WHEELCHAIR PEDAL LIFT

Submitted by

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1. CLIENT STATEMENTS

Table 1: Client statements/observations

Number	Statements
1.	Client mentioned she had difficulty entering and exiting the wheelchair.
2.	She must raise the foot pedals up when she wants to enter and then put them down then she is seated and vice versa.
3.	Foot pedals need to be raised so the client can get off the chair.
4.	When she sits in the chair, she needs to put them back down.
5.	She needs to reach up and down to attach the pedal.
6.	For the client this is a challenge, so you need to find a way to put the pedals down.
7.	The pedals have weight to them, yet they are greased.
8.	The pedals only move up and down (no turning).
9.	The manufacturer connects the pedals to the left arm of the wheelchair with a strap, that way the customer wants to put the pedals down by pulling on the strap.
10.	Your client isn't satisfied with this solution and is looking for an automated way to list/lower the pedals.
11.	The pedals have no locking mechanism.
12.	When the pedals are put in the upright position they stay there, unless the wheelchair is jolted, or the customer has put them down.
13.	I'm not sure the easiest way to power your mechanism would be directly from the wheelchair.
14.	If power was taken directly from the wheelchair you will have to account for converting the power correctly.
15.	It's ok to use batteries to power the mechanism.
16.	Your client has someone to help her change the batteries when they run out.
17.	Pedal weigh approximately 3 pounds each.
18.	The solution you come up with shouldn't take the clients weight in consideration.
19.	Your design should only be lifting the pedals not the client's legs.

20.	The wheelchair controls are on the right arm, it makes sense to have the pedal controller there.
21.	You have permission to modify the wheelchair.
22.	To be on the safe side, build a nonpermanent reversible solution that can be removed.

2. NEEDS IDENTIFICATION

Table 2: Translated customer needs

ID	Need	Importance (1-5)
1.	The design is cost effective	1
2.	The designed solution provides relief when embarking/disembarking from the wheelchair	1
3.	The design can raise or lower the pedals with the minimal effort	1
4.	The design is automimic	1
5.	The designed solution can support the weight of the pedals (approx. 6 pounds)	2
6.	Design controls are on the right arm of the chair	2
7.	Design can rely on external battery power	2
8.	The designed solution is unaffected by rain or snow (weather-proof)	2
9.	The ability to use the design on various wheelchair models	4
10.	An additional feature that helps mobility in the snow	5

3. PROBLEM STATEMENT

It is required to design mechanism that rases and lowers wheelchair pedals without spending an exorbitant amount of money. This project necessitates the system to be automatic, intuitive, lightweight, and compact.

4. LIST OF METRICS

Table 3: Metrics

Metric description	Units	Ideal Values	Marginal values	Needs (#) Addressed
Load Capacity	Pounds [Lbs]	20	15-20	5
Time of Assembly /Modification	Minutes [min]	30	0-60	1, 3, and 4
Customer satisfaction	User rating [1-10]	10/10	7-10/10	2
Cost	$[CAD]	< 100	100	1

*Refer to Table 2 above for more context on the need addressed (only numbers are provided for this table).

5. TARGET SPECIFICATIONS

Table 4: Target specifications

Design Specifications	Relation (=, < or >)	Value	Verification Method	Design Specifications
Functional Requirements				
Load capacity (lbs.)	>	15	Test	Load capacity
Time of assembly/modification (mins)	<	60	Test	Time of assembly
Constraints				
Cost ($)	<	100	Estimate	Cost
Project deadline (months)	=	3.5	N/A	Project deadline
Non-Functional Requirements				
Customer satisfaction (rating 1-10)	>	7/10	Analyze	Customer satisfaction

Table 5: Linear Actuator Specifications

Metric description	Units	Values
Rated Load/Torque	Pound Feet [Lbs-ft]	330
Parcel Dimensions	Inches [in]	10.39" x 3.70" x 2.13"
Protection Class	IP rating [IP##]	IP54
Item Weight	Pounds [Lbs]	2.29
Stroke Length	Inches [in]	4"
Retracted Length	Inches [in]	8.07"
Extended Length	Inches [in]	12.01"

Input Voltage	Volts [V]	12
Power type	N/A	DC
Max Push Load	Pounds [Lbs]	330
Max load	Pounds [Lbs]	330
Max Pull Load	Pounds [Lbs]	264
Travel Speed	Inches/second [in/sec]	0.22
Operation temperature	°C	Between -26 and +65
No-load current	Amperes [A]	0.8
Max load current	Amperes [A]	3

*A product with an IP54 rating is protected against quantity of dust that could interfere with the normal operation of the product but is not fully dust tight. The product is completely protected against solid objects. It is also protected against water splashing from any angle [14].

6. BENCHMARKING

Table 6: Benchmarking

Metrics/ Target specs	Upeasy seat assist plus (Uplift Technologies, 2000)	Chair Riser Stand Easy (Patterson Medical, n.d.)	Carex Uplift Walker (Carex Health Brands Store, 2014)	Etac Turner Pro (Etac, n.d.)	Leg wrap Positioning aid (Maddak, n.d.)
Load capacity (lbs.)	200 - 340	559	300	N/A	N/A
Cost ($CAD)	77.52	687.92	87.83	423.00	44.95
Power	No	No	No	No	No
Assembly/ Installation time (mins)	< 1	N/A	N/A	N/A	< 5
Rating (0-5 stars)	3.5	5	4.4	5	2

*Pictures of these products are provided in Appendix I.

7. DESIGN

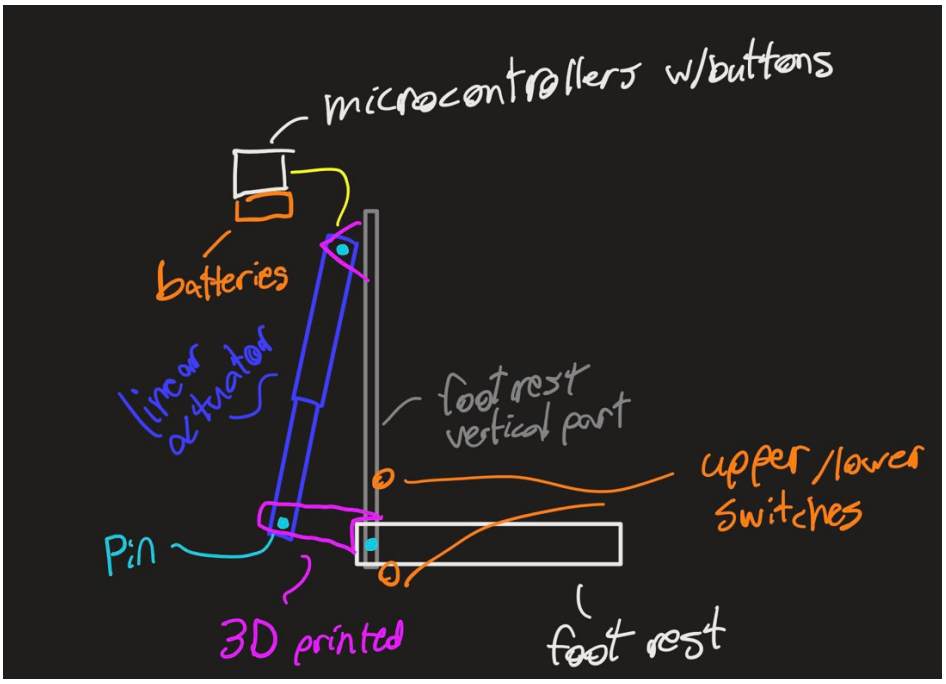

Figure 1: Proposed design

8. BOM

Table 7: Preliminary Bill of Materials

Material	Place	Cost per unit	Number of units	Total cost (CAD)
Linear Actuator [6]	Amazon	$60.99	1	$60.99
3 Pin Button Switch [7]	Amazon	$8.59	1	$8.59
Power Drill Battery [8]	Amazon	$32.99	1	$32.99
3D Printer Filament	MakerSpace	$0.00	0	$0.00
Electric Wires [9]	Canadian Tire	$8.99	1	$8.99
Iron-Free Solder Wire [10]	Amazon	$19.99	1	$19.99
Bolts [11]	Canadian Tire	$2.29	4	$9.16
Nuts [12]	Canadian Tire	$0.17	4	$0.68
Washers [13]	Canadian Tire	$0.15	4	$0.60
*Tax not included in price			**NET COST:**	**$141.99**

9. REFERENCES

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[6] https://www.amazon.ca/ECO-WORTHY-Actuator-Tracker-Multi-function-Electroic/dp/B01191JBVM/

[7] https://www.amazon.com/WINOMO-Rocker-Toggle-Waterproof-Switch/dp/B0774LY1M8/

[8] https://www.amazon.ca/Hanaix-Compatible-2607335275-2607335533-2607335557/dp/B0747J83MX/

[9] https://www.canadiantire.ca/en/pdp/certified-18-awg-25-ft-0207555p.html#srp

[10] https://www.amazon.ca/SainSmart-Solder-Electrical-Soldering-0-22lbs/dp/B07PCJTQ9K/

[11] https://www.canadiantire.ca/en/pdp/hillman-grade-5-hex-cap-screws-assorted-1617963p.html#srp

[12] https://www.canadiantire.ca/en/pdp/hillman-hot-dipped-galvanized-hex-nuts-1610448p.html#srp

[13] https://www.canadiantire.ca/en/pdp/hillman-uss-flat-washer-1-pc-1613198p.html#srp

[14] "The Complete Guide to IP Rating - IP44, IP54, IP55, IP65, IP66, IPX4, IPX5, IPX7." *IP Rating Guide | IP44, IP54, IP55, IP65, IP66, IPX4, IPX5, IPX7*, https://www.coolstuffshub.com/ip-rating-guide/.

APPENDIX I