GNG2101

Design Project Progress Update

A05-BRC1

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Table of Contents

1 Introduction

The content covered in this document is the content expected from deliverable E to deliverable I, this includes prototype 1, prototype 2, economic considerations, the design day pitch, and the video and user manual. We hope that all content is up to standard and is clearly conveyed.

2 Prototype 1, Project Progress Presentation, Peer Feedback and Team Dynamics

2.1 Prototype 1

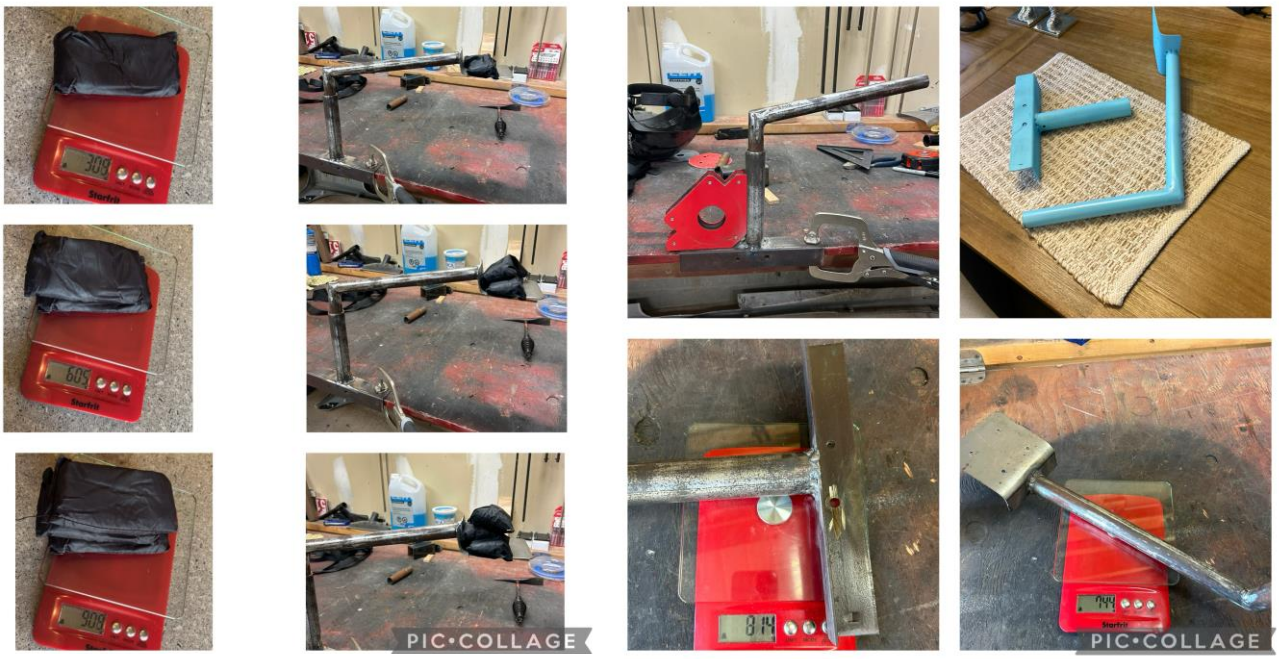
Testing Plan

The critical assumption we will be testing in this prototype is the assumption that the arm will be strong enough to hold any weight of water or other drinks at the desired location. To test this, we have created the following comprehensive tests to test the strength of the arm. This prototype relates to design for Safety, Reliability, and Weight, as the arm needs to be strong enough to hold a desired weight reliably, without any concern of the arm critically failing when in use, which would be a safety issue.

Test Name	Purpose of Test	Procedure	Qualities to Measure
Static weight test	Strength when a weight is not moving in the prototype	Attach a 300g weight onto the end of the arm while it is supported at the other end, after waiting 30s and measurements are recorded, repeat again with 500g, and 1 kg	Measure the deflection in the arm (in cm) and any failure in the arm (type of failure and location of failure)
Lateral weight test	Strength while the prototype is in motion	Attach a 300g weight to the end of the arm, from the other end, rotate the arm 90^{o} and back. Once data is	Measure the deflection in the arm (in cm) and any failure in the arm (type of

		recorded, repeat with 500g and 1 kg.	failure and location of failure)
Kinetic weight test	Strength while the cup is being inserted into the prototype	While the arm is supported at one end, drop a 300g weight on the other end from ~7cm above the arm. After data is recorded, repeat with 500g and 1 kg.	Measure the deflection in the arm (in cm) and any failure in the arm (type of failure and location of failure)
Durability test	To test the durability of the product if anything hits it	While the arm is supported from one end, hit the prototype with blunt force at most sections of the arm, such as at connection points, at the ends of the bar, and about the middle of the bar.	Record average strength of each blunt force attack (high, medium, or low), any deflection of the arm (in cm) and any failure that occurs (type of failure and location of failure)

Prototype 1 and Testing:



The prototype showed zero deflection when submitted to weights of 300g, 600g, 900g, and 10kg. There was also no change in its ability to rotate freely with minimal force no matter the weight added. To meet our client's preferences, we spray painted the final prototype in a sky-blue finish.

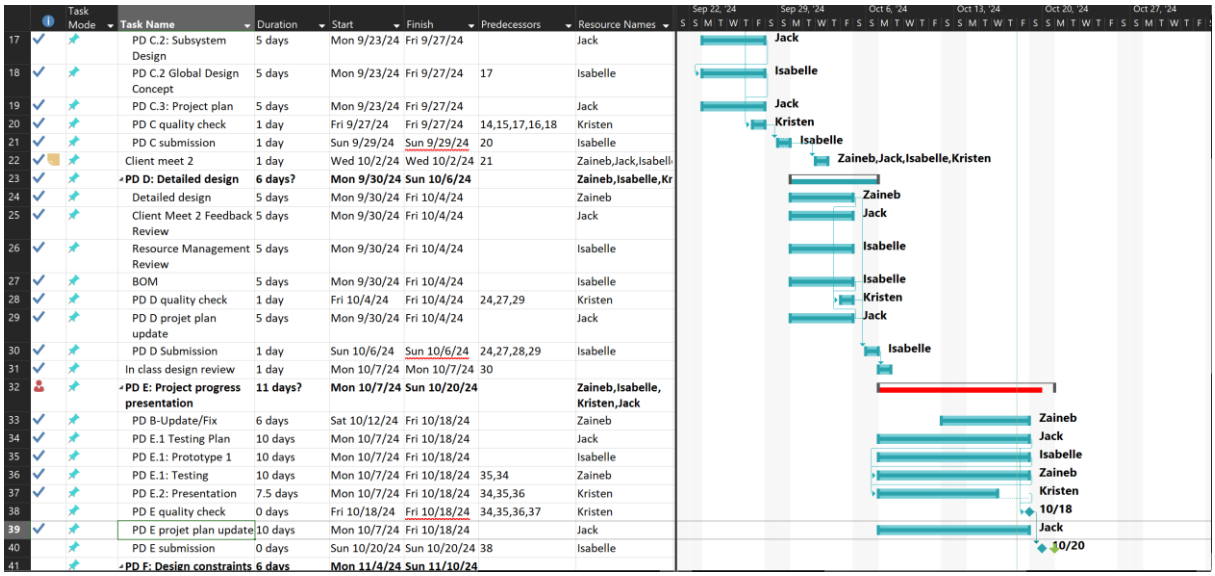
Prototype Test	Tested Assumption	Target Specs	Actual Results	DFX Factors Met
Static Weight Test	The arm can support static weights (300g, 600g, 900g, and 10kg) without excessive/zero deflection or failure.	The arm should deflect no more than 2 cm under 1 kg of weight without any permanent deformation or failure.	No visible deflection was detected. The arm was able to withstand more than expected weight of 10 kg.	Safety Reliability Weight
Lateral Weight Test	The arm can remain sturdy and stable under dynamic motion with weights (300g, 600g, 900g, and 10kg)	The arm should deflect no more than 3 cm when rotated 90° with 1 kg and return to original position.	There was no visible deflection detected. The arm was able to withstand more than expected weight of 10 kg and rotated 360 degrees with ease.	Safety Reliability Weight
Kinetic Weight Test	The arm can withstand the impact of a cup being inserted without failure.	The arm should not show permanent deformation or break when a 1 kg weight is dropped from 7 cm.	There was no visible deformation detected. The arm was able to withstand 10 kg of weight being dropped at one end, although	Safety Reliability

			the arm did rotate slightly.	
Durability Test	The arm can endure accidental impacts (e.g., bumps) during regular use without critical damage.	The arm should not show significant damage or permanent deformation when hit with low, medium and high blunt force.	No permanent damage was detected when blunt force was inflicted on the arm, although the arm rotated easily when hit forcefully.	Safety Durability Reliability

2.2 Project Progress Presentation

[Presentation Slide]

2.3 Project plan update



	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
17		PD C.2: Subsystem Design	5 days	Mon 9/23/24	Fri 9/27/24		Jack
18		PD C.2 Global Design Concept	5 days	Mon 9/23/24	Fri 9/27/24	17	Isabelle
19		PD C.3: Project plan	5 days	Mon 9/23/24	Fri 9/27/24		Jack
20		PD C quality check	1 day	Fri 9/27/24	Fri 9/27/24	14,15,17,16,18	Kristen
21		PD C submission	1 day	Sun 9/29/24	Sun 9/29/24	20	Isabelle
22		Client meet 2	1 day	Wed 10/2/24	Wed 10/2/24	21	Zaineb,Jack,Isabell
23		**PD D: Detailed design**	**6 days?**	**Mon 9/30/24**	**Sun 10/6/24**		**Zaineb,Isabelle,Kr**
24		Detailed design	5 days	Mon 9/30/24	Fri 10/4/24		Zaineb
25		Client Meet 2 Feedback Review	5 days	Mon 9/30/24	Fri 10/4/24		Jack
26		Resource Management Review	5 days	Mon 9/30/24	Fri 10/4/24		Isabelle
27		BOM	5 days	Mon 9/30/24	Fri 10/4/24		Isabelle
28		PD D quality check	1 day	Fri 10/4/24	Fri 10/4/24	24,27,29	Kristen
29		PD D projet plan update	5 days	Mon 9/30/24	Fri 10/4/24		Jack
30		PD D Submission	1 day	Sun 10/6/24	Sun 10/6/24	24,27,28,29	Isabelle
31		In class design review	1 day	Mon 10/7/24	Mon 10/7/24	30	
32		**PD E: Project progress presentation**	**11 days?**	**Mon 10/7/24**	**Sun 10/20/24**		**Zaineb,Isabelle, Kristen,Jack**
33		PD B-Update/Fix	6 days	Sat 10/12/24	Fri 10/18/24		Zaineb
34		PD E.1 Testing Plan	10 days	Mon 10/7/24	Fri 10/18/24		Jack
35		PD E.1: Prototype 1	10 days	Mon 10/7/24	Fri 10/18/24		Isabelle
36		PD E.1: Testing	10 days	Mon 10/7/24	Fri 10/18/24	35,34	Zaineb
37		PD E.2: Presentation	7.5 days	Mon 10/7/24	Fri 10/18/24	34,35,36	Kristen
38		PD E quality check	0 days	Fri 10/18/24	Fri 10/18/24	34,35,36,37	Kristen
39		PD E projet plan update	10 days	Mon 10/7/24	Fri 10/18/24		Jack
40		PD E submission	0 days	Sun 10/20/24	Sun 10/20/24	38	Isabelle
41		**PD F: Design constraints**	**6 days**	**Mon 11/4/24**	**Sun 11/10/24**		

3 Design Constraints and Prototype 2

3.1 Design constraints

The two most important non-functional design constraints for our bed rail cup holder are:

1. **Safety:** This is an important DFX because the product is designed to support individuals with limited mobility and strength. Making this product safe and reliable is impotant to prevent spills, burns (from hot beverages spilling) and any other injuries associated with the device. The cup holder needs to secure onto the bed rail without accidental dislodgement. The cup holder needs to be stable and structurly compact to avoid risks of tipping or accidently knocking it over. Keeping safety in mind will influence design decisions around materials, attachment mechanisms, and weight distribution.

   Reliability: Reliability is vital to ensure that the cup holder functions consistently over time without the need for frequent adjustments, repairs, or replacements. Since the user may not be able to fix or clean up any failures, it's crucial that the design remains reliable under regular use, accommodating various cup weights and sizes without losing stability. Reliable performance enhances usability by allowing the user to depend on the product consistently, reducing any stress associated with product failure.

   Non-Functional Constraint (Safety): The cup holder must be designed to ensure user safety, especially as the user has limited mobility. This means it should securely attach to the bed rail to prevent tipping or detachment. To ensure this, we will clamp the cup holder onto the bed rail and use bolts and screws to hold it in place. The device must not have sharp edges to avoid injury, we will ensure this by covering our final prototype with silicone and rounding any sharp edges.

Functional Constraint (Reliability): The cup holder must allow the user to easily access their drink while lying down without needing to sit up or reach far. This means making the arm of the cup holder rotatable. To ensure the arm rotates effectively, we have made two cylinders with different diameters that fit into each other and rotate as needed. This functional constraint is essential to meeting the core purpose of the product: providing easy access to a drink with minimal movement.

Physical Constraint (Size and Weight): The holder must be lightweight and compact enough to attach securely to the bed rail without being too heavy for the user to adjust or move. Its size must fit within the space available around the bed rail and not interfere with other bedside items or furniture. This constraint helps ensure the product is practical and convenient for daily use in a bedroom setting.

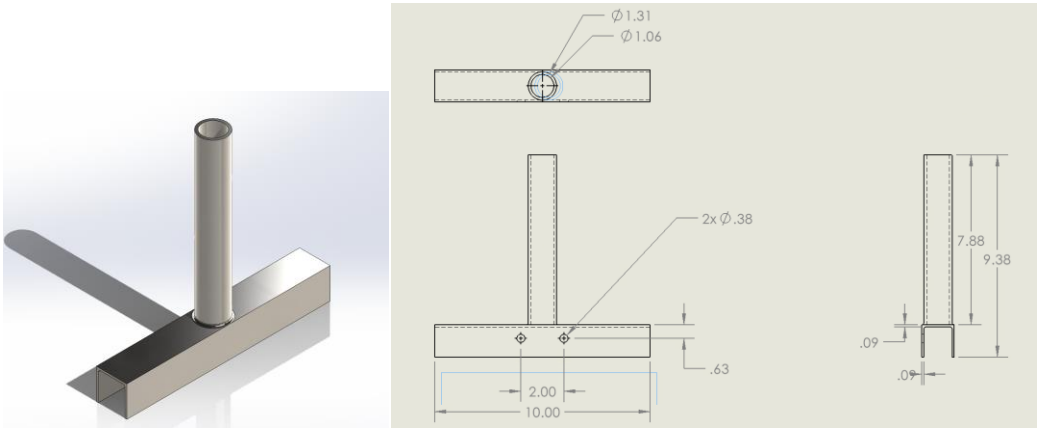
Physical constraints, size and weight: the client's bedrail is approximately 1.6in wide and the base of our cup holder that will slide over the bedrail is 2in which gives us room to add rubber padding to avoid damaging the existing bedrail. The cup holder's rotating arm is 745 grams and extends 12.5in from the wall which is ideal to the client's bed. A single bed is 38in therefore when the cup is rotated to 90 degrees it will extend to a third of the beds width.

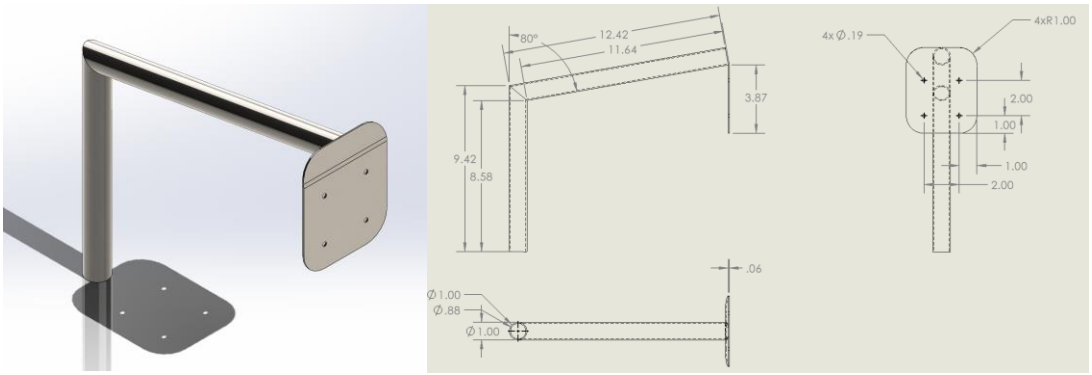
Reliability, functional constraints: The first quarter of the client's bed is adjustable so that they can lay/sit on an incline. Since our device has a height of 13.09in and a single bed is 75in. The

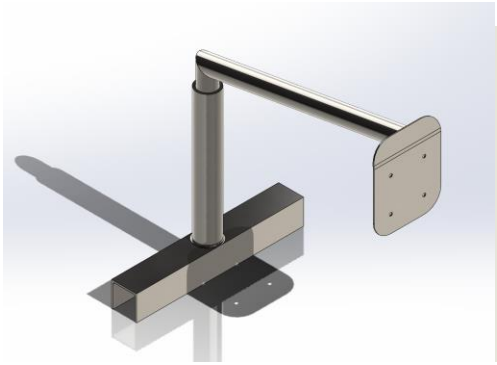
client can sit at an angle of 35 degrees while still seamlessly using the cup holding (tan ((75/4)/13.09)).

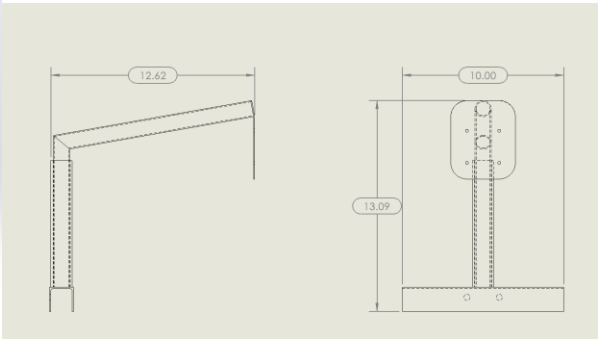
Safety, non-functional constraints: the device has been grinded down to a smooth finish with little to no sharp edges or corners. Any corners will be covered with a silicon or rubber wrap to avoid injuries during use.

Updated Detailed Design









3.2 Prototype 2

We have yet to receive any additional client feedback but we have gotten feedback from peers and instructors. Our professor suggested we go with a ball plunger for our feature of adjustability but after discussing it as a team we plan to continue with a hole and pin mechanism to prevent failure from wear and to insure safety for the client. We also have some self-generated feedback about our rotation mechanism and found that a simple bass bearing inserted to our prototype I will be sufficient.

The most critical untested product assumption is that our client will be able to operate the rotating arm with minimal effort and without experiencing discomfort. This assumption relates directly to the DFX factor of Usability from Project Deliverable B. We have tested the arm with countless weights and by applying minimal force, although it isn't clear yet if our client will be able to use the device effectively as well. This assumption will most likely be tested during client meeting 3. Another assumption is that the clamp will fit perfectly on to the bed rail without the cup holder becoming unstable. This assumption relates to the DFX factor of safety and reliability. The clamp will also be tested during client meeting 3 to ensure a snug fit.

- Second prototype (Clamping System)
    - Materials

        - The materials being used for the clamping system should be firm with a non-abrasive lining around the clamping mechanism
            - Can be silicone or a rubber padding
        - Test to find the right balance of grip and protection
    - Fit Testing
        - Test on Sienna's actual bedrail (physical test) to ensure that our theoretical calculations are correct and that the clamp is compatible with the bedrail.
        - Additionally, ensuring that the clamp is secure under various weights and movements.
    - Installation Mechanism
        - Design that uses minimal tools (i.e., easy to set up and easy to take down)
- Third prototype (Cup Holder Fit and Security)
    - Diameter and Depth
        - Test with cups of various sizes (mainly focusing on the cups that Sienna uses) to ensure that it is a secure fit.
        - Attempting to create a slight inward taper at the top of the cupholder to abolish wobbling.
    - Security and Safety
        - Silicone inserts and/or adjustable grips can aid in stabilizing the cup.
- Fourth prototype (Adjustability and Aesthetics)
    - Aesthetic Appeal
        - Rounded edges for safety purposes
        - Blue finish (Sienna's preference)
    - Adjustable Height

- If time permits, incorporating a mechanism that allows the rod to be adjustable and locked in place

We will present our updated design and show the client our prototype. We intend to test how well the device fits on the bed rail and in her bed setup to make sure the final installation will be seamless. We will provide the client pictures and videos of our testing. We will explain to her how to use the cup holder and confirm that the product fits her needs. We will explain our next steps: finishing the clamping mechanism, adding the slot for her cup, and adding height adjustability if she thinks it would benefit her.

Information we would like to gather at the next client meeting:

- Are there any specific requirements (or features that Sienna would like) that were not made evident before?
- Does the clamp fit the rail and is it secure?
- Input on size adjustments to the prototype 1 cupholder (height, length, etc…) to the Sienna's liking?

The critical assumption that prototype 2 will focus on is the strength of and ability of the clamp to hold the arm up during any and all motions.

Test Name	Purpose of Test	Procedure	Qualities to Measure
Strength Test	To test the strength of the clamp while no cup is being held.	Clamp the prototype onto the proper clamping points, then move the arm laterally, spinning the arm.	Then the Clamp is first attached, measure the rotation deflection of the clamp, (°), and any failure. After the arm has been rotated, measure the rotation deflection of the clamp, (°), and any and all failure.
Weight Test	To test the strength of the clamp while the cup is in the arm.	Repeat the Strength test however with increments of weight on the arm, from 300g, 500g, and 1 kg. Then, while the clamp is secured, drop weights on the end of the arm, from 300g, 500g, 1kg.	In each test after each weight, measure the rotation deflection of the clamp, (°), and any and all failure that occurs.
Reliability Test	To test the reliability of the clamp after many uses.	Repeatedly fasten and unfasten the clamp 5 times, then fasten the clamp once more and repeat the Strength test.	Measure the rotation deflection of the clamp, (°), and any and all failure that occurs.

Prototype Test	Tested Assumptions	Target Specs	Actual Results	DFX Factors Met
Strength Test	Strength when weight is not moving on the prototype	Ideally no deflection	With 1 kg of weight the arm does not seem to deflect	Strength Reliability
Weight Test	When cup with mass is placed onto the arm will the cup holder remain stable	The arm can support the weight while still being clamped	With 1 kg of weight the prototype did become slightly unstable	Strength
Reliability Test	That the screws for the clamp fit without any movement. Proving that, when the cupholder is fastened to the rail it will remain stable with little to no movement.	Ideally sits completely stable on the rail.	We would have to mount the system onto a piece of wood/metal bar. As we currently do not have access to these materials (pending TA and PM approval), we were able to test the fit of the bolts, washers, and nuts to	Reliability

			ensure that it fits securely onto the clamping system.	

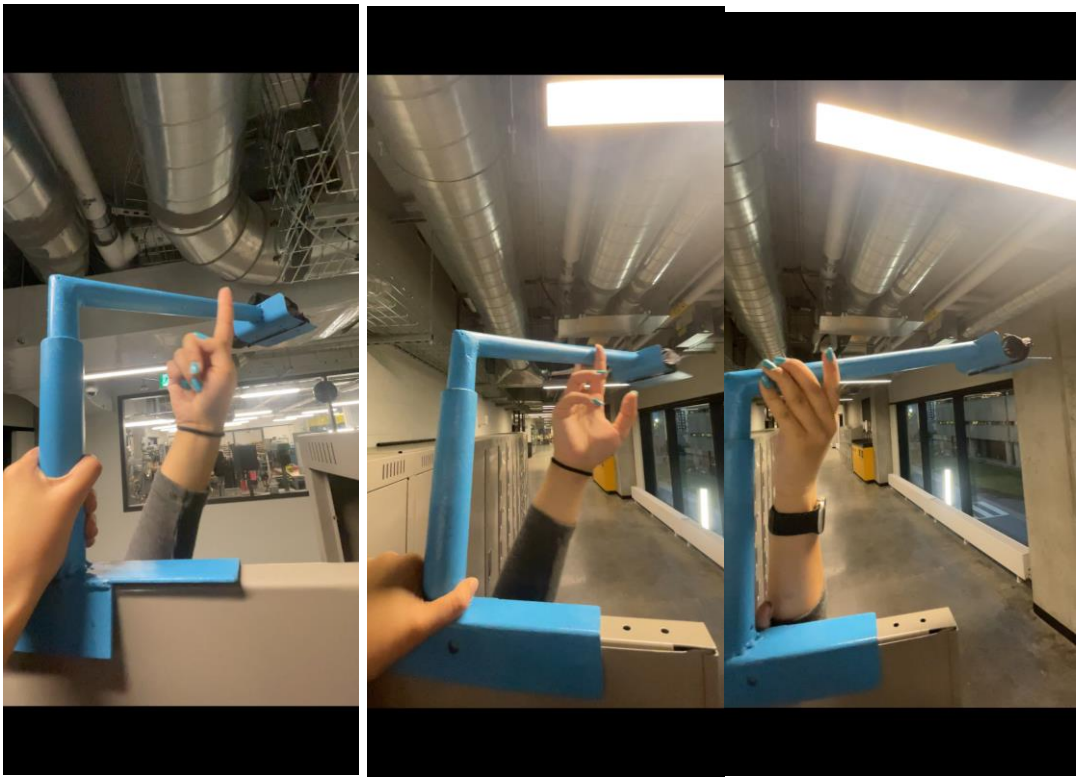


Figure 1-3: The arm supporting weights ranging for 300g-1kg

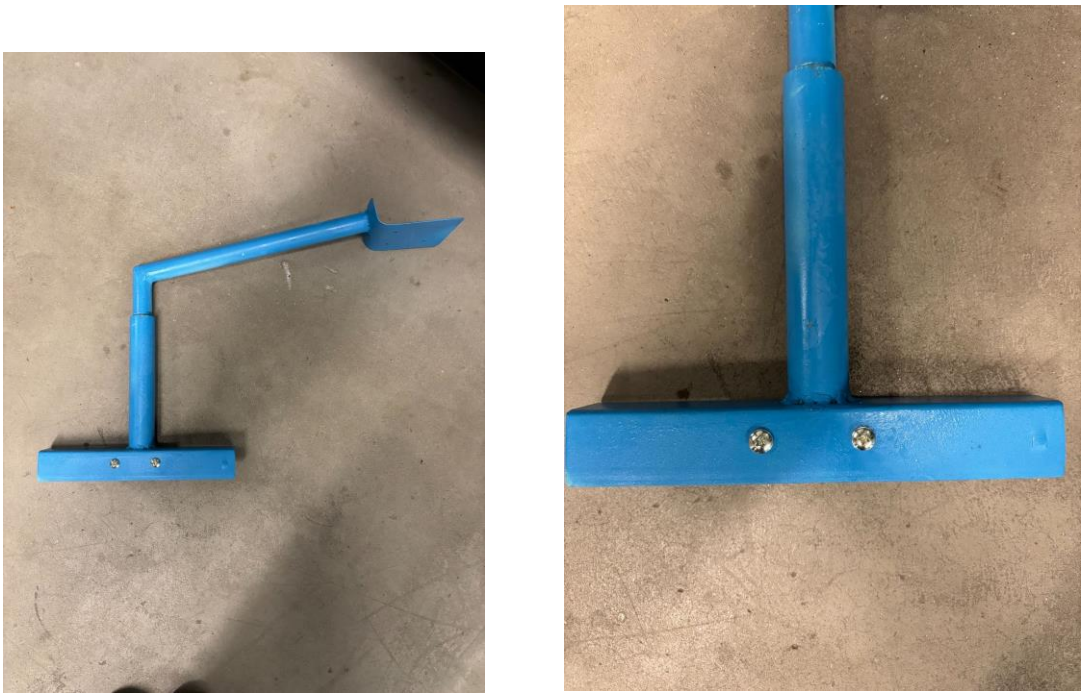
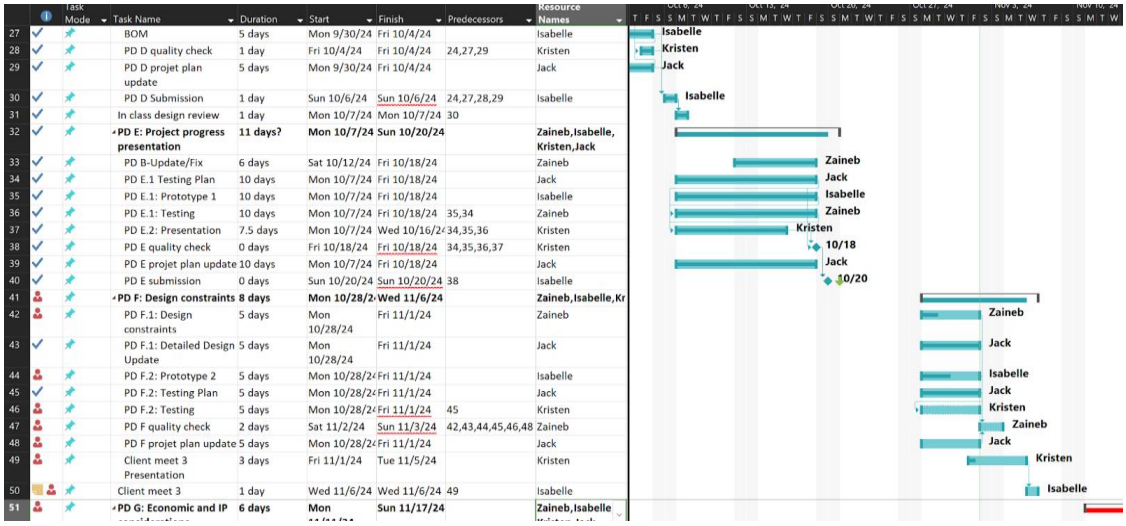


Figure 1-2: The screws in place

3.3 Project plan update



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27		BOM	5 days	Mon 9/30/24	Fri 10/4/24		Isabelle
28		PD D quality check	1 day	Fri 10/4/24	Fri 10/4/24	24,27,29	Kristen
29		PD D projet plan update	5 days	Mon 9/30/24	Fri 10/4/24		Jack
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41		**PD F: Design constraints**	**8 days**	**Mon 10/28/24**	**Wed 11/6/24**		**Zaineb,Isabelle,Kr**
42		PD F.1: Design constraints	5 days	Mon 10/28/24	Fri 11/1/24		Zaineb
43		PD F.1: Detailed Design Update	5 days	Mon 10/28/24	Fri 11/1/24		Jack
44		PD F.2: Prototype 2	5 days	Mon 10/28/24	Fri 11/1/24		Isabelle
45		PD F.2: Testing Plan	5 days	Mon 10/28/24	Fri 11/1/24		Jack
46		PD F.2: Testing	5 days	Mon 10/28/24	Fri 11/1/24	45	Kristen
47		PD F quality check	2 days	Sat 11/2/24	Sun 11/3/24	42,43,44,45,46,48	Zaineb
48		PD F projet plan update	5 days	Mon 10/28/24	Fri 11/1/24		Jack
49		Client meet 3 Presentation	3 days	Fri 11/1/24	Tue 11/5/24		Kristen
50		Client meet 3	1 day	Wed 11/6/24	Wed 11/6/24	49	Isabelle
51		**PD G: Economic and IP**	**6 days**	**Mon**	**Sun 11/17/24**		**Zaineb,Isabelle**

4 Economic and IP Considerations

4.1 Economics report

Financial Data

Variable	Fixed
Production Materials	Salaries Hiring 1 co -op student starting year 3
Steel Rod ($7/rod) about 420 purchased per year (year 1) - 2940	Rent (workshop Membership) (960/year for up to 10 employees) https://ctma.com/membership/manufacturer-signup/
Cup Holder parts (sheet metal + Cup) 750/yr	Utilities (0)
Silicone (1000/yr)	Marketing (500) - Pitching to hospitals and online ads
Roller bearing + screws (200)	Equipment (0) until we make profit to rent out a garage and get equipment
Shipping costs (cost / unit sold)	Legal/Accounting Services (1000)
	Business Insurance ($500)
	Miscellaneous Costs ($50)

A	B	C	D	E	F	G	H
Fixed Cost Item (per month) YR1	Estimated Cost (CAD)		Variable Cost Item (per month) YR1	Estimated Cost (CAD)		Cost Summary Table	
Workshop Membership	$80		Steel Rod	$125.00		Cost Type	Total (CAD)
Salaries (Employees)	$15,000		Cup	$40.00		Total Fixed Costs	$16,580
Utilities	$0		Silicone	$40.00		Total Variable Costs per Unit	$505.00
Insurance	$350		Roller Bearings + Screws	$50.00		Selling Price per Unit	$40
Marketing	$500		Spray Paint	$50.00		Contribution Margin per Unit	$23.00
Miscellaneous	$50		Production Materials (Total):	$305.00		Break-Even Units	720
Legal/Accounting Services	$500		Shipping Costs	$200.00			
Total Fixed Costs	$16,480		Total Variable Costs per Unit	$505.00			
		Funding Source	Estimated Amount/month (CAD)				
		MiTacs Grant	$6,250				
		Total Funding per month	$6,250				

Figure 1: Fixed and Variable Cost

Fixed Cost Justifications (Per Month)

Workshop Membership ($80):
The workshop membership fee at $80/month provides a shared space with the necessary equipment and facilities for up to 10 employees. This cost is economical compared to renting or purchasing a workspace, reducing initial capital expenditure and promoting a collaborative work environment.

Salaries ($15,000):
The total salary cost at $15,000/month covers the compensation of employees involved in the project. This includes wages for full-time staff at $18/hour
Utilities ($0):
Utilities are listed as $0 because initially we don't have a workspace that requires bill such as electricity or water
Insurance ($350):
Business insurance at $350/month covers basic liability, and product coverage. This is essential for protecting the company from potential risks related to product liability and employee safety.
Marketing ($500):
This budget covers advertising and promotional efforts to build awareness and target potential customers, such as hospitals and healthcare facilities. It includes online ads and direct outreach, vital for launching a new product in the market.
Miscellaneous ($50):
The $50/month allocated to miscellaneous expenses accounts for unanticipated minor costs, such as office supplies, small repairs, or minor equipment needed for day-to-day operations.
Legal/Accounting Services ($500):
These services ensure compliance with regulations, manage contracts, and oversee financial statements and tax filings.

Variable Cost Justifications (Per Month)

Steel Rod ($125):
The cost of $125/month for steel rods assumes the purchase of sufficient rods to meet production demands at $7 per rod with discounted prices as low as $3 for bulk purchases.
Cup ($40):
The cost of $40/month covers the purchase of cup components used in the assembly.
Silicone ($40):
Silicone is used for securing cup. A $40/month allocation reflects standard prices for bulk silicone purchases.
Roller Bearings + Screws ($50):
The $50/month expense for roller bearings and screws covers essential fastening for the bed rail cup holder.
Spray Paint ($50):
Spray paint costs of $50/month account for the finishing of products, enhancing aesthetic appeal and providing a protective coating to prevent corrosion.
Production Materials (Total: $305):
The total variable cost per month for production materials, including the steel rods, cups, silicone, roller bearings, screws, and spray paint, amounts to $305. This comprehensive figure ensures all primary materials for the bed rail cup holder are included.
Shipping Costs ($200):
This cost covers logistics and distribution expenses for shipping finished products to customers or retail partners. The estimate considers packaging and transportation.

Direct	Indirect
Product Materials: • Steel Rod • Cup • Silicone • Roller Bearings + Screws • Spray Paint • Shipping Costs	• Workshop Membership • Salaries (Employee • Workshop Membership • Salaries (Employees) • Insurance • Marketing • Miscellaneous • Legal/Accounting Services • Utilities

Direct Costs are directly related to the production of the bed rail cup holder. These include the materials and shipping costs that fluctuate with production volume.

Indirect Costs are associated with the overall operation but not tied directly to the production of individual units. They include fixed costs such as salaries, workshop membership fees, insurance, and other business expenses.

Income Statement

INCOME STATEMENT	Year 1														
	November	December	January	Febuary	March	April	May	June	July	August	September	October	Year 1	Year 2	Year 3
Revenue Streams															
MiTacs Grant	$6,250	$6,250	$6,250	$6,250	$6,250	$6,250	$6,250	$6,250	$6,250	$6,250	$6,250	$6,250	$75,000	$75,000	$75,000.0
Sales	$4,000	$6,000	$12,000	$8,000	$7,600	$6,000	$8,000	$4,000	$4,800	$6,400	$6,500	$5,000	$78,300	$93,960.0	$117,450.0
Total Revenue & Gains	10250	12250	18250	14250	13850	12250	14250	10250	11050	12650	12750	11250	153300	168960	192450
Cost of Goods Sold (COGS)															
Steel Rod	$125	$125	$125	$125	$125	$125	$125	$125	$125	$125	$125	$125	$1,500.00	$1,800.00	$2,250.00
Cup	$40	$40	$40	$40	$40	$40	$40	$40	$40	$40	$40	$40	$480	$576	$720
Silicone	$40	$40	$40	$40	$40	$40	$40	$40	$40	$40	$40	$40	$480	$576	$720
Spray Paint	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$600	$720	$900
Roller Bearings + Screws	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$600	$720	$900
Shipping Costs	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$200	$2,400	$2,880	$3,600
Total COGS	$505	$505	$505	$505	$505	$505	$505	$505	$505	$505	$505	$505	$6,060.00	$7,272.00	$9,090.00
Operational Expenses															
Workshop Membership	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$80	$960	$960	$960
Salaries (Team members + Co-op Students)	$10,800	$10,800	$10,800	$10,800	$10,800	$10,800	$10,800	$10,800	$10,800	$10,800	$10,800	$10,800	$129,600	$129,600	$155,520
Insurance	$350	$350	$350	$350	$350	$350	$350	$350	$350	$350	$350	$350	$4,200	$4,200	$6,000
Utilities	0	0	0	0	0	0	0	0	0	0	0	0	0	$0	$0
Customer Support & Administration	0	0	0	0	0	0	0	0	0	0	0	0	0	$0	$0
Legal/Accounting Services	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$6,000	$6,000	$12,000
Marketing	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$500	$6,000	$6,000	$6,000
Miscellaneous	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$50	$600	$6,000	$600
Total Operational Expenses	$12,280	$12,280	$12,280	$12,280	$12,280	$12,280	$12,280	$12,280	$12,280	$12,280	$12,280	$12,280	$147,360	$152,760	$181,080
TOTAL EXPENSES	$12,785	$12,785	$12,785	$12,785	$12,785	$12,785	$12,785	$12,785	$12,785	$12,785	$12,785	$12,785	$153,420.00	$160,032.00	$190,170.00
NET INCOME	-$2,535	-$535	$5,465	$1,465	$1,065	-$535	$1,465	-$2,535	-$1,735	-$135	-$35	-$1,535	-$120.00	$8,928.00	$2,280.00
INCOME TAX (14.47%)	-$367	-$77	$791	$212	$154	-$77	$212	-$367	-$251	-$20	-$5	-$222	-$17.36	$1,291.88	$329.92
NET PROFIT (LOSS - YR 1)	-$2,902	-$612	$6,256	$1,677	$1,219	-$612	$1,677	-$2,902	-$1,986	-$155	-$40	-$1,757	-$137.36	$10,219.88	$2,609.92

Figure 2: The Income Statement

The income statement reflects the financial projections for the bed rail cupholder project over the next three years, showcasing both revenue streams and operational expenses. The projected

revenues are driven by initial support from the MiTacs grant and anticipated product sales, which are expected to grow as the business gains market traction and awareness. The business is expected to grow about 20% per year because of marketing efforts and outreach to hospitals. On the expense side, costs are allocated to essential components such as salaries, production materials, marketing, insurance and legal/accounting services. The first-year operational loss is typical for new startups due to high initial fixed costs. However, the income statement demonstrates positive net profit and break-even point by second year.

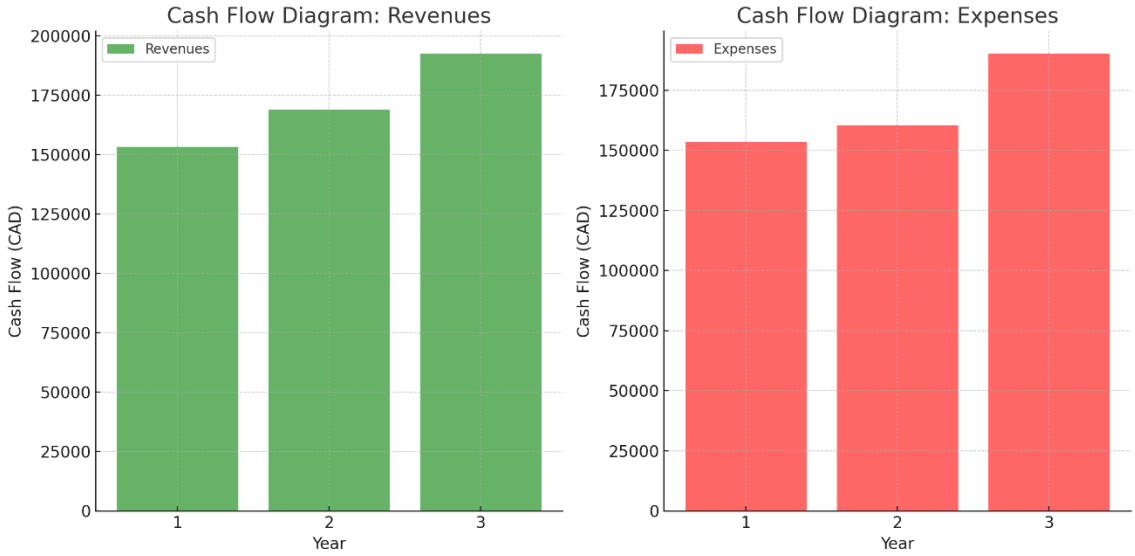


Figure 3 : Cash Flow Diagram of Revenue and Expenses

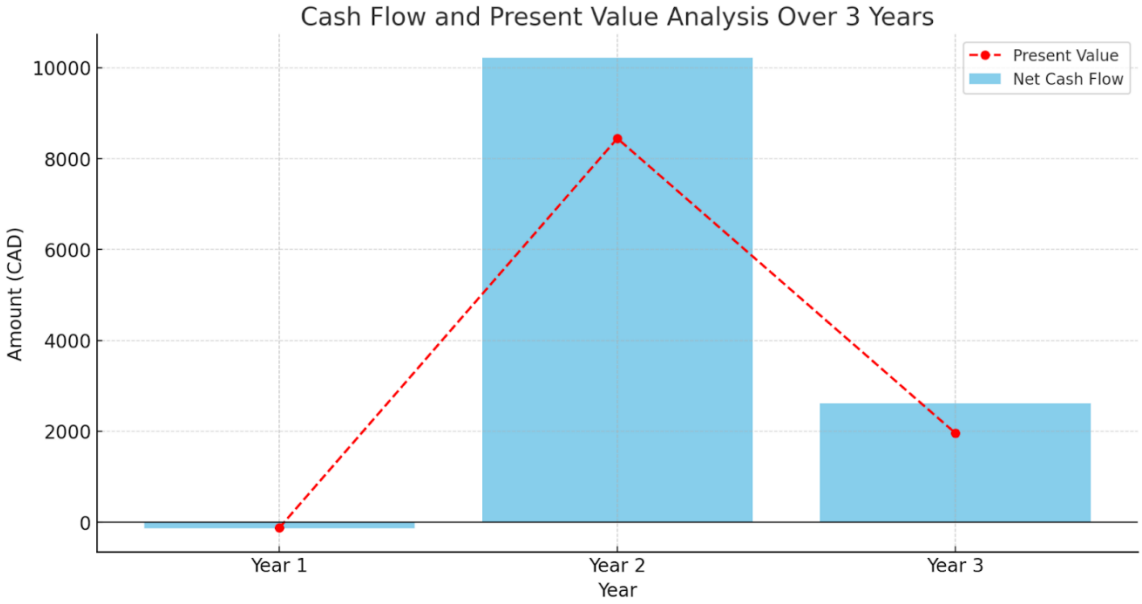


Figure 4: Cash Flow Diagram of Profit/Year

Assumptions:

Market Demand:
Assumption: The market demand for assistive devices, specifically bed rail cup holders designed for people with limited mobility, is driven by an aging population and individuals with disabilities. Market research indicates a steady growth in assistive technology, especially in healthcare and home care settings.
Justification: According to industry reports and healthcare market studies, there is a consistent increase in the demand for products that improve accessibility and quality of life. For example, the assistive technology market has been projected to grow annually due to increased awareness and improved medical care.

Market Share:

Assumption: The project assumes a modest market entry, capturing approximately 0.5% to 1% of the target market in the first year, with potential growth up to 2-3% by the third year as awareness and adoption increase.
Unit Price Strategy:
Assumption: The unit price for the bed rail cup holder is set at CAD $40 per unit based on market research on similar adaptive products and cost-plus pricing strategies.
Justification: Competitors' prices for similar assistive devices, such as cup holders or other bed attachments, range between CAD $30 and CAD $60. The CAD $40 price point positions the product competitively, balancing affordability for the target demographic.
Production and Sales Growth:
Assumption: Sales growth will start slow, with approximately 2000 units sold in the first year and increasing by about 20% for the next couple of years as the product gains popularity.
Justification: This assumption aligns with typical growth trajectories for niche products entering the market. Research indicates that establishing relationships with hospitals, elder care facilities, and disability support organizations can help scale sales over time.
Fixed and Variable Costs:
Assumption: Initial fixed costs include workshop membership fees, salaries, marketing expenses, and insurance, with no equipment investment until profits allow for reinvestment. Variable costs encompass production materials, including steel rods, silicone, spray paint, roller bearings, and shipping.
Justification: These assumptions are based on a thorough analysis of current market prices for raw materials and services.

Funding and Initial Investment:

Assumption: The project will receive initial funding through grants, specifically the MiTacs grant (CAD $6,250/month), and potential reinvestment of early sales revenue.
Justification: Grants such as MiTacs are commonly used by startups and university-affiliated projects to cover initial operational and research expenses. The consistent monthly funding provides a financial cushion for operational costs and supports initial growth phases.

Marketing Strategy and Costs:
Assumption: A budget of CAD $500/month for marketing activities, focused on targeted online advertising and partnerships with hospitals.
Justification: Targeted digital advertising and direct outreach to healthcare facilities are cost-effective strategies that align with the target demographic's purchasing behavior.

NPV Analysis:

Description	**Year 1 (CAD)**	**Year 2 (CAD)**	**Year 3 (CAD)**	**Total NPV (CAD)**
Revenues (Present Value)	153,300	168,960	192,450	423,590.53
Expenses (Present Value)	153,420	160,020	190,410	414,846.80
Net NPV Difference				**8,743.74**

Justification:

Revenue Growth: The increase in revenues over the years is likely due to market penetration, increased customer base, and projected sales increase of 20% per year.
Expense Consistency: Operational expenses remain steady with slight variations as the business expands, salaries as well as cost of goods increase due to higher product demand.
Net NPV: The positive net NPV of CAD 8,743.74 indicates that the project is expected to be profitable over three years when considering the time value of money, suggesting potential for future growth.

4.2 Intellectual property report

The various patents found that align with our bed rail cup holder:

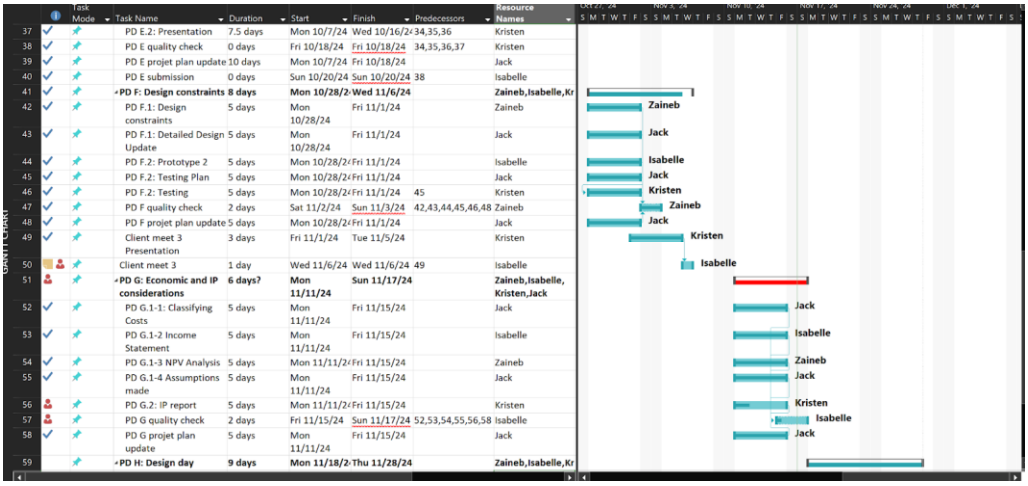
- Patent US5425497A (https://patents.google.com/patent/US5425497A/en)
- Patent US11547230 (https://www.freepatentsonline.com/11547230.pdf)
- Patent USD493072S1(https://patents.google.com/patent/USD493072S1/en)

- **Patent US5425497A** is a thermal sleeve that encompasses the cup to provide safety protection to the users to limit burns from hot drinks. For our product, we are trying to make a sleeve to provide slip resistance, extra grip, and a thermal barrier so it does not harm the user. This aligns with our product's safety goal of enhancing user experience and accessibility. To make sure that it is in compliance with Intellectual Property Laws we

must perform a patent Analysis in US5425497A to determine if its protective scope extends to features like structural design, functionality, and materials.

- **Patent US11547230** is a cup holder that has a ring structure that provides extra stability and ease of use. The key aspect of the patent is the concept of a ring surrounding the cup which we are using a variation of in our design. We must ensure that the ring structure that we create is not structurally similar to that of Patent US11547230 as it could be considered an infringement. Additionally, we must research whether the function of the ring is covered in the patent's claims.
- **Patent USD493072S1** focuses on the visual design of the cupholder, with an adjustability feature that is added onto the side of the cup where it can position the cup at different heights. This patent however focuses on more of the aesthetics of the design. In our design, we have an adjustability feature within the arm that allows it to be adjusted vertically and can be locked in place to limit unnecessary movement. We must consider this patent and ensure that our product does not follow the same structure as in Patent USD493072S1, as that would be considered an infringement.

4.3 Project plan update



	Task Mode	Task Name	Duration	Start	Finish	Predecessors	Resource Names
37	✓	PD E.2: Presentation	7.5 days	Mon 10/7/24	Wed 10/16/24	34,35,36	Kristen
38	✓	PD E quality check	0 days	Fri 10/18/24	Fri 10/18/24	34,35,36,37	Kristen
39	✓	PD E projet plan update	10 days	Mon 10/7/24	Fri 10/18/24		Jack
40	✓	PD E submission	0 days	Sun 10/20/24	Sun 10/20/24	38	Isabelle
41	✓	**PD F: Design constraints**	**8 days**	**Mon 10/28/24**	**Wed 11/6/24**		**Zaineb,Isabelle,Kr**
42	✓	PD F.1: Design constraints	5 days	Mon 10/28/24	Fri 11/1/24		Zaineb
43	✓	PD F.1: Detailed Design Update	5 days	Mon 10/28/24	Fri 11/1/24		Jack
44	✓	PD F.2: Prototype 2	5 days	Mon 10/28/24	Fri 11/1/24		Isabelle
45	✓	PD F.2: Testing Plan	5 days	Mon 10/28/24	Fri 11/1/24		Jack
46	✓	PD F.2: Testing	5 days	Mon 10/28/24	Fri 11/1/24	45	Kristen
47	✓	PD F quality check	2 days	Sat 11/2/24	Sun 11/3/24	42,43,44,45,46,48	Zaineb
48	✓	PD F projet plan update	5 days	Mon 10/28/24	Fri 11/1/24		Jack
49	✓	Client meet 3 Presentation	3 days	Fri 11/1/24	Tue 11/5/24		Kristen
50		Client meet 3	1 day	Wed 11/6/24	Wed 11/6/24	49	Isabelle
51		**PD G: Economic and IP considerations**	**6 days?**	**Mon 11/11/24**	**Sun 11/17/24**		**Zaineb,Isabelle, Kristen,Jack**
52	✓	PD G.1-1: Classifying Costs	5 days	Mon 11/11/24	Fri 11/15/24		Jack
53	✓	PD G.1-2 Income Statement	5 days	Mon 11/11/24	Fri 11/15/24		Isabelle
54	✓	PD G.1-3 NPV Analysis	5 days	Mon 11/11/24	Fri 11/15/24		Zaineb
55	✓	PD G.1-4 Assumptions made	5 days	Mon 11/11/24	Fri 11/15/24		Jack
56		PD G.2: IP report	5 days	Mon 11/11/24	Fri 11/15/24		Kristen
57		PD G quality check	2 days	Fri 11/15/24	Sun 11/17/24	52,53,54,55,56,58	Isabelle
58	✓	PD G projet plan update	5 days	Mon 11/11/24	Fri 11/15/24		Jack
59		**PD H: Design day**	**9 days**	**Mon 11/18/24**	**Thu 11/28/24**		**Zaineb,Isabelle,Kr**

5 Design Day Pitch and Final Prototype Evaluation

Good morning, we were assigned to design a cup holder that can attach to a bed rail to allow our client to independently drink water from bed. This device is targeted at users with limited mobility and or strength. Unlike the common gooseneck designs on the market, that are difficult

to manipulate, our holder rotates easily along the x-axis for effortless adjustment. Since it's made from hollow steel rods it is much sturdier and more durable. The cup holder itself is a versatile wooden disk to allow the client the possibility to upgrade their cup. As I clamp the device to this wooden board you can see how it will not come off, and before putting the arm in, we can adjust which height it sits at. As you can see the device stays static unless you push or pull it to the desired position. We will now encourage you to ask any questions and test out how the device works.

6 Conclusions

Throughout this project, we've learned valuable lessons in time management and teamwork, learning how to effectively collaborate and meet deadlines. Additionally, we've come to understand the importance of taking precise measurements early in the process, minimizing the need to repeatedly iterate on fundamental components of the design.

7 Bibliography

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