Design Project 4 – Power In Community

The Hydro Cover

ENGINEER 1P13 – Integrated Cornerstone Design Projects in Engineering

Tutorial T07

Team Thurs-16

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Submitted: April 10th, 2024

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Academic Integrity Statement

The student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University.

Click or tap here to enter text. 400511264

(Student Signature) *

The student is responsible for performing the required work in an honest manner, without plagiarism and cheating. Submitting this work with my name and student number is a statement and understanding that this work is my own and adheres to the Academic Integrity Policy of McMaster University.

Luay alabed alkader 400526433

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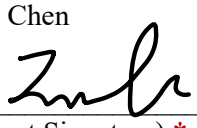
Junyi Chen 400410275



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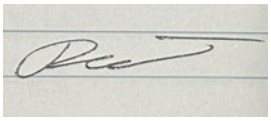

(Student Signature) *

Executive Summary

For an individual in a wheelchair, even everyday circumstances that others barely think about can be challenging to navigate and even dangerous. To a person using a motorized wheelchair, bad weather is one of those obstacles. If caught in the rain, they may struggle to don appropriate protection, and if the electrical console of their wheelchair becomes damaged from the water, they could even be stranded. Therefore, the client is in dire need of a more efficient solution than covering themselves in garbage bags.

Our innovative solution introduces a retractable rain cover inspired by the convenience of convertible car roofs and baby crib designs. Crafted with meticulous attention to detail, our final prototype boasts three PVC tube arms engineered with a locked rotation, ensuring a controlled extension of up to 60 degrees. These arms are enveloped in a transparent, waterproof plastic cover, allowing our clients to maintain optimal visibility without compromising protection from the elements. The inclusion of a strategically positioned lever on the right side ensures effortless deployment and storage, catering to the user's convenience.

Our product offers unparalleled versatility, providing a removable, compact, and swiftly deployable cover for unexpected rain showers. Designed with the user's needs in mind, it safeguards both the user and their wheelchair's electrical console while accommodating limited mobility in the spine and arms. Featuring a lightweight construction, our shield minimizes battery drain and seamlessly folds away when not in use. Its hassle-free removal from the back of the wheelchair enhances user experience, reflecting our commitment to practicality and functionality.

To further enhance the design, future iterations could incorporate a locking mechanism for the arms or base, ensuring the shield remains securely closed until needed. While our current design provides stability under normal conditions, we acknowledge the potential inconvenience caused by abrupt movements or physical disruptions and seek to address this for an even smoother user experience.

Main Body

Background Information

The client was born with a condition called Spina Bifida, which paralyzes them from the waist down as well as limiting her movement in her left hand. She travels using a motorized wheelchair and uses it to transport items. When forced to deal with bad weather conditions, she needs to cover the electrical controls of her wheelchair with plastic bags in order to prevent water damage.

Problem Framing

Refined Problem Statement:

The customer is having difficulty sheltering her wheelchair from the rain, so we want to create a cover (akin to a convertible for vehicles) to protect her from the elements.

Objectives:

- Cover is compact when not in use
- Extended length reaches electrical console
- Cover is strong enough to withstand weather conditions and daily use
- Cover is easy to lift and deploy
- Cover is detachable

Constraints:

- Must be under $100
- Must be waterproof and protect the client
- Must be under 4.5 kgs

Conceptual Design:

Existing Ideas/Solutions:

For the client, the main solution they had when encountering the rain was to cover herself and the electrical console with garbage bags. There are many other alternatives to keeping wheelchair users dry, such as raincoats, ponchos and umbrellas, and other purchasable plastic covers to protect the console.

Design Alternatives:

There were two main alternatives to the current design. One was an umbrella holder, and the other was a tent shaped cover that would slide back and forth. We decided against these designs because they would not only be harder to implement but would get more in the way when not in use.

Decision Matrices:

Weight	1	1	2	2	2	3	
Objective	cost	lightweight	durable	easy of use	compactibility	weather resistance	total
3D printed frame	4	3	5	2	5	5	46
Paper frame	5	4	2	2	5	2	33
lever design	5	5	3	4	2	5	43
crank wheel	4	3	5	5	3	5	48

Design Evaluation:

The TAs, IAIs and Science students generally agreed with the concept, and were more concerned about smaller details, such as how we would attach the cover to the wheelchair, whether it can be removable, and finding a method to make it easier for the client to open and close.

We used this feedback from the earlier stages of development to come up with some solutions, namely the lever implemented into the side of one of the arms so that the client would not need to reach above and behind them, which is something they may be incapable of doing with their disability.

Final Proposed Design:

The final cover design attaches to the back of the wheelchair with loops that can slide on and off the client's wheelchair. When the client encounters rain, all they need to do is push down on the lever until the cover extends to its full length. The rotating mechanism at the base will lock once the arms have moved a total of 60 degrees, and the client simply needs to pull the cover back up when done.
The cover extends a horizontal length of 70 cm, is 2 cm wide when folded up, and weights 2.76 kg. It's arms are made of ¾ inch PVC tubes and the base is 3d printed.

Objectives and Constraints during testing:

Our quantitative testing plan includes the extended length of the cover to see if it could protect the console at the end of the chair's armrest, the size of the cover when folded up, the PVC tubes' tensile strength, and the constraints were on the weight and the level of waterproofness.
After the testing, we found that the extended length was 70cm, was around 2cm wide when folded, and weighed 2.76 kg. We were unable to break a PVC tube, and when water was poured over the cover, the team member inside stayed completely dry.

As for how we built our project, we had to drill holes into our PVC tubes so that we could screw them into the mechanism we created. Then we had to saw the tubes down to three separate lengths as each level of our frame was slightly longer than prior (so that it could fold). With the cut off pieces of the PVC tubes, we were able to use them for the top of the frame. In addition to this we had to make a cut out for the lever on the right-hand side and then separately cut a tube to be attached onto the frame. After this, we attached the PVC tubes to each other with the fillings that we had bought, and then we screwed the tubes in the frame. The last part was just attaching the plastic cover to the frame, and we did this using hot glue.

- Construction/development methods (e.g., bill of materials, device construction, discussion of why certain materials/items would be used)

Details on testing plan and changes made:

The testing plan remained consistent over the course of the project. For easier metrics like the extended length of compact size, the prototype would just need to be measured with a tape measure or ruler. The weight was measured with a scale. We tried a variety of methods when testing the durability of the PVC pipes, trying to bend or break the pipes with our hands or other heavy objects, but nothing we did made a dent. One thing we did find when testing the durability was the copper fittings for the PVC pipes were loose and were prone to falling out if enough pressure was placed on the design, so they were replaced with plastic ones.

Conclusions

Reflecting on our design project, we have identified several areas where additional time and effort could lead to significant improvements in our device. One crucial step we would have liked to have spent more time on was the existing solutions part of our research. By gaining a deeper understanding of the existing solutions we would've been better able to design a mechanism that could extend our cover. This is because as it is right now our mechanism have a notch that stops it from extending more than 60 degrees forward, and if that notch breaks, we have the cover to catch frame of the cover. However, what would have been nice would be to have a mechanism that is not only reliant on a single notch so that it would be less likely for it to break while in use. With this is a small issue as it made no difference in our final testing. Our cover was still able to extend the required length and retract when not in use.

Additionally, implementing another prototype would have allowed us to address this specific shortcoming within our mechanism. This is because due to time limitations, we went from our preliminary design straight to the final design without having that much time to test the strength of the locking mechanism. If we had a miniature model of our final design, that would have given us room to make some final changes to our mechanism before printing as we would have caught this minor flaw earlier on.

Lastly, another thing that we would change in our design process would be to allocate more time for assembling the final prototype. This is because our team underestimated how long it would take to not just assemble the parts, but to also gather them from the specific stores. This was not a major issue for our team as we had to do some rescheduling while the project was underway. However, it would have benefited us all to plan it out from the beginning rather than stressing to allocate this stage more time. The biggest take away from this mishap is to assume the project will take longer than you originally plan.

Reference List

[1] "Preparing your wheelchair for snow: Gillette Children's," Preparing Your Wheelchair for Snow | Gillette Children's, https://www.gillettechildrens.org/stories/preparing-your-wheelchair-for-snow (accessed Mar. 2, 2024).

[2] L. Crosby, "7 products and 6 tips for wheeling in the rain," United Spinal Association, https://unitedspinal.org/7-products-and-6-tips-for-wheeling-in-the-rain/ (accessed Mar. 2, 2024).

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[4] What Is Polyester? A Complete Guide https://www.apexmills.com/media_post/what-is-polyester/

[5] Wikipedia Nylon https://en.wikipedia.org/wiki/Nylon

[6] What is Canvas Fabric: Properties, How its Made and Where https://sewport.com/fabrics-directory/canvas-fabric

[7] You Use it Daily. But What IS Polyethylene Plastic? https://www.reliance-foundry.com/blog/polyethylene-plastic

[8] Wikipedia, Dyneema Composite Fabric https://en.wikipedia.org/wiki/Dyneema_Composite_Fabric

Appendices

Appendix A: Supporting Documents

Commercial Product:

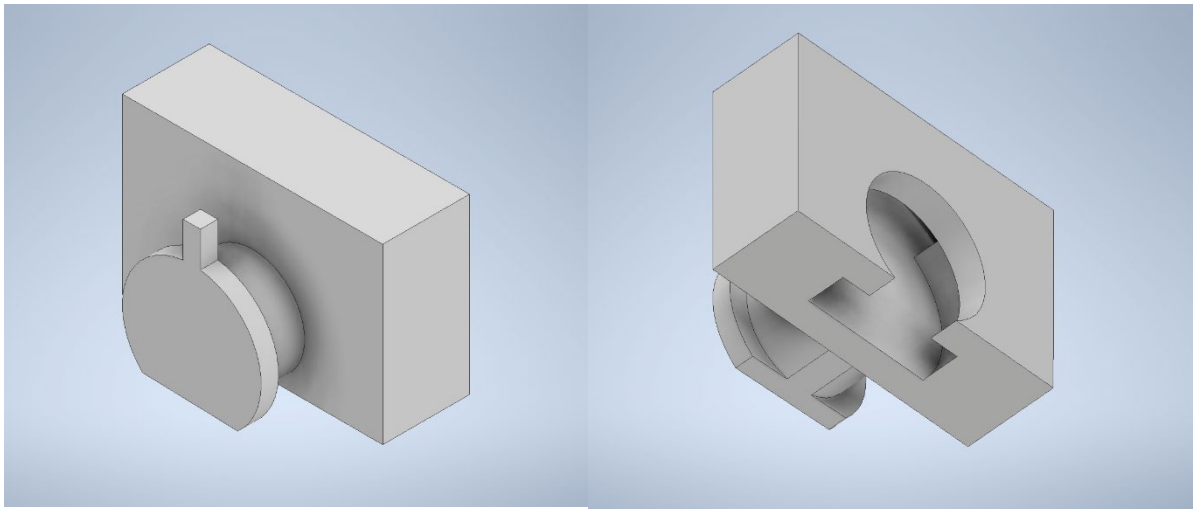
Veltop Cosy Plus 2

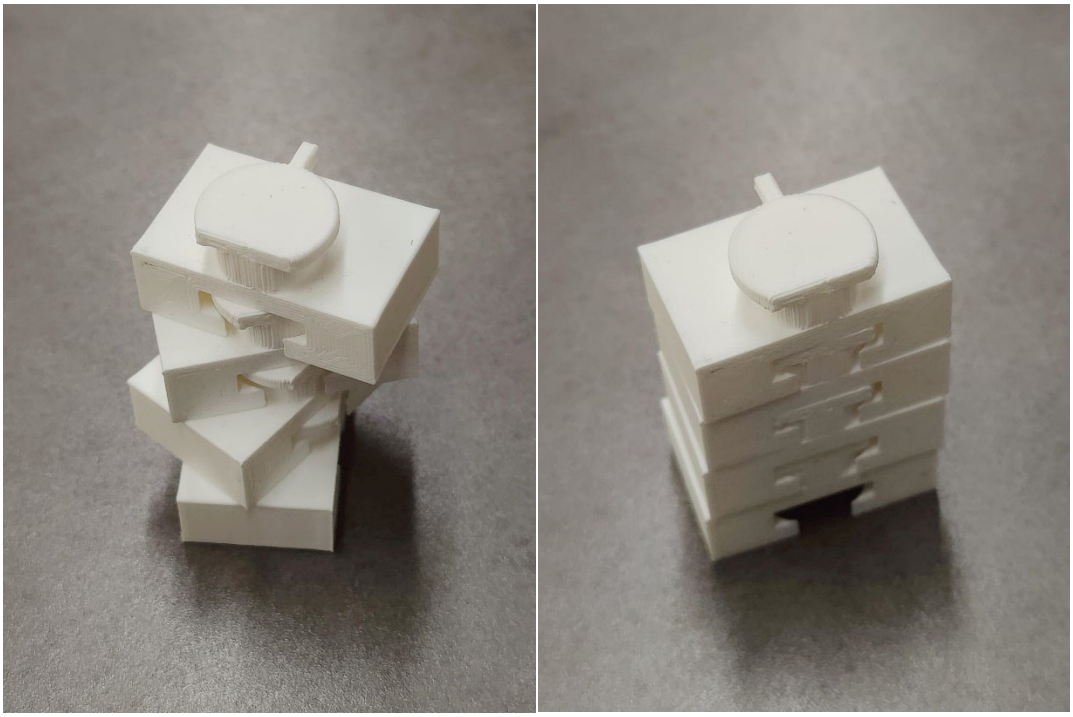
https://veltop.eu/en/veltop-cosy-plus-2/

Prototypes:

First prototypes:

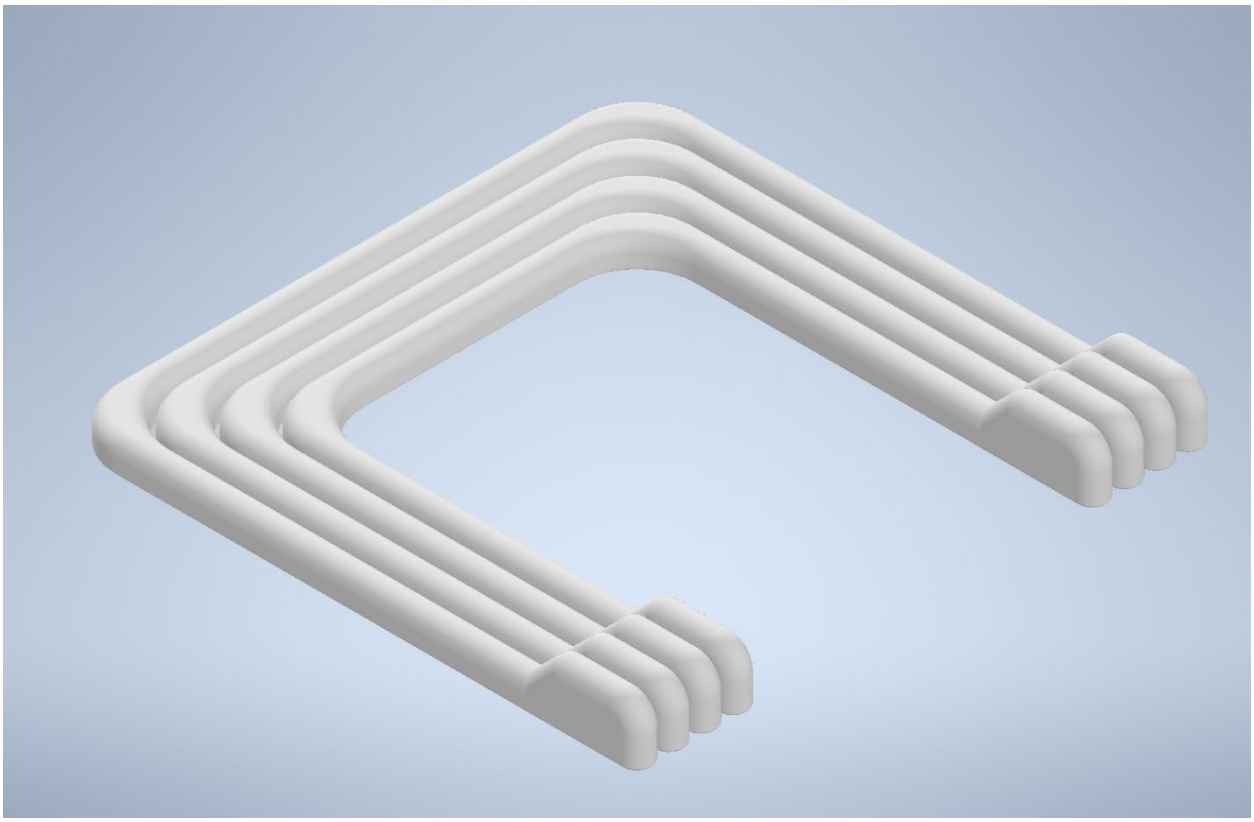
This prototype is for test the tolerance of 3D printing. Because the mechanism is printed in place and no need to assemble.

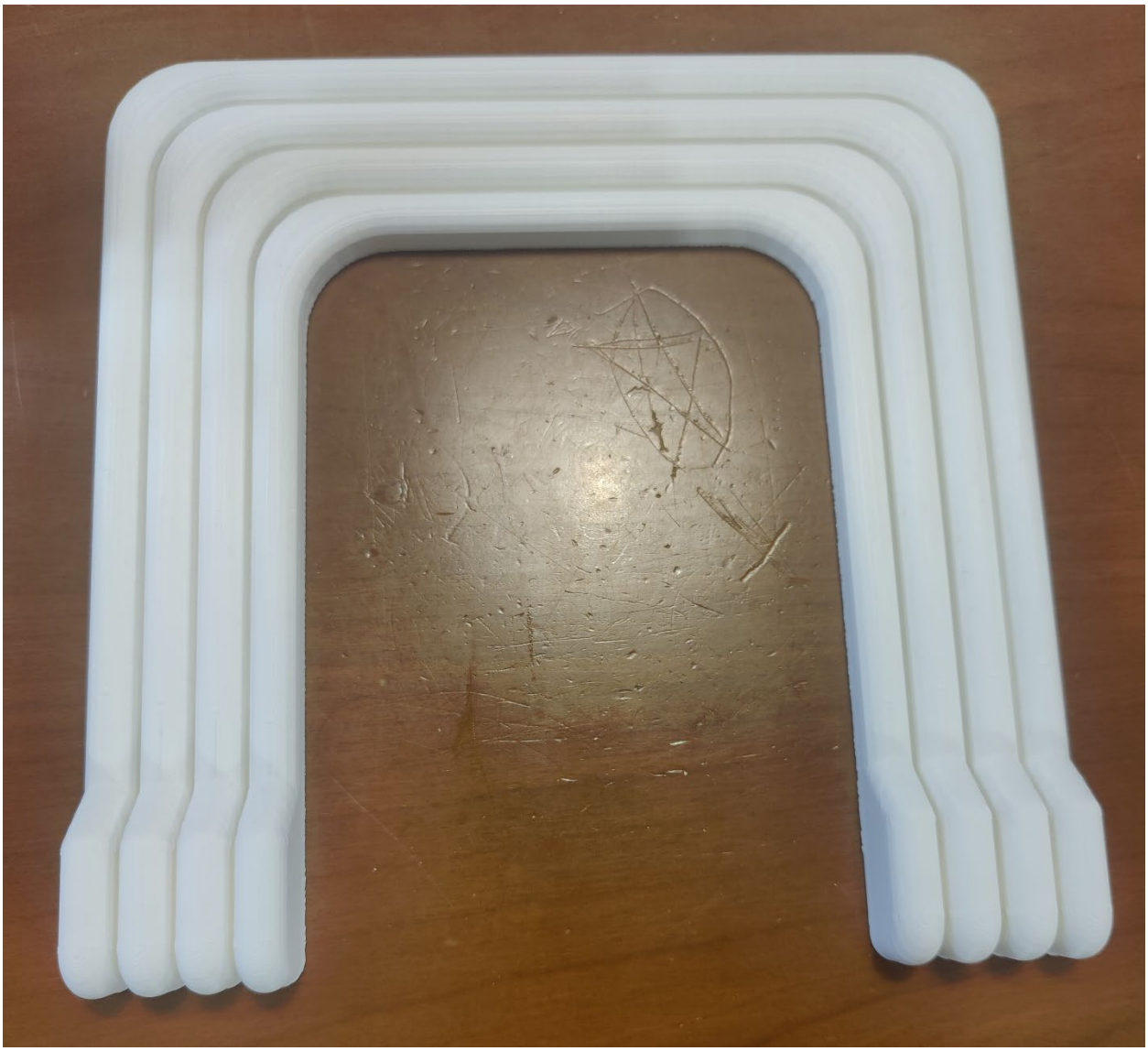




Second prototypes:

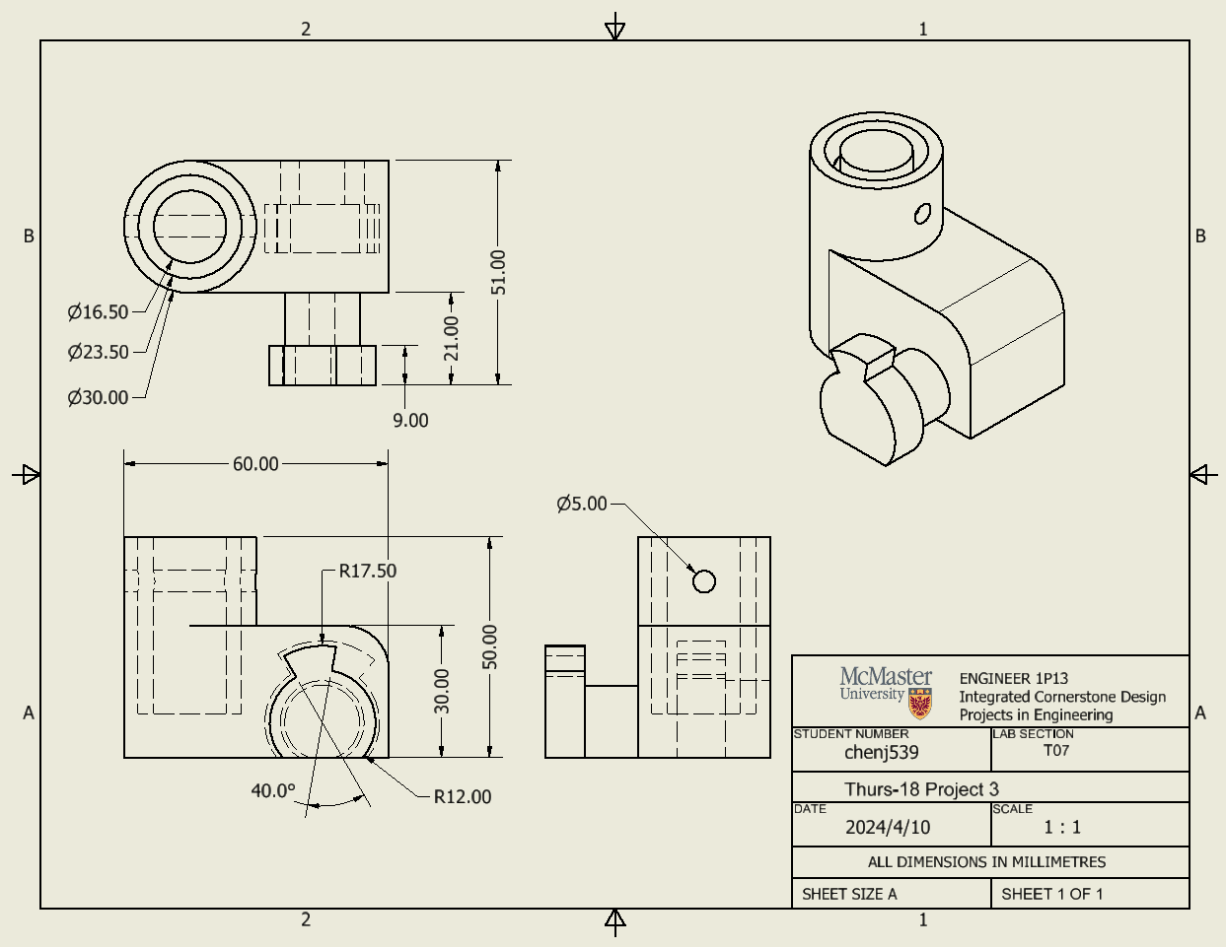
This just a prototype for determining the actual size of the design also the angle of rotation needed

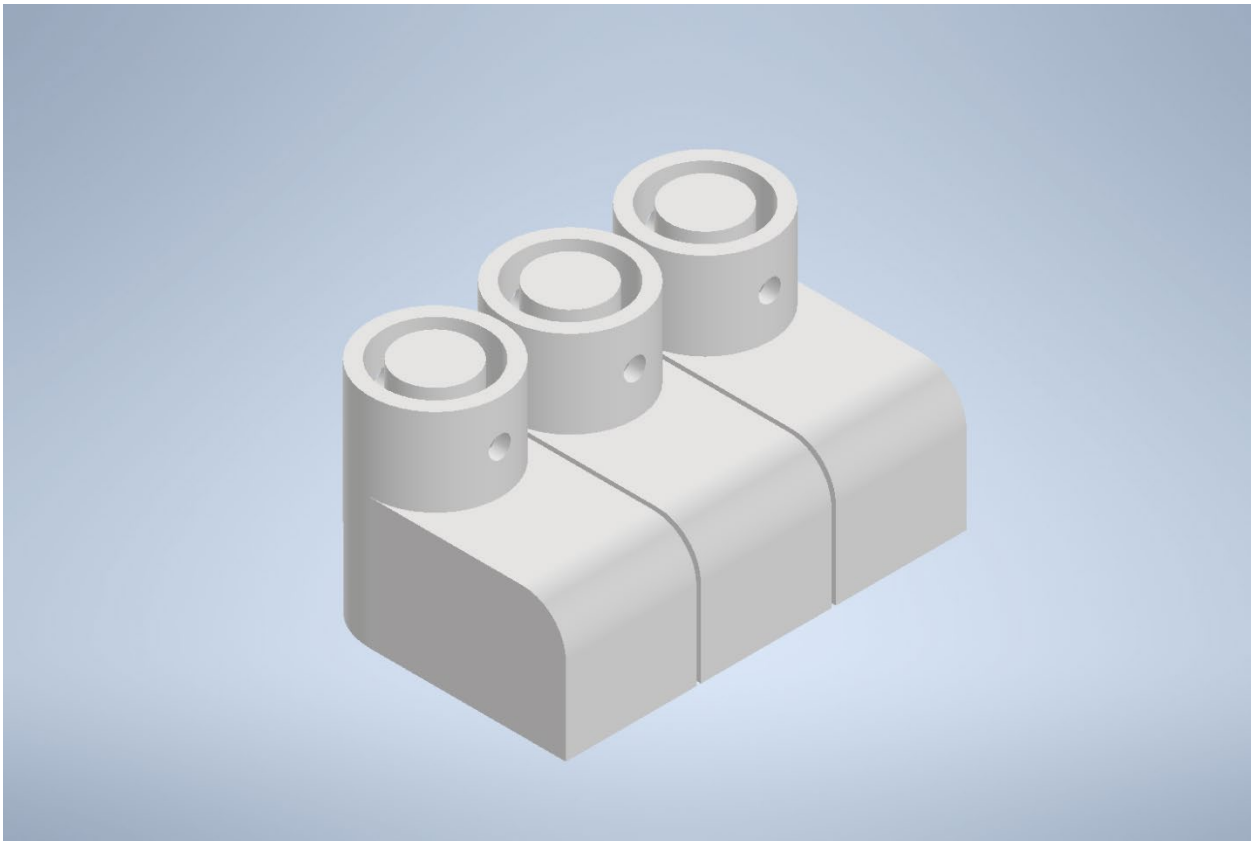


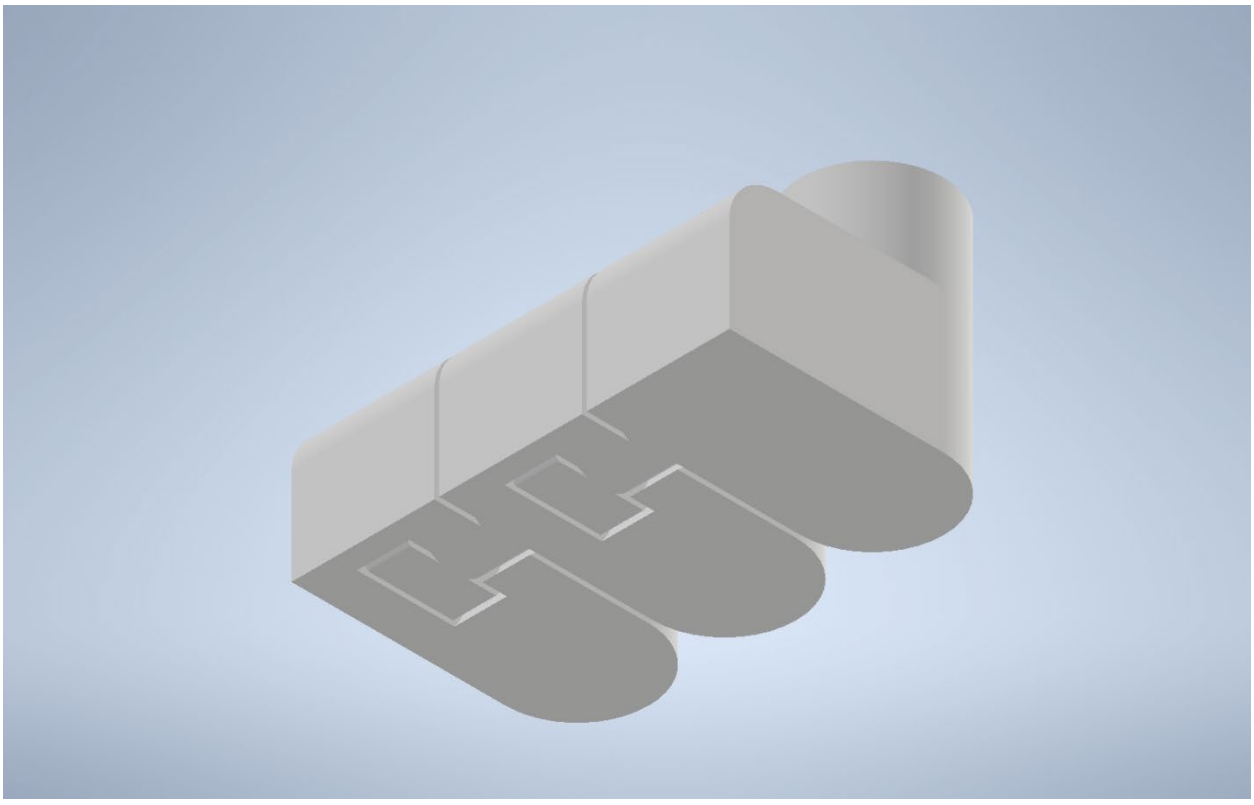


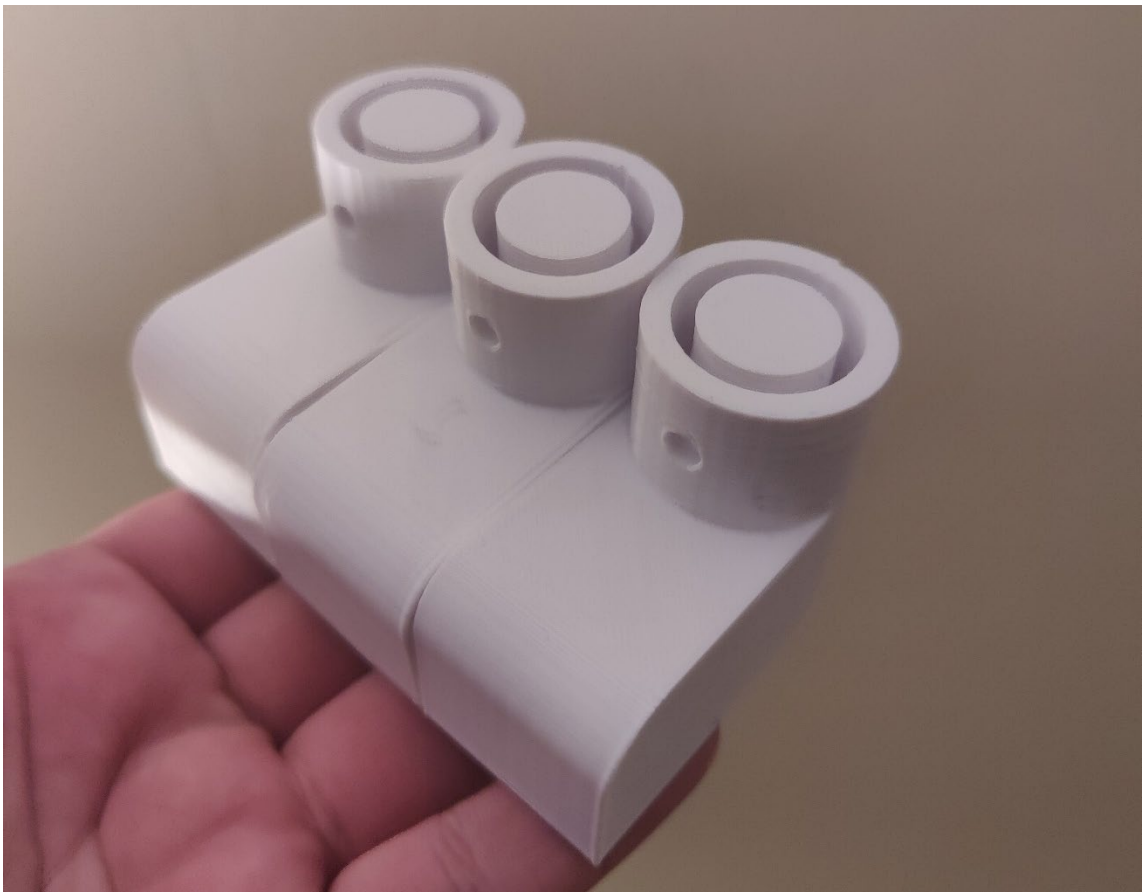
Final design(rotation mechanism only):

This is the final design, the pvc tube will be mounted to the mechanism and a M4 screw will go through to secure it won't come off









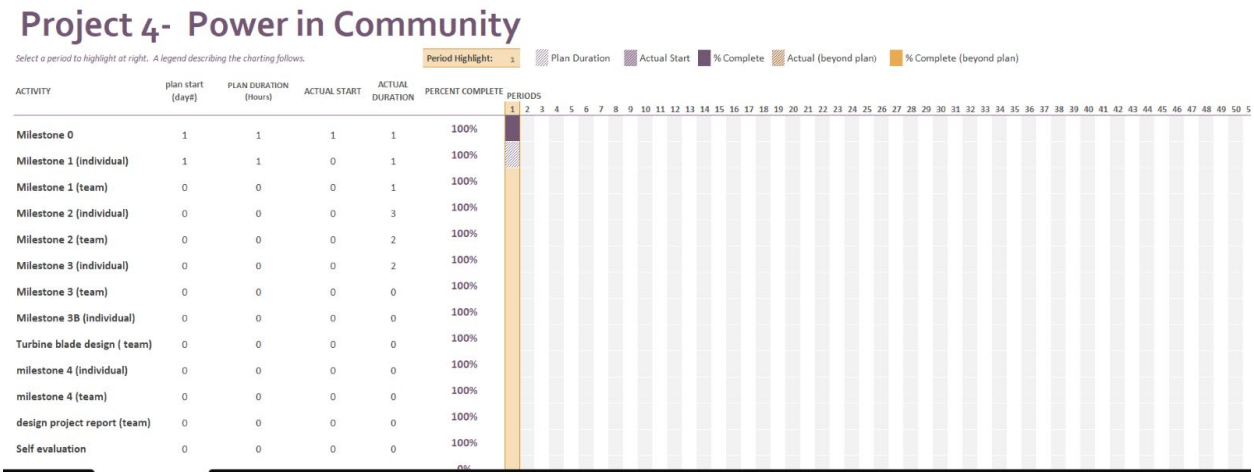
List of material costs:

- PVC tubes(7x 5ft tubes) : 62.56 CAD
- PVC fittings(3 straight fittings, 6 right angle fittings): 18.89 CAD
- Plastic table cover: 15.06 CAD
- 3D printing: No cost

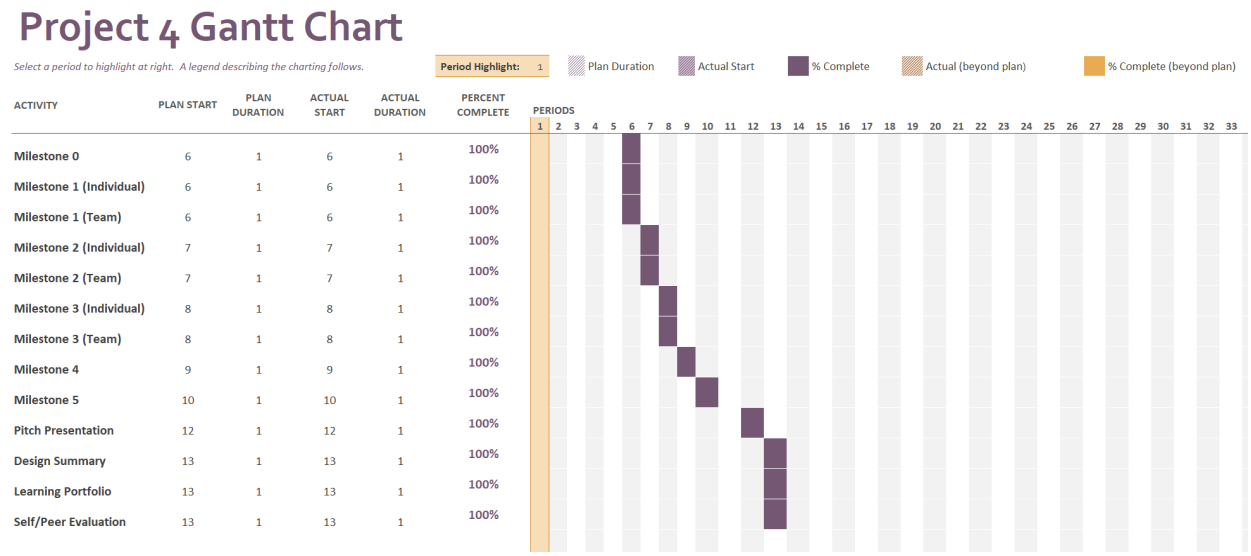
Total: 96.51 CAD

Appendix B: Project Schedule

Preliminary Gantt Chart



Final Gantt Chart:



Appendix C: Scheduled Weekly Meetings

PM-1 March 5th:

- Defined project scope and objectives.
- Discussed various material options for the anti-rain cover.
- Design Team brainstormed ideas and sketched initial concepts.
- Post-Meeting Activities: Select material and finalize initial design sketches.

PM-2 March 12th:

- Progressed with material selection and procurement.
- Design Team began prototyping key components of the cover.
- Engineering Team started structural analysis of the design.
- Informal Client-check: Preliminary design concepts presented and affirmed.
- Post-Meeting Activities: Continue prototyping and analysis.

PM-3 March 19th:

- Completed initial prototypes of key components.
- Engineering Team conducted stress tests on prototypes.
- Design Team refined dimensions and features based on test results.
- Client-check: Reviewed updated design specifications and provided feedback.
- Adjusted design for better manufacturability.
- Post-Meeting Activities: Further refinement based on client feedback.

PM-4 March 26th:

- Continued refinement of design and material selection.
- Engineering Team optimized structural integrity of components.
- Client expressed satisfaction with design progress.
- Post-Meeting Activities: Finalize design and material specifications.

PM-5 April 6th:

- Presented detailed design review to client.
- Client approved final design and material choices.
- Procurement Team initiated bulk material order.
- Manufacturing Team began production of final components.
- Post-Meeting Activities: Monitor manufacturing process.
- Product Demonstration and Delivery April 9:
- Assembled final anti-rain cover for client demonstration.
- Client inspected cover for quality and functionality.
- Addressed client queries and provided usage instructions.
- Successful demonstration of anti-rain cover's effectiveness.

→ **Delivered final product to client's satisfaction.**

Appendix D: Design Studio Worksheets

ENGINEER 1P13:
PROJECT FOUR WORKSHEETS (TEAM)

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PROJECT FOUR MILESTONE ZERO: TEAM DEVELOPMENT AND PROJECT PLANNING

MILESTONE 0 – COVER PAGE

Team ID: Thurs-16

Please list full names and MacID's of all *present* Team Members.

Full Name:	MacID:
Junyi Chen(Oliver)	Chenj539
Evan Hong	honge14
Talha Nauman Hashmi	hashmt1
Luay alabed alkader	alabedal

Insert your Team Portrait in the dialog box below.

juri

MILESTONE 0 – TEAM CHARTER

Team ID: Thurs-16

Incoming Personnel Administrative Portfolio:

Prior to identifying Leads, identify each team members incoming experience with various **Project Leads**

	Team Member Name:	Project Leads
1.	Evan Hong	XM XA XC ☐S
2.	Junyi Chen	X M X A ☐C X S
3.	LUAY ALABED ALKADER	☐ M X A XC X S
4.	Talha Nauman Hashmi	XM XA ☐C ☐S

To 'check' each box in the Project Leads column, you must have this document open in the Microsoft Word Desktop App (not the browser and not MS Teams)

Project Leads:

Identify team member details (Name and MACID) in the space below.

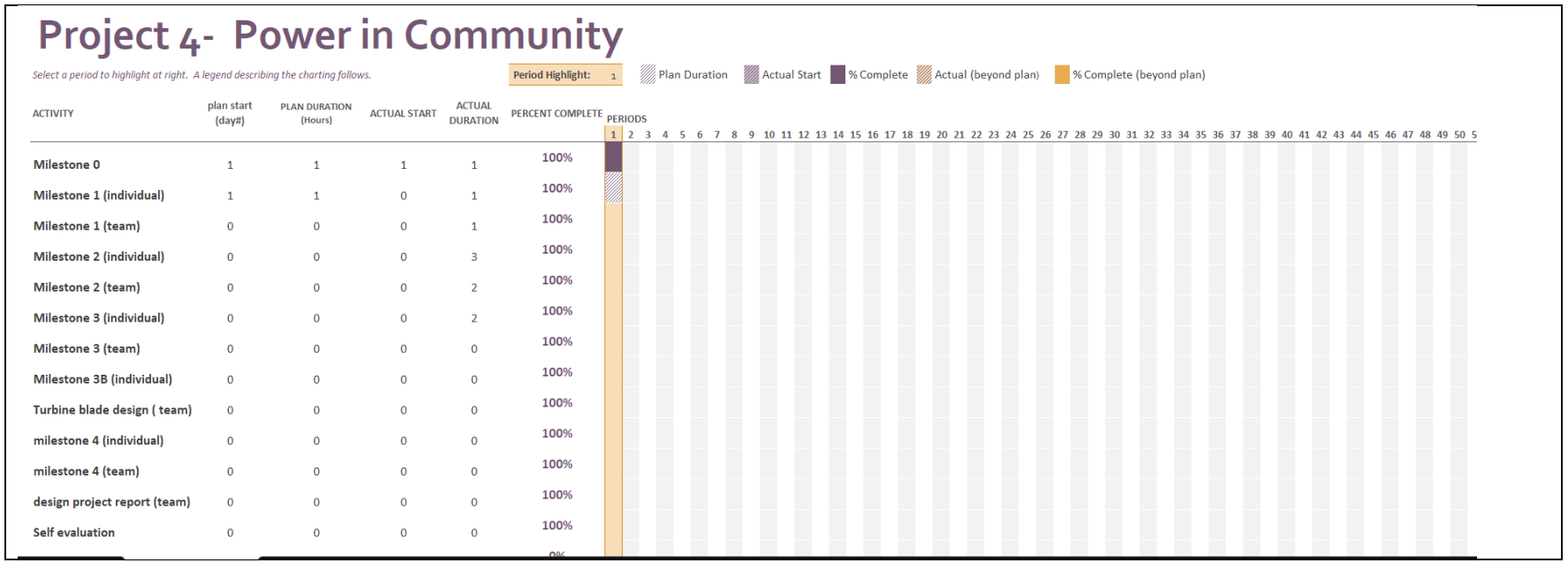
Role:	Team Member Name:	MacID
Manager	LUAY ALABED ALKADER	ALABEDAL
Administrator	Junyi Chen	Chenj539
Coordinator	Talha Hashmi	Hashmt1
Subject Matter Expert	Evan Hong	honge14

MILESTONE 0 – PRELIMINARY GANTT CHART (TEAM MANAGER ONLY)

Team ID: Thurs-16

Full Name of Team Manager:	MacID:
LUAY ALABED ALKADER	ALABEDAL

Preliminary Gantt chart



MILESTONE 0 – PREVIOUS PROJECT EXPERIENCE

Team ID: Thurs-16

In the table below, detail each of your group members' experience and skills that will be useful in Project 4. This can include prototyping knowledge, software skills, modelling, testing experience and any other relevant information.

Team Member	**Skills**
Luay alabed alkader	- Modeling - 3D printing - Basic python
Evan Hong	- Modeling in inventor - Coding in python - 3d printing
Junyi Chen	- 3D printing Slicer - Autodesk inventor - Basis python
Talha Nauman Hashmi	-basic python -Autodesk Inventor

PROJECT FOUR MILESTONE ONE: PROBLEM FRAMING AND TEST PLAN

MILESTONE 1 – COVER PAGE

Team ID:	Thurs-16

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Talha Nauman Hashmi	Hashmt1
Luay alabed alkader	alabedal
Junyi Chen	Chenj539
Evan Hong	honge14

MILESTONE 1.2 – PROBLEM FRAMING

Team ID: Thurs-16

1. As a team, come up with an initial problem statement and include it in the space below.
   → Make use of your client notes to define your primary function(s)
   → Remember to avoid solution-specific statements
      - Focus on what your design *should* do for the client in a general sense (not *how* to do it)

Who needs what because why: Our client wants to make her life more accessible so that she can live life to the fullest and have no constraints of moving.

MILESTONE 1.3 – TESTING PLAN DEVELOPMENT

Team ID: Thurs-16

1. As a team, come up with 5 objectives and at least 1 constraint that your design should meet and justify the reasoning behind your choices.
   → Feel free to use such design tools as objectives trees, how/why ladders etc.

Justify your team's reasoning behind the choice of objectives:

Objective	Rationale
1. Protect client from rain	Protect client and the wheelchairs electronics from rain and snow while outside
2. Easy and fast to set up	Client should be able to put up the rain shield quickly without much difficulty
3. Light weight	So it doesn't way the client down and use more battery life when moving around
4. high strength	Able to withstand Canadian weather and last a long time
5. Compactibility	So it easily folds up behind the chair so that It doesn't get in her way
Constraint	Rationale
1. Budget	Our budget is limited; thus, our solution must be priced at $100 or less.

2. Fill out the table below with associated metrics (including units) for each objective.
   Remember: Metrics should be something you can actually test or measure as part of your process (e.g., calculate weight of a part by iProperties in CAD, test results of a physical prototype).

Objective:	Weather resistance
Unit/Metric:	How dry she stays (qualitative)

Objective:	Ease of use
Unit/Metric:	Client satisfaction (qualitative)

Objective:	Light weight to lift and set up.
Unit/Metric:	Mass g, kg (quantitative)

Objective:	Strength
Unit/Metric:	Yield strength Pa (quantitative)

Objective:	Compatibility
Unit/Metric:	cm^3 (quantitative)

Constraint:	Limited Budget and less expensive >$100.
Unit/Metric:	Dollar

3. Next, come up with a testing plan for evaluating these objectives using the metrics you identified. Describe what equipment/resources will be needed, time to complete the test and another other pertinent information to completing the task.
   → An example testing plan is provided to you on Avenue, titled "P4 Testing Plan Example"

Objective	Testing Method
1. Weather resistance	Simulate rain over the cover and see how wet the ground is below

2. Ease of use	Use the design while in chair
3. Light weight to lift and set up.	Weight must be less than > 2 kg
4. Strength	Place stress on the structure
5. Compatibility	Measure size when folded up
Constraint	Testing Method
1. Cost	Can we afrord it

MILESTONE 1.4 – REFINED PROBLEM STATEMENT

Team ID: Thurs-16

1. As a team, create a refined problem statement using the objectives you have identified and justified. Outline the Who, Where, why, and What elements of your problem statement. Then write the refined problem statement below.

- Who? – The client
- Where? – Outdoors
- Why? – To protect her wheel chair from the harsh weather
- What? – Protect Client and wheelchair from weather

Refined Problem Statement:

The customer is having difficulty sheltering her wheelchair from the rain, so we want to create a cover (akin to a convertible for vehicles) to protect her from the elements.

MILESTONE 1.5 – DESIGN EXPLORATION PREPARATION

Team ID: Thurs-16

1. As a team, discuss which topic each member will cover in the research summary. Then, fill out the table below.

Team Member	Research Topic
Luay alaved	Metal frame
Evan Hong	Existing solutions
Junyi Chen	Cover materials
Talha Hashmi	How convertibles in cars are made

PROJECT FOUR MILESTONE TWO: DESIGN EXPLORATION AND DESIGN REVIEW #1

MILESTONE 2 – COVER PAGE

Team ID: THURS -16

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Talha Nauman Hashmi	Hashmt1
Luay alabed alkader	alabedal
Junyi Chen	Chenj539
Evan Hong	honge14

MILESTONE 2.3 – FUNCTIONAL ANALYSIS

Team ID: THURS -16

Summary of changes:

In the space below, please highlight any changes that were made to your items in Milestone 1 (objectives, constraints, problem statements, etc.) Ensure you have at least **one constraint** if you don't already have one. Make sure you also explain and justify your reasons for making those changes. Consider additional client notes and the results of your independent research assignments when making potential changes. Make sure to include an **updated** Refined Problem Statement as well.

Changes from Milestone 1

- We chose to add a crank to avoid the electrical component of a convertible, similar to an old-fashioned car window. This is because our team lacks hands-on expertise with circuits and wiring, so if we used a battery to power the converter, we would spend a significant amount of time on this project simply understanding how circuits operate. By including a crank, we are also matching our project with the client's claimed ability to operate from her spine up, which means she can use her the hands to raise or lower the gear and draw up the rain cover. In addition, like an old-fashioned car window, by adding a crank, we can attach it to the chair and add an anti-water-resistant cover to the crank to safeguard the client from the rain.

1. Include a copy of your team's functional analysis below.

Function	**Means**					
Extend	Automated	Manually pulled up	Manually cranked up and down			
Flexibility and waterproof cover	nylon	PE	Polyester cloth	Polymer materials	Canvas	Cuben Fiber

Durable skeleton	Baby Stoller design	Car convertible	Umbrella design	Funnel design	House roof /tent design	

MILESTONE 2.5 – DESIGN REVIEW

Team ID: THURS -16

Design Review Comments: Use the space below to document feedback for your design

Include feedback from your faculty mentor, staff, or assigned TA/IAI in this row - Work on how to crank up and down
Include feedback from science students in this row. (if applicable) - *Make it more coinvent for her so she doesn't need to reach* -

PROJECT FOUR MILESTONE THREE: PROTOTYPING, DECISION MAKING AND DESIGN REVIEW #2

MILESTONE 3 – COVER PAGE

Team ID: THURS -16

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
LUAY ALABED ALKADER	ALABEDAL
Evan Hong	Honge14
Junyi Chen	Chenj539
Talha Hashmi	Hashmt1

MILESTONE 3.2 – DECISION MAKING

Team ID: Thurs-16

As a team, use a decision matrix to aid you in choosing two concepts to proceed with. Your concept titles should be descriptive (i.e., "Pencil with Hook" instead of "Design A"). If you had your Design Review **before** completing this decision matrix, use the feedback you were given from the review to influence your ratings of your concept(s).

Include your team's Decision Matrix below.

Weight	1	1	2	2	2	3		
Objective	cost	lightweight	durable	easy of use	compactibility	weather resistance		total
3D printed frame	4	3	5	2	5	5		46
Paper frame	5	4	2	2	5	2		33
lever design	5	5	3	4	2	5		43
crank wheel	4	3	5	5	3	5		48

Notes for TA meeting
Look how we are actually are connecting it
Make sure it can be removed so that it can be adjusted for other wheel chairs
Don't get in her way and not making her chair an annoyance to sit in
Make it waterproof (crankshaft or lever)

Team ID: Thurs-16

The numbers you associate with your criteria (objectives and constraints) will probably be an estimation at this point, so **your top two concepts may not always end up being the top two scoring from the decision matrix**. You should provide justification for your team's thought process in choosing the top two concepts. This should include, but is not limited to, explaining:

- → Your choice of decision matrix tool
- → Your rationale behind your choice of criteria
- → Why you prioritized criteria the way that you did (if ranking and/or weighing them)
- → What metrics you used to decide your scoring of concepts within the criteria
- → Present your top concept(s) during your Design Review
  - If you had your Design Review **before** completing this part of the worksheet, your top two concepts may or may not be the ones you presented during your Design Review
  - Include in your justification how the Design Review influenced your top concepts

	Insert your team's top two concepts below.
Concept 1:	Lever
Concept 2:	3D printed wheel Crank

Include your team's justification below.

We decided to go with the lever as it is a lot simpler design making it easier to use and maintain. The problem with the wheel design is that it would need string, pulleys, mounts to place the pulley, while the lever just required two rectangles at a 90 degrees angle. The lever design did score fairly well compared to the others on the decision matrix tool, the main place that it was lacking in was compatibility but as a gr

MILESTONE 3.3 – REFINED PROJECT TIMELINE

Team ID: Thurs-16

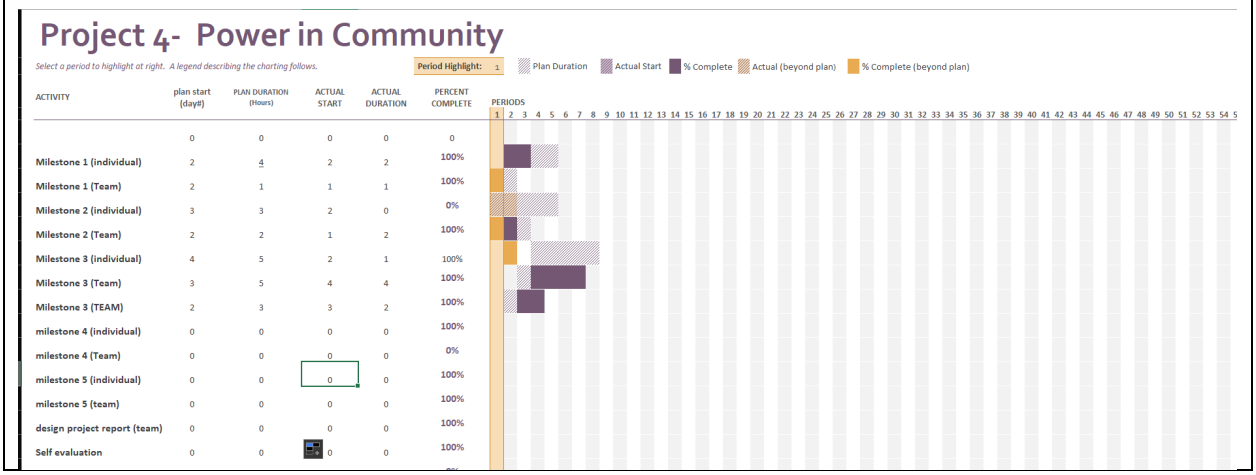
Include a list of all remaining tasks that need to be completed such that all final deliverables and remaining Milestones can be met. These may include but are not limited to:

→ Prototyping
→ Fabrication
→ Material Purchasing/Allocation

Be as specific as possible and allocate each task to a group member. There is no requirement on the number of outstanding tasks your group may have; ensure that the tasks encompass the remainder of the project and are achievable. Add these remaining tasks to your team Gantt chart and include an updated image below.

Task:	Time Needed to Complete:	Deadline to Complete By:	Assigned Group Member:
Buy materials (the pvc tubes for the sheathing mechanism and the lever, the covers and the screws)	A day	March 12th	Luay alabed alkader and Junyi
CAD model (, the place where it rotates)	4-6 hours	March 12th	Evan and Talha
Print parts	2-3 days	March 16th	Junyi Chen
Assemble	2-3 hours	March 17-18	Group

Include an updated image of your Gantt chart:



PROJECT FOUR MILESTONE FOUR: REFINED PROTOTYPING AND TESTING PLAN

MILESTONE 4 – COVER PAGE

Team ID: Thurs-16

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Evan Hong	honge14
Junyi Chen	cheng539
Talha Hashmi	hashmt1
Luay alabed alkader	alabedal

MILESTONE 4.1 – REFINED PROTOTYPE

Team ID: Thurs-16

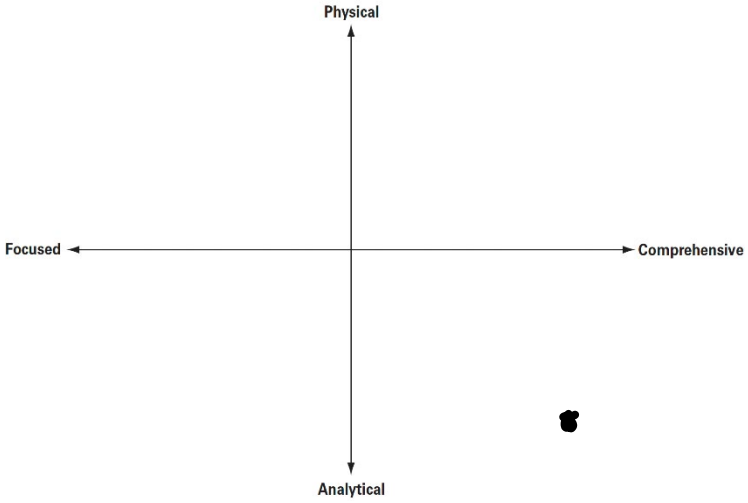
1. Create an outline for the creation of your refined prototype using the following worksheet.

Team ID:	MacID:

Write a short description of your refined prototype below.

Our prototype consists of 7 pvc tubes, some fittings and a plastic cover. It is meant to mimic how a baby Stoller protects a baby from the harsh weather. The majority of the tubes have been measured, cut and sanded to fit the base. The base mechanism has a fixed rotation that only allows for a certain range of movement, so the cover does not fall all the way down. The pvc pipes slot into an opening in each of the turning mechanisms and will be secured with screws. There are multiple fittings for the pvc pipes to connect them to each other and make right angles. A lever has also been incorperated into our design so that our client with her strong hand can raise and lower the cover.

Indicate where your prototype falls on the scale below.



Kind of Prototype:
☐ Physical or ■ Analytical
☐ Focussed or ■ Comprehensive

Purpose of Prototype: Integration. The main purpose of this prototype was to bring all of our group mates' different ideas together to create a near finalized version of our design.

Level of Fidelity: This is a higher fidelity design as it uses the same materials that we would use in our final project

Include a list of objectives and metrics for your prototype below.

Objectives	Metrics
• Lightweight	• Weight
• Small	• Surface area

- Ease of use
- Weather resistance
-

- User satisfaction
- Material survivability
-

2. Take picture(s) of your refined prototype.
   → Include picture(s) of your previous prototypes(s) that you either decided to further refine or take elements from to create your refined prototype. Only include relevant previous prototypes
   → Insert your photo(s) as a Picture (Insert > Picture > This Device)
   → **Do not include more than *two* pictures per page**

Insert picture(s) of your previous prototype(s) below. These should be the prototypes that are relevant to your current prototype, and can be used as proof of the iteration process

*Limit screenshots to no more than 2 per page. For additional screenshots, please copy and paste the above on a new page.

Insert picture(s) of your refined prototype below.


PEX 5006 NSF-61-G NSF 372 cNSF ULc S102.2 & ASTM E84

*Limit screenshots to no more than 2 per page. For additional screenshots, please copy and paste the above on a new page.

Team ID: Thurs-16

Include details on how design concept was refined (what feedback was incorporated, what features are different than previous refined concept (initial prototype), etc.).

Include details on your thought process and how the concept was refined below, with notes on relevant feedback that was incorporated ***(max. 200 words).***

The main difference between the initial and refined prototypes is that the refined is on a realistic scale. There are also only three segments as opposed to 4-5 that were in the initial prototypes to save cost and cut down on the bulk when folded up. The prototype is now much stronger and has a functioning rotation lock mechanism. It will also include a lever system, which was a part of our feedback that the client should have an easier method of lowering/raising the cover without having to reach up and behind herself.

MILESTONE 4.2 – PROTOTYPING TEST PLAN REFINEMENT

Team ID: Thurs-16

3. Detail your prototype testing plan. (**max. 500 words** TOTAL for present and future plan)
   → You have already outlined the testing plan in Milestone One. You should examine this testing plan and consider whether it is still feasible, document refinements, and then outline the methodology and equipment you need to source for next week's execution of the plan.
   → You should also document a future testing plan; document what refinements you would make and metrics you would like to examine if given more time and resources.
   → Use IEEE referencing if any research is done.

*Insert your **Present Testing Plan** (how you will test your prototype).*
The refined prototype is similar in concept to the initial prototype, so the testing will be relatively the same. To test the ease of use, someone will attempt to lower and raise the cover while inside of the prototype, using the built-in lever. To test how effective the prototype will be at keeping the client dry, someone will sit underneath as water is poured over them. To test the durability of the frame, various amounts of stress will be placed on different parts of the prototype to ensure it can withstand daily use and strong winds. To test how compact the prototype is, the structure would be measured when folded up.

*Insert your **Future Testing Plan** (how you would test your prototype with the resources that you do not currently have available but could have in the future).*

The future testing plan could include things like testing the mounting mechanism to an actual motorized wheelchair, as that is not something we have access to. Another thing we could test is the variety of materials as right now the only material that fit into the objectives and constraints that we decided on were the PVC tubes. However, if the budget wasn't an issue, far better material that is lighter and more durable could've been used.

Team ID: Thurs-16

4. Fill out the table below, detailing each team member's contribution to this stage

Team Member's Full Name:	Contribution:
Luay alabed alkader	Bought all the materials
Evan Hong	Helped assemble
Talha Hashmi	Helped assemble
Junyi Chen	CAD model and 3D print

MILESTONE 4.3 – DESIGN REVIEW

Team ID:	Thurs-16

Include your feedback from both your peers (or TAs/IAIs) and the science students below. Remember to make clear what concept(s) you're receiving feedback for. Use the name of the concept that is used from your decision matrix

Include feedback from science students in this row. - Was concerned on how easy it would be to replace, we explained how we acquired the tubes
Include feedback from your faculty mentor, staff, or assigned TA/IAI in this row - *How would we mount it, explained with clamps and Velcro*

PROJECT FOUR MILESTONE FIVE: EXECUTION OF THE TEST PLAN AND FINALIZING THE DESIGN

MILESTONE 5 – COVER PAGE

Team ID: Thurs-16

Please list full names and MacID's of all *present* Team Members

Full Name:	MacID:
Evan Hong	honge14
Junyi Chen	cheng539
Talha Hashmi	hashmt1
Luay alabed alkader	alabedal

MILESTONE 5.1 - FINAL EVALUATION OF THE OBJECTIVES AND CONSTRAINTS

Team ID: Thurs-16

As a team, for the last time, restate the quantitative and qualitative objectives, along with constraints that you had stated in your refined testing plan of Milestone 4. If these objectives/constraints, metrics, and testing methods have changed over your project, that is OK. Use the objectives/constraints, metrics, and testing methods that are most in line with your current design. You can refer to the Test Plan Guideline (can be found under P4 documents) for more details.

State your Quantitative Objectives and their Metrics below:

Tensile strength	How much force is required to pull apart a PVC tube.
Extended Length	Length of cover once extended (cm).
compact	when folded up dimensions of cover when folded up.

State your Constraints and their Metrics below:

weight	2.76 kg, goal was to be under 4.5 kg (10 lbs.)
Waterproof	Anti-water materials must keep the client dry.

Restate your current testing plan that you will be implementing today.

*Insert your **Present Testing Plan** (how you will test your prototype).*
The refined prototype is similar in concept to the initial prototype, so the testing will be relatively the same.

- To test the tensile strength of the frame, various amounts of stress will be placed on different parts of the prototype to ensure it can withstand daily use and strong winds.
- To test length the cover will be extended, and its length will be measured.
- To test how compact the prototype is, the structure would be measured when folded up.
- To test weight the protype will be weighed.
- To test how effective the prototype will be at keeping the client dry, someone will sit underneath as water is poured over them.

State and justify any changes you made from last week.
None

MILESTONE 5.2 – TESTING PLAN EXECUTION AND DISCUSSION

Team ID: Thurs-16

Execute your testing plan for your Quantitative Objectives:

State and discuss the results of your testing plan in this box.

- *For tensile strength we had two group members pull from either side of the PVC tube (kind of like a tug of war) to see if the tubes would stretch. They did not move at all, meaning we can nowhere near to the yield strength of the tubes, meaning in everyday use the tubes should be fine.*
- *For extended length, we measured 70 cm (about 2.3 ft), more than enough to cover the client and console attached to the chair.*
- *The dimensions of the cover when folded up are* 73 cm (about 2.4 ft) wide, 2 cm (about 0.79 in) long, 117 cm (about 3.84 ft) tall.

Execute your testing plan for your Qualitative Objectives:

State and discuss the results of your testing plan in this box.
The main qualitative objective was for the rain cover to be easy to use and fast to deploy and retract. The client has difficulty in twisting her spine and reaching in certain positions, so reaching up and behind to directly pull down the shield was not acceptable. To circumvent this, we added a lever to the side of the furthest segment, so the client could easily raise it up and down. To test the ease of use, a team member sat in the prototype and tried it themselves, noting which muscle groups they used and which they did not. The client noted that they were stronger and had relatively good mobility in their right arm, so the prototype will be easy to use for them.

Execute your testing plan for your Constraints:

State and discuss the results of your testing plan in this box.

- *As for the weight, we weighed a group member, and then weighed him while he was holding the cover, and there was a difference of 2.76 kg which is under of goal of 4.5 kg (or 10 lbs.).*
- A group member extended the cover and then another sprinkled water over top of it. The group member sitting underneath the cover remained dry, making the product waterproof. As a sidenote, because the tubes that the cover is made up of are meant to be used as water pipes, a little rain will cause no damage to them, making the skeleton of the cover also waterproof.

As a team, discuss the results of your testing plan. How did your design do? Did it meet all the expectations you had from your design? Did you go through any iteration based on the execution and the results of your test plan? How did the test plan influence your iterative process? Remember, focus on the overall functionality of your design rather than the aesthetic quality.

First off, a group member's weight alone and their weight while carrying the cover differed by 2.76 kg, indicating that the cover is lightweight. This is well under our target of less than 4.5 kg (10 lbs.), which allows it to be portable and manageable, which was one of our main goals.

Furthermore, the results of the waterproof test were encouraging. Water was successfully repelled by sprinkling it over the expanded cover, keeping the person underneath dry. Its waterproof

properties are further enhanced by the fact that the tubes that comprise the cover are intended to be used as water pipes, indicating resilience against rain.

These tests showed that our design worked effectively, although there is still room for improvement. A potential area of additional refinement could be the cover's resilience to harsher weather. The fact that it can tolerate light rain is comforting, but future testing in stronger rain or wind conditions would yield a more complete picture of its capabilities.

A key factor in directing our iterative process was the testing plan. We were able to determine our design's strong points and opportunities for development by methodically assessing it against predetermined standards. As a result, we decided how best to improve our design to better satisfy the functional requirements of our users. Moving forward, we will continue to iterate and refine our design based on the insights gained from our testing plan, ensuring it performs optimally in real-world scenarios.

State and discuss the modifications of your design in this box.

We didn't make many changes to our design because it was already quite straightforward and protected the client well. On the other hand, adding a lever to extend the cover was a major improvement we made. This modification turned out to be essential since it greatly enhanced the product's usability, guaranteeing that customers may easily stretch the cover and have a more comfortable experience using it.

ENGINEER 1P13:
PROJECT FOUR WORKSHEETS (INDIVIDUAL)

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PROJECT FOUR MILESTONE ONE: PROBLEM FRAMING AND TEST PLAN

MILESTONE 1.1 – CLIENT NOTES

Team ID: Thurs-16

Complete this worksheet individually before coming to Lab A for Week 6.

1. Include your client notes from the introductory client visit

Name: Junyi Chen	MacID: chenj539

- *Weather concern when using public transportation.*
- *Salt corrosion the bottom of wheelchair*
- *Love dancing.*
- *Reaching outlet*
- *Hard to open a manual door.*
- *Have problem reaching top of shelf.*
- *Narrow bathroom*
- *Always needs to have a grabber to grab anything on the floor*
- *Foldable grabber would help*
- *Seat belt had come off*
- *Wish to get dressed and shower by herself*
- *Planning for trip for several month*
- *Hard to grab thing with unique shape*
- *Hope to get a new wheel chair*
- *Use siri a lot*
- *Have a garbage bag to cover wheelchair under rain*
-

PROJECT FOUR MILESTONE TWO: DESIGN EXPLORATION AND DESIGN REVIEW #1

MILESTONE 2.1 – CLIENT NOTES

Team ID: Thurs-16

Complete this worksheet individually before coming to Lab A for Week 7.

Include your client notes from the introductory client visit

Name: Junyi Chen	MacID: chenj539

-
- *Experiences issues with seatbelt, battery pack access, and navigating in snow or rain.*
- *Finds crosswalk buttons inaccessible and has a desire to drive.*
- *Uses phone efficiently, needs to verify accessibility of places, and requires assistance for certain tasks like grocery shopping or getting into bed.*
- *Works at Walmart, facing limitations in reaching items and discomfort from cold air on back.*
- *Enjoys dancing, music, martial arts, and cooking, but faces challenges attending events or classes due to accessibility.*
- *Wheelchair batteries have a 48-hour life, affected by cold weather and environmental conditions, with replacements being costly and maintenance unavailable for regular checks.*
-

MILESTONE 2.2 – RESEARCH ASSIGNMENT

Team ID: Thurs-16

Complete this worksheet before Lab A for Week 7.

- State the question you plan to answer through your research
- Summarize your research findings (answer). Your answer should be a coherent, well-written summary of your research, not a "brain dump".
- You may include images, but don't forget to cite them properly.
- Aim for a length of about 500 words
- Properly cite your sources using IEEE formatted references and in-text citations. For information on referencing formats and choosing sources, see Design and Communication Workshop 1.

Name: Junyi Chen	MacID: chenj539

What is your question?

What cover material we should use for our design

What is your answer?

Waterproof cover materials are essential for life being regardless of weather conditions. These materials are designed to offer protection against rain, snow.

Polyester: Polyester is widely used due to its durability, resistance to stretching and shrinking, and its ability to dry quickly. It is often coated or laminated with waterproofing materials like polyurethane (PU) or silicone to enhance its water-resistant properties. [1]

Nylon: Nylon is another popular material for tents due to its lightweight and strong fibers. Similar to polyester, it is typically treated with waterproof coatings to prevent water absorption and to ensure durability against UV damage. [2]

Canvas: Traditionally, canvas (made from cotton) has been used for its robustness and breathability. Modern canvas tents are often treated with waterproofing chemicals or a wax coating to maintain their breathability while also repelling water. [3]

Polyethylene (PE): Polyethylene is a plastic material used in some tent groundsheets and covers. It is inherently waterproof and offers excellent protection against moisture but lacks breathability. [4]

Cuben Fiber: Cuben Fiber, is a high-end material known for its exceptional strength-to-weight ratio and waterproof capabilities. It is used in ultralight tents and is highly resistant to UV damage and chemicals. [5]

The primary advantage of these materials is their ability to repel water, which is often measured in terms of hydrostatic head rating. This rating indicates the amount of water pressure a material can withstand before leaking. Materials like polyester and nylon offer excellent durability against wear and tear, making them suitable for various outdoor conditions. Breathability is crucial for preventing condensation inside the tent. Materials like canvas, although heavier, provide natural breathability along with waterproof protection when treated properly. The weight of the material is a significant consideration for backpackers. Lightweight materials like nylon and Cuben Fiber are preferred for their ease of transport and setup.

List of sources:

[1] What Is Polyester? A Complete Guide https://www.apexmills.com/media_post/what-is-polyester/

[2] Wikipedia Nylon https://en.wikipedia.org/wiki/Nylon

[3] What is Canvas Fabric: Properties, How its Made and Where https://sewport.com/fabrics-directory/canvas-fabric

[4] You Use it Daily. But What IS Polyethylene Plastic? https://www.reliance-foundry.com/blog/polyethylene-plastic

[5] Wikipedia, Dyneema Composite Fabric https://en.wikipedia.org/wiki/Dyneema_Composite_Fabric

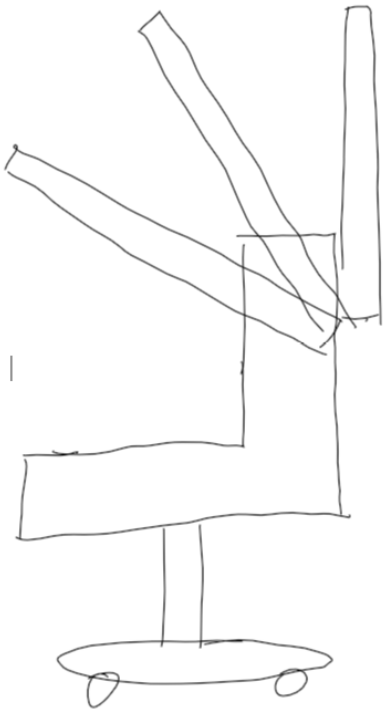
MILESTONE 2.2 – INITIAL CONCEPT EXPLORATION

Team ID:	Thurs-16

Complete this worksheet before Lab A for Week 7.

1. Include multiple images of your **initial** concept exploration, if needed
   → Include necessary annotations to help in the communication of your ideas
   → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   → Include your Team Number, Name and MacID on *each* concept image
2. Insert your photo(s) as a Picture (Insert > Picture > This Device)
3. **Do not include more than *two* concept images per page**

Name: Junyi Chen	MacID: Chenj539
Insert screenshot(s) of your concept below.	



Foldable frame

MILESTONE 2.4 – REFINED CONCEPT EXPLORATION

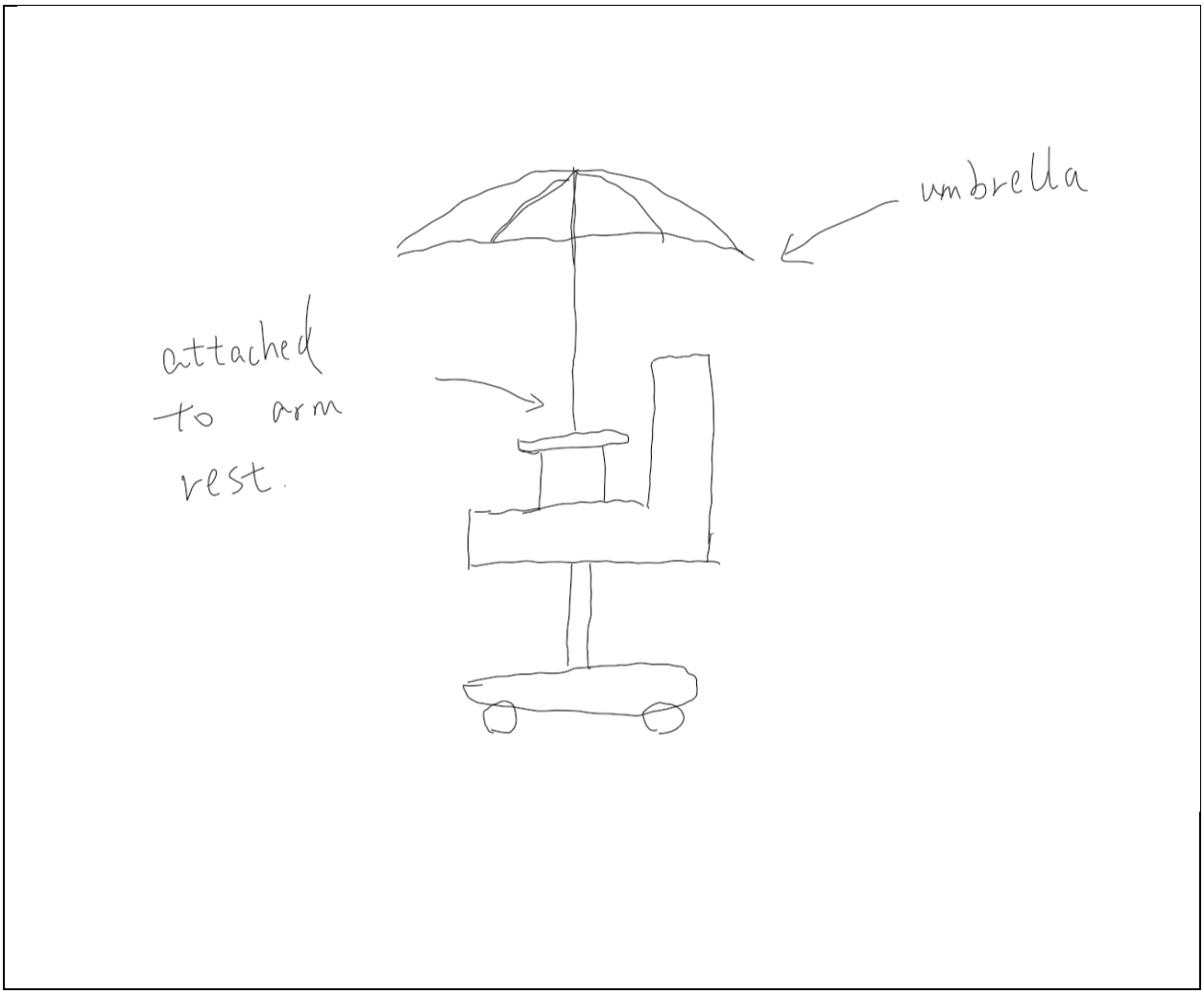
Team ID:	Thurs-16

Complete this worksheet during Lab A for Week 7.

4. Include multiple images of your **refined** concept exploration, if needed
   - → Include 2 distinct concepts based on the functional analysis
   - → Include necessary annotations to help in the communication of your ideas
   - → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   - → Include your Team Number, Name and MacID on *each* concept image
5. Insert your photo(s) as a Picture (Insert > Picture > This Device)
6. **Do not include more than *two* concept images per page**

Concept 1:

Name: Junyi Chen	MacID: chenj539
Insert screenshot(s) of your concept below.	

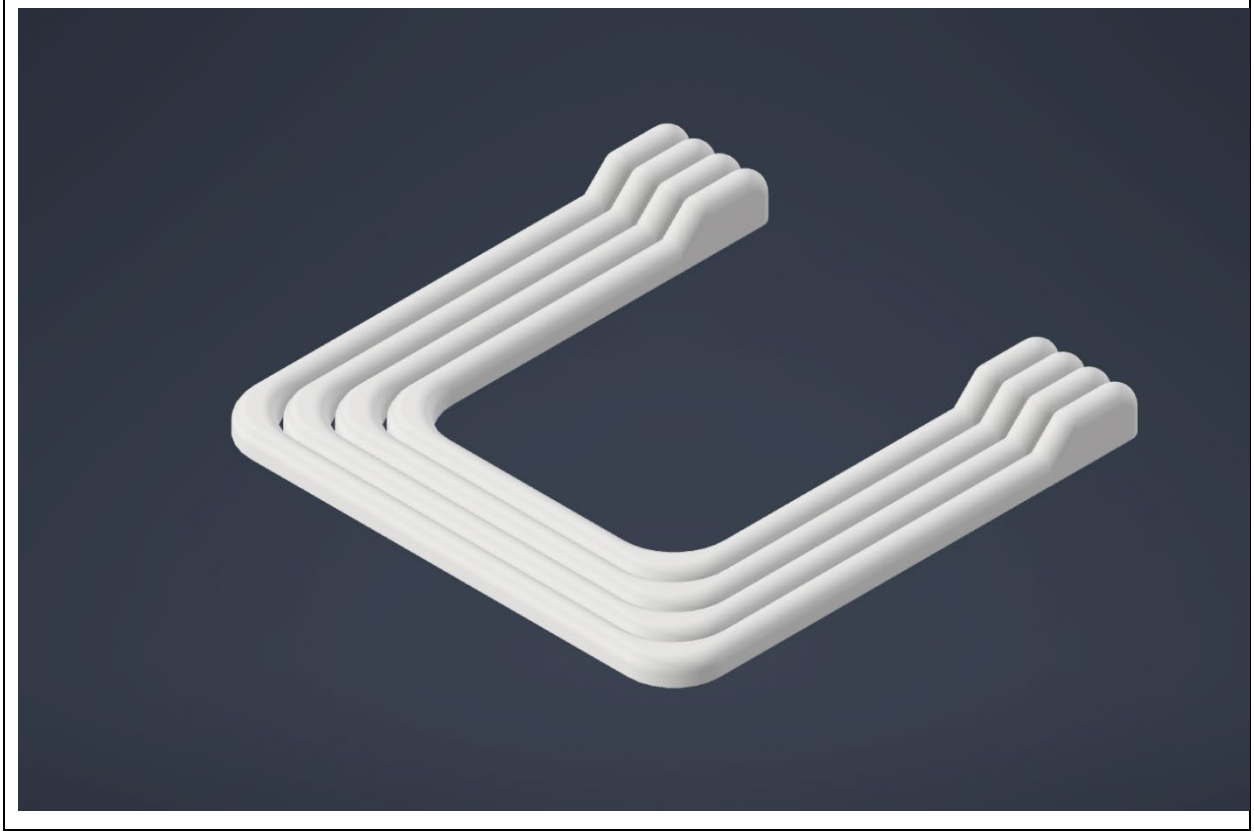

umbrella
attached to arm rest.

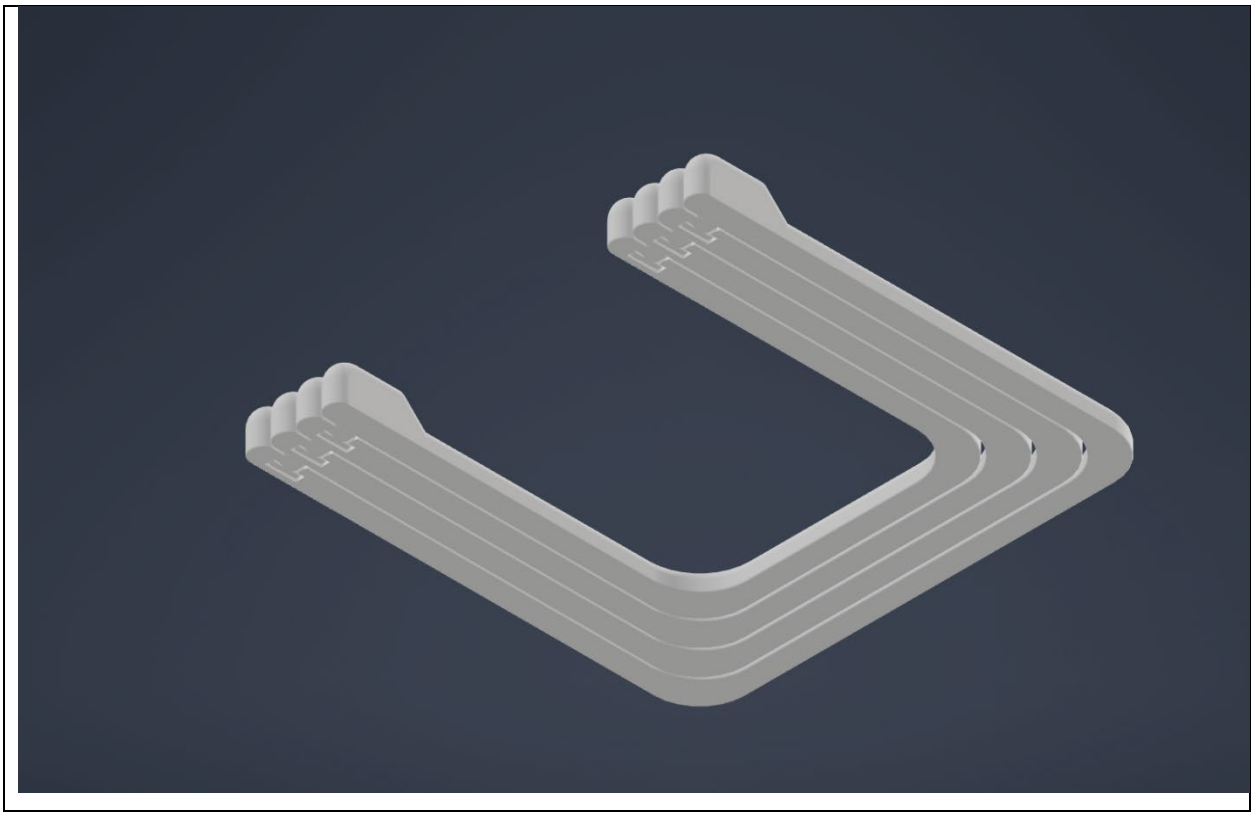
Team ID:	Thurs-16

Concept 2:

Name: Junyi Chen	MacID: chenj539

Insert screenshot(s) of your concept below.





PROJECT FOUR MILESTONE THREE: PROTOTYPING, DECISION MAKING AND DESIGN REVIEW #2

MILESTONE 3.1 – REFINED CONCEPT: INITIAL PROTOTYPE

Team ID: Thurs-16

Complete this worksheet individually before coming to Design Studio/Lab A for Week 8.

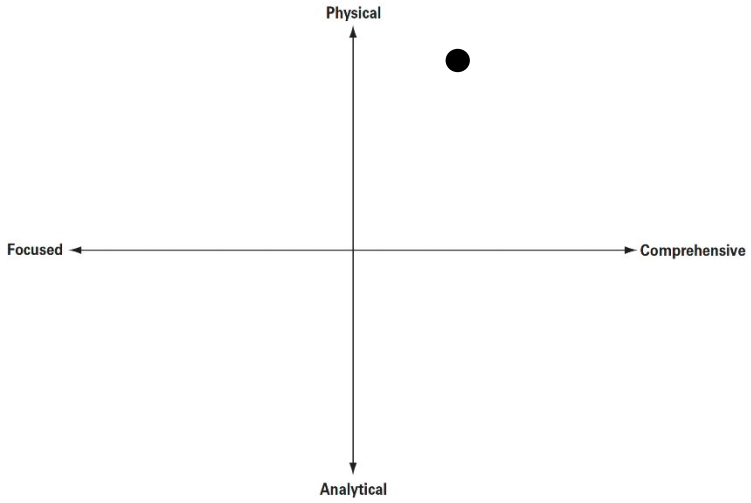
1. Write a small description of your initial prototype. Be sure to include what problem it aims to solve, how your initial prototype will be fabricated, and what functionality will be included and omitted in this initial prototype.
2. Classify whether your prototype is Physical or Analytical, and Focused or Comprehensive. Include the purpose of this prototype in the context of project 4 and the level of fidelity (low, medium, or high fidelity)
   - → **Physical vs. Analytical:** Physical prototypes are tangible artifacts that are created to approximate the final product. Analytical prototypes are non-tangible and represent the product using usually visual or mathematical models.
   - → **Focused vs. Comprehensive:** Focused prototypes implement only one or a few of the attributes of the final product. Comprehensive prototypes aim to implement most, if not all of the attributes of the final product.
3. Create a list of objectives and metrics for your initial prototype. There is no required amount of objectives or metrics, so long as the list is comprehensive.
4. Create a rough experimental plan for how you might test your prototype. Consider the methods you might use to test various objectives, how you will measure how effective each test proves to be and how realistic it would be to implement. This does not need to be detailed plan but should consider several of your objectives for the prototype.
5. Take picture(s) of your refined concept (initial prototype)
   - → Insert your photo(s) as a Picture (Insert > Picture > This Device)
   - → **Do not include more than *two* refined concept pictures per page**
   - → Include details on how concept was refined (what feedback was incorporated, what features are different than previous concept exploration, etc.)
   - → You can continue this process within the allocated time of the LabA/DS and seek feedback and discussions from your team members and/or the instructional team (IAIs, TAs, etc.).

Name: Junyi Chen	MacID: chenj539

Write a short description of your initial prototype below.

This prototype is the frame for our design. We will have some cover material over the frame to protect the client from rain or snow.

Indicate where your prototype falls on the scale below.



Kind of Prototype:

☒ Physical or ☐ Analytical

☐ Focussed or ☒ Comprehensive

Purpose of Prototype:

Test the rotary mechanism

Level of Fidelity:

Prototype is 3d printed. 0.2mm layer height, 0.4mm line width

Include a list of objectives and metrics for your prototype below.

Objectives	Metrics
• **strength**	• **Yield strength**
• **compatibility after fold**	• **Cm^3**
• **lightweight**	• **kg**
• **cost**	• **dallar**
•	•

Include a rough experimental plan on how you might test your prototype below.

Test the movement range of the prototype

Find a way to mount our design to wheel chair

Test the strength of prototype

Find the print time and the amount of material used

Insert picture(s) of your refined concept (initial prototype) below.

ENGINEERING | McMaster University

ENG1P13 Design Communication Workshop #5

Students' Handout

This workshop is to support your P4 reflection assignment. The activities in this handout are intended to be completed by the end of the workshop 5. However, students are encouraged to apply what they learn in this workshop to their studies. The aim is to build a lifelong habit of critical reflection.

Objectives

By the end of this workshop, students should be able to:

- Define the concept of critical reflection
- Explain the importance of critical reflection
- Describe the 3-stage model of reflection
- Write a critical reflection on design thinking focusing on project 4 experience

Summary of Activities and Lab Schedule

Workshop Introduction (5 min)

Introduction to Reflection, reflection model, "What"? (15 min)

Introduction to activity 1 (5 min)

Activity 1 (20 min)

So what? And intro to activity 2 (10 min)

Activity 2 (20 min)

No what? And introduction to activity 3 (10 min)

Activity 3 (20 min)

One-on-one meeting with IAI/TAs (30 min)

Final Q/A and submissions (10 min): Following the lead of your TA or IAI, complete this handout during the workshop. At the end of the workshop, submit the handout as a single pdf file on Avenue to Learn. You are not required to write a formal reflection essay. This is an individual submission.

Upload your reflection essay as a **PDF** to the *Avenue Dropbox* titled **P4 Reflection** using the **MacID_P4_Reflection.pdf** as naming convention.

Your assignment is due at 23:59 EST the day of your scheduled lab. For example, if the lab is Monday at 08:30 EST, the assignment is due at 23:59 EST on Monday.

Grading of Reflection

Your reflection assignment is worth 0.5 mark of your total Project-4 grade (6.25%). Rubric is provided on Avenue to Learn.

If you need to review the content, go to the online reflection module. Here is the link: https://ecampusontario.pressbooks.pub/engineeringreflectiontoolkit/

Introduction

Through reflection, you will be guided to explore an experience of working on a team during your project 4 focusing in design process. To accomplish this task, you will be asked to identify, question, and assess your understanding of what happened. In this way, you make meaning of your experiences through this process of reconciling what you expected would happen with what occurred. Reflection is not a reading assignment, a summary of an activity, or an emotional outlet. Rather, reflection is a way for you to achieve a sense of deeper understanding of what you have learned.

In this workshop you learn how to do this, and you will practice it by reflecting on your Project 4 experience.

Reflection Activities

Consider your experience with the design process as a first-year engineering student working on Project 4 over the past couple of months in ENG 1P13. After exploring the client's challenges and gaining insights, your team decided to focus on one area to improve our client's daily life. You have defined the problem in a problem statement that included objectives, constraints, etc. Through this exploration, you performed a functional analysis that was used to come up with different alternative ways to solve the problem. Your team needed to make a decision between the different alternatives, and you tested your ideas for feasibility. You have been encouraged to iterate as you gained deeper insight and developed empathy for the client. Through the process of iteration, you have had the opportunity to improve upon your ideas. Engineers are continually iterating through the design process. Informed designers are involved in continual learning: learning by doing, learning from brainstorming and prototyping, learning by iteration and from feedback and failure, learning by noticing and troubleshooting, learning by drawing and dialoging about ideas, materials, and people. While iteration is an informal form of reflection, you will deepen your understanding of what you have learned through formal reflection. All of these emphasize the metacognitive and reflective practice aspects of learning through design (Lawson & Dorst, 2009; Crismond & Adams, 2012).

Part 1: What?

In this section you will describe a critical incident that you will be reflecting on as related to the "Generating/Testing ideas" and "Decision-making." For each of these steps of the design process:

In three to five sentences, identify and describe ONE critical incident, breakthrough or big thought-provoking moment that either challenged your assumptions, had a positive impact on you or validated your understanding of the design process.

Here are some questions to consider:

Generating & Testing Ideas:

- How did you go about exploring ideas?
- How deeply did you explore your design options?
  - How much research?
  - Did you look into Biomimicry tools?
  - Did you consider any "What if?" questions in your explorations?
- Did you test your ideas?
- If yes, how did you test your ideas?
  - What were you trying to test (e.g., desirability, feasibility, etc.)?
  - What tool/ method did you use? (physical prototype, CAD model, etc.)
  - How much time did you spend on testing each idea?
  - How many ideas did you test?
  - How many prototypes did you make for testing each idea?
  - Did you test your ideas early on or waited until you had more details of the ideas?
- What was one challenge that you faced in the testing process of the design? (we encourage you to write more than one challenge). And What did you do to solve that challenge? (you can attach photos to explain your attempted solutions)
- From the results of our testing, one change we made to improve our design solution was … (add your response) and this change made our design solution better because … (add your response).

Your response:

We want to design some useful equipment for our client. The client use garbage bag to cover herself when raining or snowing. We design a foldable cover, got that inspiration for convertible car.

Decision Making:

- What happened during decision-making?
  - Where in the process, relative to the design process steps, did you make decisions?
  - What were the decisions about? Decisions could be about the process (e.g., how much searching of the design space was enough?) or about the design (e.g., which alternative to prototype).
  - How many options did you have to choose from?
  - How many criteria did you have to compare the options? How did you choose those criteria?
  - What tools did you use to make a decision?
- At what stage did you make a decision?
- When did this experience take place? Did you already have one final solution in mind or you were still exploring the ideas?
- What challenges did you face during decision-making process?

Your response:

We use decision making for choosing materials for our design. I got 3d printer so I want 3d printed as much as possible. But our design include long beams which is frame for our design. Aluminum extrusion is a good option, but it's heavy and beyond our budget. So we end up with PVC tube. Lightweight, easy to modify, and we can use fitting for corners. Before to get a PVC tube, I was worried about the stiffness. But I went to the shop and find out that they have stiff tubes which is ideal.

Part 2: "So What?"

In this section you will explore what you learned and describe why this incident matters to you.

In three to five sentences, discuss what you learned from this incident about idea generation, testing ideas, and decision making and that either surprised you, made you confront a misconception, or improved your understanding of the design process.

To help you think about this, consider the following:

- What was the outcome of early or late testing processes?
- Do you think delaying any of your decision-making may have improved the design?
- Could you have collected better observations or data that would have led to better decisions?
- Did you repeat your decision-making process at any other stage?

Your response:

I learned a lot about 3d printing. I just go a printer recently and I am not familiar with it. I had a lot of problem. For example, my printer kept jammed. The slicer software have a lot option. But finally I figure them out. Then it works pretty well because we have multiple prototype, it kept printing for few days, and works perfectly

In two to three sentences, explain why these new insights are important to you.

Your response:

I think know how to use a 3d printer would be beneficial for engineers. It's a extremely useful tool for prototyping.

Part 3: "Now What?"

In two to three sentences, discuss how you will integrate this new insight into future design projects. To help you think about this, consider the following:

- I learned that... (Express and important learning, not a statement of fact)
- This learning matters because... (Consider how this learning has value to you as an engineer)
- How will I apply my learning?
- How will I design differently next time?
- How will I deal with a similar situation in the future?
- Considering this learning, I will... (Set specific, assessable goals; consider benefits and challenges involved in this plan)

Your response:

For future design, fit into client's need is the first goal. Always think about what kind of device can help for clients. When the design is finish, test it as a user will definitely help before hand over the design. Also ask more people or actual users to test it will make sure the design will fit to majority user.

In two to three sentences, describe the possible benefits and challenges involved in your plan.

Your response:

The clients would be satisfied with our design, but challenges is that it might lead to more work and more time required. And sometime, the design we want might beyond our ability.

References:

Lawson, B., & Dorst, K. (2009). Design expertise. Oxford, UK: Architectural Press.

Crismond, D. P., & Adams, R. S. (2012). The informed design teaching and learning matrix. Journal of Engineering Education, 101 (4), 738-797.

PROJECT FOUR **REFLECTION – INDIVIDUAL** RUBRIC

Criteria	1 Below Expectation	2 Marginal	3 Meets Expectation	4 Exceeds Expectation
Communication	Many punctuation, grammar, and capitalization errors.	Noticeable punctuation, grammar, and capitalization errors.	Professionally written with minimal errors.	Professionally written with no errors. Good flow of ideas and concise when necessary.
Content – What?	Missing 3 or more items from Level 3.	Missing 1 or 2 items from Level 3.	• Written in first person • Clear description of context. i.e., history, environment, and/or key participants - who, what, when, where, how, why? • Draws from most senses to describe the incident, experience, problem, situation • Offers concrete examples and illustrations to clarify and enhance knowledge claims and understanding. • Uses some judgment, interpretation, and/or personal bias in explanations. • Identifies some initial thoughts or feelings experienced during the described event • Provides definitions of technical terms and key concepts.	
Content – So What?	Missing 3 or more items from Level 3.	Missing 1 or 2 items from Level 3.	• Identifies successes or positive aspects of the experience. • Identifies challenges that were experienced. • Identifies why the experience they chose to highlight was important to their learning. • Identifies how their knowledge or perspective has changed as a result of the experience.	
Content – Now What?	Missing all items from Level 3.	Missing 1 or 2 items from Level 3.	• Explicitly mentions something that they learned during the experience. • Explains why their new learnings are important. • Outlines how they might use their new learnings in the future.	

List of Penalties	Deduction
Missing Name or MacID	**–10%**
Late Penalty	**–20% per day**

ENGINEERING | McMaster University

ENG1P13 Design Communication Workshop #5
Students' Handout

This workshop is to support your P4 reflection assignment. The activities in this handout are intended to be completed by the end of the workshop 5. However, students are encouraged to apply what they learn in this workshop to their studies. The aim is to build a lifelong habit of critical reflection.

Objectives

By the end of this workshop, students should be able to:

- Define the concept of critical reflection
- Explain the importance of critical reflection
- Describe the 3-stage model of reflection
- Write a critical reflection on design thinking focusing on project 4 experience

Summary of Activities and Lab Schedule

Workshop Introduction (5 min)
Introduction to Reflection, reflection model, "What"? (15 min)
Introduction to activity 1 (5 min)
Activity 1 (20 min)
So what? And intro to activity 2 (10 min)
Activity 2 (20 min)
No what? And introduction to activity 3 (10 min)
Activity 3 (20 min)
One-on-one meeting with IAI/TAs (30 min)
Final Q/A and submissions (10 min): Following the lead of your TA or IAI, complete this handout during the workshop. At the end of the workshop, submit the handout as a single pdf file on Avenue to Learn. You are not required to write a formal reflection essay. This is an individual submission.
Upload your reflection essay as a **PDF** to the *Avenue Dropbox* titled **P4 Reflection** using the **MacID_P4_Reflection.pdf** as naming convention.
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Introduction

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In this workshop you learn how to do this, and you will practice it by reflecting on your Project 4 experience.

Reflection Activities

Consider your experience with the design process as a first-year engineering student working on Project 4 over the past couple of months in ENG 1P13. After exploring the client's challenges and gaining insights, your team decided to focus on one area to improve our client's daily life. You have defined the problem in a problem statement that included objectives, constraints, etc. Through this exploration, you performed a functional analysis that was used to come up with different alternative ways to solve the problem. Your team needed to make a decision between the different alternatives, and you tested your ideas for feasibility. You have been encouraged to iterate as you gained deeper insight and developed empathy for the client. Through the process of iteration, you have had the opportunity to improve upon your ideas. Engineers are continually iterating through the design process. Informed designers are involved in continual learning: learning by doing, learning from brainstorming and prototyping, learning by iteration and from feedback and failure, learning by noticing and troubleshooting, learning by drawing and dialoging about ideas, materials, and people. While iteration is an informal form of reflection, you will deepen your understanding of what you have learned through formal reflection. All of these emphasize the metacognitive and reflective practice aspects of learning through design (Lawson & Dorst, 2009; Crismond & Adams, 2012).

Part 1: What?

In this section you will describe a critical incident that you will be reflecting on as related to the "Generating/Testing ideas" and "Decision-making." For each of these steps of the design process:
In three to five sentences, identify and describe ONE critical incident, breakthrough or big thought-provoking moment that either challenged your assumptions, had a positive impact on you or validated your understanding of the design process.

Here are some questions to consider:
Generating & Testing Ideas:

- How did you go about exploring ideas?
- How deeply did you explore your design options?
  - How much research?
  - Did you look into Biomimicry tools?
  - Did you consider any "What if?" questions in your explorations?
- Did you test your ideas?
- If yes, how did you test your ideas?
  - What were you trying to test (e.g., desirability, feasibility, etc.)?
  - What tool/ method did you use? (physical prototype, CAD model, etc.)
  - How much time did you spend on testing each idea?
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- What was one challenge that you faced in the testing process of the design? (we encourage you to write more than one challenge). And What did you do to solve that challenge? (you can attach photos to explain your attempted solutions)
- From the results of our testing, one change we made to improve our design solution was … (add your response) and this change made our design solution better because … (add your response).

Your response:

Exploring Ideas:

- We started by generating different ideas to see whether we could meet our client's need for wheelchair cover.
- We investigated several wheelchairs covers that were already on the market, rain-resistant fabrics, and control mechanisms to fully explore our design alternatives.
- We considered design concepts influenced by nature, such as how some plants shed water or how animals adjust to rain, even though we didn't explicitly use biomimicry techniques.

- To push the limits of conventional thinking and think of creative solutions, "what if?" questions were essential to our investigations.

Ideas of Testing:

Yes, we put our ideas to the test to determine their viability, functionality, and desirability. To test our concepts, we mostly employed actual prototypes that let us interact with the designs in a practical way. Several attempts of testing spent testing each proposal, depending on how intricate it was. We experimented with several possibilities, building prototypes for each to get input and improve our ideas, and we also tested how compatible it is with harsh weather, like rain, wind, etc. Early in the design phase, testing allowed us to spot any problems and make necessary revisions to our concepts.

Challenges faced:

Making sure the wheelchair cover was stable and durable especially in harsh weather was one of the challenges we faced during the testing process.
We experimented with various materials and reinforcing methods to overcome this difficulty, and we put our designs through rigorous durability testing to determine their strength and resilience.

Improving the Design Solution:

We improved our design solution by adding more securing mechanisms to increase stability and longevity, because of the testing findings.
This modification improved our design solution by giving the user more security and assurance that the cover would stay in place even in windy or rainy situations.

Decision Making:

- What happened during decision-making?
  - Where in the process, relative to the design process steps, did you make decisions?
  - What were the decisions about? Decisions could be about the process (e.g., how much searching of the design space was enough?) or about the design (e.g., which alternative to prototype).
  - How many options did you have to choose from?
  - How many criteria did you have to compare the options? How did you choose those criteria?
  - What tools did you use to make a decision?
- At what stage did you make a decision?
- When did this experience take place? Did you already have one final solution in mind or you were still exploring the ideas?
- What challenges did you face during decision-making process?

Your response:

From this project I learned how important it is to test ideas early in the design phase. Testing early helped us find problems and make our design process smoother. I also realized that delaying decisions can sometimes hold us back from exploring other options or solving problems quickly.

These lessons are important because they show how vital it is to do lots of testing and make decisions early in the design process. In future projects, I'll approach them with a more strategic mindset. By understanding the value of early testing and proactive decision-making, I can create better user experiences and achieve more successful outcomes.

Part 2: "So What?"

In this section you will explore what you learned and describe why this incident matters to you.

In three to five sentences, discuss what you learned from this incident about idea generation, testing ideas, and decision making and that either surprised you, made you confront a misconception, or improved your understanding of the design process.
To help you think about this, consider the following:

- What was the outcome of early or late testing processes?
- Do you think delaying any of your decision-making may have improved the design?
- Could you have collected better observations or data that would have led to better decisions?
- Did you repeat your decision-making process at any other stage?

Your response:

I found out that testing designs early and making decisions ahead of time are super important for making good designs. This matters because it helps me create designs that really focus on what users need and work well. In the future, I'll prioritize testing early and fixing problems fast to improve my designs quicker. But there might be challenges with managing time and resources. Still, making great designs in the long run is worth it, even if there are some bumps along the way.

In two to three sentences, explain why these new insights are important to you.

Your response:

My understanding of good design processes has improved because of these new insights, which highlight the importance of early testing and quick decision-making. These guidelines will help me make sure that my projects in the future are more effective, user-focused, and ultimately successful. I can now confidently tackle design difficulties and provide meaningful solutions that satisfy user demands because of this insight.

Part 3: "Now What?"

In two to three sentences, discuss how you will integrate this new insight into future design projects. To help you think about this, consider the following:

- I learned that... (Express and important learning, not a statement of fact)
- This learning matters because... (Consider how this learning has value to you as an engineer)
- How will I apply my learning?
- How will I design differently next time?
- How will I deal with a similar situation in the future?
- Considering this learning, I will... (Set specific, assessable goals; consider benefits and challenges involved in this plan)

Your response:

The experience that I gained from this project is the significance of early testing in the design phase. Early idea testing helped us spot possible problems and improve the efficiency of our design iterations. I also came to the realization that delays in making decisions can occasionally limit our ability to go forward by preventing us from looking into other options or quickly dealing with issues.

I find these observations to be significant because they emphasize how crucial it is to do plenty of testing and make decisions early in the design process. I may approach future design projects with a more strategic mentality and eventually produce better user experiences and more successful outcomes by knowing the value of early testing and proactive decision-making.

In two to three sentences, describe the possible benefits and challenges involved in your plan.

Your response:

Effective time and resource management is necessary to carry out exhaustive testing and reach choices quickly. Potential stakeholder disagreements about decision-making procedures and project schedules may also provide challenges. Applying this new understanding to design projects in the future will require striking a balance between these factors.

References:

Lawson, B., & Dorst, K. (2009). Design expertise. Oxford, UK: Architectural Press.

Crismond, D. P., & Adams, R. S. (2012). The informed design teaching and learning matrix. Journal of Engineering Education, 101 (4), 738-797.

[1]
A. Watt, "Resource Planning – Project Management," *Opentextbc.ca*, Aug. 15, 2019. https://opentextbc.ca/projectmanagement/chapter/chapter-11-resource-planning-project-management/

[2]
"What is Early Testing and Why to Start Testing Early in SDLC (Practical)," *www.softwaretestinghelp.com*. https://www.softwaretestinghelp.com/early-testing/

[3]
Project 4 in the content of 1P13.

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Content – Now What?	Missing all items from Level 3.	Missing 1 or 2 items from Level 3.	• Explicitly mentions something that they learned during the experience. • Explains why their new learnings are important. • Outlines how they might use their new learnings in the future.	

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Late Penalty	**–20% per day**

PROJECT FOUR MILESTONE THREE: PROTOTYPING, DECISION MAKING AND DESIGN REVIEW #2

MILESTONE 3.1 – REFINED CONCEPT: INITIAL PROTOTYPE

Team ID: THURS-16

Complete this worksheet individually before coming to Design Studio/Lab A for Week 8.

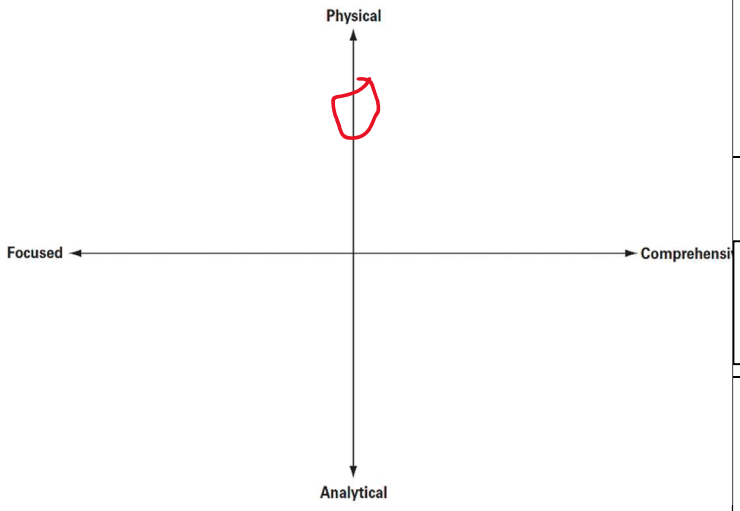
1. Write a small description of your initial prototype. Be sure to include what problem it aims to solve, how your initial prototype will be fabricated, and what functionality will be included and omitted in this initial prototype.
2. Classify whether your prototype is Physical or Analytical, and Focused or Comprehensive. Include the purpose of this prototype in the context of project 4 and the level of fidelity (low, medium, or high fidelity)
   - → **Physical vs. Analytical:** Physical prototypes are tangible artifacts that are created to approximate the final product. Analytical prototypes are non-tangible and represent the product using usually visual or mathematical models.
   - → **Focused vs. Comprehensive:** Focused prototypes implement only one or a few of the attributes of the final product. Comprehensive prototypes aim to implement most, if not all of the attributes of the final product.
3. Create a list of objectives and metrics for your initial prototype. There is no required amount of objectives or metrics, so long as the list is comprehensive.
4. Create a rough experimental plan for how you might test your prototype. Consider the methods you might use to test various objectives, how you will measure how effective each test proves to be and how realistic it would be to implement. This does not need to be detailed plan but should consider several of your objectives for the prototype.
5. Take picture(s) of your refined concept (initial prototype)
   - → Insert your photo(s) as a Picture (Insert > Picture > This Device)
   - → **Do not include more than *two* refined concept pictures per page**
   - → Include details on how concept was refined (what feedback was incorporated, what features are different than previous concept exploration, etc.)
   - → You can continue this process within the allocated time of the LabA/DS and seek feedback and discussions from your team members and/or the instructional team (IAIs, TAs, etc.).

Name: LUAY ALABED ALKADER	MacID: ALABEDAL

Write a short description of your initial prototype below.

My prototype is a plastic cover designed to be installed on the top of a wheelchair, serving as a protective canopy for the wheelchair passenger against rain and other elements.

Indicate where your prototype falls on the scale below.



Kind of Prototype:

☑ Physical or ☐ Analytical

☐ Focussed or ☐ Comprehensive

Purpose of Prototype:

Protect the client from the rain and the harsh weather.

Level of Fidelity:

Medium as the design is easy to make

Include a list of objectives and metrics for your prototype below.

Objectives	Metrics
• **Protect from rain.**	• **kg**
• **Light weight**	• **Dollar**
• **Easy to install.**	• **size**
• **Easy to mount.**	• **strength**
• **Easy to use**	• **durability**

Insert picture(s) of your refined concept (initial prototype) below.

PROJECT FOUR MILESTONE TWO: DESIGN EXPLORATION AND DESIGN REVIEW #1

MILESTONE 2.1 – CLIENT NOTES

Team ID: THURS-16

Complete this worksheet individually before coming to Lab A for Week 7.

Include your client notes from the introductory client visit.

Name: LUAY ALABED ALKADER	MacID: ALABEDAL

Personal Information:

Name: Tiffany
Age: 33
Diagnosis: Spina Bifida
Mobility & Assistance:

Uses a power wheelchair for primary mobility.
Requires assistance from a nurse and PSW for daily activities.
Occupation:

Employee at Walmart, responsible for stocking shelves and assisting customers.
Challenges:

Limited mobility in the lower half of the body.
Needs assistance with everyday tasks.
Difficulty navigating inaccessible doors and uneven surfaces.
Difficulty reaching high shelves at work.
Experiences cold sensitivity due to back implants.
Goals:

Increase independence in daily activities.
Improve accessibility and safety measures related to wheelchair use.
Find solutions for reaching high shelves at work.
Address cold sensitivity, particularly during winter months.

MILESTONE 2.2 – RESEARCH ASSIGNMENT

Team ID: THURS-16

Complete this worksheet before Lab A for Week 7.

- State the question you plan to answer through your research
- Summarize your research findings (answer). Your answer should be a coherent, well-written summary of your research, not a "brain dump".
- You may include images, but don't forget to cite them properly.
- Aim for a length of about 500 words
- Properly cite your sources using IEEE formatted references and in-text citations. For information on referencing formats and choosing sources, see Design and Communication Workshop 1.

Name:	MacID:
What is your question? How are we going to use metal frame for the wheelchair cover?	
What is your answer? The use of a metal frame enhances the wheelchair cover's longevity and structural soundness. With well-selected materials like sturdy steel or thin aluminum, the frame provides robust support without gaining unnecessary weight. The wheelchair's dimensions are carefully considered at every stage of the frame's construction and welding, ensuring a secure fit and optimal functionality. Users may easily connect the cover to the frame thanks to its strategically placed attachment points, which also offer solid weather protection. The wheelchair cover is made of a well-thought-out aluminum construction that ensures it will survive everyday usage and provide comfort and peace of mind to its user, whether they use it for inside or outdoor activities.	
List of sources: [1] "Rigid Frame Wheelchairs; Turning Energy into Motion | Education in Motion Blog," *Sunrise Medical*. https://www.sunrisemedical.com/education-in-motion/blog/july-2021/rigid-frame-wheelchairs-turning-energy-into-motion	

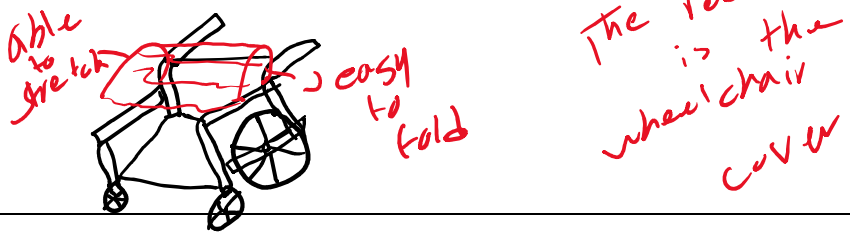
[2]
"Rigid Frame Wheelchairs; Turning Energy into Motion | Education in Motion Blog," *Sunrise Medical*. https://www.sunrisemedical.com/education-in-motion/blog/july-2021/rigid-frame-wheelchairs-turning-energy-into-motion

MILESTONE 2.2 – INITIAL CONCEPT EXPLORATION

Team ID:	THURS-16

Complete this worksheet before Lab A for Week 7.

1. Include multiple images of your **initial** concept exploration, if needed
   - → Include necessary annotations to help in
   - → the communication of your ideas
   - → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   - → Include your Team Number, Name and MacID on *each* concept image
2. Insert your photo(s) as a Picture (Insert > Picture > This Device)
3. **Do not include more than *two* concept images per page**

Name: luay Alabed alkader	MacID: alabedal98
Team number: Thurs-16 	

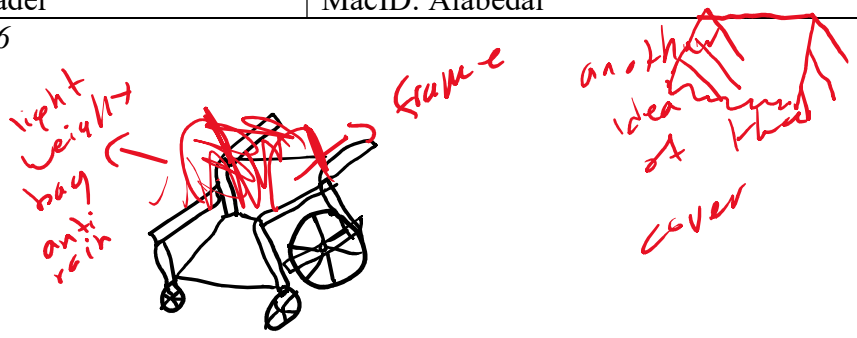
MILESTONE 2.4 – REFINED CONCEPT EXPLORATION

Team ID: THURS-16

Complete this worksheet during Lab A for Week 7.

4. Include multiple images of your **refined** concept exploration, if needed
   - → Include 2 distinct concepts based on the functional analysis
   - → Include necessary annotations to help in the communication of your ideas
   - → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   - → Include your Team Number, Name and MacID on *each* concept image
5. Insert your photo(s) as a Picture (Insert > Picture > This Device)
6. **Do not include more than *two* concept images per page**

Concept 1:

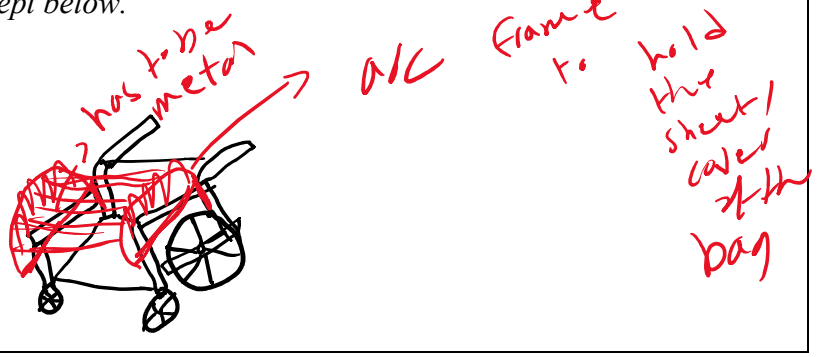
Name: luay Alabed alkader	MacID: Alabedal
Team number: Thurs-16 \\\ 	

Team ID: THURS-16

Concept 2:

Name: LUAY ALABED ALKADER	MacID: ALABEDAL

Insert screenshot(s) of your concept below.



ENGINEER 1P13:
PROJECT FOUR WORKSHEETS (INDIVIDUAL)

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PROJECT FOUR MILESTONE ONE: PROBLEM FRAMING AND TEST PLAN

MILESTONE 1.1 – CLIENT NOTES

Team ID: Thurs-16

Complete this worksheet individually before coming to Lab A for Week 6.

1. Include your client notes from the introductory client visit

Name: Talha Nauman Hashmi	MacID: Hashmt1

Notes for p4 client:

Works at Walmart, she's the greeter, but helps with other departments with stocking shelves

Can not travel on snow

Batteries are in the red part of the wheel chair

Some doors aren't accessible

Cant reach stuff because of height of the wheel chair

Her hobbies are

martial arts

She likes to dance

Has spine brittia

Helped her friend with the curved spine

She's 33

She got the crosswalk buttons to be more accessible

Loves barbie

Two H rods in her spine

Her torso down doesn't work

Wants a device that could help her with her hobbies

Rain is a big issue for her

Her equipment gets damaged because of water

PROJECT FOUR MILESTONE TWO: DESIGN EXPLORATION AND DESIGN REVIEW #1

MILESTONE 2.1 – CLIENT NOTES

Team ID:	Thurs-16

Complete this worksheet individually before coming to Lab A for Week 7.

Include your client notes from the introductory client visit

Name: Talha Nauman Hashmi	MacID: Hashmt1

- *Wheelchair, edge 3*
- *Screen is not waterproof.*
- *Things that are taller than her are hard for her reach.*
- *Would like a phone holder for her wheel chair.*
- *She's more stronger on her right arm than her left arm*
- *Could reel in a fishing rod*
- *Charges all her batteries at once*
- *Stores battery in her backpack*
- *Has issues reaching around her chair*
- *She likes pink, bright sparkly*
- *Back of her chair digs into her armpits*
- *Flat stuff she cant pick with the Reacher grabber*
- *Don't go over 10 pounds*
- *Her right thumb is only strong enough to rotate a crank*

MILESTONE 2.2 – RESEARCH ASSIGNMENT

Team ID: Thrus-16

Complete this worksheet before Lab A for Week 7.

- State the question you plan to answer through your research
- Summarize your research findings (answer). Your answer should be a coherent, well-written summary of your research, not a "brain dump".
- You may include images, but don't forget to cite them properly.
- Aim for a length of about 500 words
- Properly cite your sources using IEEE formatted references and in-text citations. For information on referencing formats and choosing sources, see Design and Communication Workshop 1.

Name: Talha Nauman Hashmi	MacID: Hashmt1

What is your question?

How are convertibles covers?

What is your answer?

There are two main types of convertibles, that are typically seen in automotive design: the manual roof variant, relying on manual manipulation, and the electronically powered counterpart, offering automated operation through integrated electronic systems. With that being said, both systems come with a hardtop and soft top variation. The hardtops are made out of the same material that the rest of the car is made out of (typically aluminum and steel) while the soft top is made from something that has a little bit more flexibility like nylon or PVC. For this project any material should be okay as long as it is light enough so it does not weigh our client down as that would use more of her chairs battery and make it harder for her to set up in the heat of rain.

For manual roofs, simplicity is key compared to their electronic counterparts. These roofs typically feature a straightforward design, utilizing latches on the roof and windshield top, with the manual force of your hands bringing the components together. Manual roofs often incorporate a folding frame to maintain structural integrity. Typically, the soft top version of the roof ends up taking up less space in the trunk giving more storage area [1]. As mentioned before, another option with a manual roof is a removable hardtop, which gets secured to the car's body with latches, locks, and/or fasteners [2]. However, the biggest downside of the removeable hardtop is the fact that it doesn't fold down into the trunk of the car, but rather you need to externally store it somewhere

else whenever it is not in use. This really takes away from the ease of use of a convertible making a manual hardtop a not so good idea for this project as our client has limited mobility meaning using a feature like this may be difficult for her to use if she is by herself.

In contrast, automated roofs offer convenience with the press of a button which eliminates the need of manual effort through integrated motors and electronics. To be more specific, a gear system is on both sides of the vehicle and is connected to a mechanism that helps lifts the roof. When the motor activates, these gears power the lifting mechanism and then engage with brackets containing gear teeth, which are also a part of the roof. These gears then dictate the movement of the convertible into the desired position. Some motors are equipped with hydraulic pumps which raise and lower the top [3]. In addition to this, automated hardtops often fold into multiple pieces, storing itself in the car's boot solving the issue of storage that it's manual counterpart faces.

Regardless of whether the roof of a car is a soft top, hard top, manual, or automated, its purpose to protect the inside of the car from the outside is still the same. If a car were not to have a roof the electronics inside could be damaged in the event of rain or the user may get cold without having a way to block out the outside environment [4]. This is important for our client as currently her wheelchair does not have any sort of roof on it, making her and her chair susceptible to damage.

List of sources:

[1] "Convertible," WhyHighEnd [Online]. Available: http://www.whyhighend.com/convertible.html [Accessed Mar. 2, 2024].

[2] C. Team, "Everything to know about convertible roof types," carandbike [Online]. Available: https://www.carandbike.com/news/everything-to-know-about-convertible-roof-types-2762707 [Accessed Mar. 2, 2024].

[3] D. Hawley, "How to repair and clear a convertible top," J.D. Power, [Online]. Available: https://www.jdpower.com/cars/shopping-guides/how-to-repair-and-clear-a-convertible-top [Accessed Mar. 2, 2024].

[4] A. Kalita, "Roof design : Skill-lync," Skill Lync [Online]. Available: https://skill-lync.com/student-projects/roof-design-639 [Accessed Mar. 2, 2024].

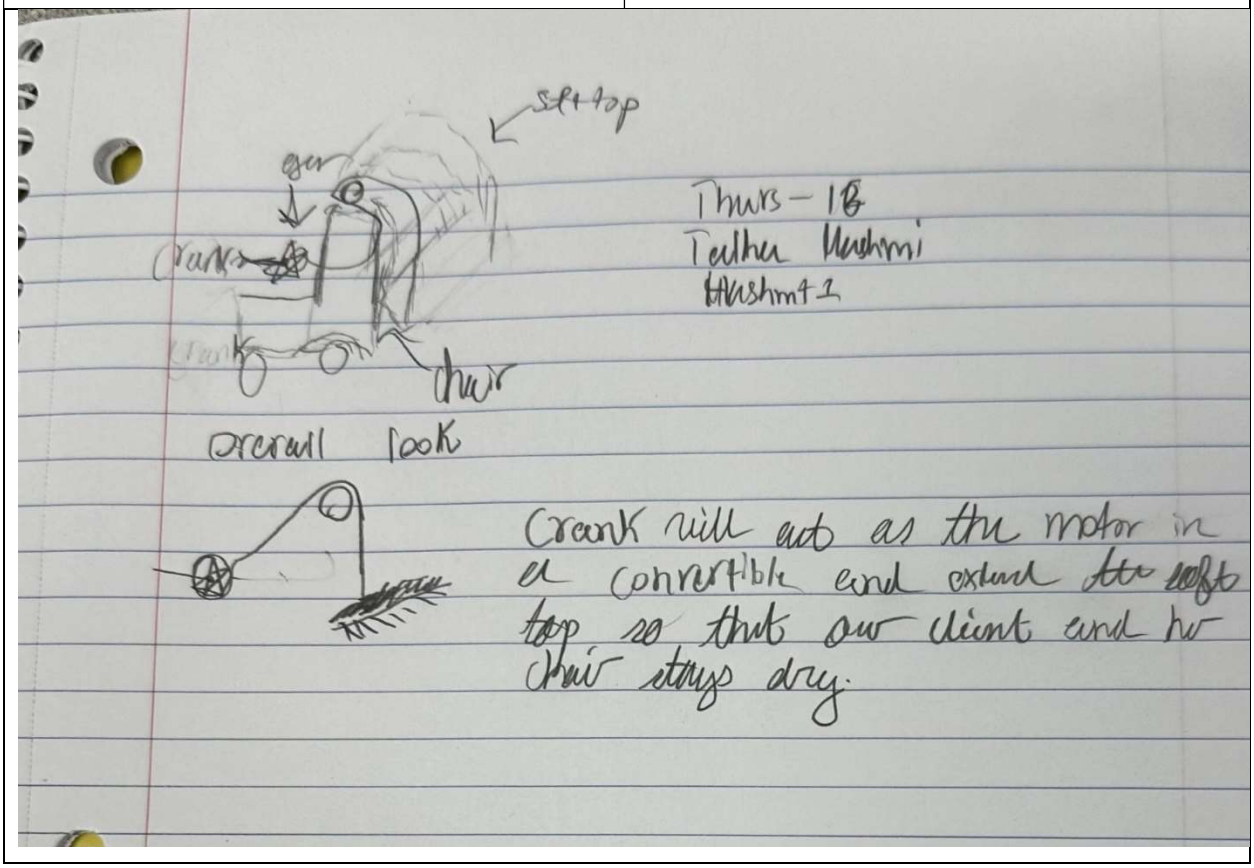
MILESTONE 2.2 – INITIAL CONCEPT EXPLORATION

Team ID:	Thrus-16

Complete this worksheet <u>before</u> Lab A for Week 7.

1. Include multiple images of your **initial** concept exploration, if needed
   - → Include necessary annotations to help in the communication of your ideas
   - → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   - → Include your Team Number, Name and MacID on *<u>each</u>* concept image
2. Insert your photo(s) as a Picture (Insert > Picture > This Device)
3. **<u>Do not include more than *two* concept images per page</u>**

Name: Talha Nauman Hashmi	MacID: Hashmt1



MILESTONE 2.4 – REFINED CONCEPT EXPLORATION

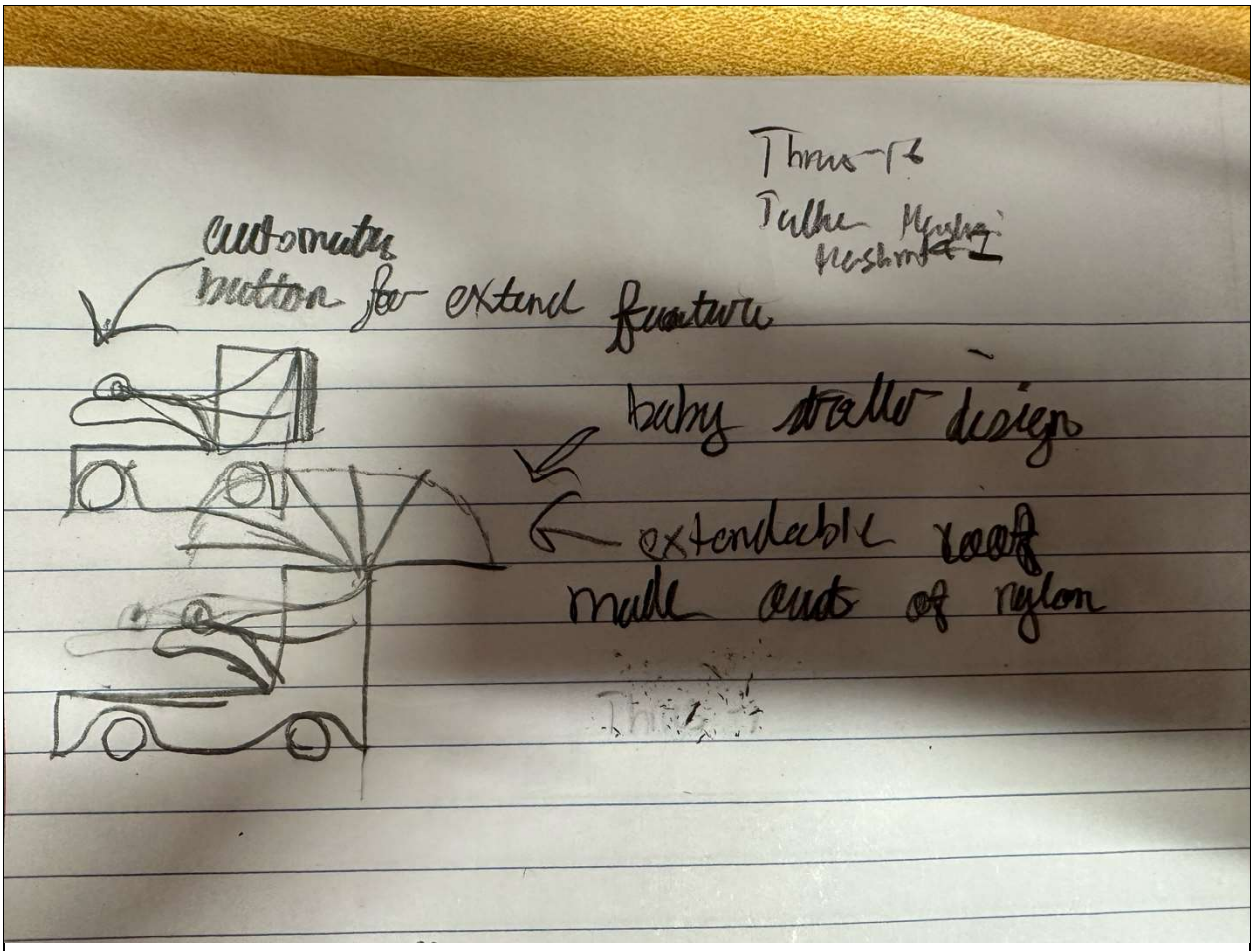
Team ID: Thrus-16

Complete this worksheet during Lab A for Week 7.

4. Include multiple images of your **refined** concept exploration, if needed
   → Include 2 distinct concepts based on the functional analysis
   → Include necessary annotations to help in the communication of your ideas
   → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   → Include your Team Number, Name and MacID on *each* concept image
5. Insert your photo(s) as a Picture (Insert > Picture > This Device)
6. **Do not include more than *two* concept images per page**

Concept 1:

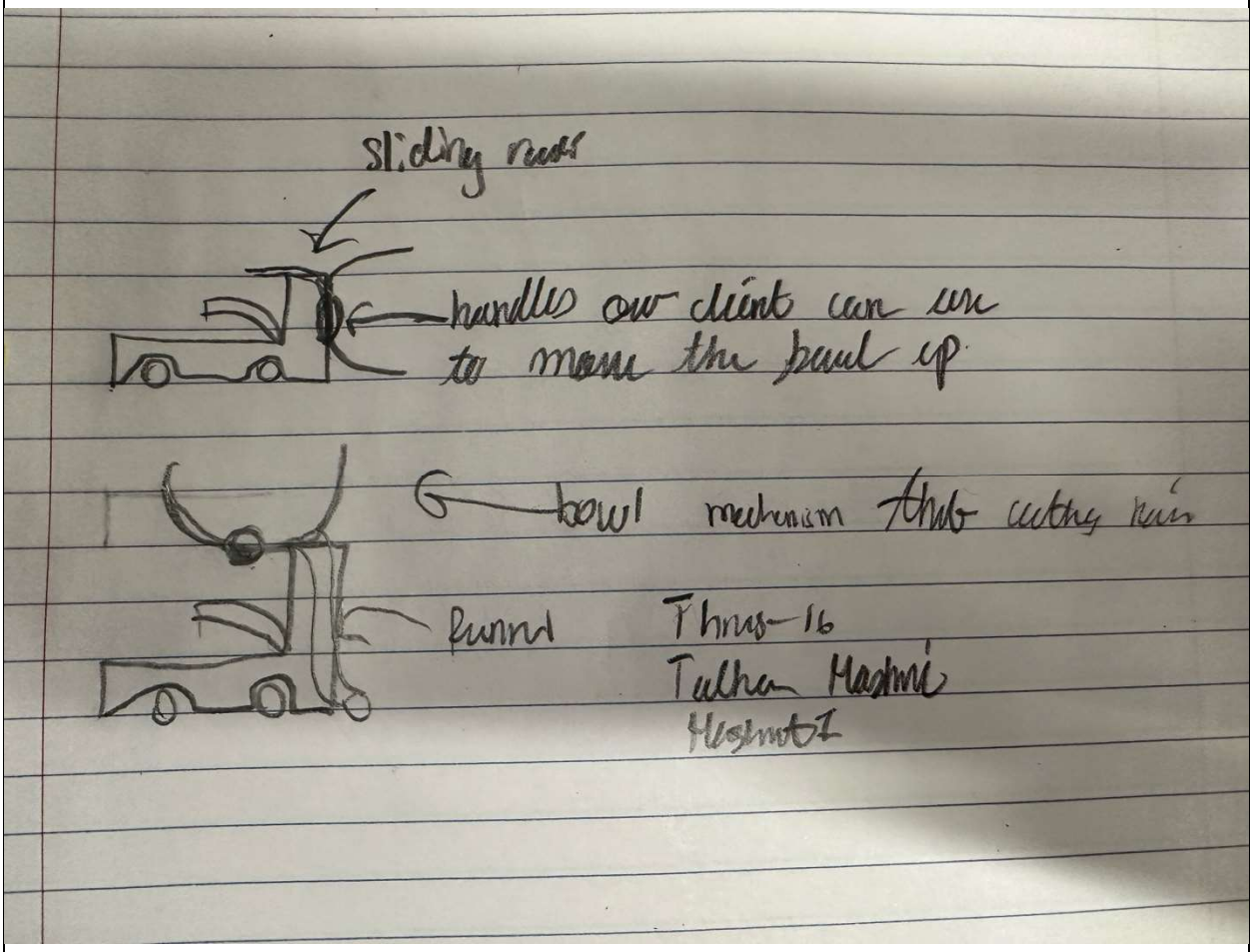
Name: Talha Nauman Hashmi	MacID: Hashmt1


automatic
button for extend feature
extendable roof
made out of nylon

Team ID:	Thurs-16

Concept 2:

Name: Talha Nauman Hashmi	MacID: Hashmt1



PROJECT FOUR MILESTONE THREE: PROTOTYPING, DECISION MAKING AND DESIGN REVIEW #2

MILESTONE 3.1 – REFINED CONCEPT: INITIAL PROTOTYPE

Team ID: Thrus-16

Complete this worksheet individually before coming to Design Studio/Lab A for Week 8.

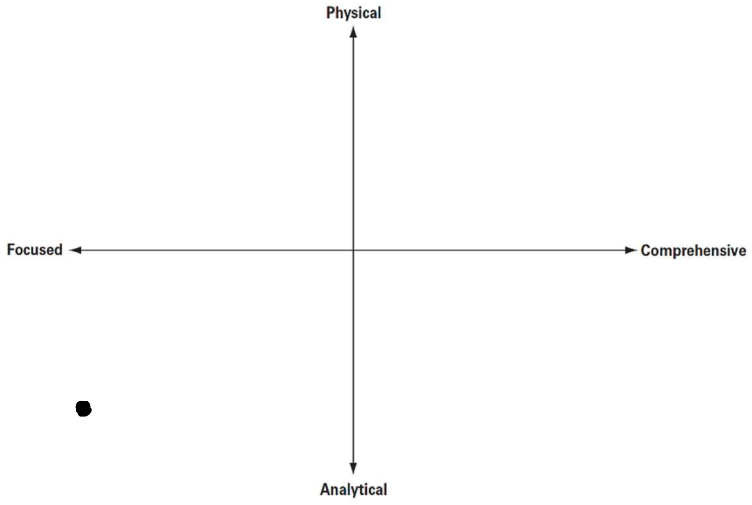
1. Write a small description of your initial prototype. Be sure to include what problem it aims to solve, how your initial prototype will be fabricated, and what functionality will be included and omitted in this initial prototype.
2. Classify whether your prototype is Physical or Analytical, and Focused or Comprehensive. Include the purpose of this prototype in the context of project 4 and the level of fidelity (low, medium, or high fidelity)
   - → **Physical vs. Analytical:** Physical prototypes are tangible artifacts that are created to approximate the final product. Analytical prototypes are non-tangible and represent the product using usually visual or mathematical models.
   - → **Focused vs. Comprehensive:** Focused prototypes implement only one or a few of the attributes of the final product. Comprehensive prototypes aim to implement most, if not all of the attributes of the final product.
3. Create a list of objectives and metrics for your initial prototype. There is no required amount of objectives or metrics, so long as the list is comprehensive.
4. Create a rough experimental plan for how you might test your prototype. Consider the methods you might use to test various objectives, how you will measure how effective each test proves to be and how realistic it would be to implement. This does not need to be detailed plan but should consider several of your objectives for the prototype.
5. Take picture(s) of your refined concept (initial prototype)
   - → Insert your photo(s) as a Picture (Insert > Picture > This Device)
   - → **Do not include more than *two* refined concept pictures per page**
   - → Include details on how concept was refined (what feedback was incorporated, what features are different than previous concept exploration, etc.)
   - → You can continue this process within the allocated time of the LabA/DS and seek feedback and discussions from your team members and/or the instructional team (IAIs, TAs, etc.).

Name: Talha Hashmi	MacID: Hashmt1

Write a short description of your initial prototype below.

I decided to make a prototype of the crank our team could use for our design. It uses a manual kinetic system (that could be turned more into a gear system) to wind up the string. This string will then be attached to the covering that would raise it back up after it extends. The wheel would also need to be connected to the chair with a bearing so it could rotate (that would be store bought), and then the strings would connect to pulleys (also store bought) to be able to wind the covering back in. The crank itself would be 3D printed and would be able to wind the string up once the bearing was put into place.

Indicate where your prototype falls on the scale below.



Kind of Prototype:

☐ Physical or ■ Analytical

■ Focussed or ☐ Comprehensive

Purpose of Prototype: Integration: The purpose is to see where or not a crank wheel would integrate well with the other general ideas my group members have about this project. The main issue our group was having was not having a means to close the covering after it had been extended.

Level of Fidelity: This prototype is medium fidelity prototype as if a final product were to be printed it would look similar to what it is right now, however small changes would need to be

	made to account for the store bought items.

Include a list of objectives and metrics for your prototype below.

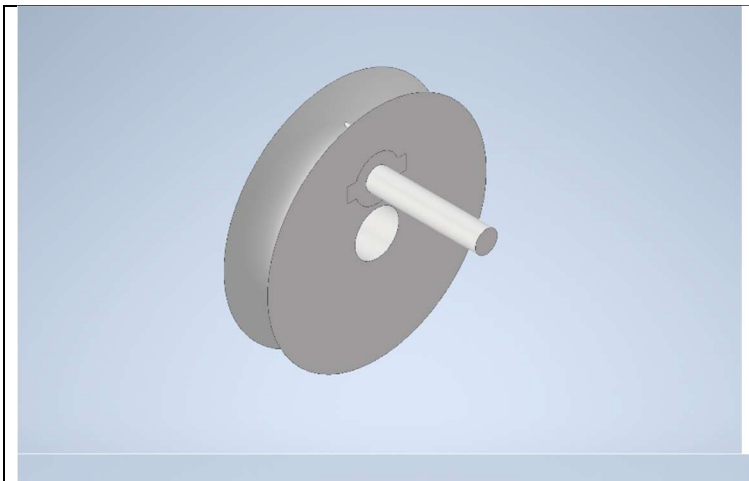
Objectives	Metrics
• **Be able to rotate 360 degrees**	• **Angle of rotation**
• **Lightweight**	• **Weight**
• **Small**	• **Surface area**
• **Ease of use**	• **User satisfaction**
• **Weather resistance**	• **Material survivability**

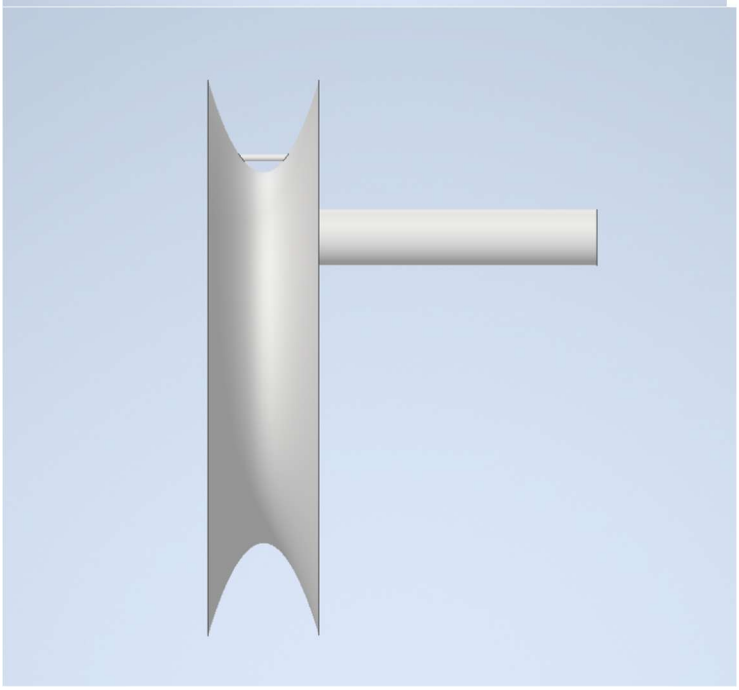
Include a rough experimental plan on how you might test your prototype below.

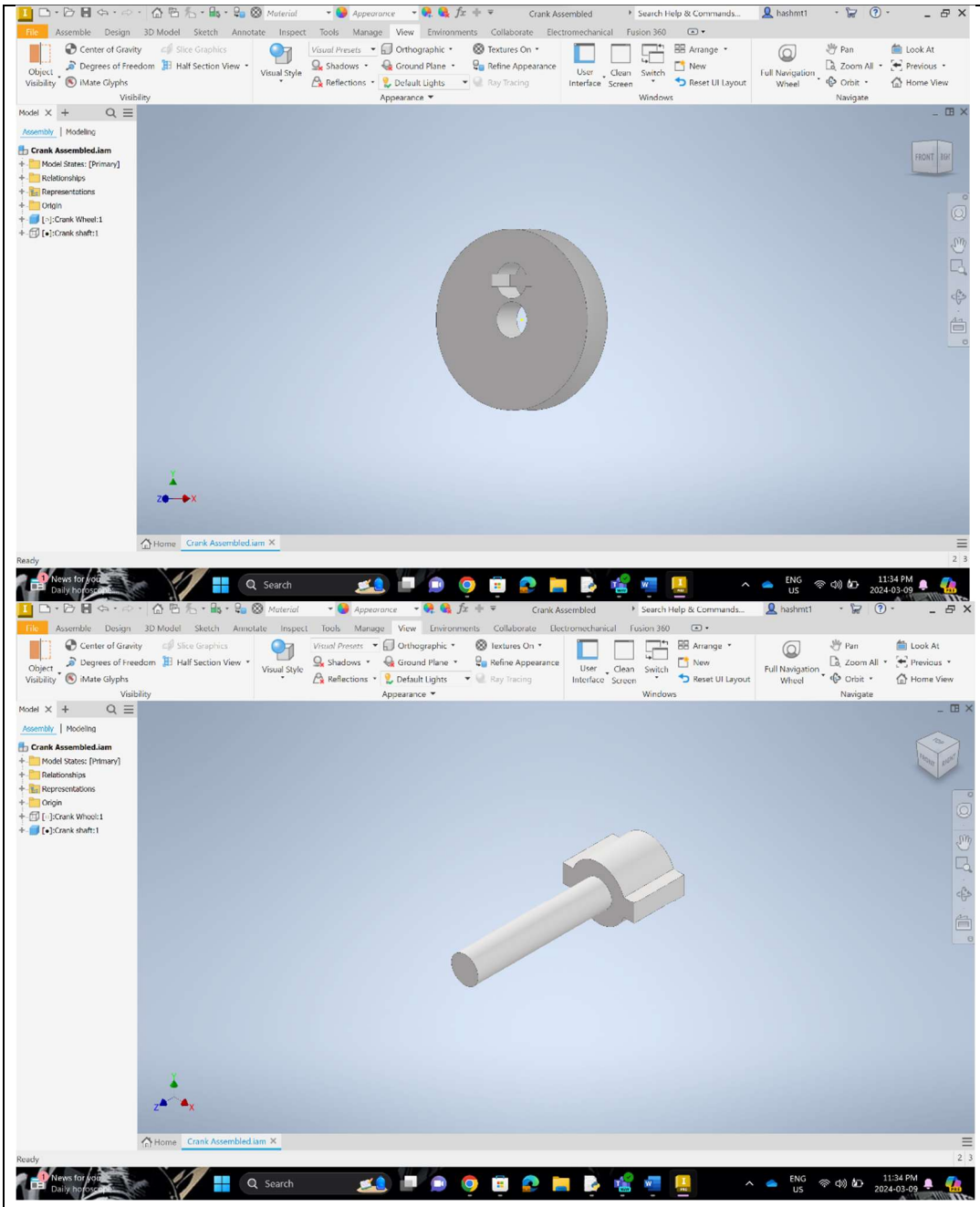
I would first check the iproperties on inventor to understand how small the prototype would be.

After I would check the volume and multiply it be the density of the material that we have chosen for the crank, this would give me the weight of the total crank. After I would check if the crank would be able to rotate the wheel 360 degrees once printed and attached to the bearing. After that I would test the material that I end up choosing in different environments to test for rust (if made from metal), erosion, or melting point. I am checking rust and erosion for rain, and temperature to make sure in the hot summer our clients mechanism doesn't break.

Insert picture(s) of your refined concept (initial prototype) below.







What was changed between this prototype and the last was the realistic implementation of a windup mechanism, as before me and my team were debating if it should have an electronic system but we realized that our team doesn't have enough previous experience with circuits to successfully complete the project. This is why I felt this focused prototype should be made as it was one of the few things we were still debating on.

PROJECT FOUR FINAL DELIVERABLE: PROJECT REFLECTION

The activities in this handout are intended to be completed by the end of the project 4. You will apply what you learn in Design Communication Workshop 4 to complete this task.

Submission Details

Each Team Member: upload your reflection essay as a PDF to the Avenue Dropbox titled P4 Reflection using the MacID_P4_Reflection.pdf as naming convention

Grading of Reflection

Your reflection assignment is worth 1 mark of your total Project-4 grade (12.5%). Rubric is provided on Avenue to Learn.

If you need to review the content, go back to Design Communication Workshop 4 and/or go through the online reflecti0on module. Here is the link:
https://ecampusontario.pressbooks.pub/engineeringreflectiontoolkit/

Reflection Activity

Consider your experience with the design process as a first-year engineering student working on Project 4 over the past couple of months in ENG 1P13. After exploring the client's challenges and gaining insights, your team, decided to focus on one area to improve our client's daily life. You have defined the problem in a problem statement that included objectives, constraints, etc. Through this exploration, you performed a functional analysis that was used to come up with different alternative ways to solve the problem. Your team needed to make a decision between the different alternatives, and you tested your ideas for feasibility. You have been encouraged to iterate as you gained deeper insight and developed empathy for the client. Through the process of iteration, you have had the opportunity to improve upon your ideas. Engineers are continually iterating through the design process. Informed designers are involved in continual learning: learning by doing, learning from brainstorming and prototyping, learning by iteration and from feedback and failure, learning by noticing and troubleshooting, learning by drawing and dialoging about ideas, materials, and people. While iteration is an informal form of reflection, you will deepen your understanding of what you have learned through formal reflection. All of these emphasize the metacognitive and reflective practice aspects of learning through design (Lawson & Dorst, 2009; Crismond & Adams, 2012).

Part 1: What?

In this section you will describe a critical incident that you will be reflecting on as related to the "Generating/Testing ideas" and "Decision-making". For each of these steps of the design process:

In three to five sentences, identify and describe ONE critical incident, breakthrough or big thought-provoking moment that either challenged your assumptions, had a positive impact on you or validated your understanding of the design process. Here are some questions to consider.

Generating & Testing Ideas:

- How did you go about exploring ideas?
- How deeply did you explore your design options?
  - How much research?
  - Did you look into Biomimicry tools?
  - Did you consider any "What if?" questions in your explorations?
- Did you test your ideas?
- If yes, how did you test your ideas?
  - What were you trying to test (e.g., desirability, feasibility, etc.)?
  - What tool/ method did you use? (physical prototype, CAD model, etc.)
  - How much time did you spend on testing each idea?
  - How many ideas did you test?
  - How many prototypes did you make for testing each idea?
  - Did you test your ideas early on or waited until you had more details of the ideas?
- What was one challenge that you faced in the testing process of the design? (we encourage you to write more than one challenge). And What did you do to solve that challenge? (you can attach photos to explain your attempted solutions)
- From the results of our testing, one change we made to improve our design solution was … (add your response) and this change made our design solution better because … (add your response).

Response:

During P4, I faced a significant challenge that made me reshape how I view teamwork and time management in these design projects. What I mean by this is that even though I had contributed to the project's ideas for the prototype, a team member completed the CAD model without involving the rest our group which robbed us of the opportunity to improve on our technical skills for this project. This is because a lot of this project for my group was more assembly of store-bought parts, rather than designing different mechanisms. However, while this may originally seem like an issue it taught me the importance of spreading out the work in these design projects. This is because after this that group member felt as he had done his job which gave the rest of us more opportunities to help with the rest of the project.

Decision Making:

- What happened during decision-making?
  - Where in the process, relative to the design process steps, did you make decisions?
  - What were the decisions about? Decisions could be about the process (e.g., how much searching of the design space was enough?) or about the design (e.g., which alternative to prototype).
  - How many options did you have to choose from?
  - How many criteria did you have to compare the options? How did you choose those criteria?
  - What tools did you use to make a decision?
- At what stage did you make a decision?
- When did this experience take place? Did you already have one final solution in mind or you were still exploring the ideas?
- What challenges did you face during decision-making process?

Response:

Due to the mentioned issue, this pushed me to make a decision to how involved I wanted to be for this project. I realized that I have the power to choose what I want to do which gives me more control on the outcomes of the situation. With this being said I also understand now that I need to see what my team mates want.

Part 2: "So What?"

In this section you will explore what you learned and describe why this incident matters to you.

In three to five sentences, discuss what you learned from this incident about idea generation, testing ideas, and decision making and that either surprised you, made you confront a misconception, or improved your understanding of the design process.

To help you think about this, consider the following:

- What was the outcome of early or late testing processes?
- Do you think delaying any of your decision-making may have improved the design?
- Could you have collected better observations or data that would have led to better decisions?
- Did you repeat your decision-making process at any other stage?

Response:

As mentioned, the reason why this is important to me is that it made me realize that I am in control of the amount of involvement I get in this project. The work and learning experiences are there if you look for it. What I mean by this is because of my lack of involvement in the cad models, it gave me the opportunity to learn more about the assembly of this project which also gave me a little bit more insight for things when CADing them. What I mean by this is I learned that in real life not everything will fit as snug as you planned it to be, which why its importance to give yourself some "wiggle room" when design things for In real life.

In two to three sentences, explain why these new insights are important to you.

Response:

This is important to me as I feel as though I am better in tune of a the design process, as I have now understood that everyone is pulling their weight in their own way. Some people believe that they would be most effective at what they're good at which then prompts them to do what theryre good at. It also makes me more understand and appreciative of the work that others do.

Part 3: "Now What?"

In two to three sentences, discuss how you will integrate this new insight into future design projects, including next week prototyping and design review 2 where you still have a chance to improve your design. To help you think about this, consider the following:

- I learned that... (Express and important learning, not a statement of fact)
- This learning matters because... (Consider how this learning has value to you as an engineer)
- How will I apply my learning?
- How will I design differently next time?
- How will I deal with a similar situation in the future?
- Considering this learning, I will... (Set specific, assessable goals; consider benefits and challenges involved in this plan)

Response:

Now that I understand everyone's place in these projects, I understand that it is important to clarify with your team mates what they want to do and more importantly why. This then gives you a chance to see what your other team mates want out of this project, which will allow you to better distribute the work amongst the group. We are past next week prototyping and design review, however if there was more work to be done I would have a sit down conversation with my group mates to see exactly what they want.

In two to three sentences, describe the possible benefits and challenges involved in your plan.

Response:

This will allow me to be more mindful of my teammates as it will put me in their shoes and see their point of view. A challenge of this is if there is an individual that wants to free load it would be hard to see what he wants out of the project as the only thing he wants is the grade.

References:

Lawson, B., & Dorst, K. (2009). Design expertise. Oxford, UK: Architectural Press.

Crismond, D. P., & Adams, R. S. (2012). The informed design teaching and learning matrix. Journal of Engineering Education, 101 (4), 738-797.

ENGINEER 1P13:
PROJECT FOUR WORKSHEETS (INDIVIDUAL)

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PROJECT FOUR MILESTONE ONE: PROBLEM FRAMING AND TEST PLAN

MILESTONE 1.1 – CLIENT NOTES

Team ID: Thurs-16

Complete this worksheet individually before coming to Lab A for Week 6.

1. Include your client notes from the introductory client visit

Name: Evan Hong	MacID: honge14
- *Client wants a better mobility aid* - *Deal with poor weather conditions* - *Struggle with reaching things* - *Example traffic lights* - *Outlets* -	

PROJECT FOUR MILESTONE TWO: DESIGN EXPLORATION AND DESIGN REVIEW #1

MILESTONE 2.1 – CLIENT NOTES

Team ID:	Thurs-16

Complete this worksheet individually before coming to Lab A for Week 7.

Include your client notes from the introductory client visit

Name: Evan Hong	MacID: honge14

- *Model of the wheelchair base: quantum edge 3*
- *Visibility of console is ok, it smashed a year ago from a collision and needed to be replaced*
- *Console is not waterproof, usually wrapped in a grocery or garbage bag*
- *Big issue is dealing with height*
- *Dimension of wheelchair:*
- *Stronger in right arm because of disability*
- *Doesn't have proper places to put keys wallet phone*
- *Puts a bag on the back of the chair but it gets stuck all the time*
- *If the bag slips it hits the wheels*
- *Issue with battery (if there is no outlet, she is stuck until someone can help her)*

MILESTONE 2.2 – RESEARCH ASSIGNMENT

Team ID: Thurs-16

Complete this worksheet before Lab A for Week 7.

- State the question you plan to answer through your research
- Summarize your research findings (answer). Your answer should be a coherent, well-written summary of your research, not a "brain dump".
- You may include images, but don't forget to cite them properly.
- Aim for a length of about 500 words
- Properly cite your sources using IEEE formatted references and in-text citations. For information on referencing formats and choosing sources, see Design and Communication Workshop 1.

Name: Evan Hong	MacID: honge14
What is your question? What are the current solutions to bad weather for people using wheelchairs?	
What is your answer? There are not many options for wheelchair users when dealing with bad weather. Usually, just wearing a rain jacket isn't going to cut it. The best option to stay dry would be some form of rain poncho, however, it can be difficult to put on for some users who are less maneuverable. Ponchos also do not protect the electrical components of motorized wheelchairs. The general solution for protecting the wheelchair console is to cover it in some kind of plastic bag, which can be effective in the short term but is not foolproof and will not last long. A motorized wheelchair user could also use an umbrella, but it would be unwieldy and use up one of their hands. It would also be impossible for a manual wheelchair user to use an umbrella unless they had something in their wheelchair to secure it in place. There are many different types of ponchos a wheelchair user can buy, whether they fully cover the body or end halfway down the legs, to the material or lining used in the poncho. Ponchos can be made from cheap plastic, nylon and other fabrics as well as fleece or polyester linings to stay warm. There are even options that are just a sleeve for your legs, if you already have a good raincoat. Wheelchair users also need to be very careful when moving around in the rain, as getting water inside of their electrical components or the wheels can mess with its function and lubrication. Also, a wheelchair can get stuck in mud, potholes obscured with water, snow, etc. For most of these issues, the wheelchair user just needs to be careful when traveling outside and avoid these spots along the road, or risk getting stuck or perhaps needing to replace or fix their wheelchair more frequently. They can also	

purchase wheel sleeves or covers for the wheels to keep themselves and the interior of their homes clean.

As for winter weather, moving around in a wheelchair can be quite dangerous, especially in ice. Wheelchair users need to make sure their chairs are in good condition, and powered chair users need to make sure their battery is fully charged, as they will run out faster in the cold. Some wheelchairs also have the option to switch on winter tires, which will be a big help and grant lots of needed traction in the snow. Another thing wheelchair users can buy are wheelchair snow blades, which act like small skis that allow the wheelchair to get through snow more easily.

List of sources:

[1] "Preparing your wheelchair for snow: Gillette Children's," Preparing Your Wheelchair for Snow | Gillette Children's, https://www.gillettechildrens.org/stories/preparing-your-wheelchair-for-snow (accessed Mar. 2, 2024).

[2] L. Crosby, "7 products and 6 tips for wheeling in the rain," United Spinal Association, https://unitedspinal.org/7-products-and-6-tips-for-wheeling-in-the-rain/ (accessed Mar. 2, 2024).

[3] I. bloggers, "Wheelchair rain covers as cool as they are dry," Passionate People by Invacare, https://passionatepeople.invacare.eu.com/wheelchair-rain-covers/ (accessed Mar. 2, 2024).

https://passionatepeople.invacare.eu.com/wheelchair-rain-covers/

https://unitedspinal.org/7-products-and-6-tips-for-wheeling-in-the-rain/

https://www.gillettechildrens.org/stories/preparing-your-wheelchair-for-snow

client meetings

MILESTONE 2.2 – INITIAL CONCEPT EXPLORATION

Team ID:	Thurs-16

Complete this worksheet before Lab A for Week 7.

1. Include multiple images of your **initial** concept exploration, if needed
   → Include necessary annotations to help in the communication of your ideas
   → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   → Include your Team Number, Name and MacID on *each* concept image
2. Insert your photo(s) as a Picture (Insert > Picture > This Device)
3. **Do not include more than *two* concept images per page**

Name: evan hong	MacID: honge14
Insert screenshot(s) of your concept below. 	

MILESTONE 2.4 – REFINED CONCEPT EXPLORATION

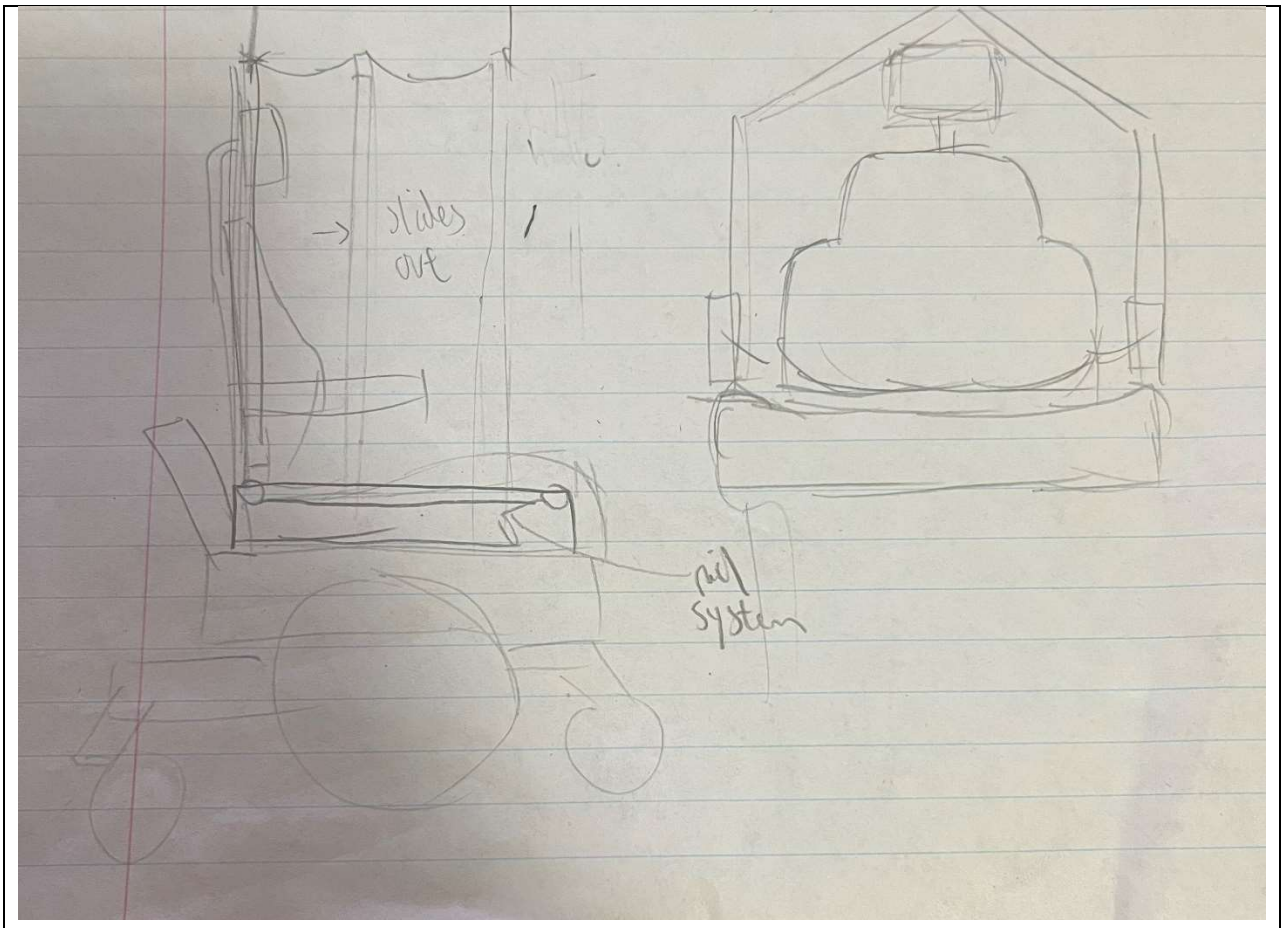
Team ID:	Thurs-16

Complete this worksheet during Lab A for Week 7.

4. Include multiple images of your **refined** concept exploration, if needed
   - → Include 2 distinct concepts based on the functional analysis
   - → Include necessary annotations to help in the communication of your ideas
   - → These can be photos of hand sketches, photos of initial prototypes, screen grabs of basic CAD models
   - → Include your Team Number, Name and MacID on *each* concept image
5. Insert your photo(s) as a Picture (Insert > Picture > This Device)
6. **Do not include more than *two* concept images per page**

Concept 1:

Name: evan hong	MacID: honge14
Insert screenshot(s) of your concept below.	



Tent based design

Pulled forward and back

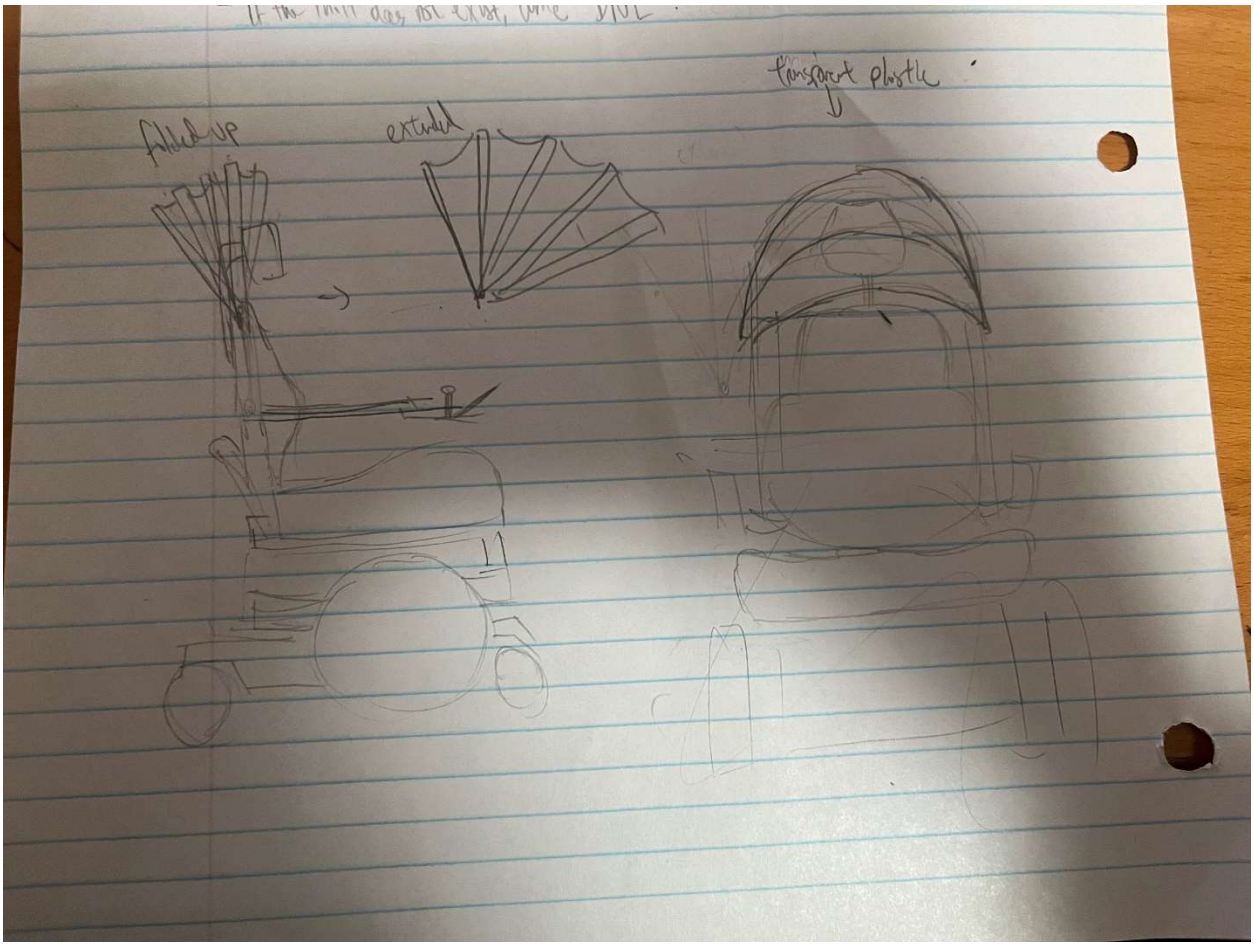
Team ID: Thurs-16

Concept 2:

Name: evan hong	MacID: honge14

Insert screenshot(s) of your concept below.

Car convertible like design



PROJECT FOUR MILESTONE THREE: PROTOTYPING, DECISION MAKING AND DESIGN REVIEW #2

MILESTONE 3.1 – REFINED CONCEPT: INITIAL PROTOTYPE

Team ID: Thurs-16

Complete this worksheet individually before coming to Design Studio/Lab A for Week 8.

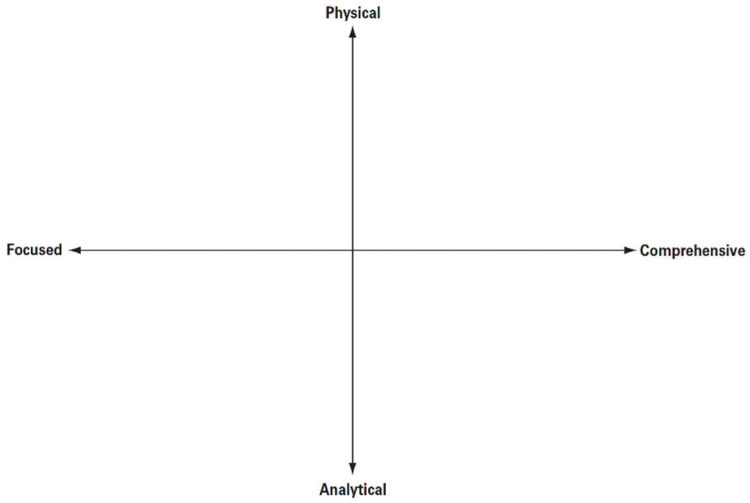
1. Write a small description of your initial prototype. Be sure to include what problem it aims to solve, how your initial prototype will be fabricated, and what functionality will be included and omitted in this initial prototype.
2. Classify whether your prototype is Physical or Analytical, and Focused or Comprehensive. Include the purpose of this prototype in the context of project 4 and the level of fidelity (low, medium, or high fidelity)
   - → **Physical vs. Analytical:** Physical prototypes are tangible artifacts that are created to approximate the final product. Analytical prototypes are non-tangible and represent the product using usually visual or mathematical models.
   - → **Focused vs. Comprehensive:** Focused prototypes implement only one or a few of the attributes of the final product. Comprehensive prototypes aim to implement most, if not all of the attributes of the final product.
3. Create a list of objectives and metrics for your initial prototype. There is no required amount of objectives or metrics, so long as the list is comprehensive.
4. Create a rough experimental plan for how you might test your prototype. Consider the methods you might use to test various objectives, how you will measure how effective each test proves to be and how realistic it would be to implement. This does not need to be detailed plan but should consider several of your objectives for the prototype.
5. Take picture(s) of your refined concept (initial prototype)
   - → Insert your photo(s) as a Picture (Insert > Picture > This Device)
   - → **Do not include more than *two* refined concept pictures per page**
   - → Include details on how concept was refined (what feedback was incorporated, what features are different than previous concept exploration, etc.)
   - → You can continue this process within the allocated time of the LabA/DS and seek feedback and discussions from your team members and/or the instructional team (IAIs, TAs, etc.).

Name: Evan Hong	MacID: honge14

Write a short description of your initial prototype below.

The general frame/skeleton of the rain shield made of paper, tape, a marker and a hair tie

Indicate where your prototype falls on the scale below.



Kind of Prototype:

X Physical or ☐ Analytical

X Focussed or Comprehensive

Purpose of Prototype: to model how the skeleton would fold/unfold

Level of Fidelity: Low

Include a list of objectives and metrics for your prototype below.

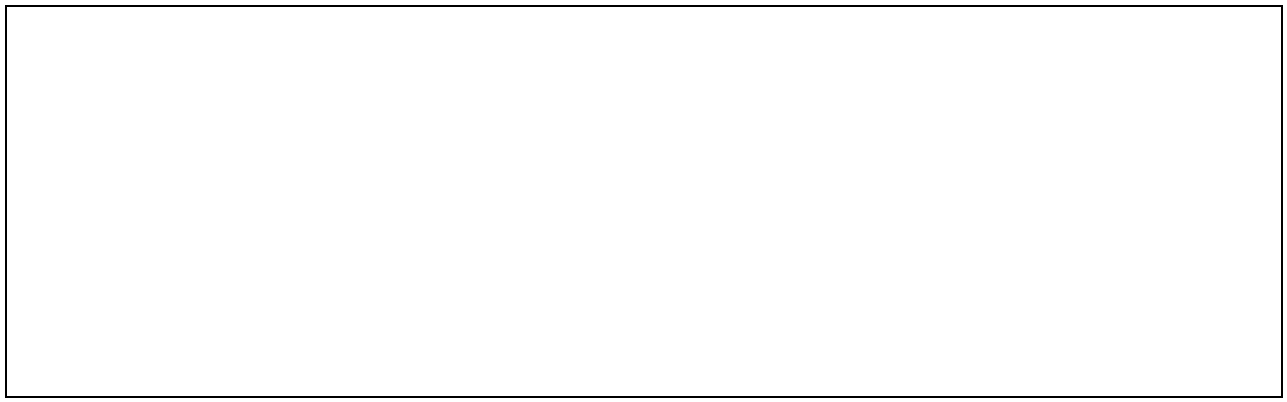
Objectives	Metrics
• **Expand outward and back in**	• **Size when folded up**
• **Be able to fold back in on itself**	• **How far it folds forward**
• **Stop folding out at a maximum point**	•
•	

Include a rough experimental plan on how you might test your prototype below.

Opening and closing the skeleton

Place small amounts of force on the frame to test its strength

Insert picture(s) of your refined concept (initial prototype) below.



PROJECT FOUR FINAL DELIVERABLE: PROJECT REFLECTION

The activities in this handout are intended to be completed by the end of the project 4. You will apply what you learn in Design Communication Workshop 4 to complete this task.

Submission Details

Each Team Member: upload your reflection essay as a PDF to the Avenue Dropbox titled P4 Reflection using the MacID_P4_Reflection.pdf as naming convention

Grading of Reflection

Your reflection assignment is worth 1 mark of your total Project-4 grade (12.5%). Rubric is provided on Avenue to Learn.

If you need to review the content, go back to Design Communication Workshop 4 and/or go through the online reflecti0on module. Here is the link:
https://ecampusontario.pressbooks.pub/engineeringreflectiontoolkit/

Reflection Activity

Consider your experience with the design process as a first-year engineering student working on Project 4 over the past couple of months in ENG 1P13. After exploring the client's challenges and gaining insights, your team, decided to focus on one area to improve our client's daily life. You have defined the problem in a problem statement that included objectives, constraints, etc. Through this exploration, you performed a functional analysis that was used to come up with different alternative ways to solve the problem. Your team needed to make a decision between the different alternatives, and you tested your ideas for feasibility. You have been encouraged to iterate as you gained deeper insight and developed empathy for the client. Through the process of iteration, you have had the opportunity to improve upon your ideas. Engineers are continually iterating through the design process. Informed designers are involved in continual learning: learning by doing, learning from brainstorming and prototyping, learning by iteration and from feedback and failure, learning by noticing and troubleshooting, learning by drawing and dialoging about ideas, materials, and people. While iteration is an informal form of reflection, you will deepen your understanding of what you have learned through formal reflection. All of these emphasize the metacognitive and reflective practice aspects of learning through design (Lawson & Dorst, 2009; Crismond & Adams, 2012).

Part 1: What?

In this section you will describe a critical incident that you will be reflecting on as related to the "Generating/Testing ideas" and "Decision-making". For each of these steps of the design process:

In three to five sentences, identify and describe ONE critical incident, breakthrough or big thought-provoking moment that either challenged your assumptions, had a positive impact on you or validated your understanding of the design process. Here are some questions to consider.

Generating & Testing Ideas:

- How did you go about exploring ideas?
- How deeply did you explore your design options?
  - How much research?
  - Did you look into Biomimicry tools?
  - Did you consider any "What if?" questions in your explorations?
- Did you test your ideas?
- If yes, how did you test your ideas?
  - What were you trying to test (e.g., desirability, feasibility, etc.)?
  - What tool/ method did you use? (physical prototype, CAD model, etc.)
  - How much time did you spend on testing each idea?
  - How many ideas did you test?
  - How many prototypes did you make for testing each idea?
  - Did you test your ideas early on or waited until you had more details of the ideas?
- What was one challenge that you faced in the testing process of the design? (we encourage you to write more than one challenge). And What did you do to solve that challenge? (you can attach photos to explain your attempted solutions)
- From the results of our testing, one change we made to improve our design solution was … (add your response) and this change made our design solution better because … (add your response).

Response:

One challenge we faced was implementing a way for the client to easily open and close the rain cover. The client has a limited range of mobility in her spine and arms, so they would be unable to reach up and behind themselves to pull the cover down. Initially, we were stuck on the thought of a crank system, where a rope would pull and let the cover down, but we realized that it would be difficult to create and for the client to operate. Instead, we settled on a straight lever, which was easier to both build and use.

Decision Making:

- What happened during decision-making?
  - Where in the process, relative to the design process steps, did you make decisions?
  - What were the decisions about? Decisions could be about the process (e.g., how much searching of the design space was enough?) or about the design (e.g., which alternative to prototype).
  - How many options did you have to choose from?
  - How many criteria did you have to compare the options? How did you choose those criteria?
  - What tools did you use to make a decision?
- At what stage did you make a decision?
- When did this experience take place? Did you already have one final solution in mind or you were still exploring the ideas?
- What challenges did you face during decision-making process?

Response:

A decision we had to make was during the initial design process when deciding on the different prototype designs. Aside from the design we went with, there was also a sliding tent design and a design revolving around holding an umbrella. In the end, we chose our current cover design based on the criteria that It would be portable, compact, and easier to use.

Part 2: "So What?"

In this section you will explore what you learned and describe why this incident matters to you.

In three to five sentences, discuss what you learned from this incident about idea generation, testing ideas, and decision making and that either surprised you, made you confront a misconception, or improved your understanding of the design process.

To help you think about this, consider the following:

- What was the outcome of early or late testing processes?
- Do you think delaying any of your decision-making may have improved the design?
- Could you have collected better observations or data that would have led to better decisions?
- Did you repeat your decision-making process at any other stage?

Response:

Something I learned from changing our crank idea to the simpler lever idea was that sometimes overcomplicating things could be detrimental and the better solution could just be the simpler idea. Our team was very on board with the crank idea, and we even made some preliminary CAD models, and we realized later that it was not going to work. Had we observed the situation more objectively, we could have saved a lot of time and effort and maybe refined our final prototype more.

In two to three sentences, explain why these new insights are important to you.

Response:

This experience was important to me because it taught me to not get attached to an initially good idea, and to weigh all my options without bias. Additionally, this also encourages me to look for the opinions of others who do can view my situation objectively, such as another group member or a TA. This is important to me because while we did not waste too much time on this project, as an engineer, this kind of mistake can be much more costly.

Part 3: "Now What?"

In two to three sentences, discuss how you will integrate this new insight into future design projects, including next week prototyping and design review 2 where you still have a chance to improve your design. To help you think about this, consider the following:

- I learned that... (Express and important learning, not a statement of fact)
- This learning matters because... (Consider how this learning has value to you as an engineer)
- How will I apply my learning?
- How will I design differently next time?
- How will I deal with a similar situation in the future?
- Considering this learning, I will... (Set specific, assessable goals; consider benefits and challenges involved in this plan)

Response:

After this learning experience, I will strive to put more thought and be more careful to avoid committing to hasty decisions. To accomplish this, I will try to communicate more with Tas and look for more outside opinions, as well as trying to weigh my options objectively.

In two to three sentences, describe the possible benefits and challenges involved in your plan.

Response:

Some benefits that could be gained from this plan are avoiding wasted time and resources and better feedback from outside sources. However, I must also be careful not to take too long in making decisions, as that will cause delays and may waste too much time.

References:

Lawson, B., & Dorst, K. (2009). Design expertise. Oxford, UK: Architectural Press.

Crismond, D. P., & Adams, R. S. (2012). The informed design teaching and learning matrix. Journal of Engineering Education, 101 (4), 738-797.