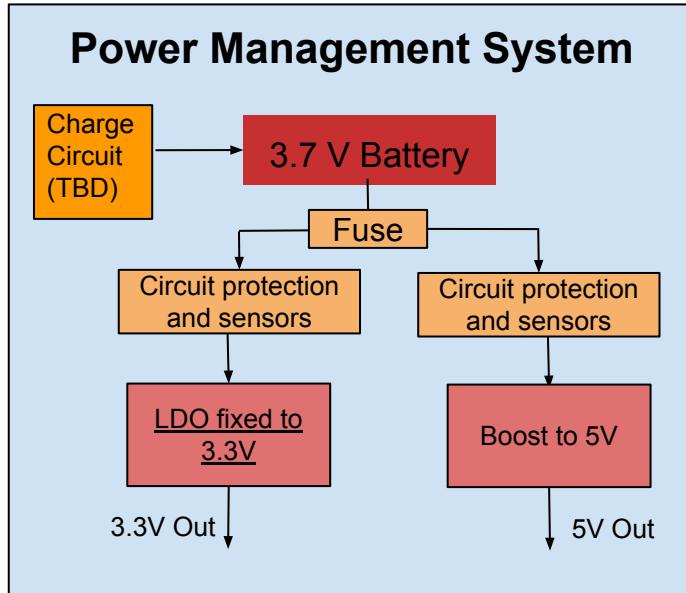
Battery requires ~8.3 Ah for a 10-hour lifespan

Options:

[1] 9.4 Ah, includes thermal data and I2C; \$67

[2] 10 Ah; \$30

[3] 12 Ah; \$55



- Use circuit breaker or reusable fuse
- Add schottky diode (right outside of battery)
- Use flyback diode in parallel to vibration motor
- Mitigate ESD (electrostatic discharge) using a two diode system, xy capacitor, or decoupling caps for when we charge using 5V usb-c connector

Rechargeable Li-ion battery:

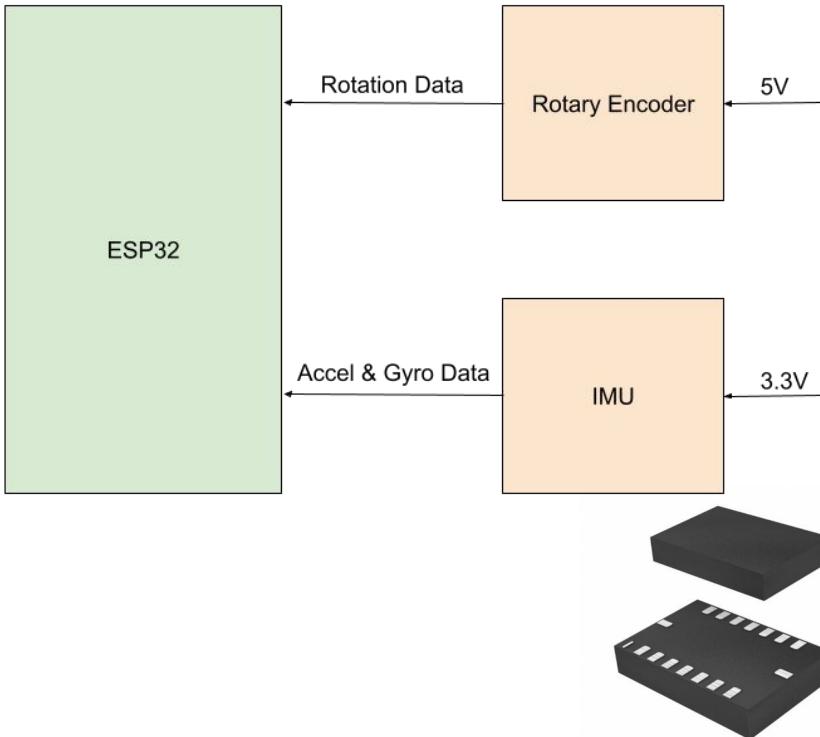
- Faster charge
- More cycles
- Higher efficiency

To be determined

- Fuses (breakers instead)
- Thermistors?
- Current Sense
- Voltage sense (battery management IC or op amp)

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Yaw (Ava)



Rotary Encoder: (primary yaw sensor)

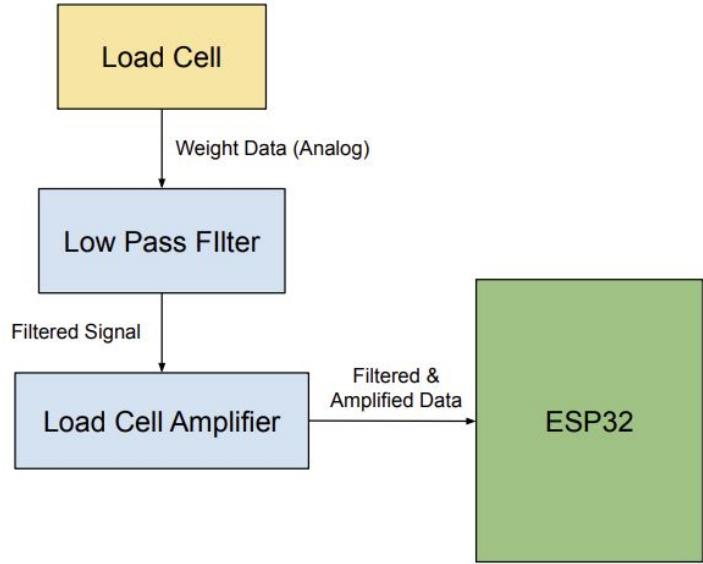
- 1024 PPR (0.352° intervals)
- Data w/CLK, SDO, CS
- Lifespan: 100,000,000 revolutions
- [EMS22A50-B28-LS6 Bourns Inc. | Sensors, Transducers | DigiKey \(\\$40\)](#)

IMU:

- 6-axis (accelerometer and gyroscope)
- Includes up to 4 interrupts
- I2C (also includes SPI)
- [BMI088 Bosch Sensortec | Sensors, Transducers | DigiKey \(\\$7\)](#)

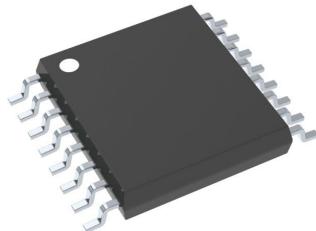
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Roll (Bryan)



Load Cells:

- 4 needed (each foot, front & back)
- 200 lb operating range per LS
- **\$30 each**
- 5 volts

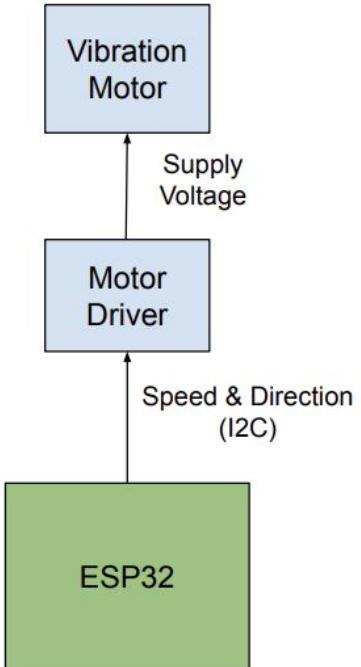


Load Cell ADC:

- 24 bit ADC
- Gain of 128
- Communication: I2C
- LPF needed
- \$9.50 each
- [ADS12204](#)

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Haptic Feedback (Bryan)

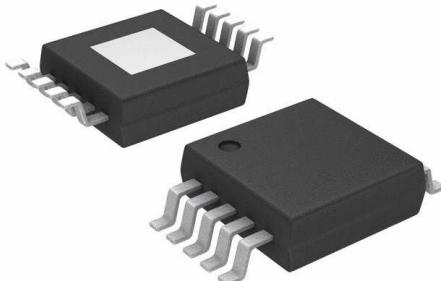


Vibrating Motor:

- 5 Volts
- Max Current: 0.65A
- Produces 8.4 G's
- Brushed DC motor w/ counterweight

Motor Driver:

- Made for batteries
- Can supply load for 2.75V ~ 6.8V
- Max Current Output: 1 A
- Comms: I2C
- [DRV8830DGQR](#)



Integration Next Steps

Electrical:

1. Order sensors (yaw, roll, etc.)
2. Finalize power requirements
3. Begin schematics

Mechanical:

1. Finalize calculations & perform FEA
2. Basic testing of some OTS parts
3. Order parts

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