GNG2101 Report

Project Deliverable C - Conceptual Design and Project Plan

Submitted by

[One handed walker steering. A2, Team 3]

Defne Oguz, 300226153

Jérémie Losier, 300152546

Jorge Jimenez Alatorre, 300334653

Saheel Nahaboo, 300259386

Sarp Ekin Berktay, 300237014

October 2nd, 2022

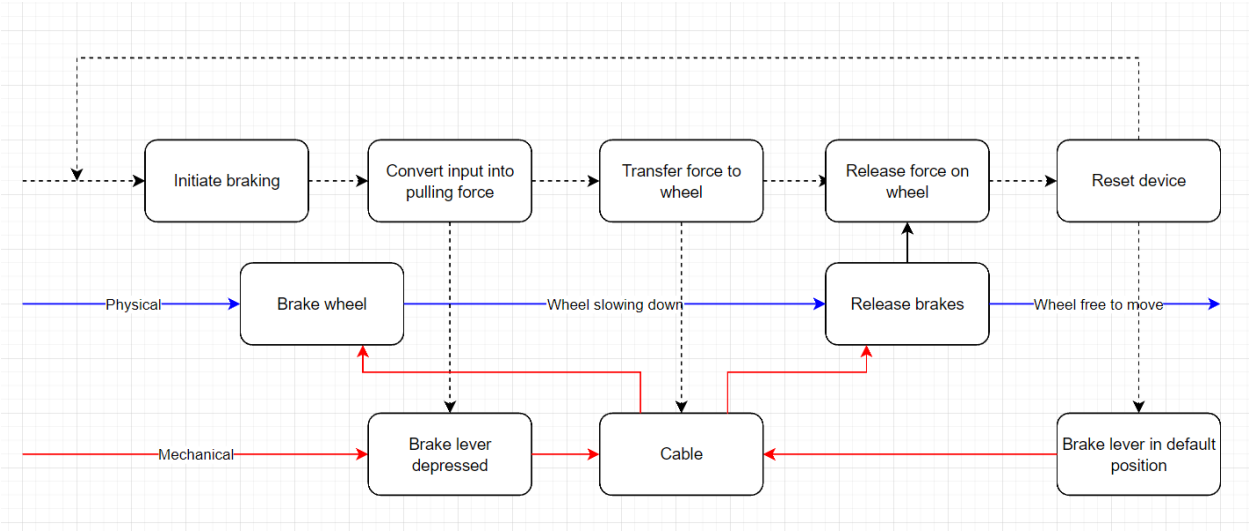
University of Ottawa

Core functionality

Required product functions

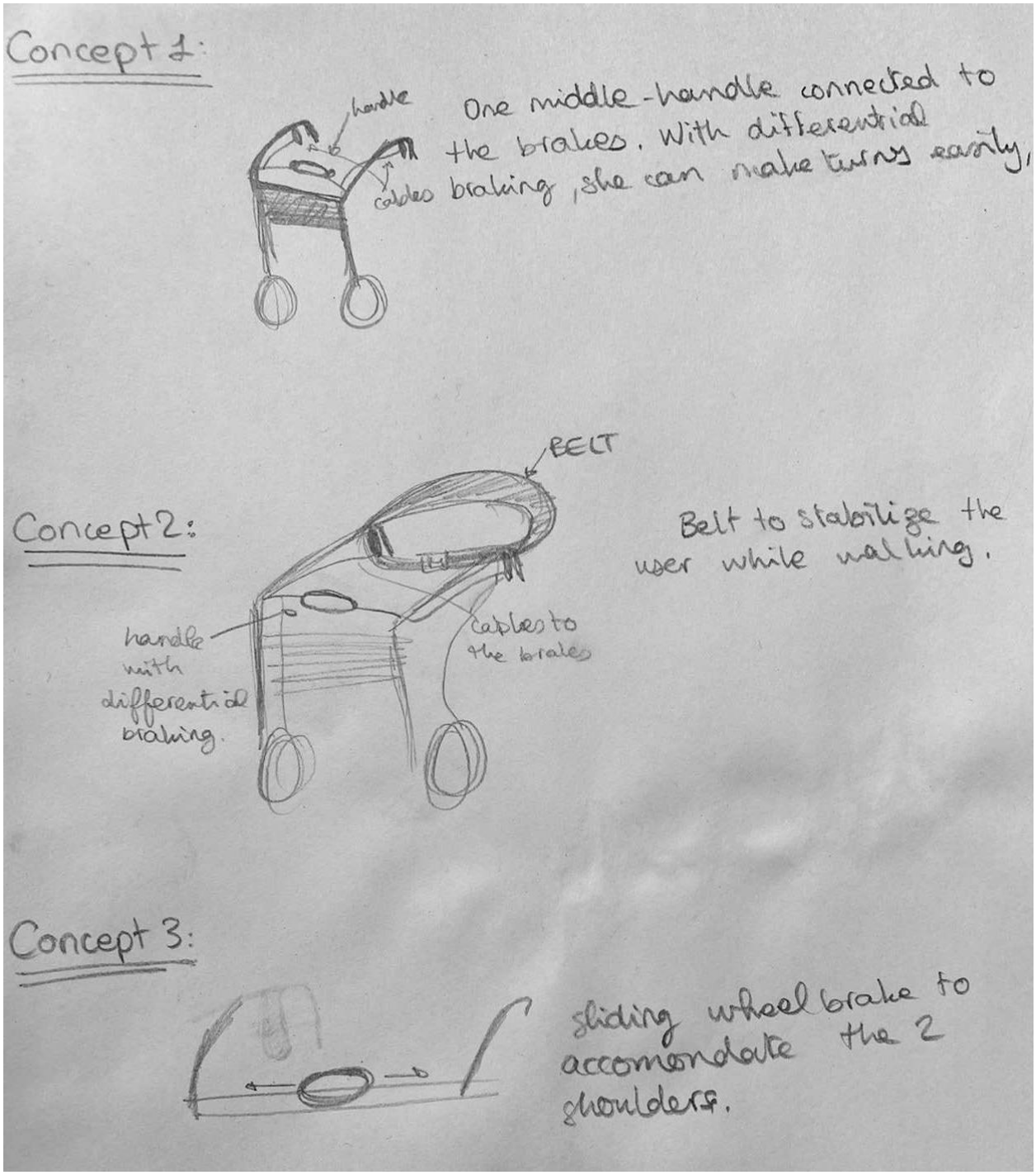
1. The device lasts a long time
2. The device can endure extreme weather conditions (snow, rain, cold and heat)
3. The brackets can be on installed easily on any walker
4. The fasteners fit tight
5. The device allows an easy installation without making permanent changes to the walker
6. The device is affordable
7. The device enables the walker to function on different terrains
8. The device is lightweight
9. The device is capable of turning with one hand
10. The device is safe to use at night

Functional decomposition



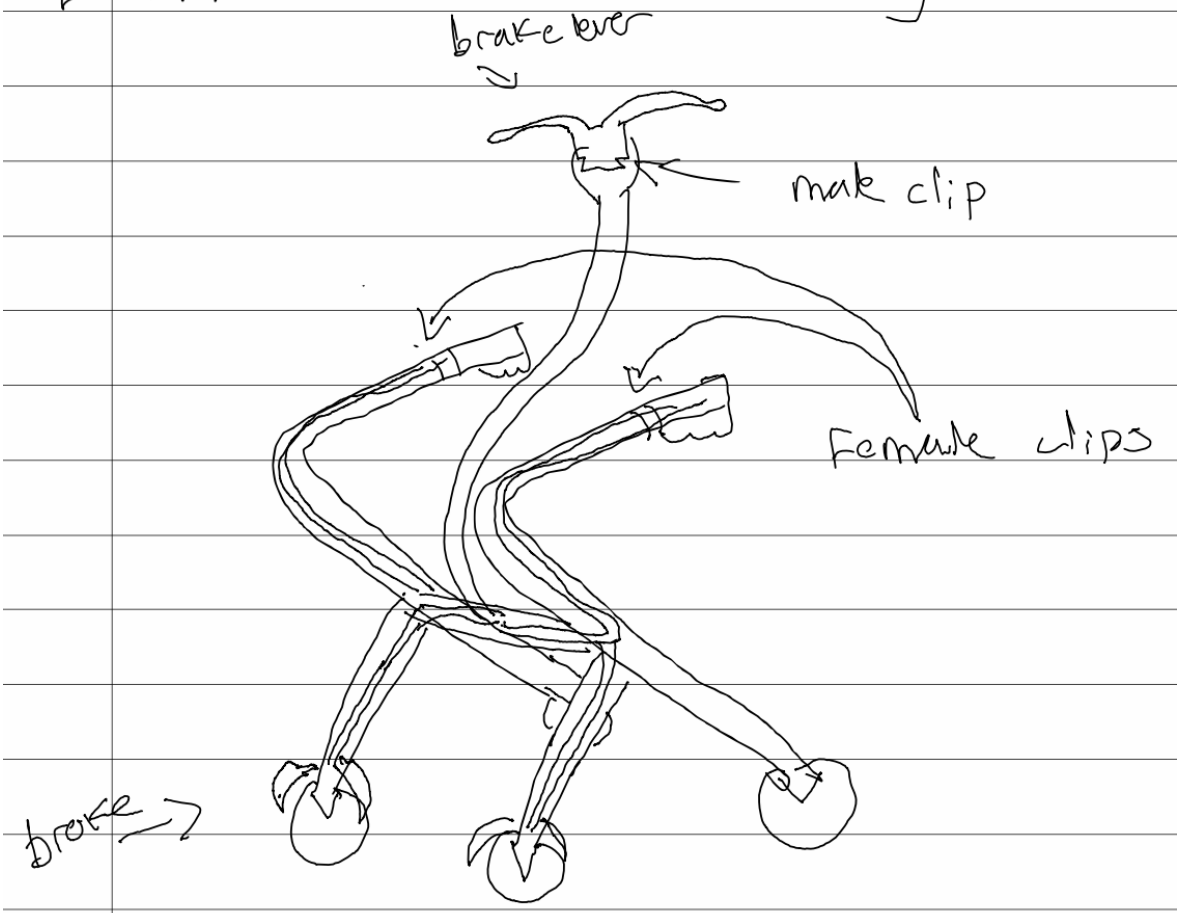
Product concepts

-Product Concepts created by Defne Oguz:



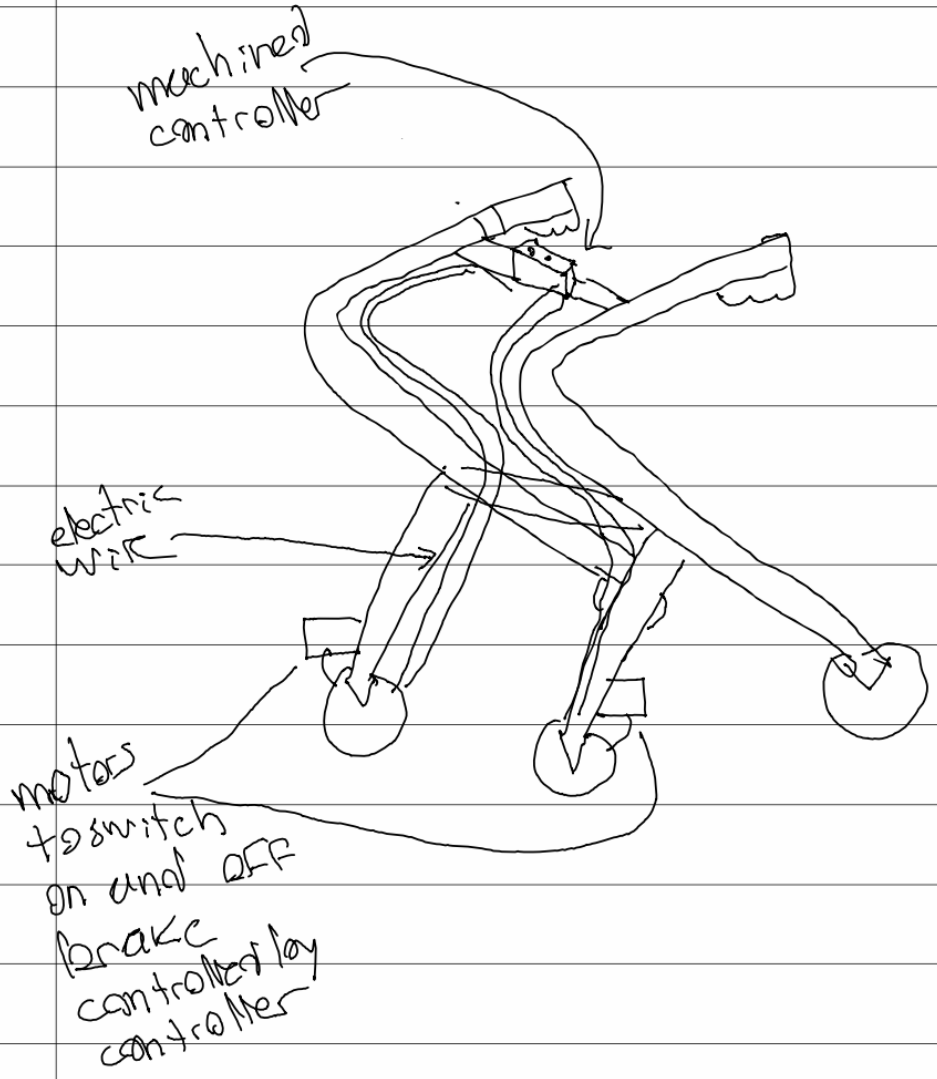
-Product Concepts created by Jérémie Losier:

1. hand activated differential braking



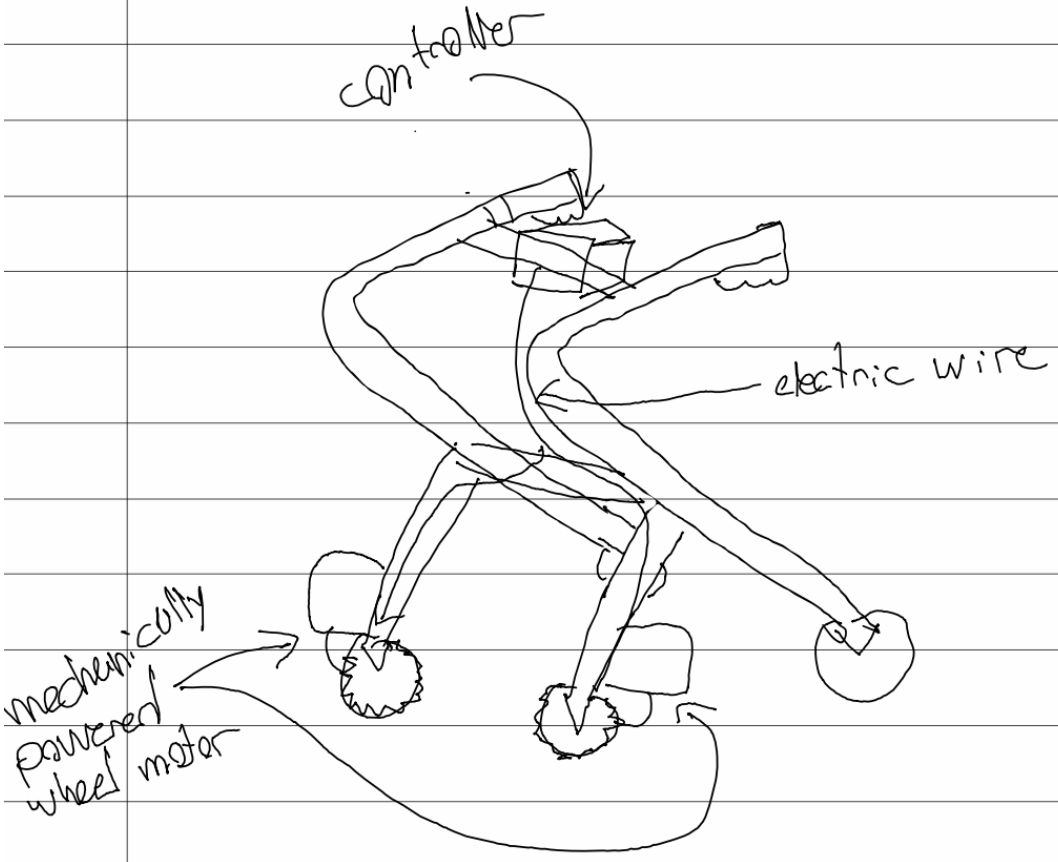
you can switch brake Lever to either side
brake levers like bike brakes
uses differential braking
needs dexterity to squeeze brake

2 powered differential braking



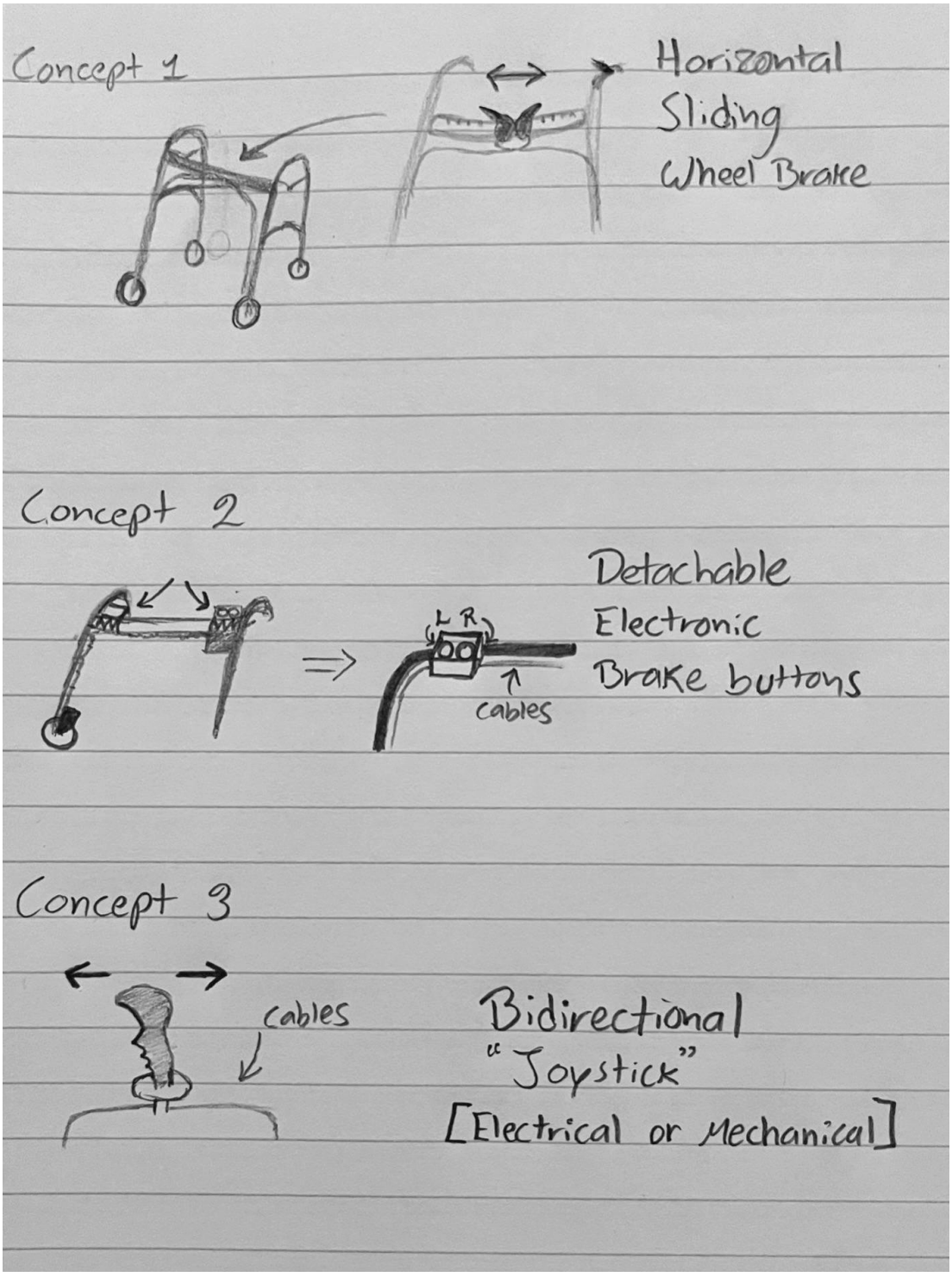
battery powered controller with electric
small motor to close and open brake
uses differential braking
only needs press of button

3. electric wheel powering

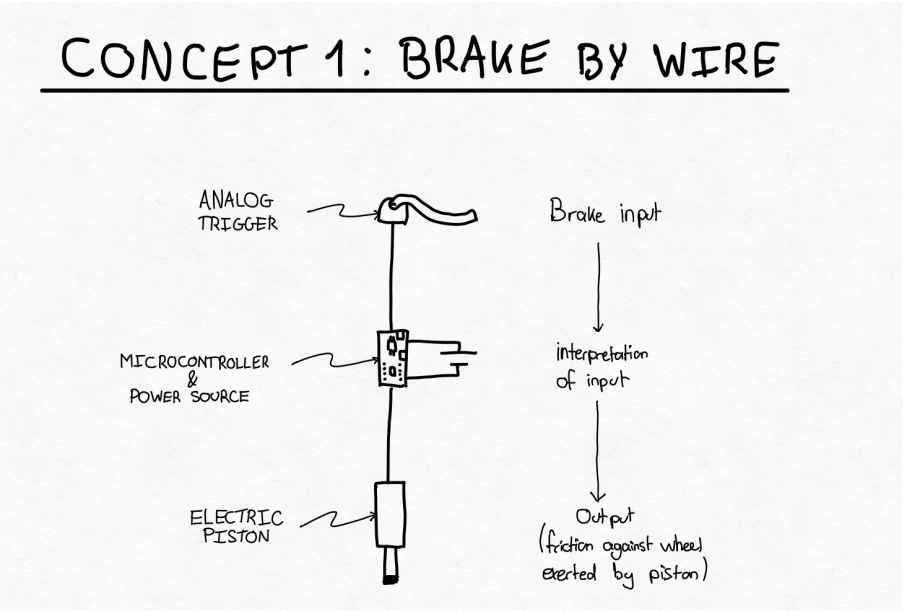


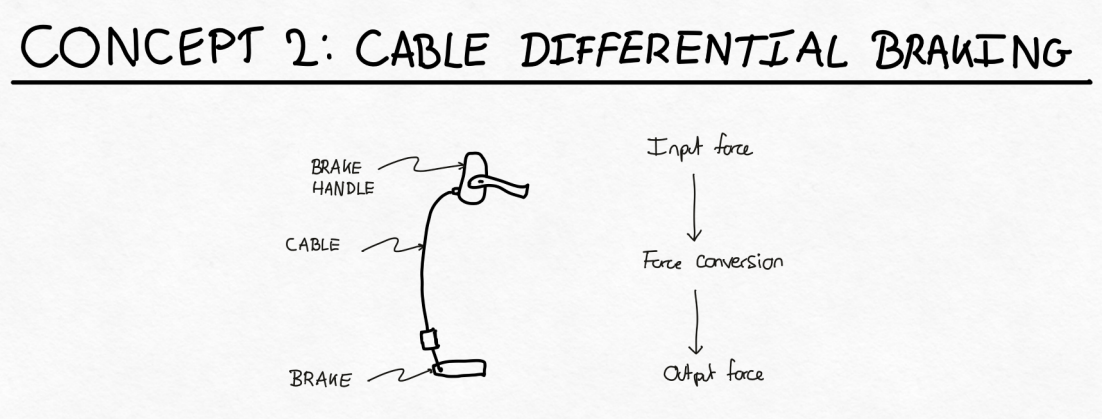
turns the wheel opposite to wanted turn direction
pushes opposite wheel to turn
battery powered
only need press of button

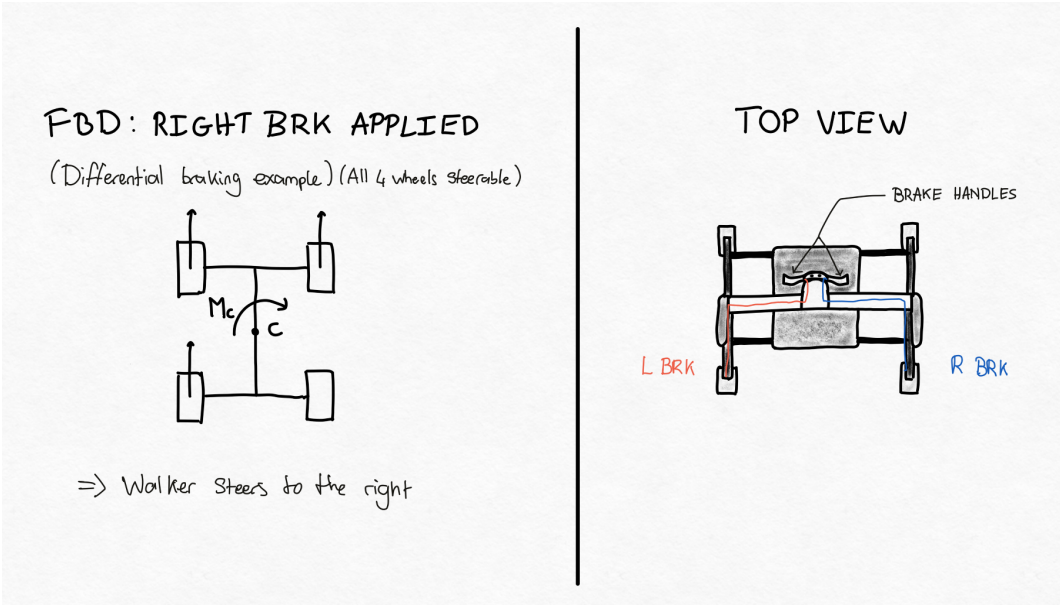
-Product Concepts created by Jorge Jimenez Alatorre:



-Product Concepts created by Saheel Nahaboo:

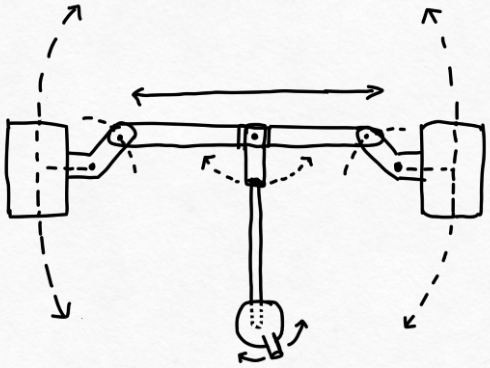


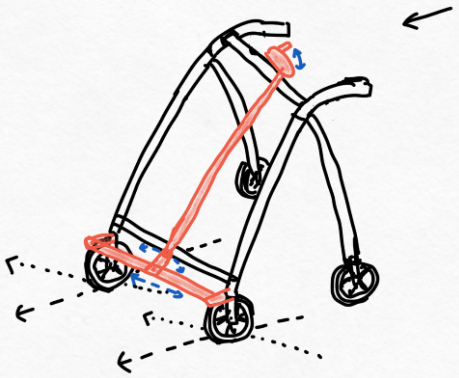




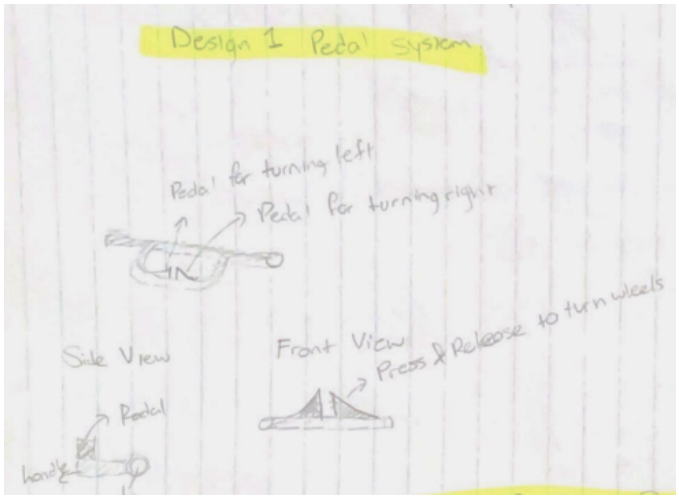
CONCEPT 3: TIE ROD & PITMAN ARM

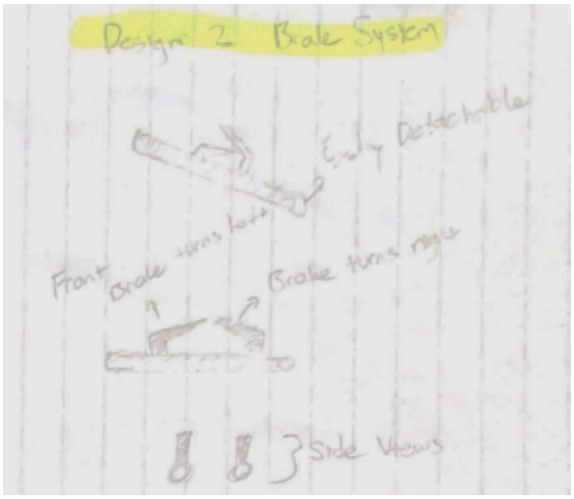
(GO-KART STEERING)

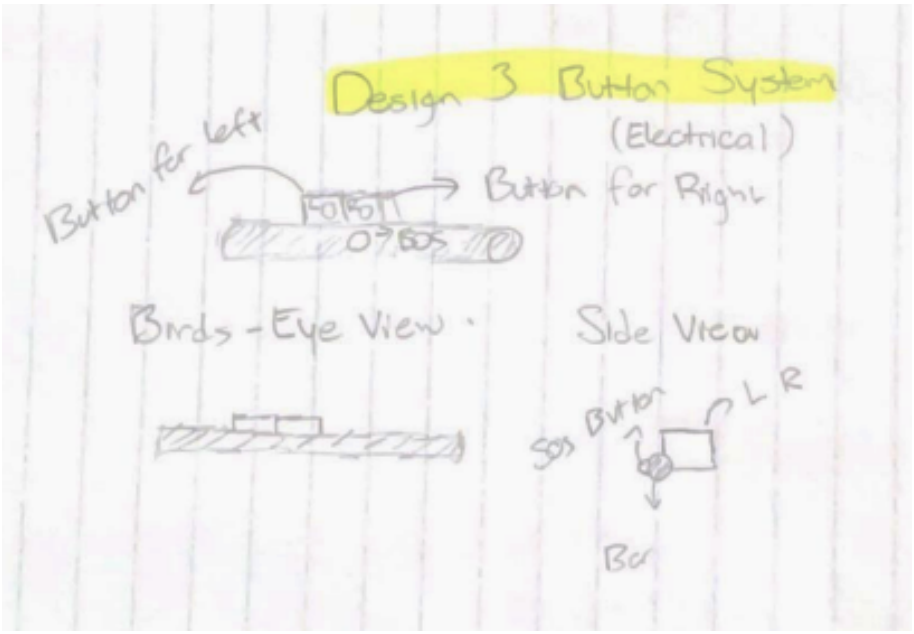




-Product Concepts created by Sarp Ekin Berktay:







Concept evaluation

Target Specifications					
Metric #	**Functional Requirements**	**Relation**	**Value**	**Unit**	**Verification Method**
1	Force required to use device	<	10	N	Test
2	Maneuverability (Turning Radius)	<	2	m	Test
3	Agility (Rotational speed)	>	30	$deg.s^{-1}$	Test
#	**Non-Functional Requirements**	**Relation**	**Value**		
4	Total weight	<	8.5	kg	Test
5	Dimension	<	0.55	m^3	Test
6	Reliability (MTBF)	>	2500	h	Estimate
7	Material	-	Aluminium	N/A	Analysis
8	Detachability (Time to assemble)	<	20	min	Test
9	Ease of use	-	-	N/A	Test
#	**Constraints**	**Relation**	**Value**	**Unit**	
10	Cost	<	100	CAD	Given
11	Time to complete project	<	1/12/2022	Date	Given

Concept Options (Part 1 of 3)											
Selection criteria	Weight	**Defne** Concept 1		**Defne** Concept 2		**Defne** Concept 3		**Jérémie** Concept 1		**Jérémie** Concept 2	
Force required	0.15	**5**	0.75	**9**	1.35	**8**	1.2	**5**	0.75	**10**	1.5
Maneuverability	0.13	**5**	0.65	**7**	0.91	**8**	1.04	**4**	0.52	**8**	1.04
Cost	0.13	**5**	0.65	**6**	0.78	**6**	0.78	**5**	0.65	**1**	0.13
Total weight	0.15	**5**	0.75	**4**	0.6	**5**	0.60	**5**	0.75	**4**	0.60
Dimension	0.11	**5**	0.55	**3**	0.33	**6**	0.66	**7**	0.77	**7**	0.77
Reliability	0.11	**5**	0.55	**5**	0.55	**6**	0.66	**7**	0.77	**3**	0.33
Material	0.07	**5**	0.35	**4**	0.35	**5**	0.35	**5**	0.35	**3**	0.21
Ease of installation	0.15	**5**	0.75	**6**	0.9	**5**	0.75	**4**	0.6	**3**	0.21
Total Score		**Ref. = 5**		**5.77**		**6.04**		**5.16**		**4.79**	

Concept Options (Part 2 of 3)											
Selection criteria	Weight	**Jérémie** Concept 3		**Jorge** Concept 1		**Jorge** Concept 2		**Jorge** Concept 3		**Saheel** Concept 1	
Force required	0.15	**10**	1.5	**4**	0.6	**10**	1.5	**5**	0.75	**10**	1.5
Maneuverability	0.13	**8**	1.04	**5**	0.65	**7**	0.91	**7**	0.91	**8**	1.04
Cost	0.13	**1**	0.13	**7**	0.91	**2**	0.26	**5**	0.65	**4**	0.52
Total weight	0.15	**3**	0.45	**5**	0.75	**3**	0.45	**4**	0.60	**5**	0.75
Dimension	0.11	**4**	0.44	**5**	0.55	**1**	0.11	**4**	0.44	**5**	0.55
Reliability	0.11	**1**	0.11	**6**	0.66	**1**	0.11	**6**	0.66	**4**	0.44
Material	0.07	**1**	0.07	**1**	0.07	**2**	0.14	**3**	0.21	**5**	0.35
Ease of installation	0.15	**1**	0.15	**3**	0.45	**1**	0.15	**3**	0.45	**2**	0.3
Total Score		**3.89**		**4.64**		**3.63**		**4.67**		**5.45**	

Concept Options (Part 3 of 3)											
Selection criteria	Weight	**Saheel** Concept 2		**Saheel** Concept 3		**Sarp Ekin** Concept 1		**Sarp Ekin** Concept 2		**Sarp Ekin** Concept 3	
Force required	0.15	**10**	1.15	**4**	0.6	**4**	0.6	**5**	0.75	**10**	1.50
Maneuverability	0.13	**7**	0.91	**6**	0.78	**6**	0.78	**3**	0.39	**6**	0.78
Cost	0.13	**8**	1.04	**1**	0.13	**5**	0.65	**5**	0.65	**1**	0.13
Total weight	0.15	**7**	1.05	**2**	0.3	**7**	1.05	**2**	0.30	**1**	0.15
Dimension	0.11	**7**	0.77	**2**	0.22	**7**	0.77	**5**	0.55	**3**	0.33
Reliability	0.11	**8**	0.88	**4**	0.44	**2**	0.22	**5**	0.55	**4**	0.44
Material	0.07	**6**	0.42	**3**	0.21	**5**	0.35	**5**	0.35	**5**	0.35
Ease of installation	0.15	**9**	1.35	**1**	0.15	**5**	0.75	**1**	0.15	**2**	0.30
Total Score		**7.57**		**2.83**		**5.17**		**3.69**		**3.98**	

We decided on Saheel's Concept 2 Since it has all the right features and its score is the highest among the rest.

To make the previous concept rankins and decision we based our selection criteria on the target requirements found with the functional requirements gathered in our first client meeting. After having our selection criteria the following step was to assign a weight to obtain final scores according to the level of importance explicitly stated by the client and discussed as a group. These weights were distributed among all eight of our selection criteria options as follows:

- 0.15 (15%) = High importance
- 0.13 (13%) = Mid-High importance
- 0.11 (11%) = Medium importance
- 0.09 (9%) = Medium-Low importance
- 0.07 (7%) = Low importance

The previous weights amount to a total of 1 or 100%, now the next step to calculate the final scores was to grade the concepts according to the criteria in numerical values (1 to 10); where the lowest number (1) indicates that it's much worse than the reference concept and the highest number (10) indicates that it's much better than the reference concept; with 5 being the same compared to the reference having integer scores in between respectively. As a result, the scores will be all positive and the one having the highest score will be the best concept according to the sum of its weighted scores.

Promising solutions

The Cable Differential Braking (Saheel's concept 2) is the first solution we thought about. It works with the already in place brake system and operates with differential braking in order to steer. It scored the highest among the rest of the concepts.

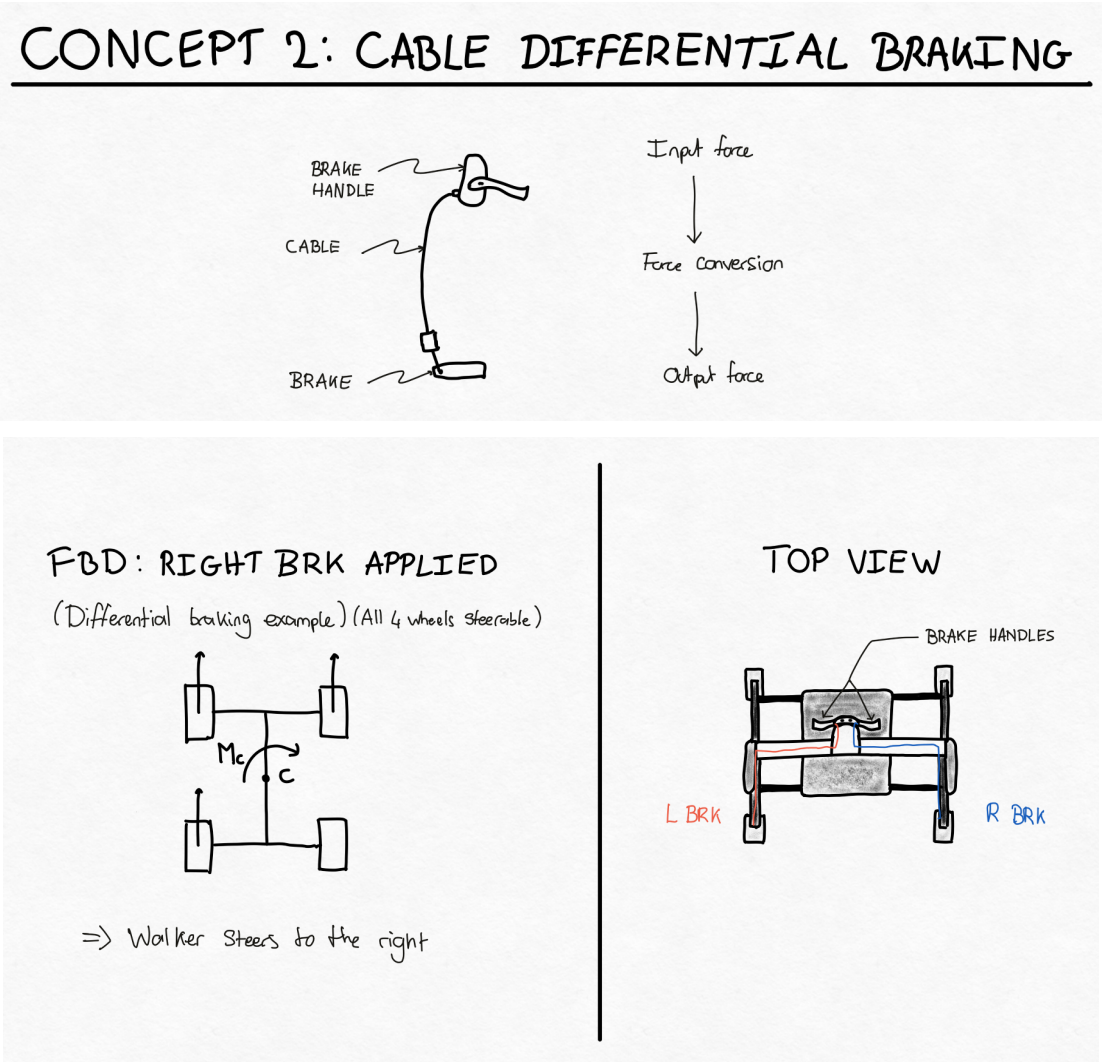
The Go-karting steering (Saheel's concept 3) is also interesting. It incorporates the alternative to differential braking which was wheel steering. It also scored pretty high on the concept options rating.

The Detachable electronic button brake (Jorge's second concept) was also a noticeable concept. It uses differential braking but in a different way than most other concepts. The device uses an electronic brake that squeezes the wheel to turn in the desired direction. The only issue with this device is that it needs to be recharged and the electronic brakes can be weak and sensitive to weather.

Group design concept

After discussing and analyzing all the product concepts generated we found some similarities among several of them. Having that in mind we decided to chose Saheel's second concept because it had the highest score and it was basically an integration of all the promising concepts; which also had the target specifications into consideration. Our approach was as a group selection but we did not score our own product concepts to avoid bias scoring (the rest of the team scored that project). Finally we decided to use the following visual representation because it is clear enough and is easy to understand the way it should work in future iterations.

Visual representation



Concept's relationship to the target specifications, benefits and drawbacks.

We believe that the concept we chose relates to what we had imagined ever since the task was given to us. Aside from that, the metrics for the target specifications are perfect. The functional/non-functional requirements for this concept are all met without having any big compromise and the concept is feasible within the constraints set. The reliability, ease of use, and

the low price highlight the benefits of this concept. Whereas for the drawbacks, the rest of the requirements have not exceeded to an extent where we can call it a benefit. We decided for it to be that way because we had to pick between a project that would excel every target specification, or a project that would meet but not excel the target specifications, but that would be feasible to build, simple to use and cost-effective.

Conclusion

After completing the required product functions and functional decomposition, we were able to come up with 15 independently generated concepts and put each of those to life through a sketch. Comparison of said concepts was then conducted through a robust and complex quality grading system. This comparison was helpful while deciding what concept we were going to follow-through with. The concept we ended up choosing was Saheel's concept 2; it entailed differential braking and required a mechanical input of force to choose a turning direction.