Deliverable B - Needs, Problem Statement, Metrics, Benchmarking and Target Specifications

Group 8
Submitted by Tahmeed Khan

Student Number	Name
300168393	Elsa Lange
300177400	Tahmeed Khan
300172151	Brad Cole
300165613	Matt White

September 25th, 2021
GNG2101 : Introduction to Product Development and Management for Engineers and Computer Scientists
The Centre of Entrepreneurship and Design
Faculty of Engineering
University of Ottawa

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Abstract

This document outlines a detailed list of the client statements which were translated into client needs and given a ranking based on the need's perceived importance to the client's satisfaction. Subsequently, a problem statement was created to briefly summarize the client's problem as well as a list of metrics with associated units to evaluate our prototype and competitor's design with. Finally, four different gait trainer braking systems were technically benchmarked and ranked based on the aforementioned metrics. Ideal and marginal target specifications were created. The document concludes with a reflection on how the first client interview impacts our design process.

Client Statements and Problem Statement

Table 1 - Client Statements and Translated Needs Statements

	Client Statements/Observations	Client Need Statements	Importance
1	My son is the intended user of the product. He has cerebral palsy, and requires a gait trainer almost all of the time.	n/a	n/a
2	My biggest concern for my son is his safety. I don't want him to get hurt by the device.	The braking system is safe and reliable.	1
3	My son is very active and on the move all the time.	The braking system is durable and long-lasting.	4
4	I want a system that allows my son to socialize and move independently without having to have a parent or guardian an arms length away at all times.	The braking system can be activated from a distance.	2
5	Any modification to the gait trainer cannot be permanent. Any change needs to be reversible for reasons concerning the warranty.	The braking system is attachable and detachable while maintaining the trainer's state.	3
6	My son uses the gait trainer in all settings, indoor and outdoor.	The braking system functions in various common walking environments.	5
7	I would like something that has variable braking capabilities.	The system stops the trainer with controlled deceleration.	6
8	Gait trainers are used by individuals of various ages and sizes.	The system is adaptable to multiple versions/models of gait trainers and users.	7

In table 1, the client statements were translated into client needs and ranked with one being the most important and 7 being the least important. The first client statement is background information, and thus cannot be translated into a client needs statement.

Problem Statement

The client needs a safe and reliable remote braking system for his son's pediatric gait trainer, the R82 Crocodile. It can be activated from a distance to let him practice walking independently—most existing brakes are manual and require the guardian to be within arms reach.

Metrics

Figure 1- Metrics For the Crocodile R82 Gait Trainer[1]

	Size 1 Inch
Width between handles (J)	7½–13¼"
Width between handles with Starter kit	3½–9¾"
Height from floor to handles (K)	16½–28¼"
Height from floor to handle with Starter kit	15–27½"
Handgrip width	1¼"
Handgrip length	7½"
Brake grip distance	3"
Height from floor to supports	20½–30"
Overall width (G)	24½"
Length	28¼"
Mass device	15.4 lb
Turning diameter	39¼"
User height, maximum	42¼"
Max user mass	66 lb
Small castor	1×5½"
Large castor	1¼×8"
Static stability downhill	15°
Static stability sideways	7°
	4,5°

This figure shows the metrics for the R82 Crocodile Gait Trainer. These metrics will allow for braking system specifics to be determined later on.

[1] Retrieved From: http://www.r82.com/products/walking/crocodile/c-23/c-72/p-165/?sku=48265

Table 2 - List of Metrics and Units

Metric	Units	Client Statements
Functional Requirements		
Braking Distance	Metres (m)	The braking system is safe and reliable.
Range of Transmission	Metres (m)	The braking system can be activated from a distance.
Speed of Transmission	Seconds (s)	The braking system is safe and reliable.
Activation Method	Remote	The braking system can be activated from a distance.
Function	Versatility of braking system (Rating 1-5)	The system stops the trainer with controlled deceleration. The braking system functions in various common walking environments.
Non-Functional Requirements		
Mass	Kilograms (kg)	The system is adaptable to multiple versions/models of gait trainers and users
Constraints		
Cost	CAD ($)	N/A
Battery/power life	Hours (h)	The braking system is durable and long-lasting.

Benchmarking and Target Specifications

Table 3 - Technical Benchmarking Based on Client Needs

Product and company	Rollator Brakes	Grillo Gait Trainer Brakes	R8 Crocodile Hand Brake	Rifton Pacer Gait Trainer Small Pacer (K620)/ Rifton Casters.
Link	https://mobilitymedicalsupply.com/how-do-rollator-brakes-work/	https://www.medifab.co.nz/sites/default/files/Grillo%20Gait%20Trainer%20Flyer%20201903.pdf	http://www.r82.com/products/walking/crocodile/c-23/c-72/p-165/?sku=48265 "Accessories" header	https://www.rifton.com/products/gait-trainers/pacer-gait-trainers?tab=dimensions
Activation Method	Handles that are squeezed.	Foot brake	Squeezed handles	Press on the brake, drag or wheel lock.
Function	Has handles that can independently brake back wheels. Uses a braking system similar to a bicycle brake (brake pads). Handles are connected to throttle cable which uses mechanical advantage through a lever to apply brake pads. Along with this the brake pad is applied directly to the outside of the wheel. The brake pad is not flat, but instead has three grooved slots that fit into the tread of the tire. This makes it so that the brake cannot slide past either side of the wheel.	Rear wheels: Anti-reverse locks which stops the wheel from going backward Pedal parking brake - operated by the red pedal. Useful for positioning the user and transport Adjustable Friction to reduce speed of movement. 4 levels Hand brake compatibility Front wheel: Directional locks to prevent front wheels from steering, ensure	Efficient brake for stopping/parking. Slows down the propulsion when the handles are squeezed. Locking lever can be flipped to activate the parking brake.	Includes a caster on the front and back wheels which includes a brake, swivel lock, variable drag and optional odometer. The swivel lock maintains the wheel in a straight line.

		linear stability.		
Cost	$30.00 (without tax) This price is only for the brakes.	$216.86 CAD (pedal brakes only)	$299 CAD (brakes only) for all sizes of Crocodile.	The braking system is included in the total price of the gait trainer. $1000 USD.
Specifications	Is only a braking system meant to replace brakes on most models of gait trainer/walkers.		Brake Grip Distance: 3 inches	Elbow Height: 18 ½ - 27 ½ inches

In Table 3, four similar braking systems were used for technical benchmarking.

Table 4 - Ranking of the Benchmark Braking Systems

Product and company	Importance (weight)	Rollator Brakes	Grillo Gait Trainer Brakes	R8 Crocodile Hand Brake	Rifton Pacer Gait Trainer: Rifton Casters
Activation Method	3	1	2	1	2
Function	2	3	2	2	1
Cost	1	3	2	2	1
Total		12	12	9	9

The importance value for the dedicated attribute was multiplied by the ranking for each row. The importance value stemmed from the ranked client needs. Each braking system has its own column, and the sum of each column is recorded at the bottom. The product with the greatest total is rated the highest, which was a tie between the Rollator brakes and the Grillo Gait Trainer brakes.

Table 5 - Customer Reviews of Similar Products

Name of product	Customer's reviews
Rollator Brakes (Used on most models of Walkers)	"Good product, fast delivery and very easy to install. Highly recommended product. A little pricey for delivery, but still cheaper than buying a new walker!" Retrieved From: https://www.lifesupply.ca/brake-rollator-right-and-left

Rifton Pacer Gait Trainer Small Pacer (K620)	I couldn't find any review online but according to the disability subreddit, Rifton has a good reputation as a high quality gait trainer.

Table 5 contains customer review tables for the various products we benchmarked in table 2. In general, these products only have a few online reviews as gait trainer braking systems are in a niche market.

Table 6 - Target Specifications and Constraints

Design Specifications	Relation (=, < or >)	Value	Units	Verification Method	Reasoning
Functional Requirements					
Braking Distance	<	Ideal: 1 Acceptable: 2	m	Testing	The gait trainer should safely stop before the child is endangered.
Range of Transmission	<=	Ideal: 10 Acceptable: 8	m	Testing	The gait trainer should be able to brake roughly within Bluetooth range.
Speed of Transmission	<=	Ideal: 0 Acceptable: 500	ms	Testing	The gait trainer's controller should respond immediately.
Constraints					
Cost	≤	Ideal: 100 Functional: 150 (with permission)	CAD	BOM Estimation	It's possible that we may have to go over $100 with the technology required.
Battery/power life	>	Ideal: 12 Acceptable: 8	hours	N/A	It should last as long as possible
Non-functional Requirements					
Mass	<	Ideal: 3 Functional: 5	lbs	Measuring	The mass of the braking systems

					should not greatly impact the mass of the gait trainer.

In Table 6, some preliminary target specifications and constraints were displayed in the table above. These values will be refined during the conceptual design and prototype stages.

Conclusions and Reflections

To conclude, our group has a clear understanding of our client needs. The group obtained information from the client interview such as the type of gait trainer, the user of the final product, and some metrics for the braking system.

During the client meeting, the client also provided images of the gait trainer that included dimensions of the manual braking system and frame which will be useful in the prototyping phase of our project.

Furthermore, obtaining a gait trainer would be beneficial during the prototyping phase. In this project the user has a R82 Crocodile gait trainer, however the client has requested that our design be applicable to all models and makes of gait trainers.

References

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