Cerebral Palsy Chair

ENGR 1100 - Engineering Design I

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Canadians are diagnosed with cerebral palsy, a disorder that prevents the individual from freely moving. [5]


These kids are bound to use walkers or chairs **for most of their life.**

[1]

Exorbitant prices.

Wheelchairs will **range in price** depending on the **make**, **model**, and **accessories**.

But countless **families cannot afford** the **abrupt prices** for mobility aid that their child needs.

That's why a **low-cost** made out of **recyclable material** wheelchair is an excellent option.

[2]

Problem Definition

Objectives

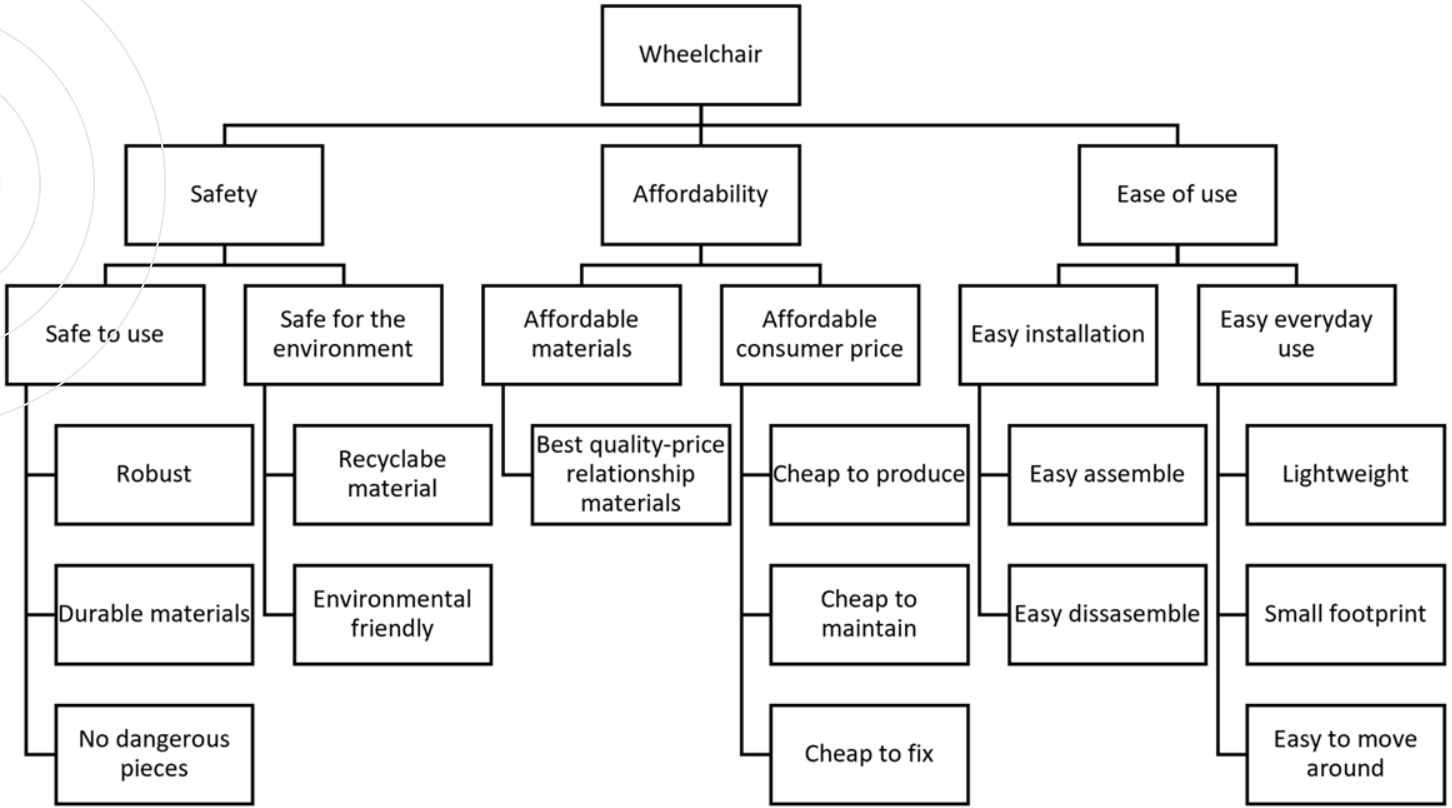
- **Safe** for a 2-3-year-old child.
- **Affordable** for low-income families.
- **Environmental friendly** with recyclable material.
- **Easy** to **use** and easy to assemble.

Constraints

- Can take more than **35 pounds**.
- No **sharp edges** or **small parts** that can pose a choking hazard.
- All **surfaces** must be adequately **sealed**.

[3]

Objective tree



Importance chart

Safe for a 2-3-year-old kid	10
Easy to assemble/disassemble	7
Easy to store	6
Easy to move around	9
Comfortable	8
Low retail price	8
Low manufacturing cost	7

Design process

We started by **identifying needs and constraints** of children with cerebral palsy. We looked at **current solutions** and how they were being solved. After we **brainstormed** and came up with different ideas. We **selected the best** features and worked on implementing them all on a single design. We built a **prototype** to get a clearer idea. We **tested** the prototype and then we revised our design and **created a new** improved design.

Solution 1

We wanted to make something **standard but** at the same time **different** too. We came up with a design that focused on the **freedom** of **movement**.

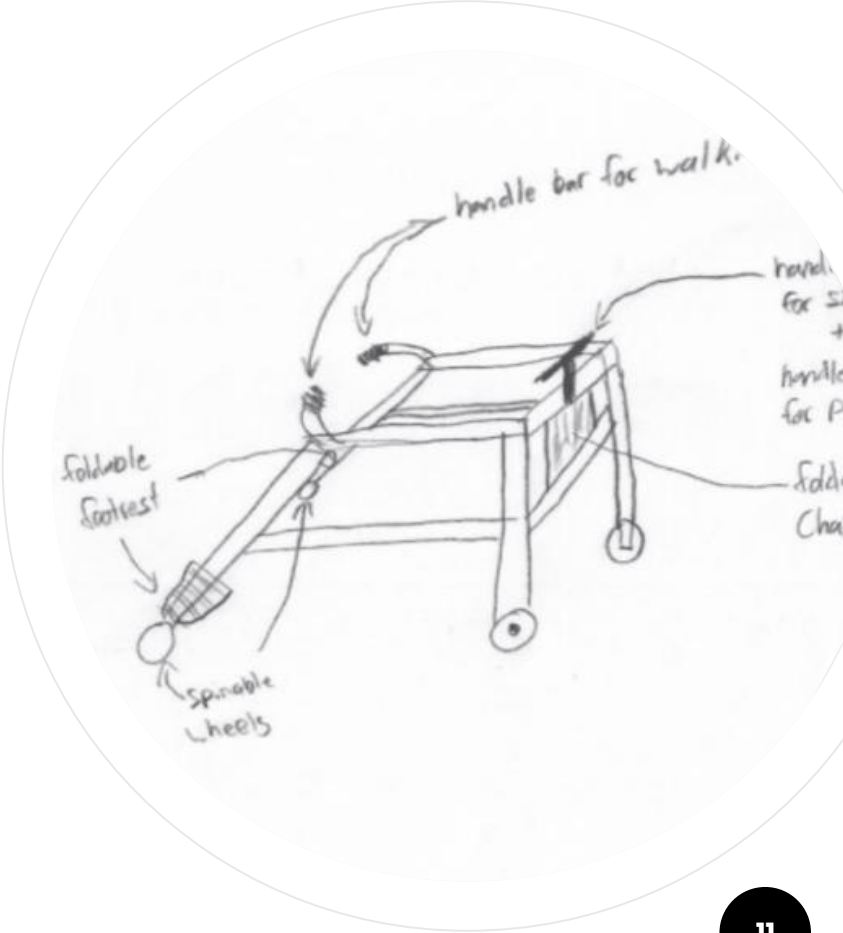
In the end, we found that we could **structure** everything **more efficiently**, with same functions on a smaller form factor.

Solution 2

Our approach was to make a **simpler** design able to be used as a **walker** and a **chair**.

It also has 2 sets of **handlebars**, one for the **user** and one for a **parent** to **push**.

We did **not choose** this design as we found that the frame did **not** have **enough** structural **support**.

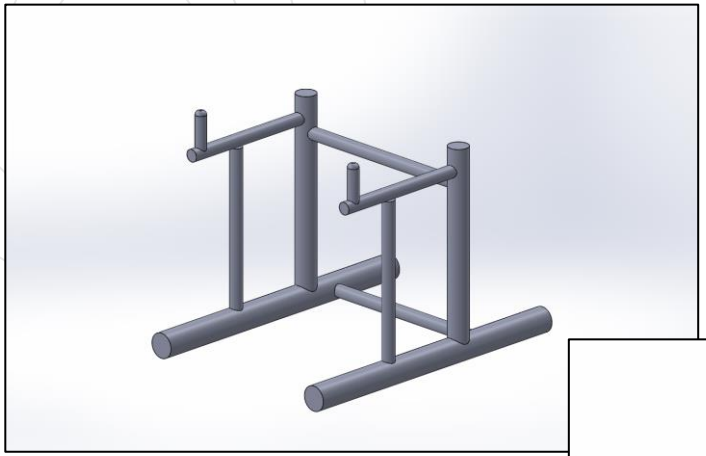


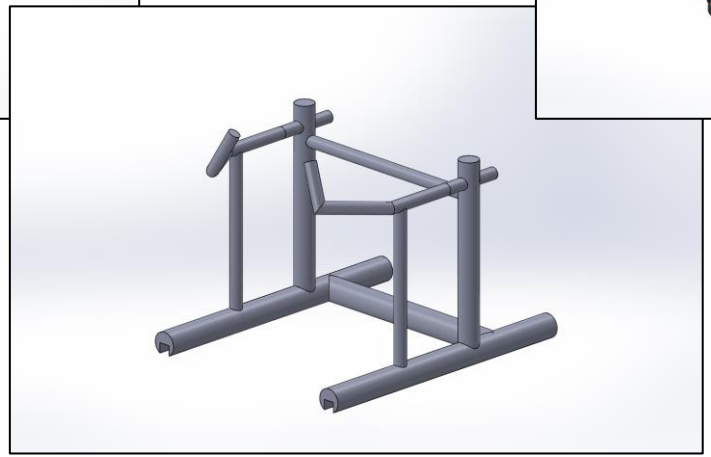
Final Solution

This design is **lightweight** and compact, we used aluminum in Solidworks and cardboard in the real prototype, so it can be **portable** and **easy to use**.

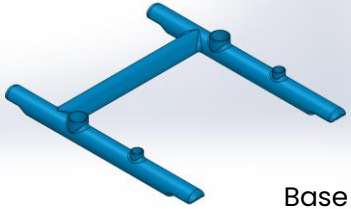
This is an **improved design** based on our second solution, which will let the user be able to **sit** down by using a harness being **more comfortable**.

Iterative Process





Components

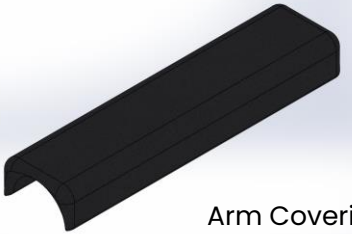


Base

Top Support

Right Arm

Left Arm

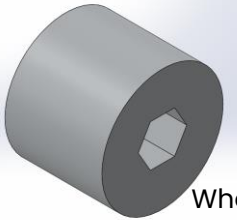


Arm Covering

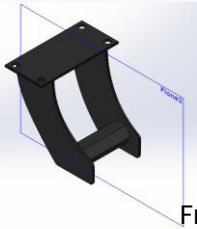
Hand Covering

Harness/Seat

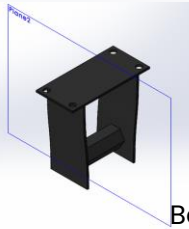
Wheel



Wheel Hub



Front Wheel Bracket



Back Wheel Bracket

Wheel Screw

Function tree

Decision matrix

Design criteria / Weighting factor / Alternatives	Use of standard parts	Safe	Simplicity and maintenance	Durability	Public acceptance	Reliability	Cost to develop	Cost to buyer	Performance	Sum
	0.05	0.16	0.11	0.11	0.10	0.13	0.10	0.13	0.11	1.0
Solution 1	4 / 0.2	7 / 1.12	6 / 0.66	8 / 0.88	8 / 0.8	6 / 0.78	5 / 0.5	5 / 0.65	6 / 0.66	6.25
Solution 2	7 / 0.35	8 / 1.28	8 / 0.88	9 / 0.99	8 / 0.8	7 / 0.91	7 / 0.7	6 / 0.68	8 / 0.88	7.47
Solution 3	8 / 0.4	9 / 1.44	9 / 0.99	9 / 0.99	8 / 0.8	9 / 1.17	7 / 0.7	8 / 1.04	10 / 1.1	8.63

Environmental Considerations.

We built our SolidWorks version out of **aluminum 6061 alloy**. It is **sustainable**, can be **recycled** multiple times. For our real life prototype, we used **cardboard**, which can be **recycled** easily and be used for other purposes. [6][7]

[8]

Economical Considerations.

We worked with **aluminum 6061 alloy** in our SolidWorks version. **Other** metals are far more **expensive**. For our real prototype, we worked with **cardboard tubes**. In total we spent around **$40.00** for all necessary supplies.

[2]

Safety Considerations.

The entire design has **no sharp edges** to prevent from getting cuts. We went with a **harness** kind of seat that would protect the user by **safely securing** them, unlike a normal seat, where they could fall out.

[9]

Limitations

Had to be made out of cardboard, which made the overall structure less durable. Was not weather resistant as it can lose durability when sitting in wet conditions. Needs different sidearm components in order to change heights which would cost more money.

Teamwork

Meeting 1

Team Member	Current Task	Completion State	Next Task
Luka	Coming up with Solutions	50%	Continuing to look for other solutions
Toma	Coming up with Solutions	50%	Starting report/research
Emiliano	Coming up with Solutions	50%	Design/Building 1st solution

Meeting 2

Team Member	Current Task	Completion State	Next Task
Luka	Coming up with Solutions	80%	Build an iteration of final design on SolidWorks
Toma	Designing 2nd Solution	90%	Starting report/research
Emiliano	Designing 1st Solution	70%	Build 1st solution on SolidWorks

Teamwork

Meeting 3

Team Member	Current Task	Completion State	Next Task
Luka	Finish building first iteration of final solution	95%	Start the final iteration of final design
Toma	Researching and writing report	30%	Continue to research and write report
Emiliano	Finish building first solution on SolidWorks	85%	Start writing the Design Problem

Meeting 4

Team Member	Current Task	Completion State	Next Task
Luka	Finishing the final solution design on SolidWorks	95%	Building Real-Life Prototype
Toma	Continuing to research and write report	60%	Building Real-Life Prototype
Emiliano	Working on various charts and tables	60%	Researching for the report

Teamwork

Meeting 5

Team Member	Current Task	Completion State	Next Task
Luka	Create Sketches for final design and help finish the report	85%	Record testing of Real Life Prototype
Toma	Finishing Report	89%	Record testing of Real Life Prototype
Emiliano	Start making Exploded/Collapse Video	60%	Start making Powerpoint

Meeting 6

Team Member	Current Task	Completion State	Next Task
Luka	Making Powerpoint Video	40%	Hand in Project 3
Toma	Making Powerpoint Video	40%	Hand in Project 3
Emiliano	Making Powerpoint Video	40%	Hand in Project 3

Conclusion

And future work.

We achieved plenty of designs on how to create a cerebral palsy walker. We came up with designs to make the best possible walker that can also be used as a chair. Our objective was to build a prototype on SolidWorks from the sketches we came up with. After that we built and assembled a simple, lightweight version made out of cardboard, being cheap, accessible and sustainable.

In the final design, we achieved all of our functions, objectives and constraints. Our final solution designed on SolidWorks was made out of aluminum, while the real-life prototype was built out of cardboard tubes. Both materials are affordable, highly recyclable, lightweight and durable.

For future improvements, we would add telescopic pieces in the arms and the base to adjust the width and height. We would also add a variety of different colours for children to choose from, allowing them to be personalizable. Finally, we would test different types of weather coating to further protect the design from corroding.

Thanks!

If you have any questions

don’t hesitate to contact us.

Luka Aitken
Toma Aitken
Emiliano Garcia

References

1. Leigh Day, 2017.
2. iStock, 2017.
3. Nicklaus Children's Hospital, 2018.
4. LER Pediatrics, 2015.
5. “Cerebral Palsy Diagnosis.” CanChild. https://www.canchild.ca/en/diagnoses/cerebral-palsy#:~:text=400,common%20physical%20disability%20in%20children [Accessed November 20, 2020].
6. “Why is Recycling Aluminum so important?” Alupro. https://alupro.org.uk/consumers/why-is-recycling-aluminium-so-important/#:~:text=Aluminium%20can%20be%20recycled%20forever,the%20metal%20from%20raw%20materials [Accessed November 23, 2020]
7. “Multi-Purpose White Glue – Features and Benefits.” Lepage. https://www.lepage.ca/en/lepage-products/build-things/wood-glue/multi-purpose_whiteglue.html [Accessed November 23, 2020
8. GettyImages, 2020.
9. Safe & Together Institute, SAFETY FIRST Road Sign. 2019.