GNG 2101

Final Presentation

e-Walkers® presents the design of a walker brake system

Team Z7

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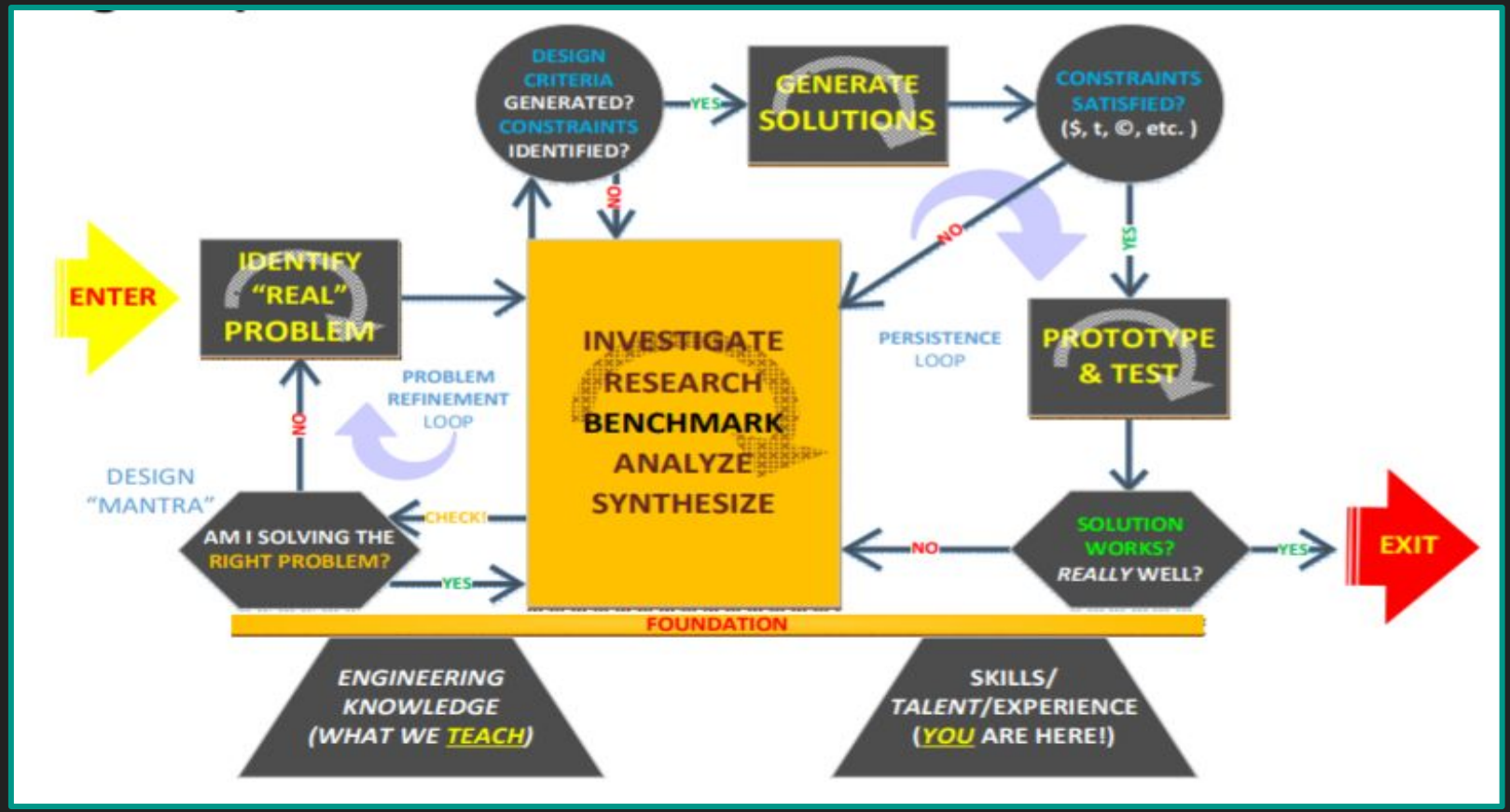
Agenda

1. Background
2. Design Methodology
3. Project Plan
4. Customer Needs
5. Problem Statement
6. Function Decomposition
7. Benchmarking
8. Target Specifications
9. Conceptual Design
10. Prototype I & II
11. 3D Modelling
12. Physical Prototype & Videos
13. Test Results
14. Trials & Tribulations
15. Business Model & economics
16. Conclusion, lessons, & future steps

Background

- Client is partially paralysed on the right side.
- Client’s current walker would twist away, leaving him unbalanced.
- Client desires a walker to engage both brakes with only 1 hand.
- No previous attempts made to solve the issue.
- Team given a budget of $100 to develop a solution.

Design Methodology - IEDP



Project Plan

#	Task	Time Duration (1 box = 1 week)	Owner
1	Client Needs		Sandeep
2	Problem Statement		Ahsan
3	Product Benchmarking		Victor
4	Target Specifications		Ahsan
5	Conceptual Design		Sandeep
6	3D Modelled Design		Chris
7	Acquiring all Materials & Components		Wyse
8	Design of Physical Prototype		Chris
9	Tests and Validation		Meghan
10	Project Closeout		Wyse

Customer Needs

ID	Need		Rating
1	The walker brake	has an interactive system that requires limited hand gripping strength.	5
2	The walker brake	system that has a low force threshold.	5
3	The walker brake	only has one interactive component needed to be able to stop both sides of the walker.	5
4	The walker brake	comes to a gradual stop.	5
5	The walker brake	is waterproof/weatherproof.	4
6	The walker brake	is foldable.	4
7	The walker brake	is safe for client use.	5
8	The walker brake	is light and portable as possible.	3
9	The walker brake	Is within client’s reaching range.	3
10	The walker brake	retains the structural integrity of the actual walker.	5
11	The walker brake	has ergonomic features such as having a braking mechanism close to handle.	3
12	The walker brake	has a fail safe mechanism.	5

Problem Statement

The clients require a safe, universal braking system to stop the motion of a walker gradually while using minimal grip strength and a single user interface. The brake system needs to be waterproof and foldable without altering the structural integrity of the walker.

High Level Functional Decomposition

Benchmarking

#1

#2

#3

Product and Feature	1. Piper Series Walker by Evolution Walkers	2. Glider Plus Adjustable Rollator	3. Rollator Walker by KMINA PRO
Cost	US$439.35	£195	$149.99
One handed braking system	Yes	Yes	Yes
Lightweight	Yes (12 lbs for smallest size)	Yes (6.5 kg, 14.3 lbs)	Yes
Foldable	Yes	Yes	Yes
Failsafe mechanism	No	No	No
Brakes can be activated with low grip strength	Yes	Yes	Yes
Lockable brakes	Yes	Yes	Yes
waterproof/ weatherproof	Yes	Yes (Optional Add-On)	Yes
gradual stop	Yes	Yes	Yes

Target Specifications

Metric ID	Need ID	Metric	Units	Marginal Value	Ideal Value
1	8	Total weight of the walker	lbs	13	<28.6
2	4	Stopping distance	in	8	12
3	1, 2	Force to begin braking	kg		< 5
4	10	Size of braking mechanism	in	-	<22 x <23 x <31
5	N/A	Cost	$CAD	-	<100
6	6	Foldable walker with brake	Yes/No	Yes	Yes
7	3	One-hand interaction with brake	Yes/No	Yes	Yes
8	5	Weather resistance / Waterproof	Yes/No	Yes	Yes
9	7, 12	Safe for client use	Yes/No	Yes	Yes
10	9,11	Height of braking handle from gripping bar	in	3.5	< 4.5

Conceptual Design

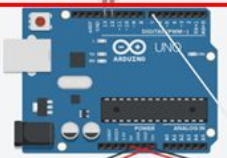
Detailed Design
Revision 1

Brake Cable Set

Brake
Pad
System

Force
Sensor

Battery



Servo
Motor

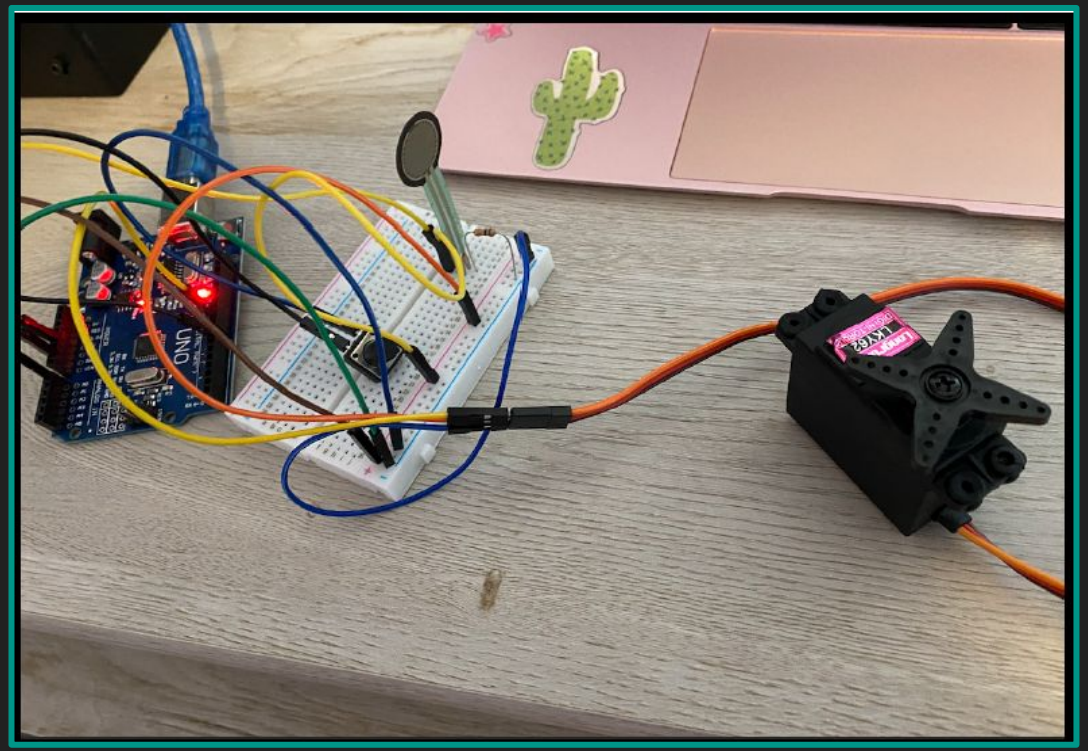
Waterproof
Box

Cable
Splitter
Box

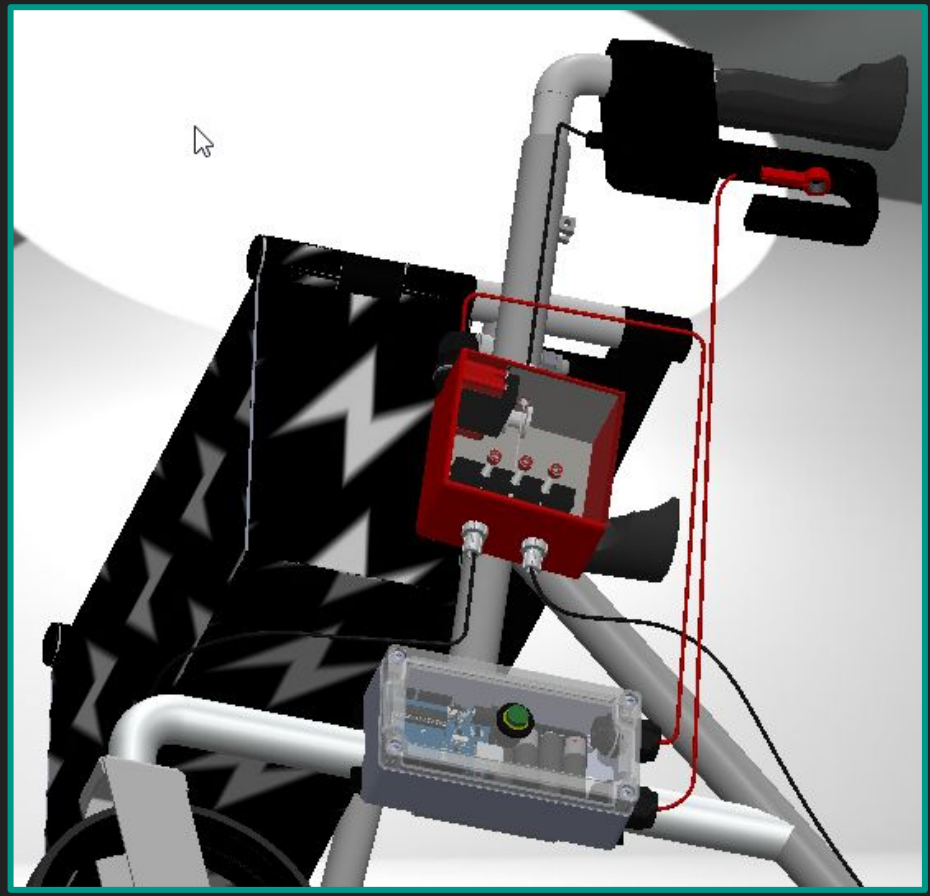
Prototype I & II

Cable Splitter on Bicycle

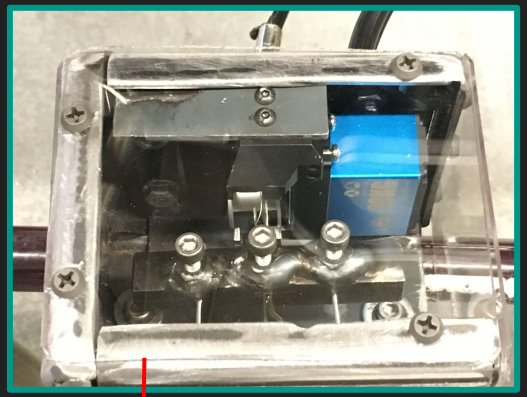
Force Sensor and Servo on Breadboard



3D Modelled Prototype

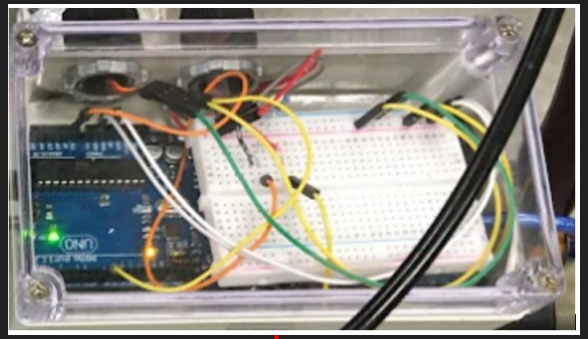


Functional Physical Prototype



Cable splitter & winch wheel in a waterproof enclosure

Force Sensor

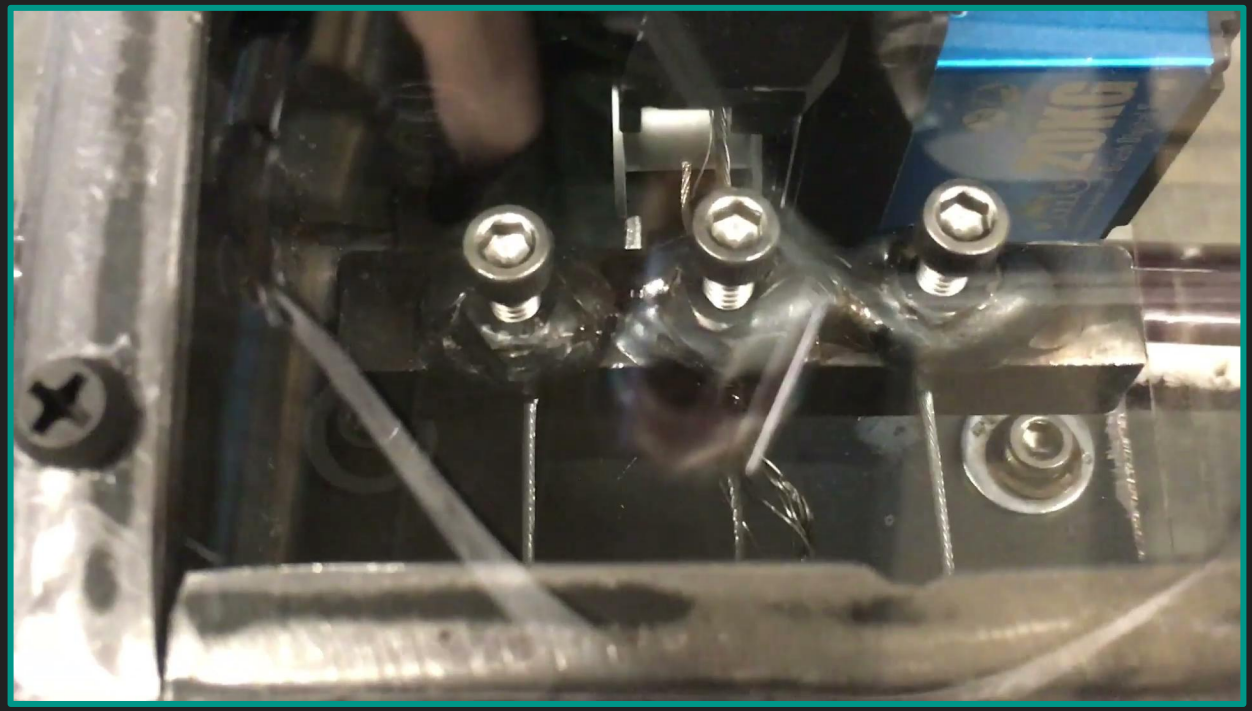


Circuit sealed in a waterproof box

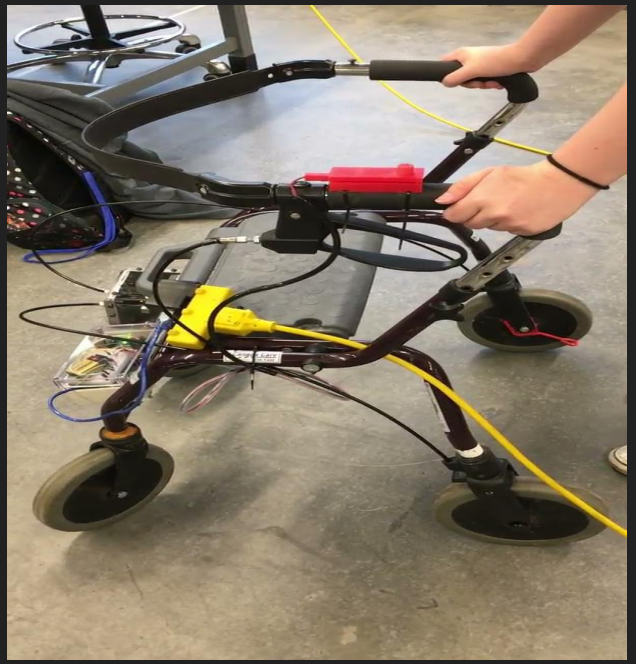
Rear brake cables in waterproof tubes

Video Demonstration of Force Sensor / Servo Brake

Video Demonstration of One Hand Brake Lever



Video Demonstration of One Hand Emergency Brake



Video Demonstration of Walker Foldability

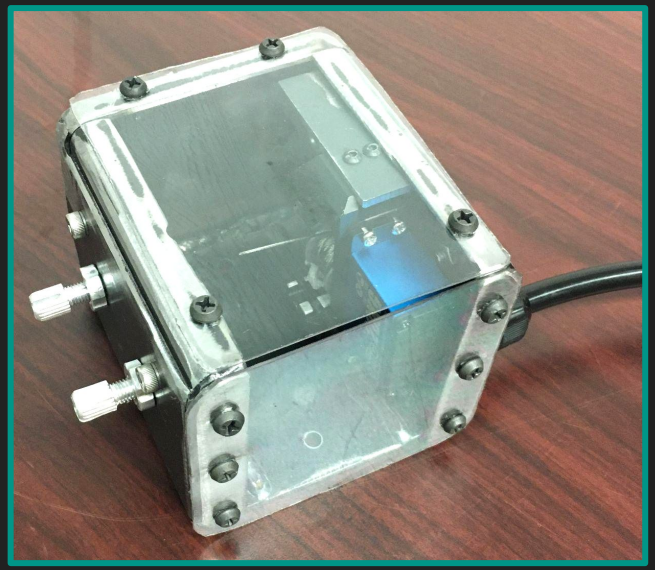
Test Results

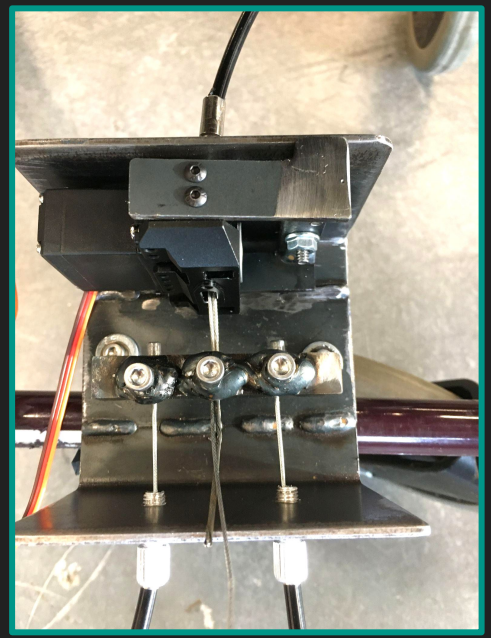
Metric	Units	Marginal Value	Ideal Value	Measured Value
Cost	$CAD	-	<100	98.92
Force Required to Begin Braking	kg	-	< 5	4.36
One-hand interaction with brake	Yes/No	Yes	Yes	Yes
Weather resistance / Waterproof	Yes/No	Yes	Yes	Yes
Foldable walker when brake attached	Yes/No	Yes	Yes	Yes
Safe for client use	Yes/No	Yes	Yes	Yes

Trials & Tribulation

1. Building the cable splitter enclosure and mounting of servo wheel to the bracket was difficult.

2. Balancing brake cable tension to brake both wheels equally at the same time was difficult as it took 20 trials.





Business Model and Economics

1. Razor Blade Model:
    - Lower upfront cost for trying product.
    - Higher installation fees make most of profit.

2. 3-year income statement: net income of $142,797.39

3. NPV break-even: 1212 units to be sold in year 2 to make company profitable.

Conclusion

- Prototype is highly functional with the electro-mechanical combination of servo wheel, force sensor and brake splitter.

- Prototype is of high fidelity as it meets target specifications & all critical needs of client.

Lessons Learned and Future Steps

- Learned how to complete project tasks under tight deadlines.
- Learned how to make a business plan for brake product.
- Will develop a user manual for installing the brake system.
- Will present final prototype to client and judges on design day.

Thank You for Your Time

Questions?