Dressing Tree Project; 6-1-Trees

- GNG 2101 A03 (Fall 2023) - Prof. Hanan Anis

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uOttawa

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Agenda

1. User Needs, Benchmarking, Problem Statement, Target Specification
2. Business model and economics
3. Design Subsystems
4. Prototypes
5. Final Product

Background

A dressing tree that enables a 7 year old girl with arthrogryposis (multiplex congenita) to get dressed independently using a system of hooks.

User Needs

1. **Safety**
   - Stability
   - Support
2. **Adjustability**
   - Adjustable as the user grows
3. **Independent Use**
   - Ease of use
   - Catered for fine motor skills
4. **Size**
   - Floor space taken up by footprint
   - Product height

Problem Statement

A need exists for a durable, adjustable, easy-to-use, inexpensive Dressing Tree to be used by individuals with Arthrogryposis Multiplex Congenita (AMC)—a rare congenital rheumatological disorder limiting movement in joints—to get dressed independently and safely. It must be height-adjustable to accommodate for a difference in height long term, and to assist the user in independently dressing/undressing themselves, being of use with various articles of clothing.

Benchmarking

Dressing tree Specification	Rubbermaid 1784455 Fasttrack Compact Hanging Hook 	Rubbermaid 5E11 Fasttrack Multi-Purpose Hook 	ALITARE Garage Power Tool Hook 	Amazon Basics Wall-Mounted Farmhouse Coat Rack, 5 Hooks, Espresso 
Safety	25 pounds max	50 pounds max	50 pounds max	5 pounds max
Cost	$12.60	$26.60	$22.98/2 hooks	$31.31
Modifiability	You can remove the rubber, soft grip, can move the hook	You can move it		
Size/Weight	7.78 x 21.27 x 7.78 cm (about 3.06 in); 0.28 Grams	26.4 x 7.9 x 18.8 Centimeters 399 Grams	24.89 x 16.51 x 15.39 cm (about 6.06 in); 689 Grams	57.4 x 7.1 x 11.7 Centimeters 562 Grams
Material	Aluminum	Aluminum/Rubber	Polyvinyl Chloride	Espresso Wood

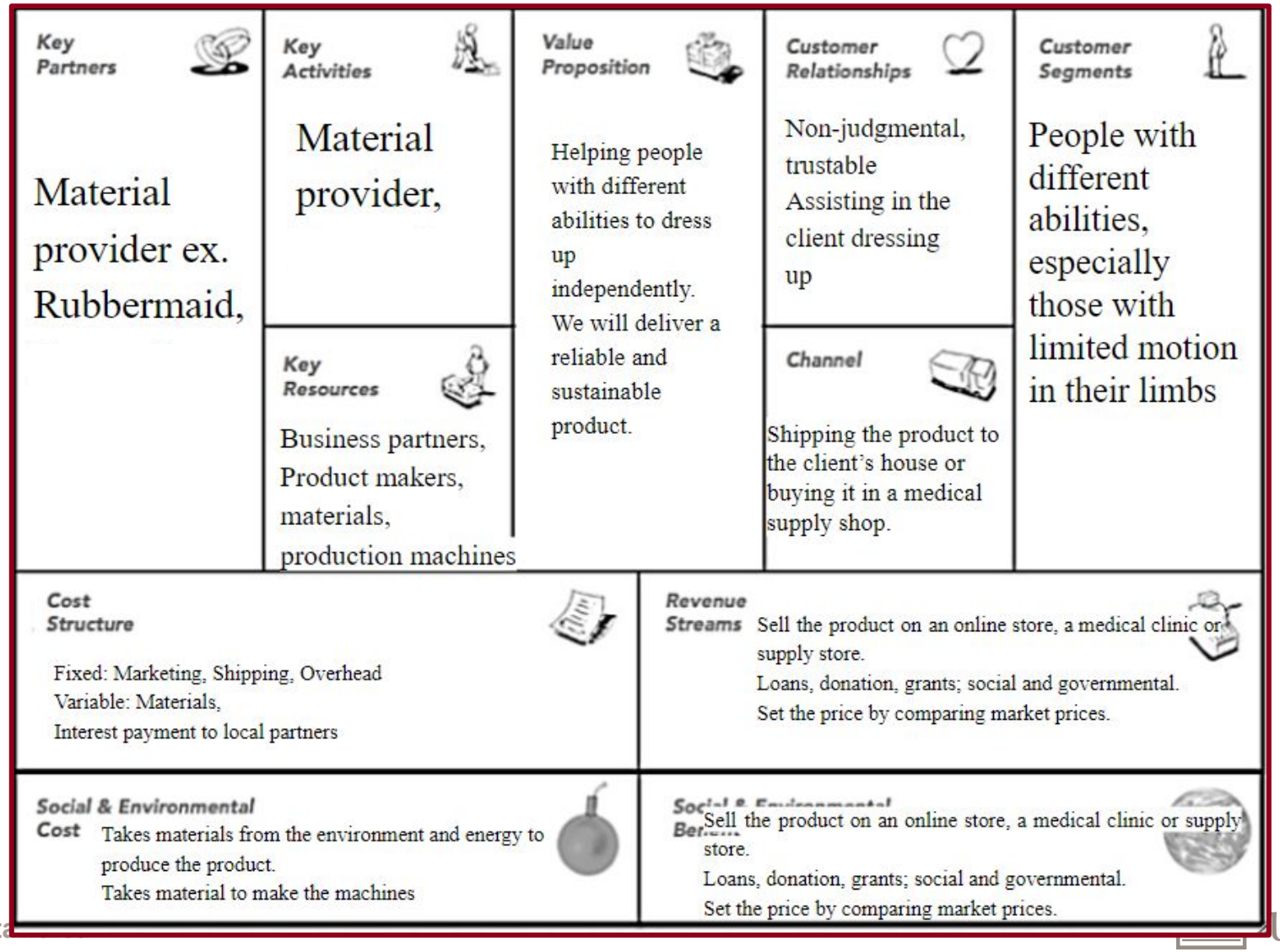
Target specification

Table 5: Target specification

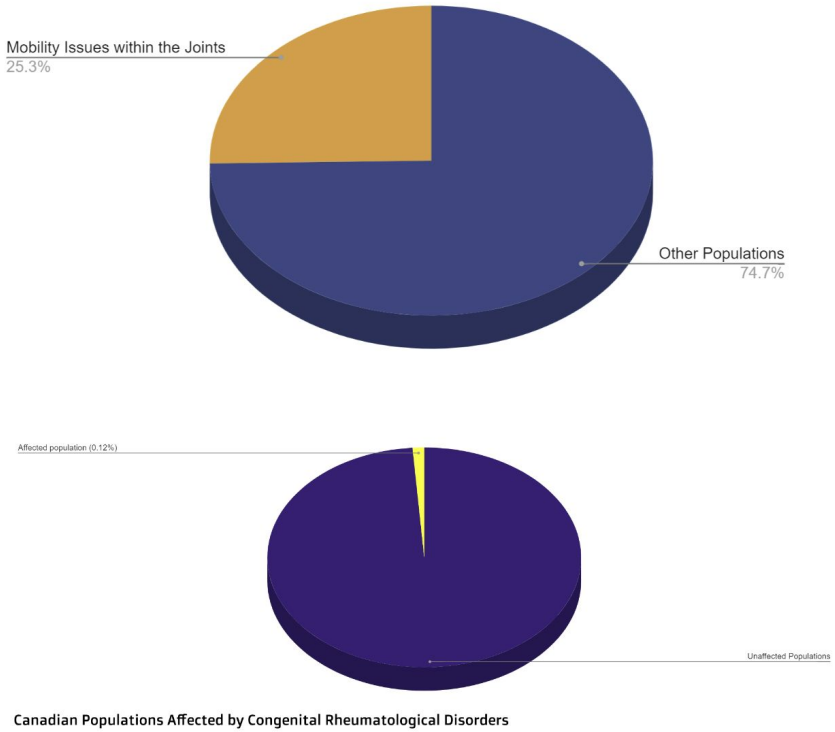
Metric #	Metric	Unit	Marginal Value	Ideal Value	Reasoning
Functional Requirements					
5	Size of Handles (lengths and diameter)	cm	Length: <10 Diameter: <3	Length: 8 Diameter: 2	Cannot be too small, for easy use
7	Force of Handles	N	~800	801	She doesn't fall
8	Voltage of Electricity for Motor	V	10 Nm (torque)		Needs to be safe to plug in a wall for constant use
9	Speed of Adjustment	m/s	~0.1	0.1	Should not be too fast
10	Max Height of Adjustment	m	~4 ft	1 ft to 5ft	Needs to fit in a room
Constraints					
3	Floorspace	m^2	<1	1	Cannot take up too much space
1	Product Height	m	>1.3	2.5	Must be tall enough for her as she grows
4	Product Weight	kg	>22	80	Needs to be stable considering her weight (including growth), Portability comes after safety.
2	Time	s	>10	15	Efficiency and ease of use are important, but does not want to be so fast that injuries occur
11	Cost	$	<150	125	Client would pay around $150.00 CAD
Non-Functional Requirements					
5	Aesthetics	Yes	N/A	N/A	Fit in her room and with her personal style

-Safety most important part
-Force of handles
-Max/Min height adjustment
-Product weight
transportation

Business Model



Economics - Identifying Our Market



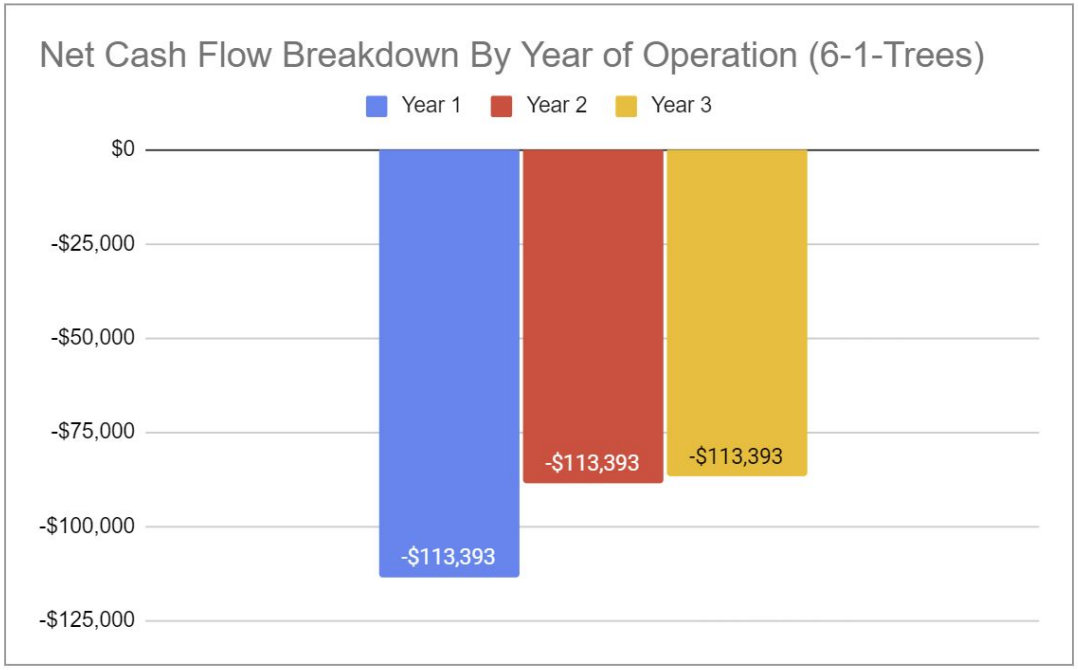
However, not everyone experiencing such issues will be aware of our product. If we do choose to advertise our product to rheumatologists (the main doctors who see these patients), and within their offices we can increase our targeted marketing to around the 52% of the ideal users. Of the population of Canada, we end up with around 6039 possible sales from market reach in our first 3 years.

References: The National Center for Biotechnology Information, National Library Of Medicine
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3199043/

Economics - Expenses and Net Cash Flow

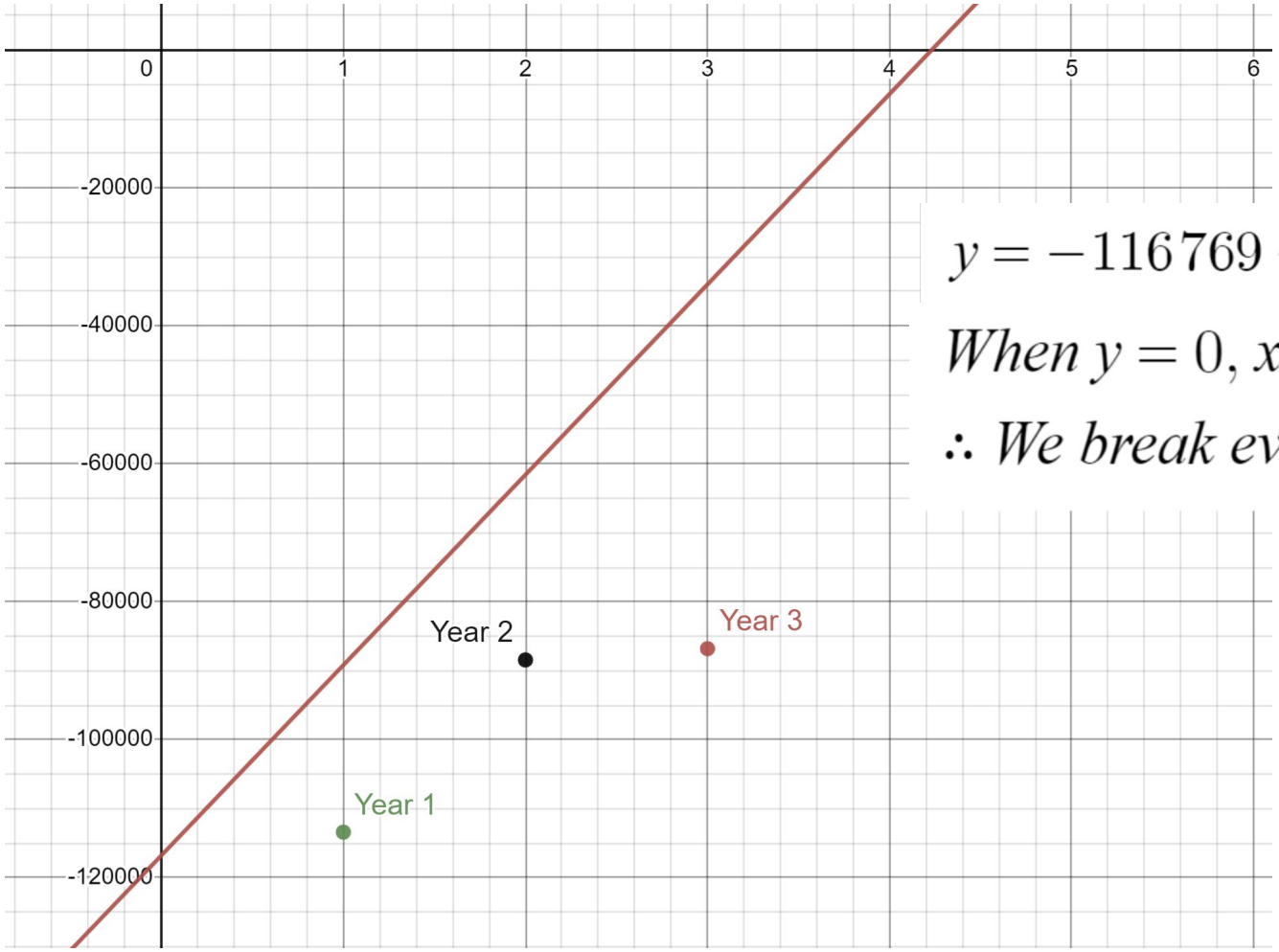
Income Statement for 6-1-Trees Over a Span of 3 Years

Item	Year 1	Year 2	Year 3	Expense Categorisation	Cash Flow Direction	Value of Item	Notes
Marketing	$32,000.00	$40,000.00	$48,000.00	Variable	Out (Expense)	-$120,000.00	
Rent	$24,000.00	$24,000.00	$24,000.00	Fixed	Out (Expense)	-$72,000.00	
Labour	$70,958.00	$70,958.00	$70,958.00	Variable	Out (Expense)	-$212,874.00	
Production Materials	$11,272.80	$22,545.60	$28,182.00	Variable	Out (Expense)	-$62,000.40	
Insurance	$2,000.00	$2,000.00	$2,000.00	Fixed	Out (Expense)	-$6,000.00	
Shipping	$1,099.10	$2,198.20	$2,747.75	Fixed	Out (Expense)	-$6,045.04	
Machinery (Mill)	$8,700.00	$0.00	$2,500.00	Fixed	Out (Expense)	$10,200.00	
Sales	$36,636.60	$73,273.20	$91,591.50	Fixed	In (Income)	$201,501.30	



Net Cash Flow (3 Years):	-$267,218.14	*Σ Money(In) + Σ Money(Out)*
Income Tax Rate:	0%	
Income Tax Paid:	$0.00	*Taxable Income (Profit) * Tax Rate*
Net Income:	-$267,218.14	*Revenue After-Tax (Net Income - Taxes)*

Economics - Break Even Analysis



$$y = -116\,769 + 27\,597x$$

$$When\ y = 0,\ x = 4.231$$

$$\therefore\ We\ break\ even\ in\ 4.2\ years$$

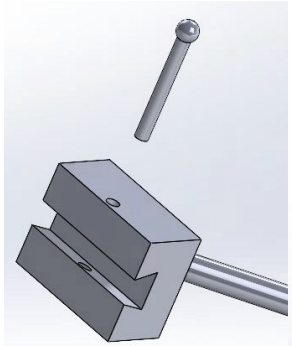
Past Ideas/Older Concepts

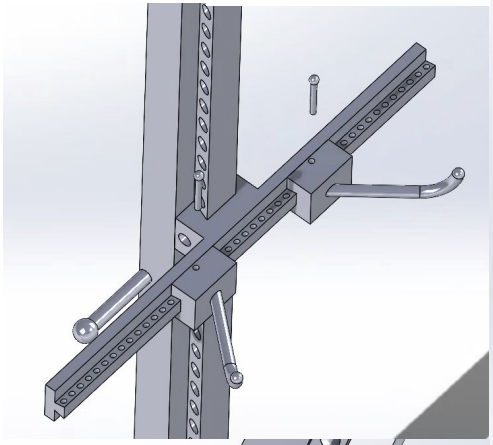
What Went Wrong:

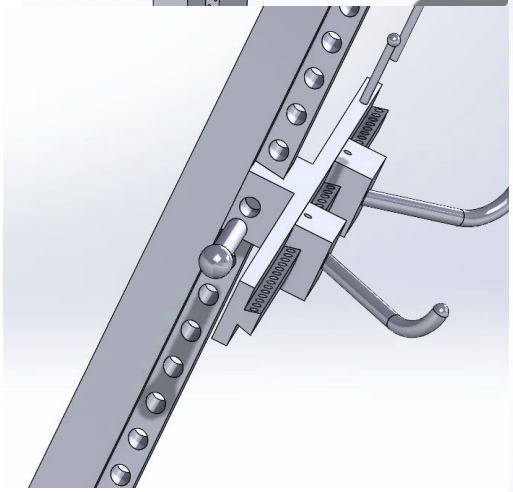
- Issues with torque and strength at the end of the horizontal bars
- Hard to manufacture as the track is specific
- Issue with wear and tear of pins
- Ability to slide both hooks on one side

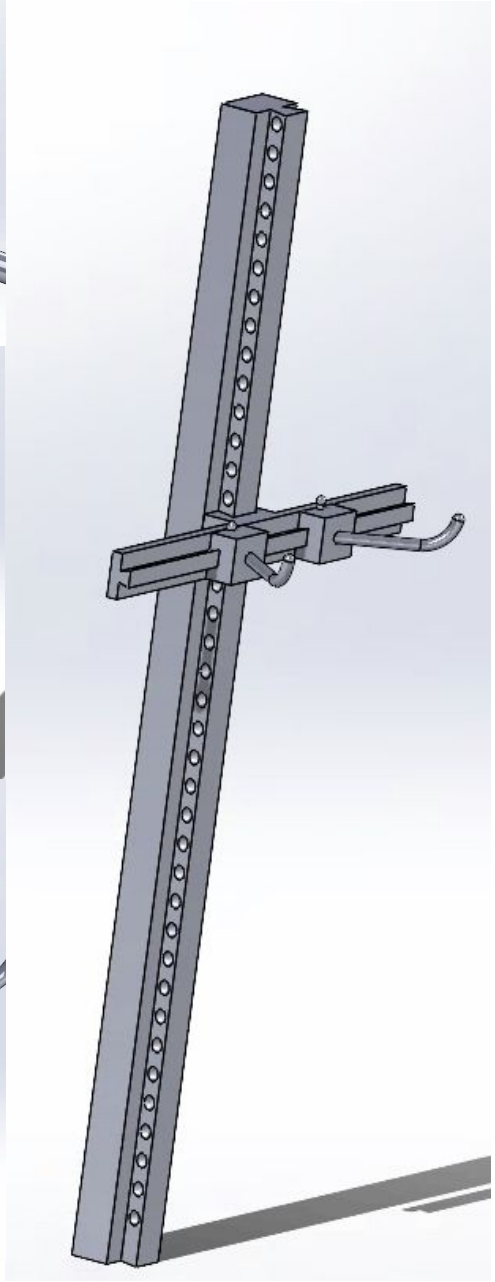
Steps Taken:

- Took what the client liked and what worked well and made it manually adjustable
- Took what the Professor and TA advised us to do
- Found more widely available components that were off the shelf









Client Feedback

Structure:

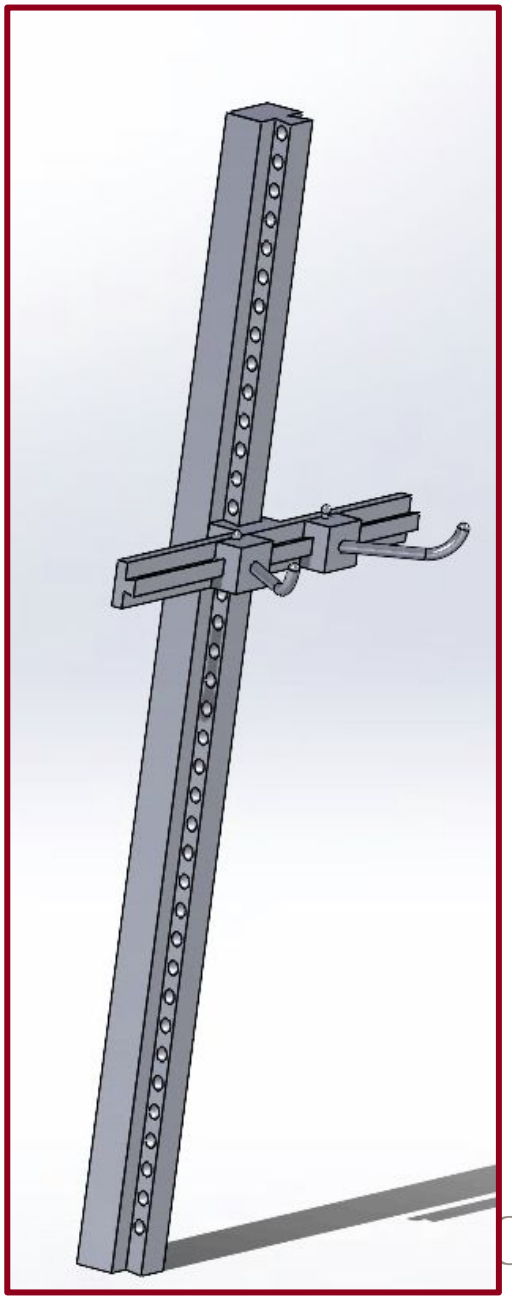
- Vertical and Horizontal axis
- All the way down to the floor
- On a flat wall is more versatile

Hooks and Attachments :

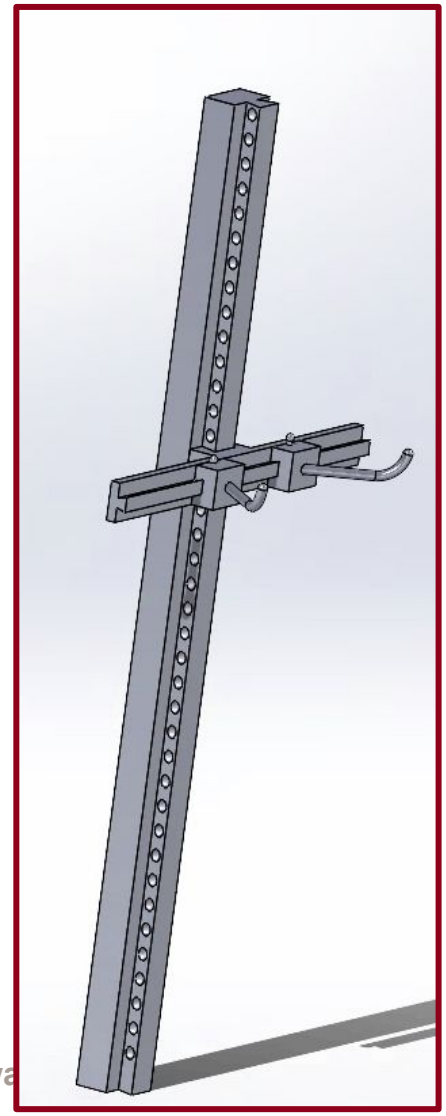
- In favour of using similar hooks to the ones the user is familiar with
- Different types of hooks for different applications

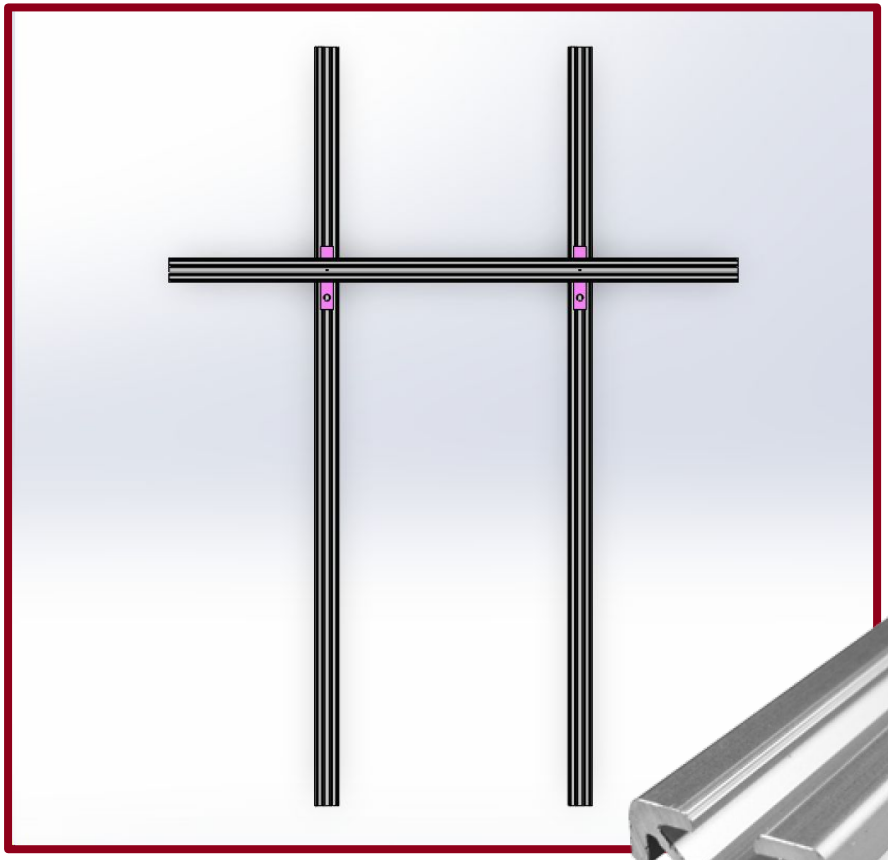
General Feedback :

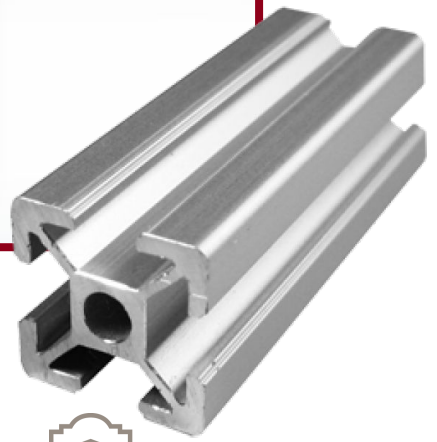
- Liked the way we catered to what the user was used to in order to promote comfortability with a new product
- Liked the way it is completely customizable



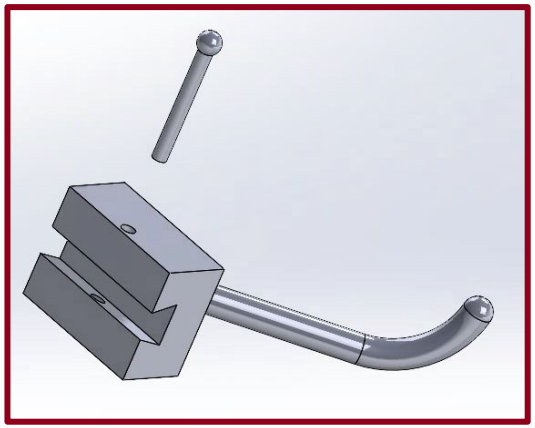
Solution Options; Structure

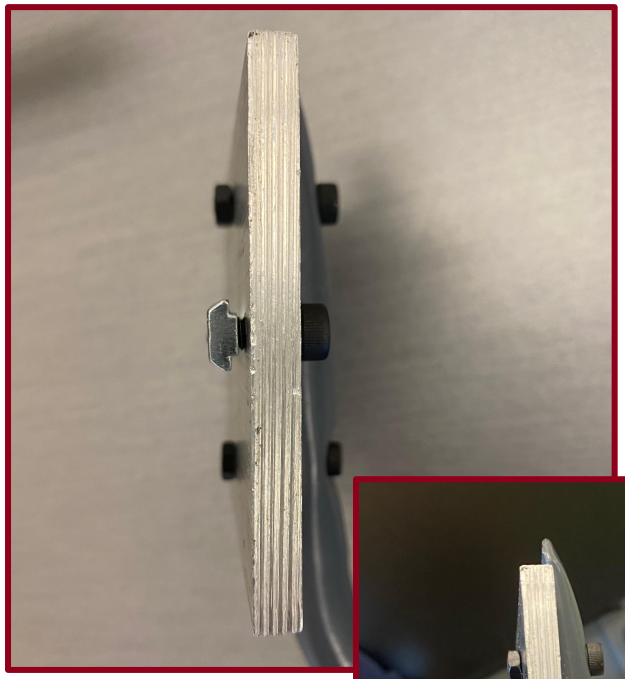


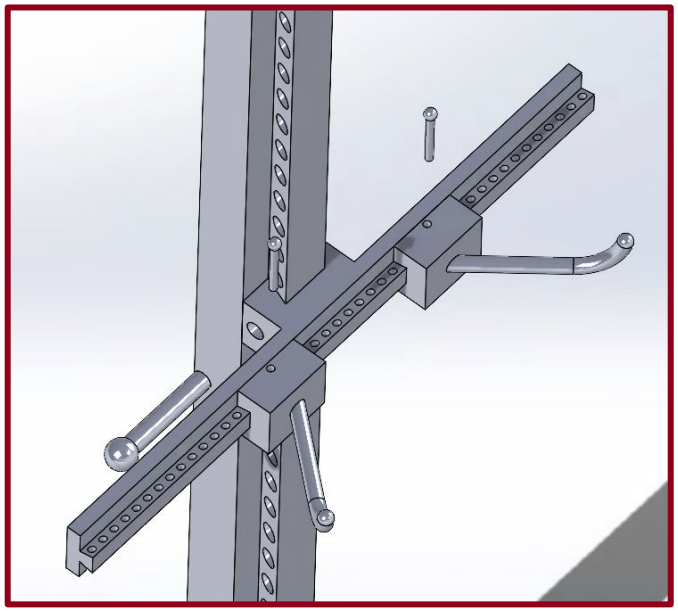




Solution Options; Hooks







Trials and Tribulations

Trials:

- The structure
- The movement of the hooks

Tribulations:

- Constructing a unique structure
- The type of hooks used

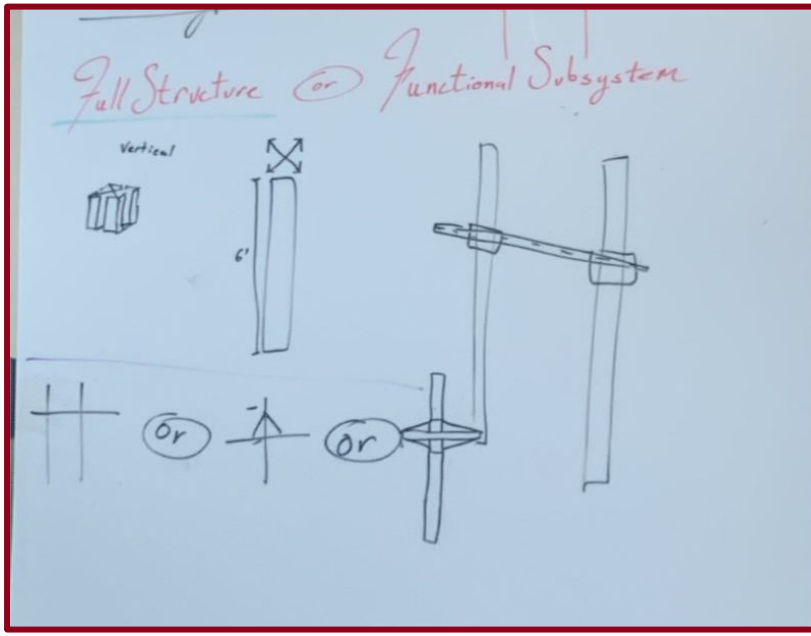
Goals

- Stable and durable
- Adjustable to be a long lasting product
- Customizable for a specific person
- Easy to use; catered for fine motor skills
- Can be used independently

Lessons Learned

In relation to teamwork:

- Have a plan for each meeting; stay on topic
- Communicate clearly
- Support one another



In relation to the dressing tree:

- Weld, Mill, saw etc.
- Always re-iterate and improve
- Room for adjustments
- Implement feedback
- Needed the bigger t-nuts
- Messed up drilling holes (alignment)

Future Work

- Consider the idea of selling it
  - Finding potential clients
  - Marketing the product
  - Follow the income statement
- Add second horizontal bar
  - adds the possibility for more hooks
- Discuss adding more hooks for different articles of clothing
  - Hats
  - Gloves
  - Socks

Prototype Solidworks Model #1

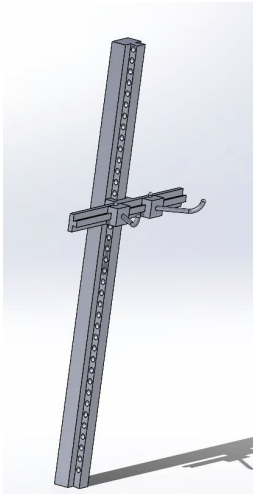


Figure 1: Full Prototype (Solidworks Assembly)

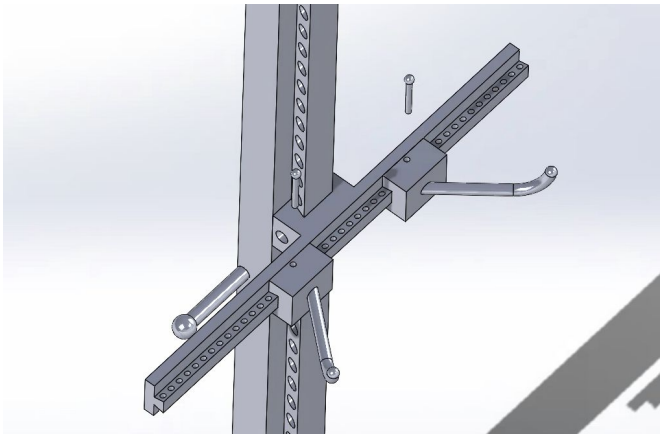


Figure 2: Top view of hooks on rails with pins

- Low Fidelity
- Interpret structure

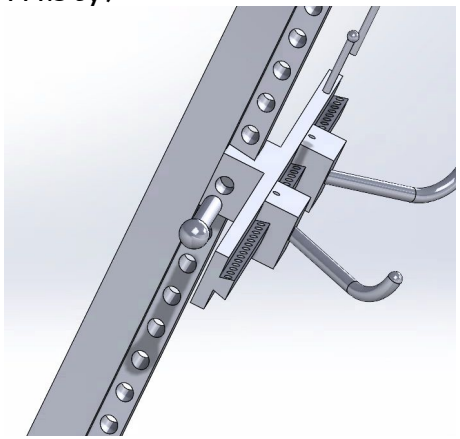


Figure 3: Side view of pins for vertical rail

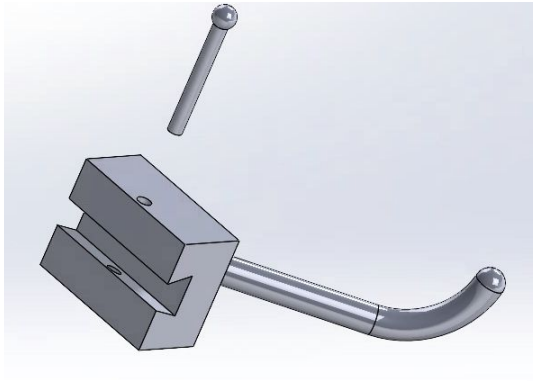
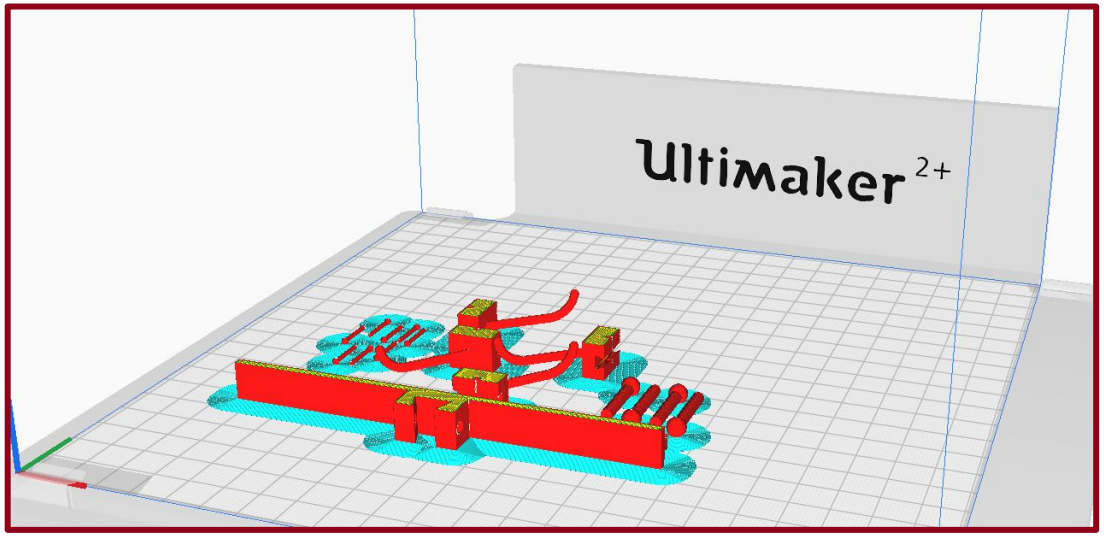


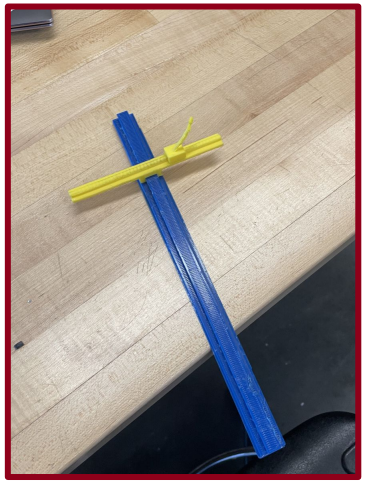
Figure 4: Isolated Right Hook and Small Pin

Physical Prototype #2

For our 2nd prototype we are 3D printing

- Medium fidelity
- Display the design concept
- Focus; show the locking mechanisms and adjustability (Dove tail and pin locking system)





Final Prototype #3

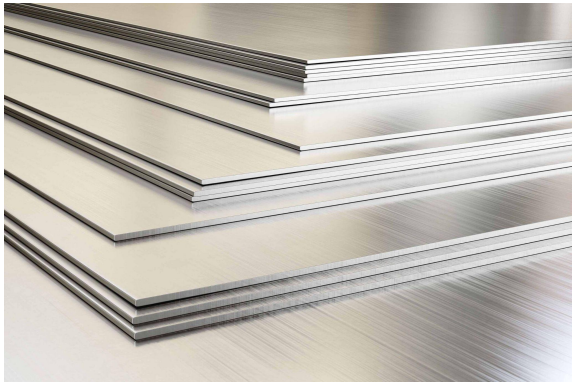
- High fidelity
- Display the design concept
- Test the concepts structure, hooks, stability etc.

Our concept

- Customizable for each user
- Easy to transport (low weight)
- User friendly set-up; only requires a 4mm Allen key to set up and adjust
- User is able to use it and change the hooks independently
- Off the shelf components; easy to assemble

  Takes less than 5 minutes

Modular Concept



Thank you for listening, we appreciate your time!

Question, Comments, Feedback?