

Concept Generation

CubeSat Team

General Atomics

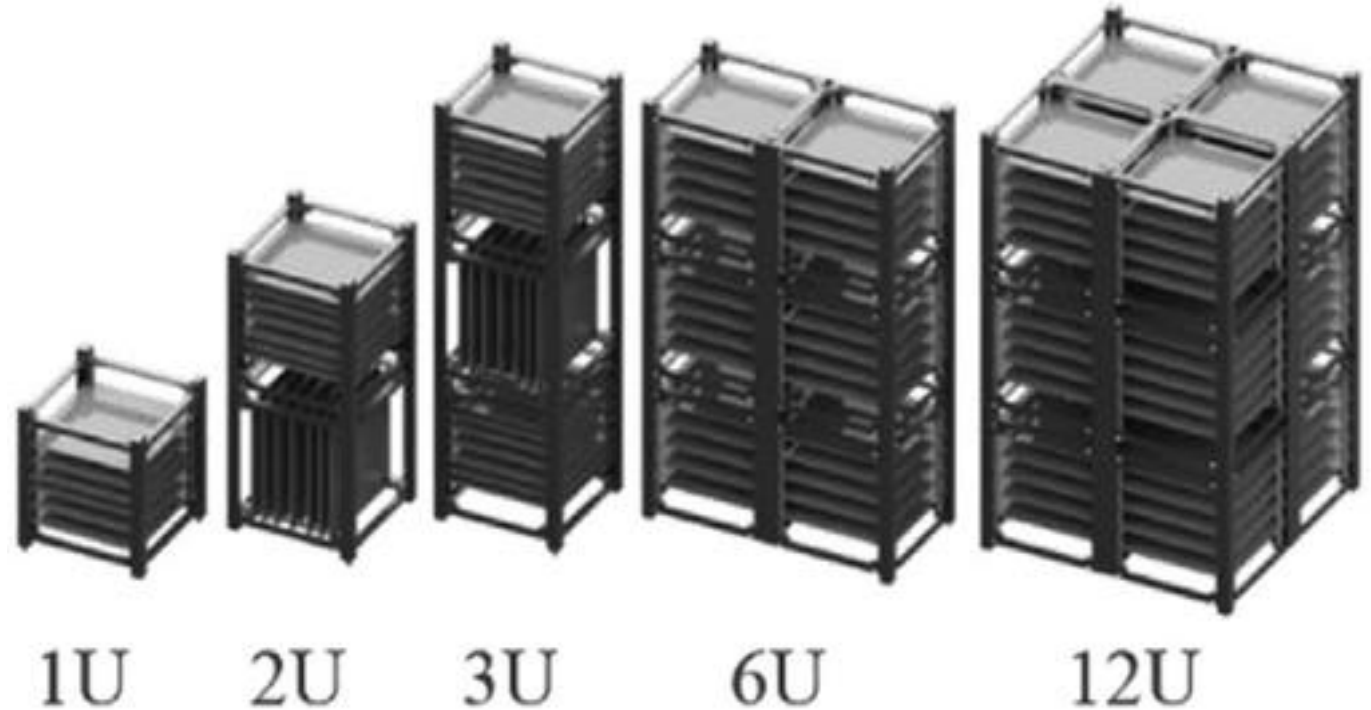
Jacob Belin, Richard Campos, Jackie Fonseca, Zack Retzlaff

Project Description

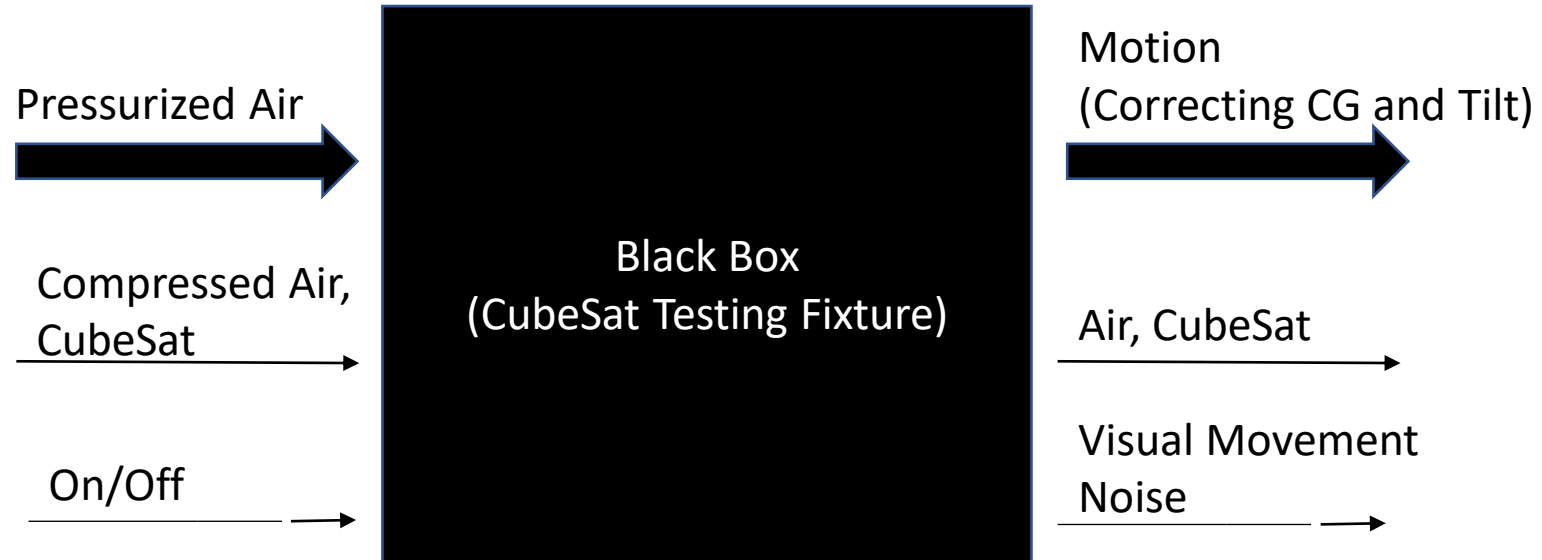
- **Goal:** To design a testing fixture that will securely attach a 12U CubeSat to an Air Bearing Stand while relocating the center of gravity to the center of rotation.

- **Requirements:**

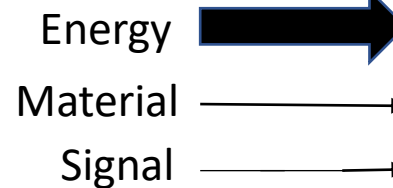
- Refocus CG
- Limit Tilt Degree
- Non-Magnetic
- Adjustable to different Payloads



Black Box Model



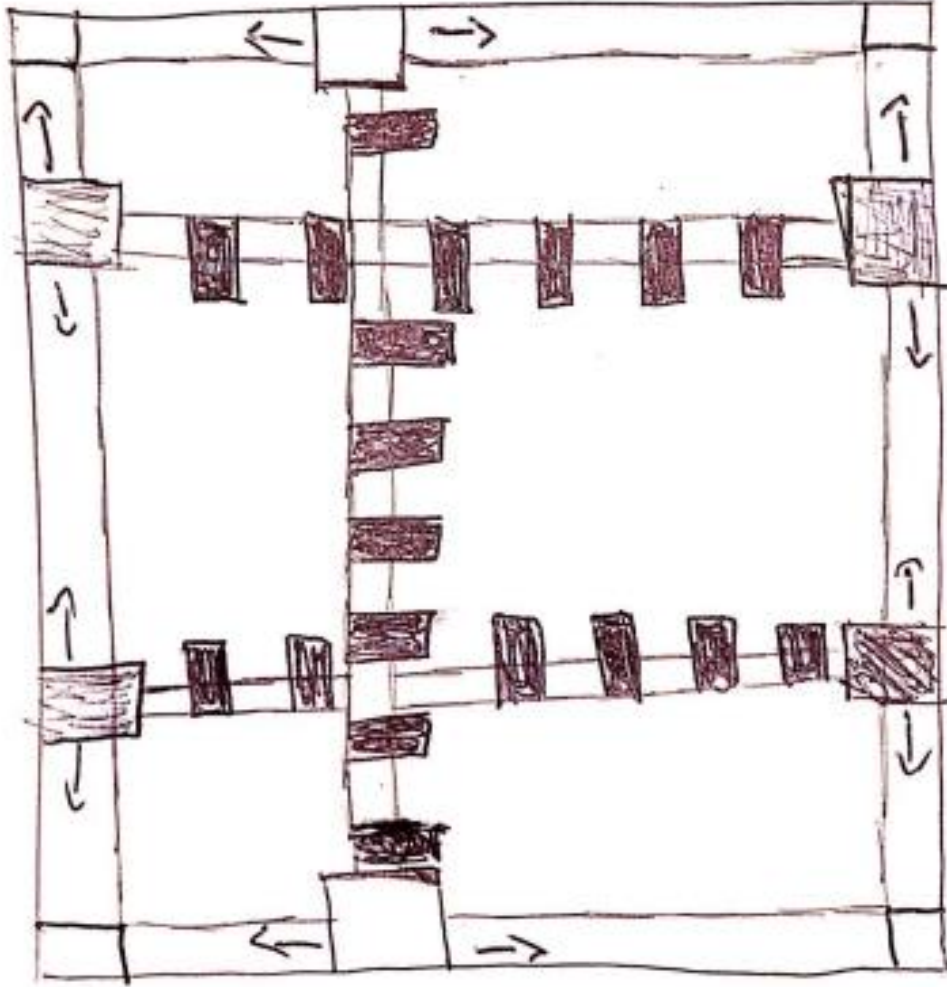
**Flow
Key**



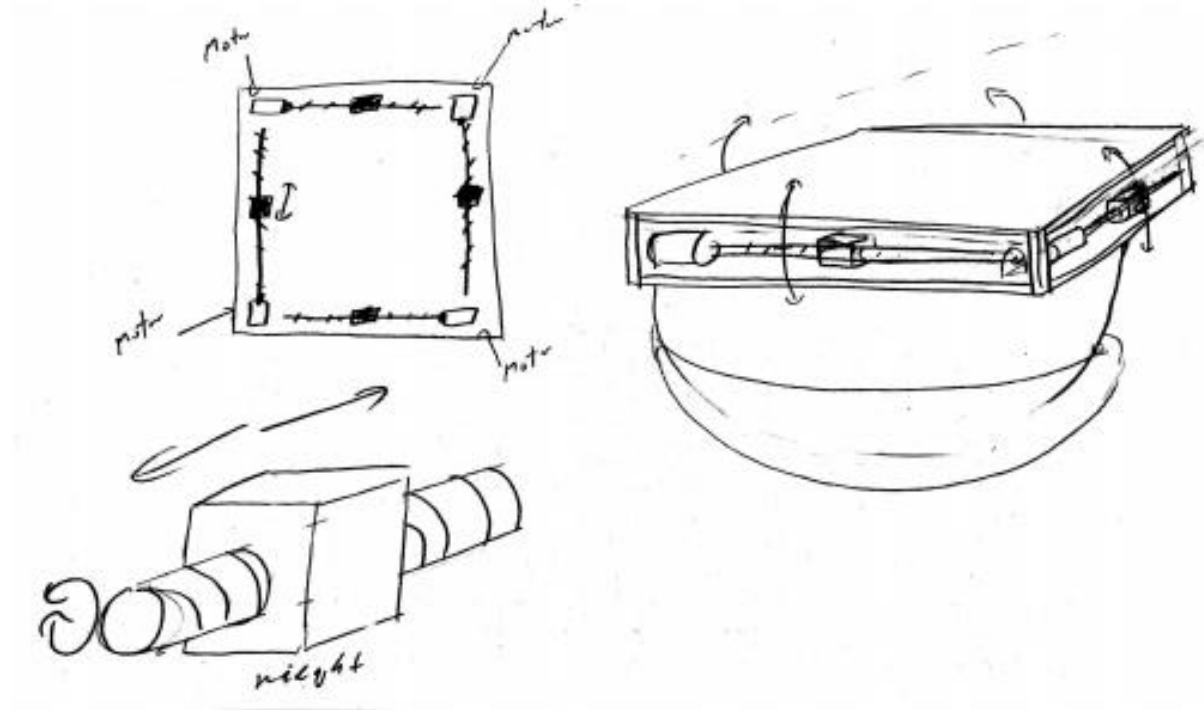
Morphological Matrix

Sub Function	1	2	3
Secure 12U	Clamps	Screws	Ratchet Straps/Elastics
Locate Center of Gravity	Force Sensors	Arduino	Gyroscope
Refocus Center of Gravity	Sliding Plate	Counter-Weights	Pneumatic Counter Wt
Attach to Air Bearing	Nuts/Bolts	Removable Cinch	Pin and Key-way
Adjustable Payloads	Compressible Plate	Spring Loaded Plate	Molded fitting for straps
Account for Umbilical	Shorter Side Panels	Short Fixture Panel	Bearing facing one way

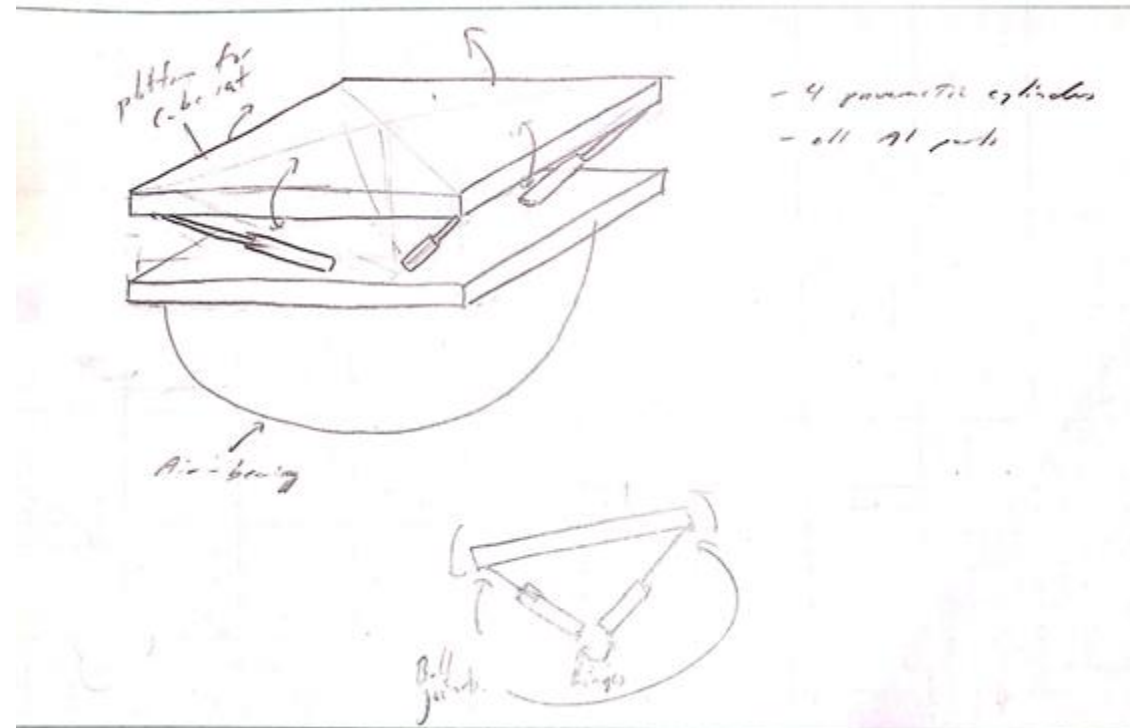
Sliding Rail w/ Clamps (Concept 1)



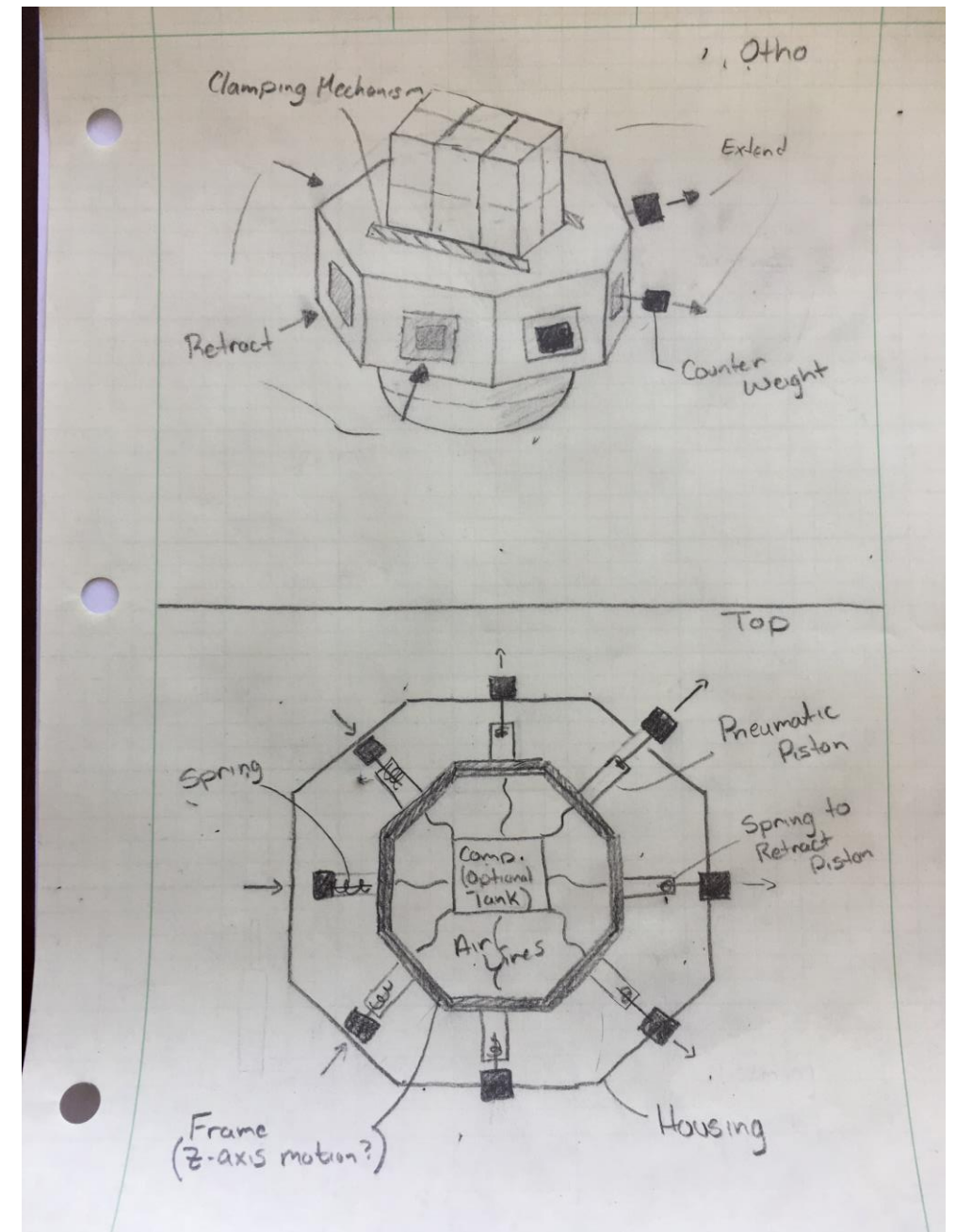
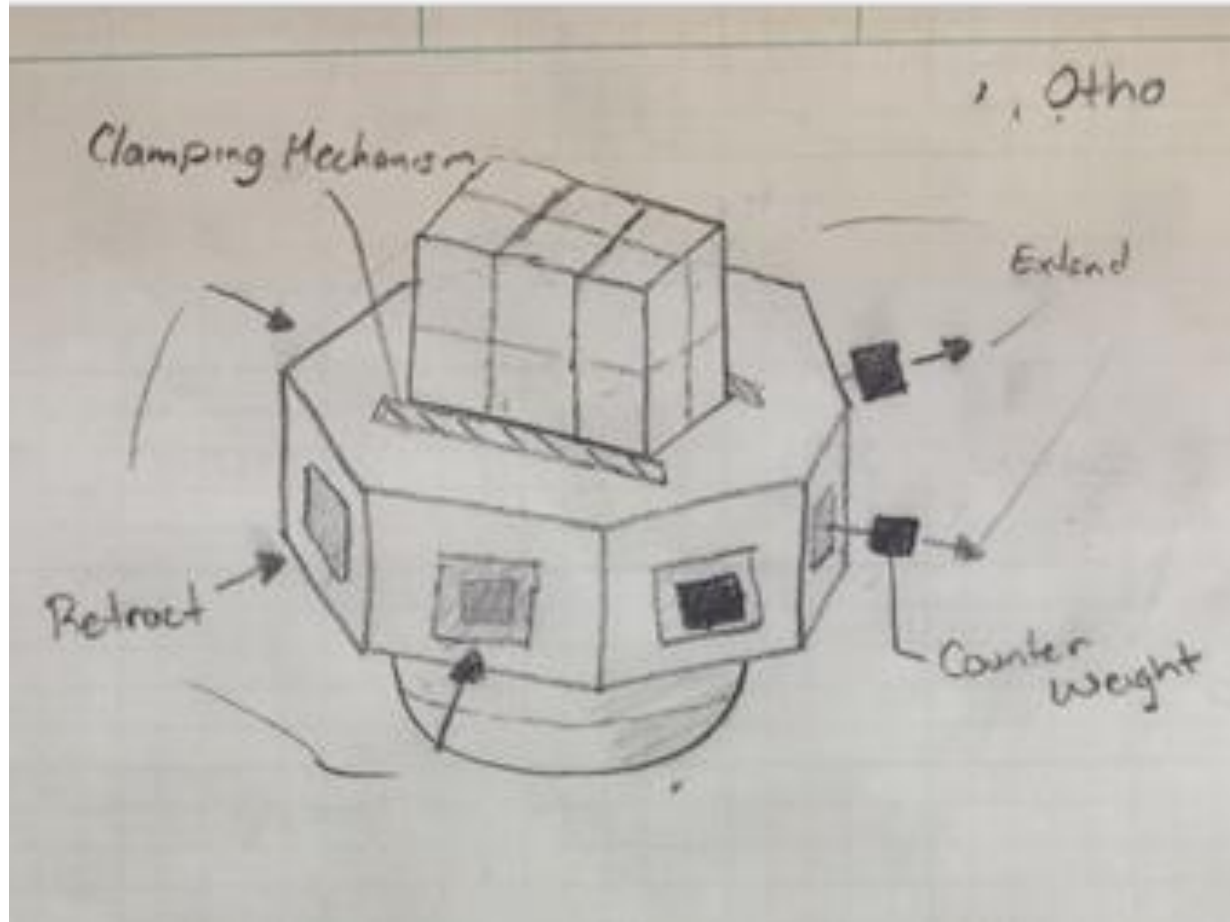
Power Screw Counter-Weight (Concept 2)



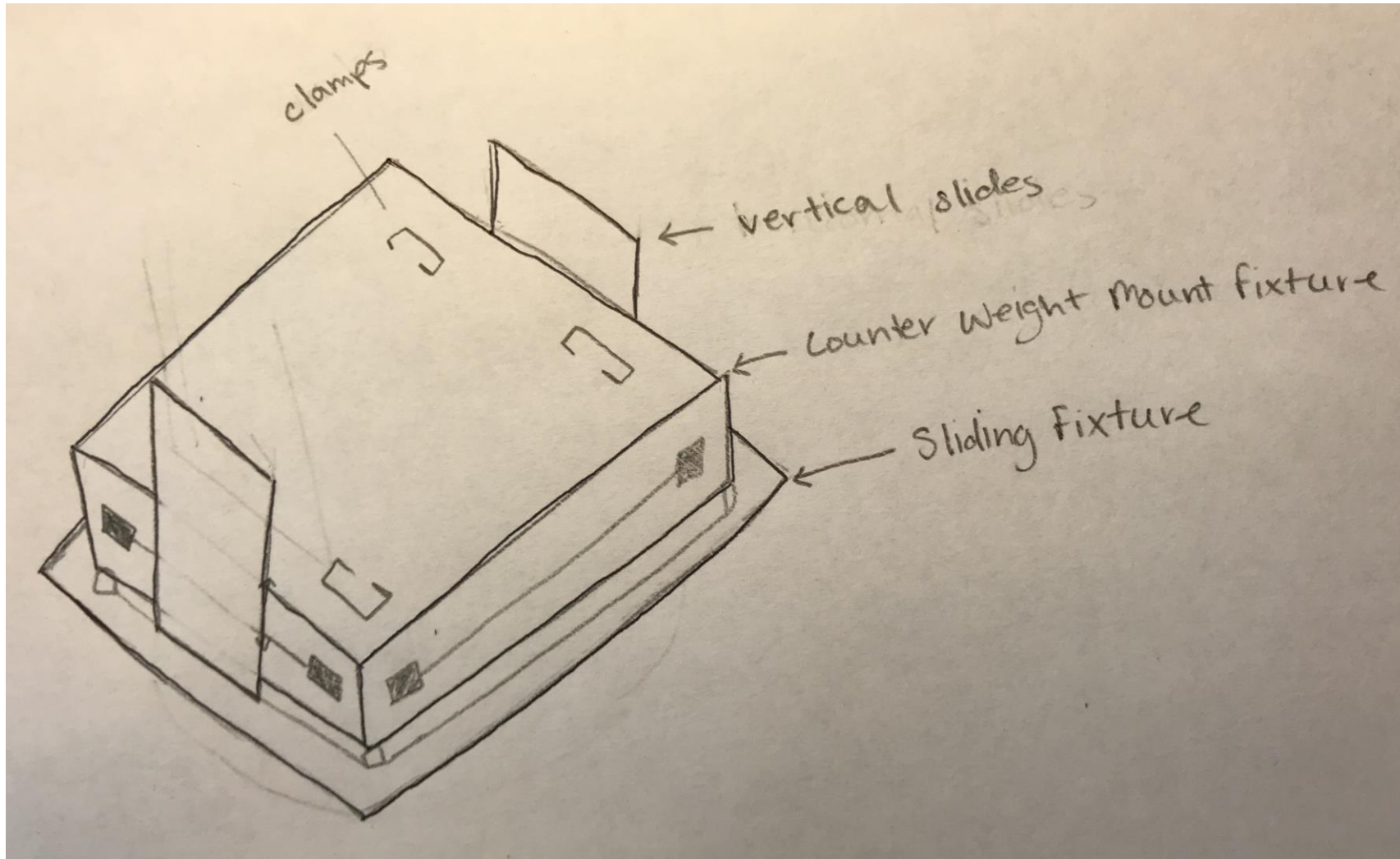
Pneumatic Gimble (Concept 3)



Pneumatic Rod Counter-Weights (Concept 4)



Combination (Concept 5)

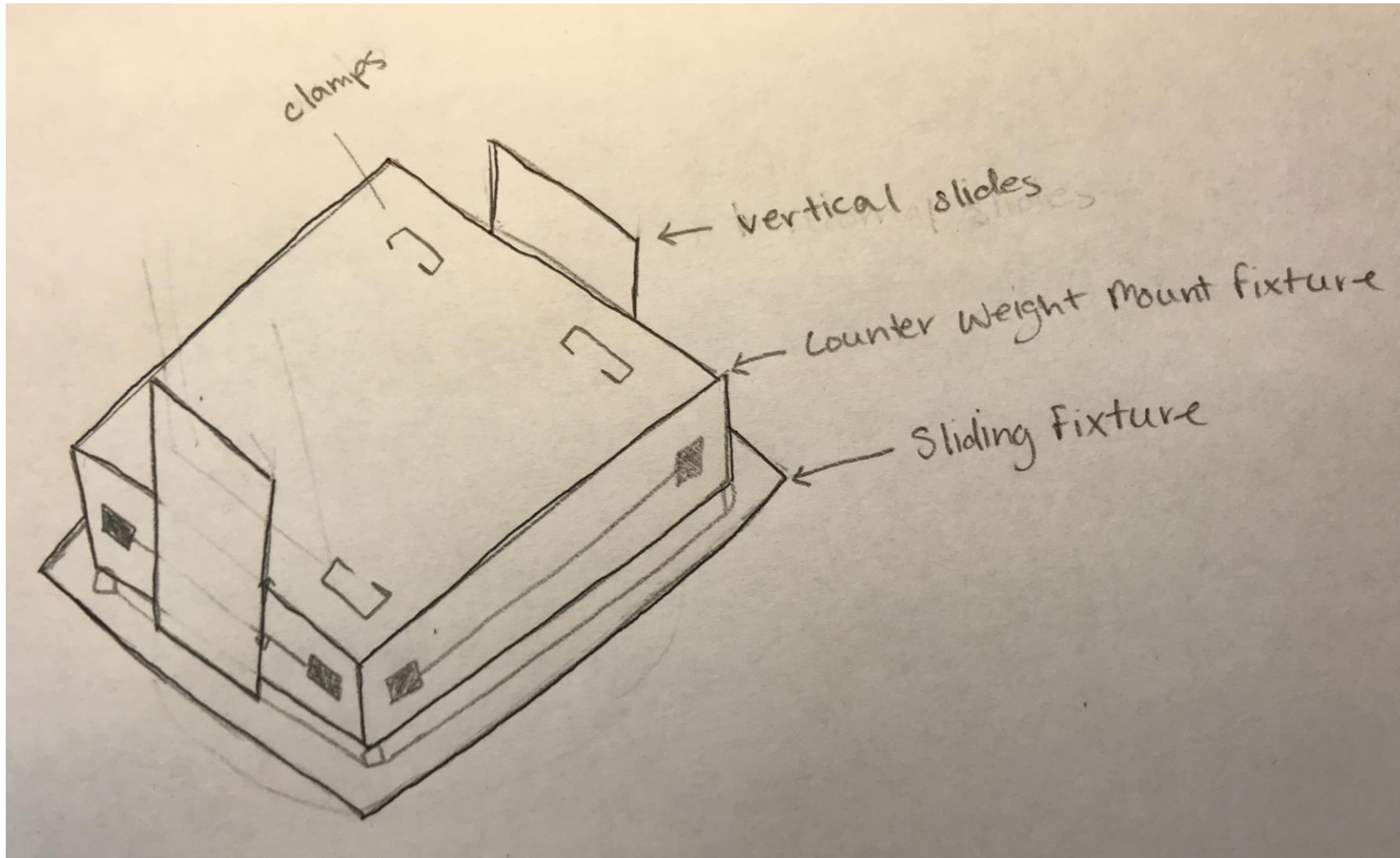


Concept Evaluation

Decision Matrix - Score designs with engineering requirements

Criteria (ER)	Weight (%)	Design 1		Design 2		Design 3		Design 4		Design 5	
		Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Accept 24 kg	0.073	5	0.365	5	0.365	5	0.365	5	0.365	5	0.365
Movability	0.077	5	0.385	1	0.077	1	0.077	1	0.077	5	0.385
Limit Tilt	0.071	4	0.284	4	0.284	3	0.213	4	0.284	5	0.355
360 Deg rotation	0.146	5	0.73	5	0.73	5	0.73	5	0.73	5	0.73
Weight Less	0.071	4	0.284	3	0.213	4	0.284	3	0.213	2	0.142
Size limit	0.077	4	0.308	4	0.308	4	0.308	4	0.308	4	0.308
Min. Material Strength	0.132	3	0.396	4	0.528	3	0.396	4	0.528	4	0.528
Min. Lifetime Cycle	0.123	3	0.369	3	0.369	3	0.369	3	0.369	3	0.369
CG Placement	0.23	4	0.92	4	0.92	4	0.92	4	0.92	4	0.92
Total	1		4.041		3.794		3.662		3.794		4.102

Potential Final Design



Bill of Materials (prototype)

- Pneumatic cylinders
- Pneumatic tubing
- Small air compressor
- Brass fittings
- Air storage tank
- Wood
- Fasteners (plastic and metal)
- CO2 canisters (potential)
- Elastics
- Arduino Supplies
- Accelerometers
- Springs
- Lubricants for air cylinders (optional)
- Aluminum sheet
- 3D printing material
- Brackets
- 12V Battery
- Budget – TBD
- Tentative Budget –
 - Prototype - \$500
 - Final Design - \$700
 - Machining - \$200
 - Contingency - \$100

Bill of Materials (prototype)

	Quantity	Price	Cost	Source
Pneumatic Cylinders	4	\$ 65.95	\$ 263.80	https://www
Tubing	3'	\$ 12.98	\$ 12.98	https://www
Compressor	1	\$ -	0	
Brass Fittings	10	\$ 4.00	\$ 40.00	https://www
Storage Tank	1	\$ 17.96	\$ 17.96	https://www
Wood 1"x4"	8'	\$ 22.45	\$ 22.45	https://www
Fasteners (Plastic)	1	\$ 6.00	\$ 6.00	https://www
Fasteners (Metal)	6	\$ 0.46	\$ 2.76	https://www
Elastics	3	\$12.65	\$37.95	https://www
Accelerometers	4	\$ 7.95	\$ 31.80	https://www
Springs	1	\$ 6.95	\$ 6.95	https://www
Lubricant	1	\$ 4.95	\$ 4.95	https://www
AI (6"x18")	5	\$ 4.02	\$ 20.10	https://www
3D Material	4	\$ 19.85	\$ 79.40	https://www
12V Batter	1	\$ 6.20	\$ 6.20	https://www
		Total	\$553.30	

What's Next

- Finalizing design with GA
- Prototyping
- CAD Model of final design concept
- Testing

Questions?