



*Hamza Arshad*

*PORTFOLIO*

*The purpose of my portfolio* is to demonstrate my engineering experience and competency to potential employers by highlighting these experiences and connecting them to engineering-related skills, specifically to skills needed for design engineers.

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*The intended audience of my portfolio* are mechanical engineering employers hiring design engineers, specifically for the aerospace industry.

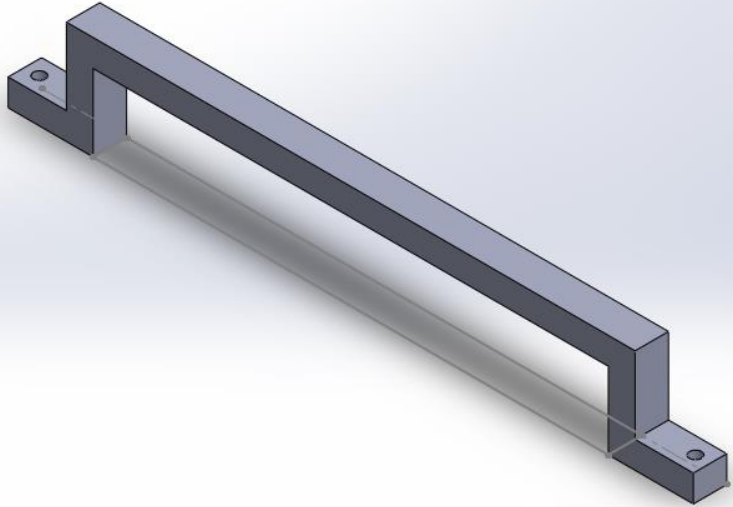
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# INTRODUCTION

- See myself in a “design engineering” role
    - Considers both theory and application
    - Personally, I value a career of applying theoretical knowledge into new, improved products
  - Specifically, interested in aerospace engineering and designing new mechanical structures for space systems
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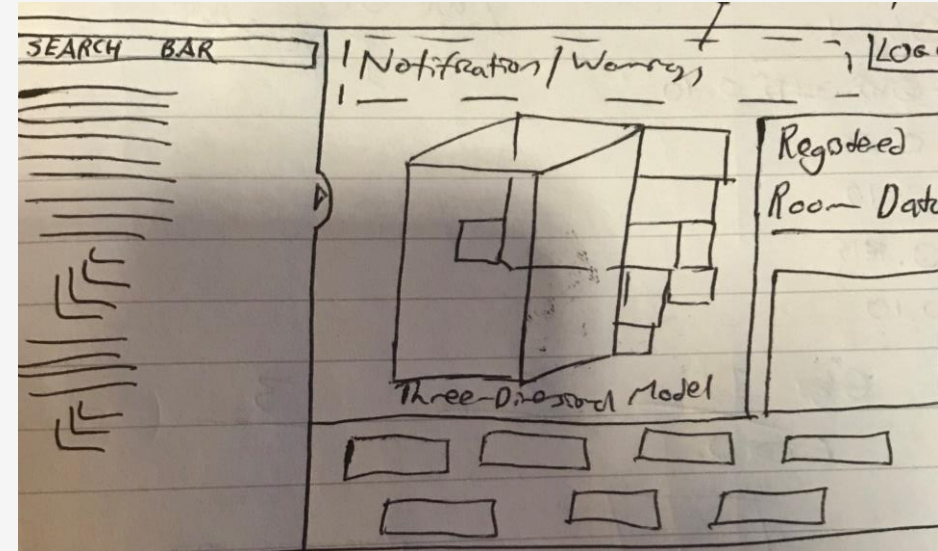
I'll highlight three skills that showcase my competency for aerospace engineering:



USE OF ENGINEERING TOOLS



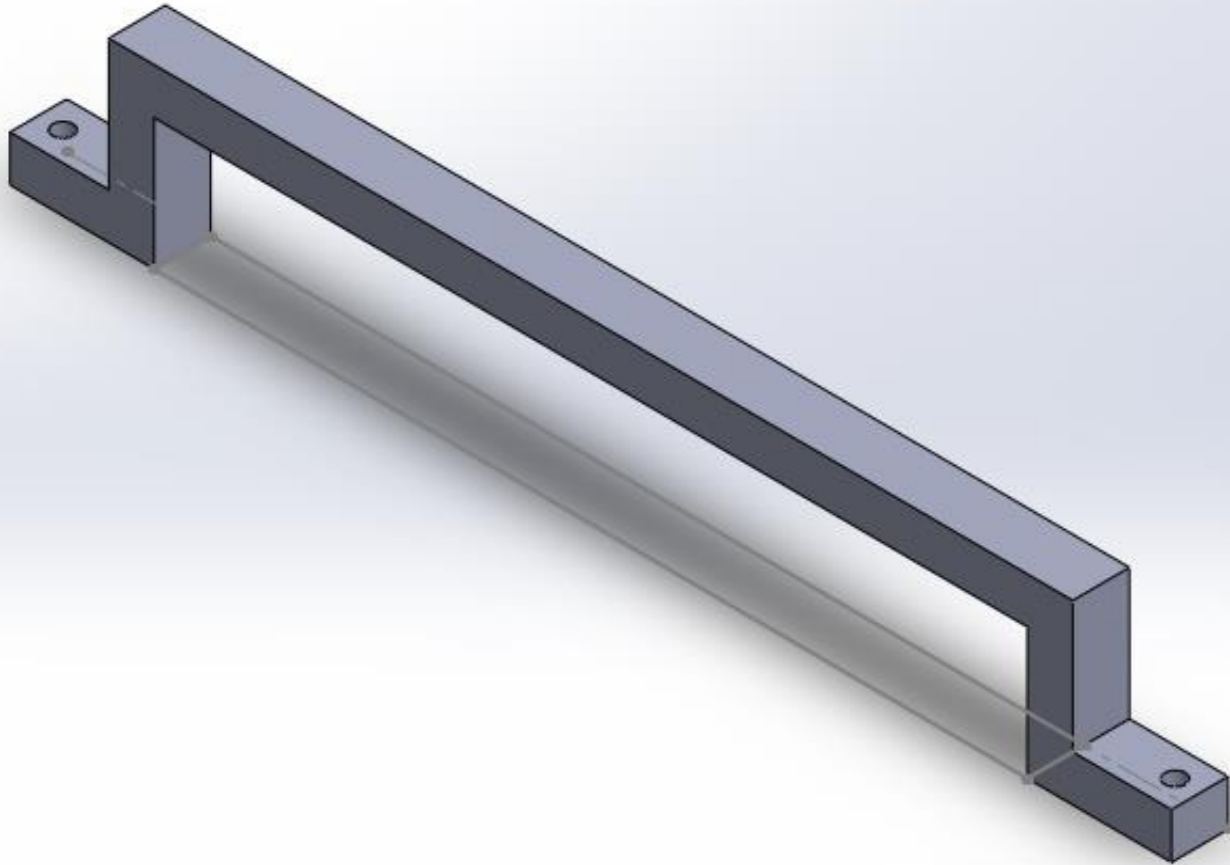
TEAMWORK



DESIGN

# USE OF ENGINEERING TOOLS

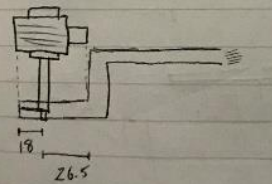
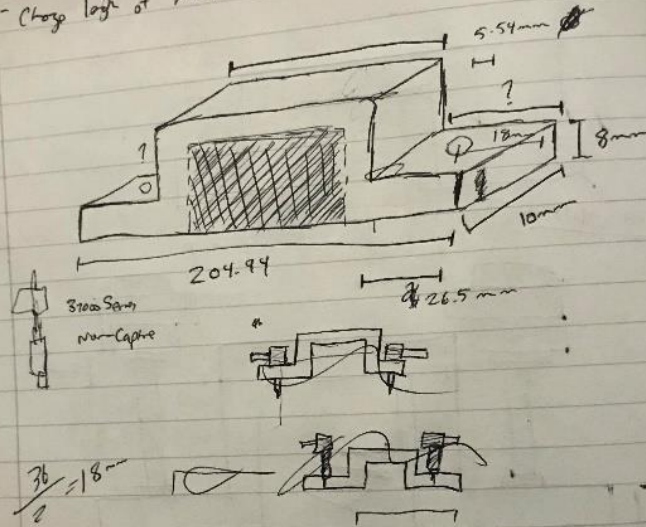
- Use of 'SolidWorks' to CAD various components of a satellite for the 'University Of Toronto Aerospace Team' (UTAT), including:
    - New actuation board for popping microfluidic blisters
    - 2700 batteries
  - Use of 'SolidWorks' to CAD the gearbox of a mechanical rover for the MIE243 design project
  - Used the 'CES' software to benchmark the prices of custom made axles on the mechanical rover for the MIE243 design project
-



CAD OF A NEW ACTUATION PLATFORM

- Designed and dimensionally constrained a new, potential actuation board for popping microfluidic blisters in the satellite
- Needed to pop blisters, in order to allow the fluid inside to flow towards another area of the satellite to start a microbiology experiment
- Showcases the use of CAD software, a vital engineering tool

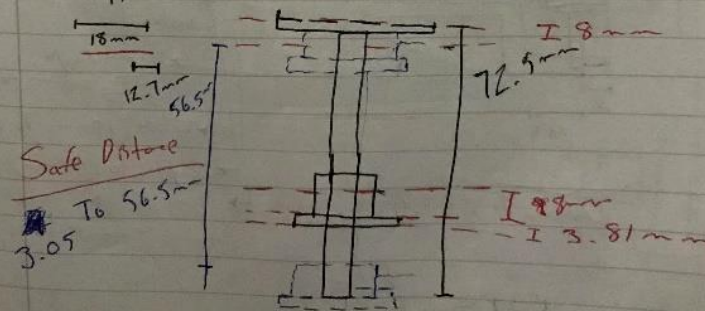
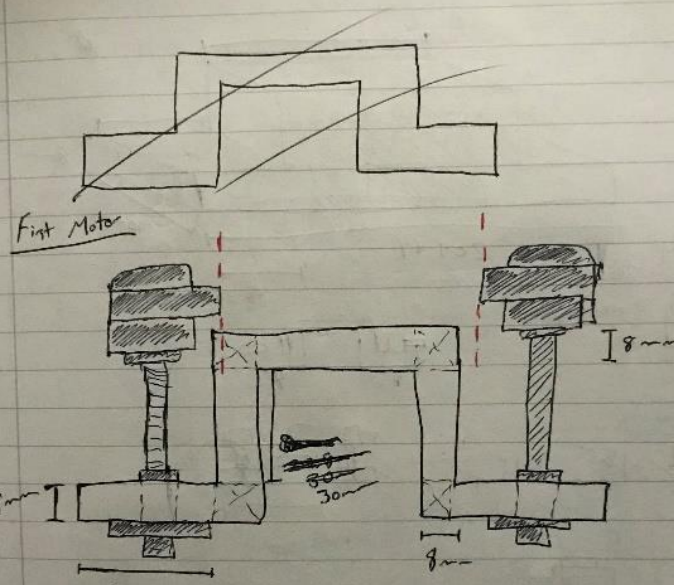
Horizontal  
New Design  
- 10mm from Bottom Actuator To "Grey" - 18mm  
- Change Legit  
- Change length of intrusion to start



Centered To 28.67 mm



Constraints  
→ 10mm Length  
→ 10mm → Rest Position  
→ Width (10mm To 25.5 mm)  
→ Length (204.94 mm)  
→ Move to start a little more to start the work



- Used previous and current satellite CADs to determine the right dimensions
- Showcases a critical use of available engineering tools

USED PREVIOUS CADs TO CONSTRAIN THE DIMENSIONS



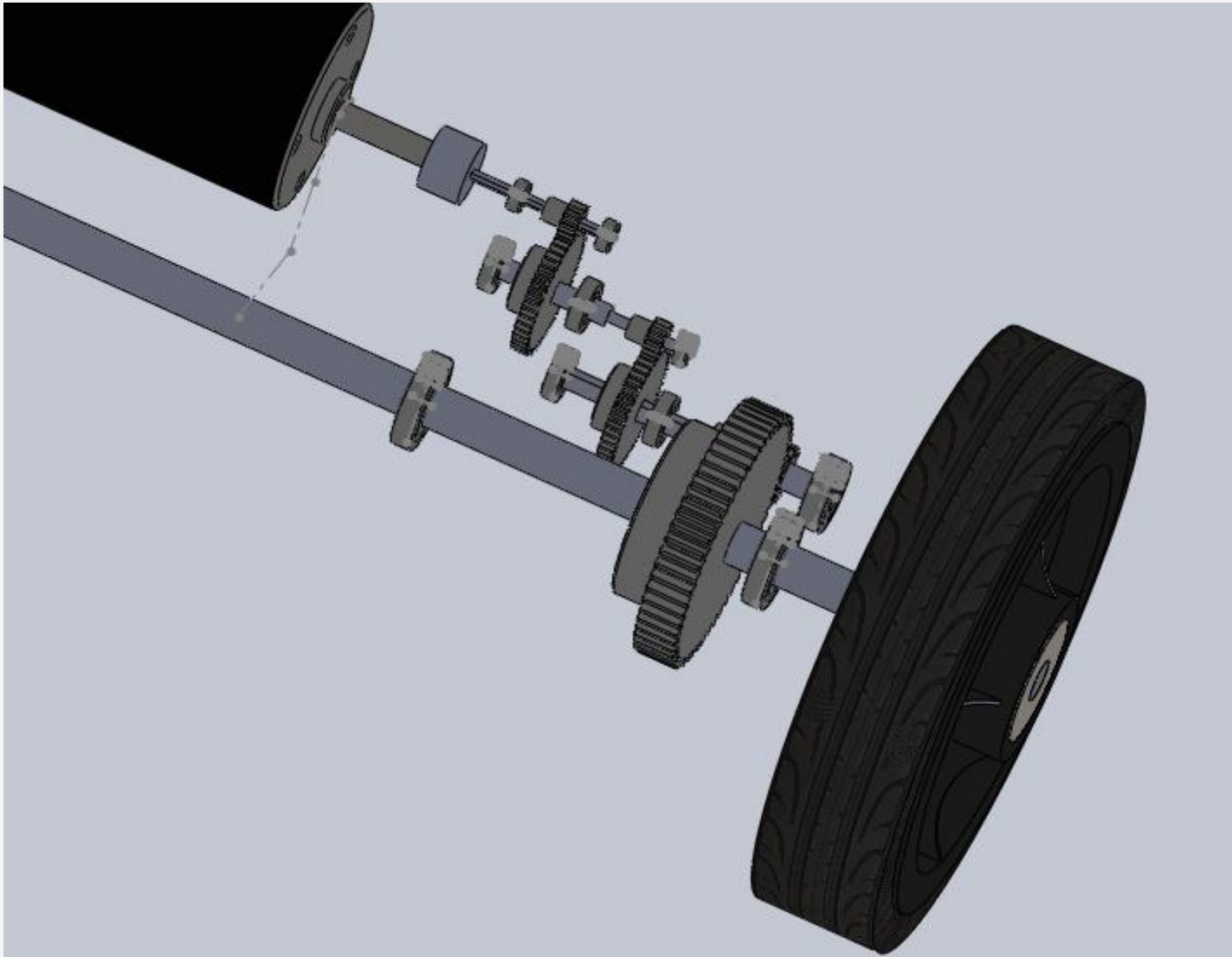


2700 BATTERY CADs; COMPLETED FOR THERMAL TESTING



# USE OF ENGINEERING TOOLS

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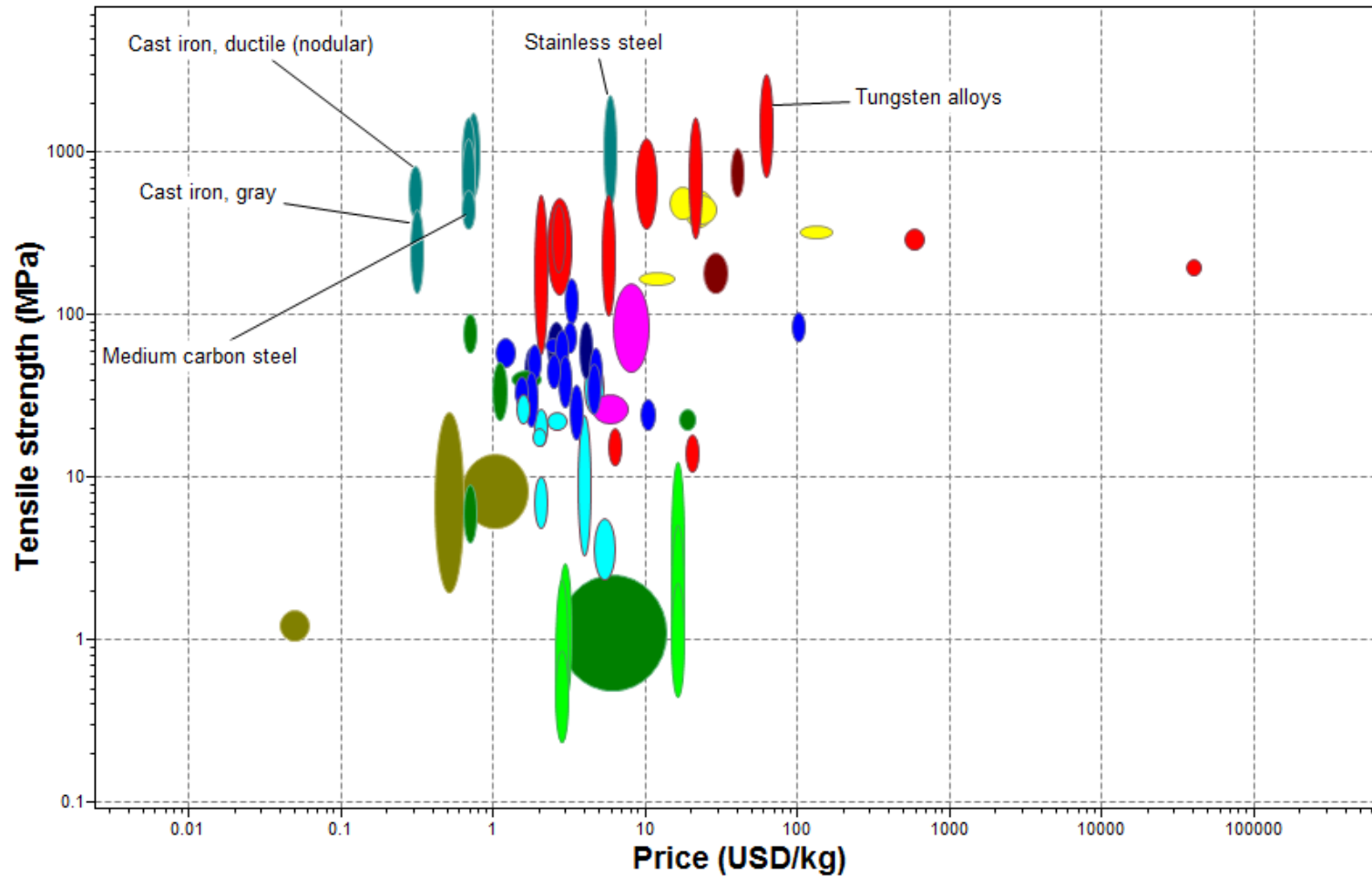


CAD OF THE BACK-POWER MECHANISM FOR THE ROVER

- The rover requires a large torque at its back-wheels to move, so it was necessary to create a gearbox for increasing torque
- Used 'SolidWorks' to create gears and mates to simulate the torque conversion
- Showcases my knowledge of mechanical and basic mates in the software

# USE OF ENGINEERING TOOLS

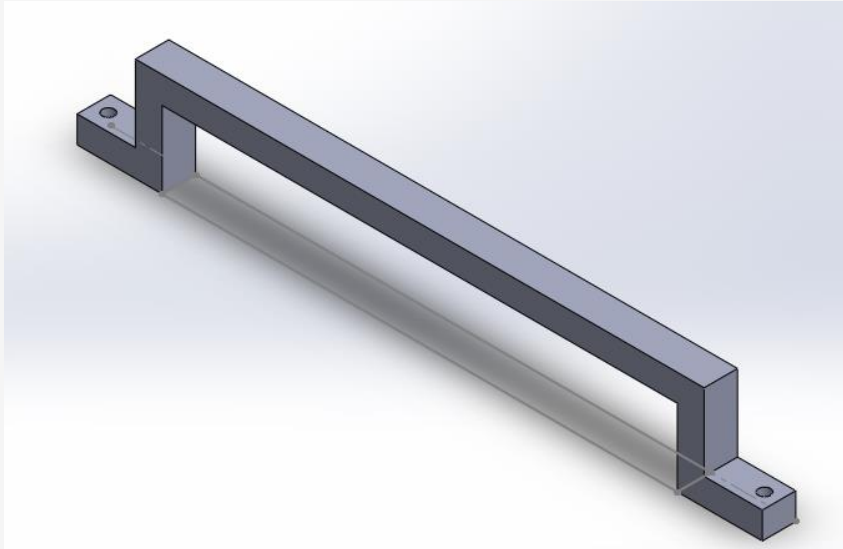
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USED THE 'CES' SOFTWARE TO DETERMINE IDEAL MATERIALS

- Used the 'CES' software to find a material for the axles of the rover, with low price and high strength as factors
- Determined "cast iron" to be the ideal choice
- Showcases both a use of an engineering material selection software and engineering design principles by prioritizing certain material factors

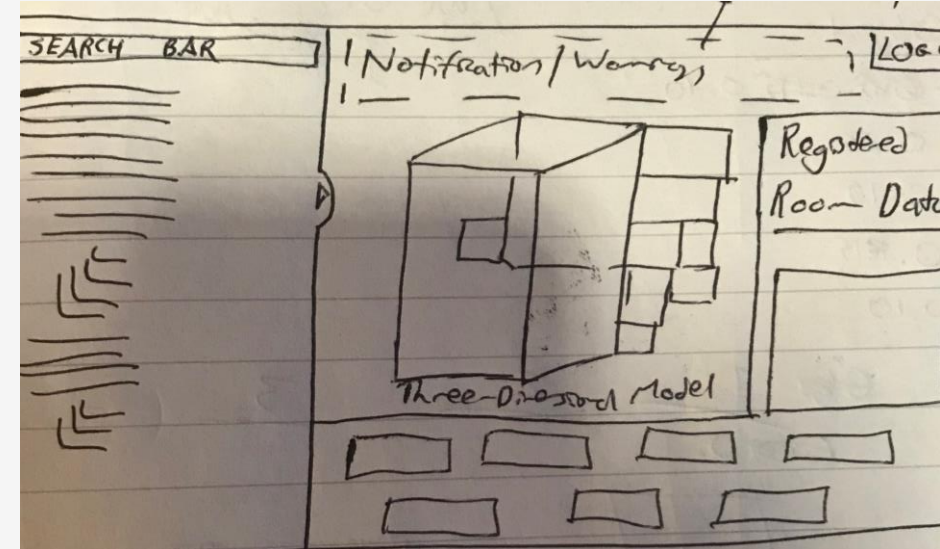
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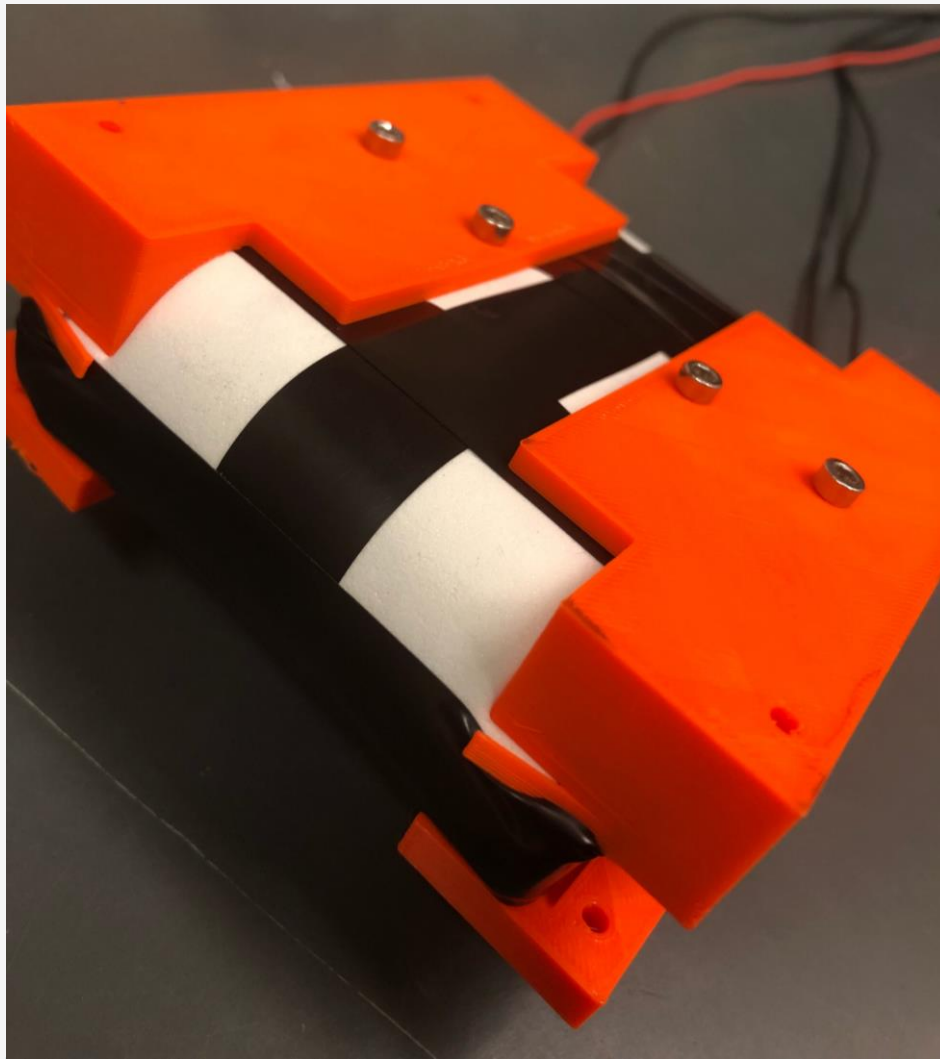
TEAMWORK



DESIGN

# TEAMWORK

- UTAT
    - Have to work with a multi-disciplinary team, consisting of people with different backgrounds, such as biology and computer science
    - Example: 2700 Batteries – Designed for a thermal team to do insulation testing on them
    - Mainly, I work closely with the mechanical/structures team
  - Student Council
    - Worked with a team of six to implement events and assemblies at Jarvis Collegiate Institute
    - Helped to bring on “grade representatives”
-



THERMAL INSULATION TESTING WAS DONE ON  
THE 2700 BATTERIES

- In order for the 2700 batteries used by 'UTAT' to function in space, they have to be insulated; hence, the need for insulation testing
- Showcases the multi-disciplinary work at 'UTAT' and how I worked with two different teams on a single project



# SUBSYSTEM OVERVIEW



## < STRUCTURES

Designs mass efficient mechanical features throughout the satellite. Includes primary, secondary, and payload structures



## PAYLOAD

Unique biological payload aimed to assess the risk of infections during long-term space missions. Includes biology, microfluidics, and instrumentation



## THERMAL

Designs the controls that maintain operational temperatures for all spacecraft units and models the orbital environment



## COMMUNICATIONS

Responsible for data TX/RX. Includes configuring radios and designing antennas for the spacecraft and ground station



## POWER

Designs the circuitry that distributes solar generated power to all on-board systems



## COMMAND & DATA >

The Brain of the satellite. Handles and stores data, controls the exchange of information, and maintains system health

SIX OF SEVEN TEAMS OF UTAT'S SPACE SYSTEMS DIVISION

- Taken from <https://www.utat.ca/space-systems/>
- Showcases the number of teams at the “space systems” division of UTAT, where I work

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FRIDAY, OCTOBER 30th in the UPPER GYM

JARVIS SAC PRESENTS...

# HALLOWEEN DANCE

BRING YOUR  
SAC CARD

WEAR COSTUME

TICKETS: \$2.50  
SNACKS: \$0.25+  
GLOW STICKS: \$0.25  
FREE WATER & CANDY

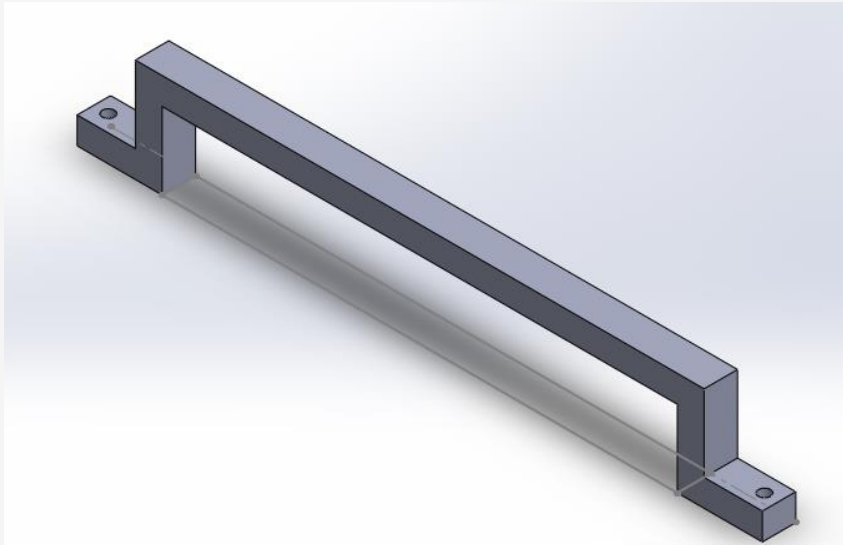


2:30 PM-5:00

POSTER FOR THE "HALLOWEEN DANCE"

- One of the events planned by the student council that I was a part of; My contributions consisted of making the tickets and a "masters list" of ticket purchasers
- Important, as it shows how I've worked with a non-technical team, developing strong communication skills with people not from engineering; Shows that I can work with a wide range of people

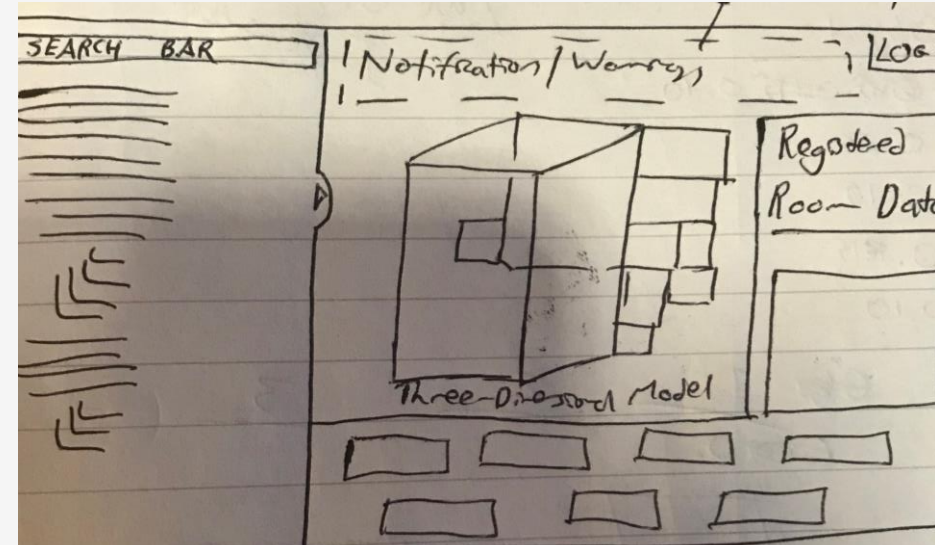
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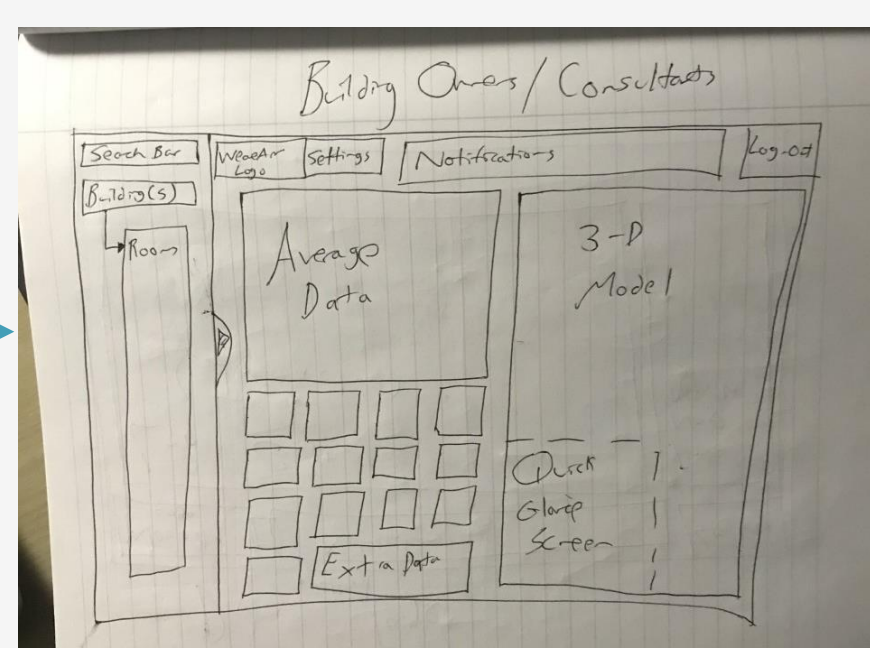
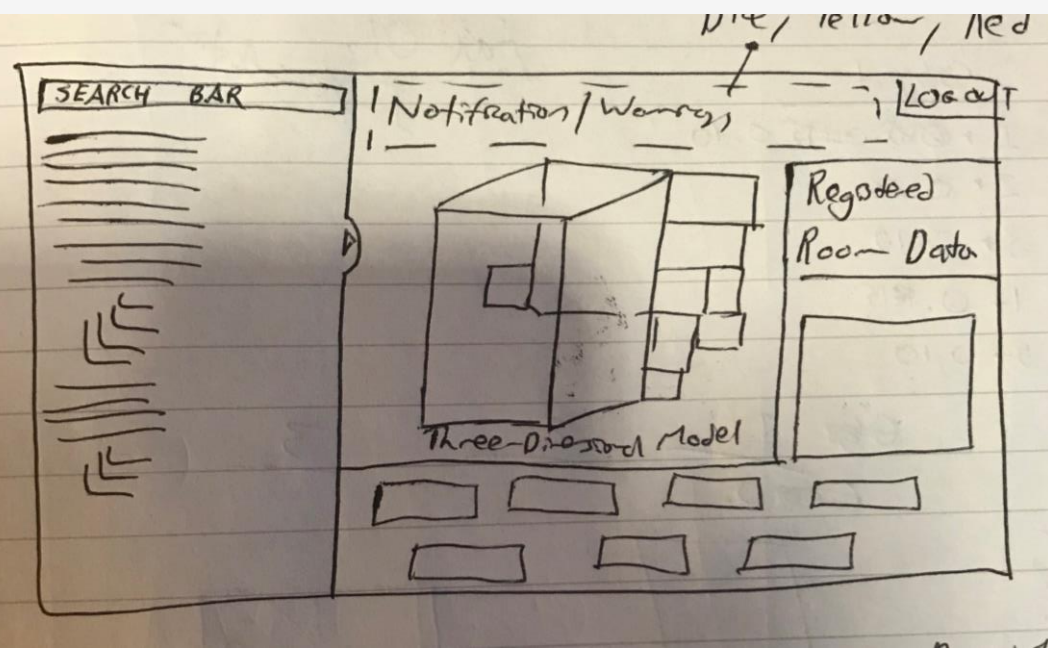


DESIGN



# DESIGN

- WeavAir
    - Part of 'Engineering Strategies And Practice II' design course
    - Created a solution space of up to fifty solutions for a new 'HVAC' interface system and went through major design iterations
  - UTAT
    - Solve an actuation engineering problem
    - Came up with a solution space to define this design problem
  - MIE243 Design Project
    - Used a weighted decision matrix and graphical matrix to determine the "best" engineering solution to a mechanical rover design problem
-



- In order to prioritize my team's objectives of "quick access to data" and "simple to use and navigate", three major design iterations were performed on one design
- Showcases the use of engineering criteria of functions, objectives, and constraints to define and improve potential designs

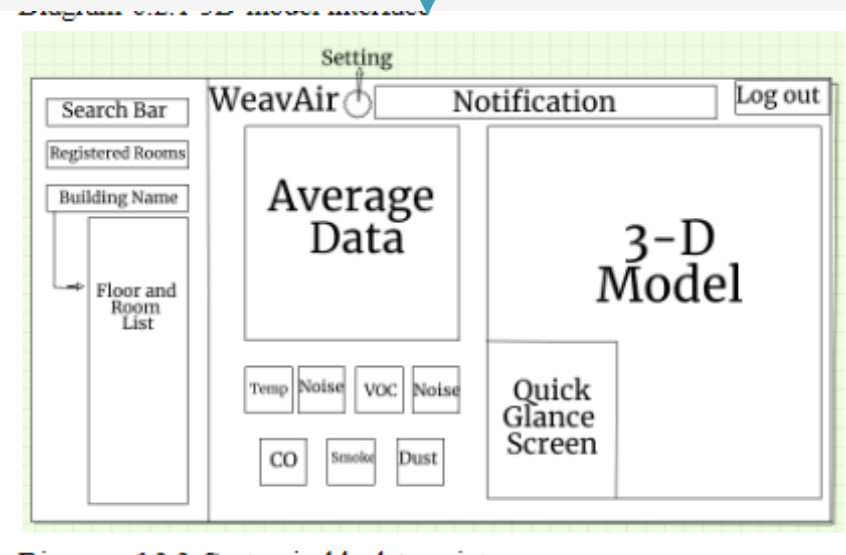
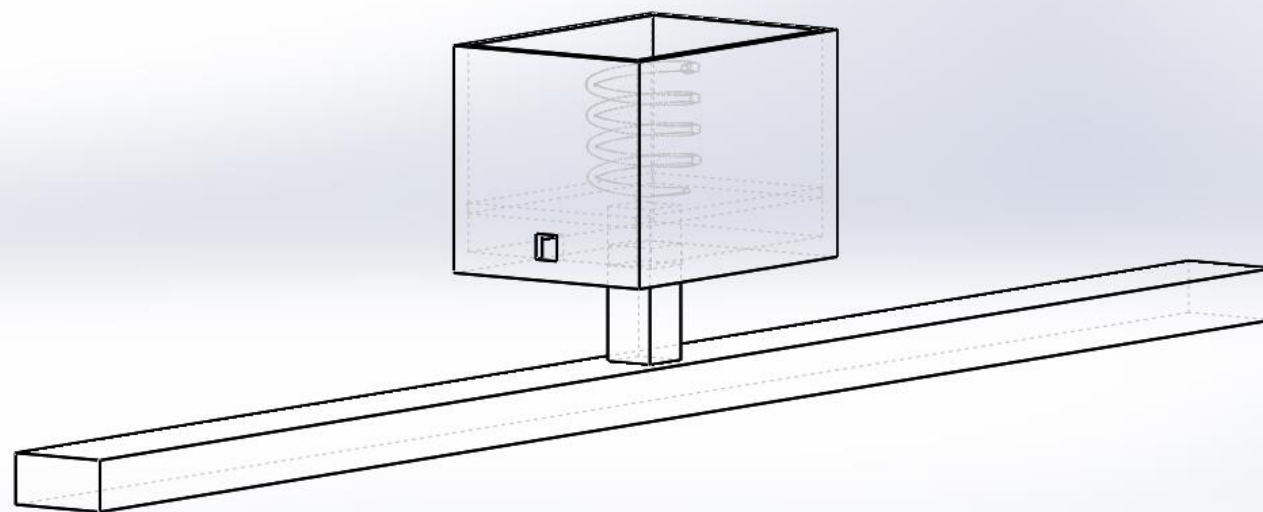
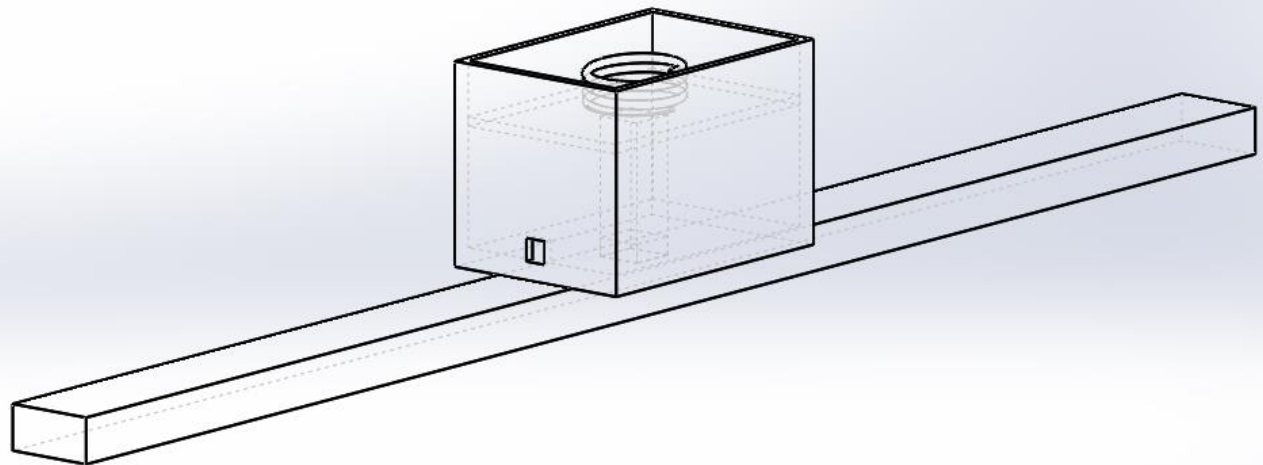


Diagram 6.2.2 Customizable data points

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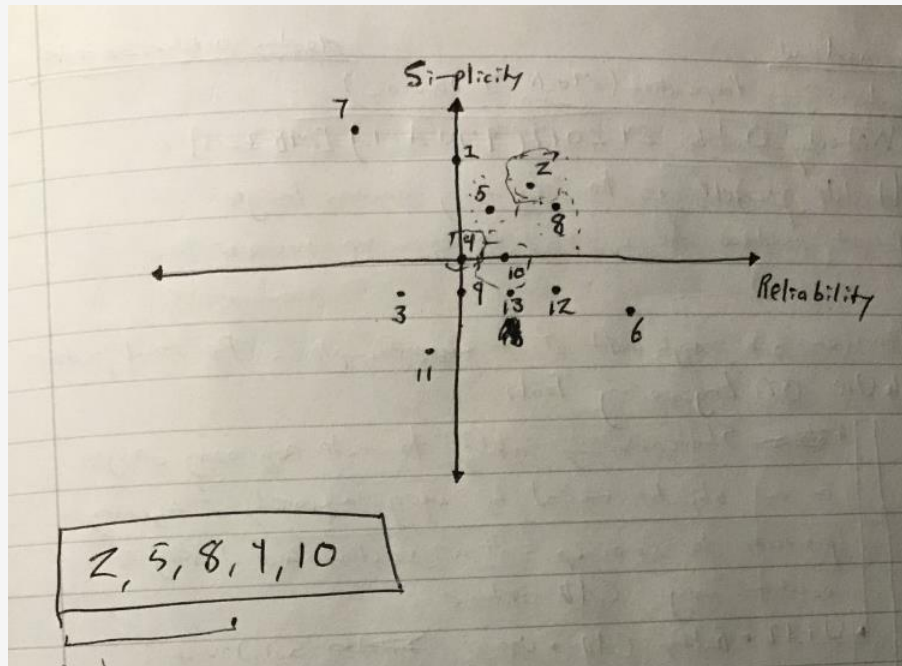


CAD OF A POTENTIAL “PRESSURE SYSTEM” SOLUTION TO THE DESIGN PROBLEM

- An engineering problem with the actuation board was the synchronization of motors (two motors were being used at either end of the board)
- Alongside a team member, we drafted a document with potential solutions, such as:
  - Pressure system board (figure on the left)
  - Replace one motor with a spring
- Showcases how I defined a design problem and used engineering tools (Ex: SolidWorks) to improve a previous design

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Handwritten title: Weighted Decision Matrix

Objectives, Weights

- O1 (10%)
- O2 (15%)
- O3 (25%)
- O4 (30%)
- O5 (20%)

Objective	2	5	8	9	10
O1 (10%)	60%	55%	70%	70%	65%
O2 (15%)	70%	75%	70%	60%	55%
O3 (25%)	70%	70%	75%	70%	70%
O4 (30%)	85%	55%	40%	75%	75%
O5 (20%)	65%	65%	75%	65%	80%
	72.5	63.75	63.25	69	70.75
	2	4	5	3	2

"GRAPHICAL MATRIX" AND "WEIGHTED DECISION MATRIX" FOR THE ROVER DESIGN

- Used two important design criteria, simplicity and reliability, to narrow down potential rover designs
- Also, used a "weighted decision matrix" to further narrow down to three rover solutions
- Showcases the use of important factors, either requested by the client or found through research, to define narrow engineering design choices