

Design Matrix

Portable elevating and transfer seat for wheelchair users

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Design Matrix Criteria:

Effectiveness: This category represents how effectively the user can transfer from the wheelchair to another surface. The team believes this category should have the highest weight of 20 because the goal of the device is to make it easier for a user to transfer from a wheelchair to a new surface, which is what this category measures.

Comfortability: This category refers to how comfortable the user finds the surface of the device they sit on. The team decided to give this category a relatively high weight of 15 because the user may be sitting on the device for a long period of time, so having a comfortable surface to sit on is very important.

Ease of Fabrication: Ease of fabrication is defined as the level of knowledge and skill required to fabricate the model as well as replace any needed parts. This category is ranked fairly high because the client has requested that the product be easy to fabricate at home, if possible.

Ease of Use: Ease of use is defined as how easy it is for the user to raise, lower, and laterally move the device. This category is ranked pretty high because if the the operation of the device is difficult or strenuous, users will likely not want to use the device as often.

Durability: Durability is defined as the ability to withstand wear and pressure. The device should be strong enough to raise and lower the patient's body weight whenever needed. The device should also be able to last a significant amount of time if it is durable. This category received a pretty high weight because the device is intended to be used indefinitely.

Safety: Safety is defined as the risk of danger presented to the user by using this device. This includes the risk of the device failing during usage and putting the user in danger. Safety is weighted at a medium level because it is important that the user is safe and does not have any risk of getting injured while using the device. However, it is not higher because the client is not too concerned over safety.

Weight: This category refers to the overall weight of the finished product. The team decided to have this category of not much concern with a weight of 5 as the overall weight of the device will not affect the ability to perform and was not mentioned as an area of much importance by the client.

Cost: This category is referring to the total price of all the materials and production of the device for the finished product. The team decided to place the category as one of the lowest in importance with a weight of 5 because cost is not much of a concern as it is predicted that, by the end of the semester, the budget of the project will not be reached.

Designs:

Car Jack

The purpose of this device is to lift the user to a desired height while supporting the weight of the user and allowing stability for transfer on and off the device. The car jack design is a simple design idea in which a manual crank car jack is placed underneath a wooden baseboard and a more comfortable seat. The wooden baseboard will be connected to the seat piece by tracks, allowing the seat to move laterally. In order for this device to be used, the user will need to turn the crank to lift himself, and turn the crank the opposite way to lower himself. In order to move laterally, the user will need to unlock tracks before use, and lock the tracks back into their resting position when finished in order to provide maximum stability while lowering himself. The car jack will be strong enough to lift the user to the required heights and will provide plenty of stability at higher heights because of the strength of the material.

Gas Spring

This device would lift the user to a specific height using a pneumatic gas spring. A pneumatic gas spring design is found in many office chairs. The user will apply minimal pressure to the ground with their feet, allowing the gas spring to provide lift. The gas spring can be operated by pressing a lever attached to it. Once the desired height is acquired, the user can release the lever, locking it into place. This secures the seat into position at each height. The gas spring would sit on top of the existing wheelchair, with a platform above it to provide stability as well as a cushion for support.

Scissor Lift

This design consists of a scissor lift that is mounted on top of the existing metal platform on the wheelchair. The top of the scissor lift would be connected to another platform, with a metal track mounted on top. A cushioned seat would be mounted onto the metal track. The purpose of the scissor lift would be to move the seat vertically, while the metal track would allow the seat to

move laterally. A retractable metal bar would be used to lock the seat into place at a specific position. Figure 1 shows an overview of the design. Figure 2 shows the concept of the metal track, specifically.

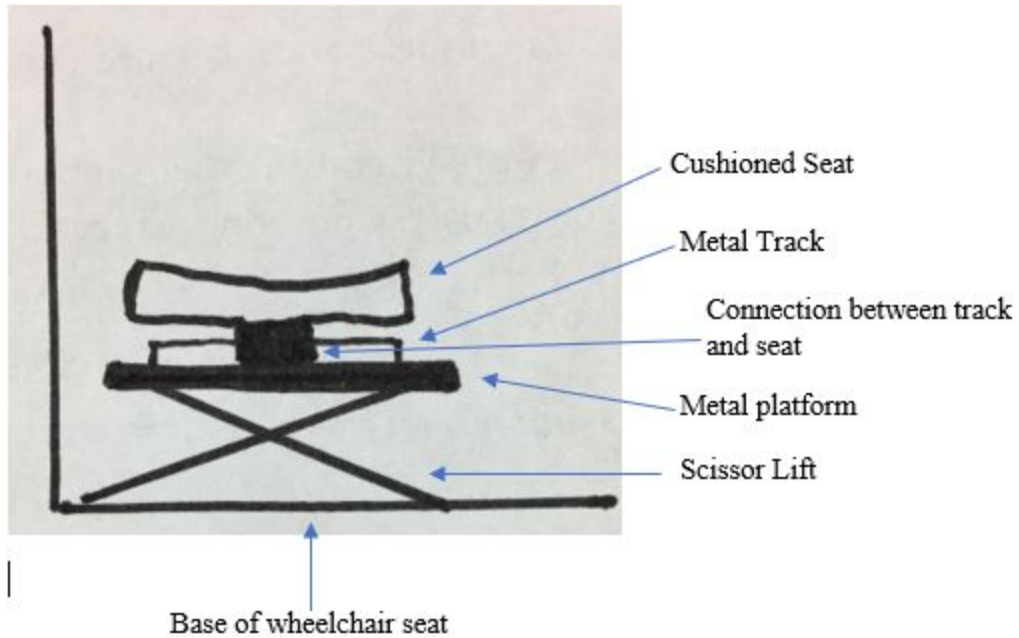


Figure 1. The scissor lift design, with a metal platform attached to the top of the scissor lift. On top of the platform is a metal track, and the base of the cushioned seat moves laterally along the track.

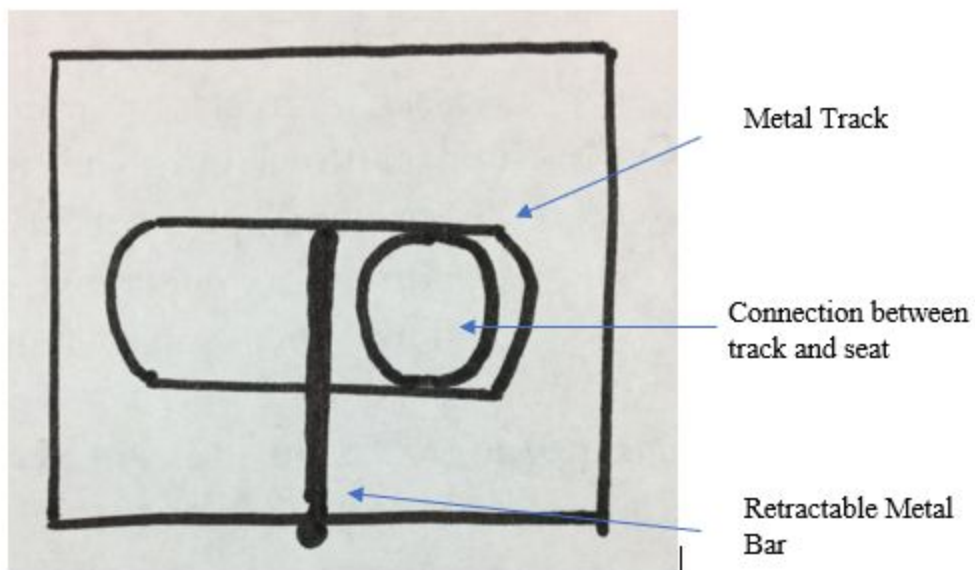





Figure 2. View from looking down under the base of the cushioned seat. The seat is connected to a piece that can move along a metal track, when the retractable metal bar is turned.

Design Matrix:

Design	Car Jack		Gas Spring/ The Office Chair		Scissor Lift	
						
Criteria (weight)						
Effectiveness(20)	4/5	16	4/5	16	4/5	16
Comfortability (15)	3/5	9	2/5	6	4/5	12
Ease of fabrication (15)	4/5	12	3/5	9	2/5	6
Ease of Use (15)	1/5	3	2/5	6	5/5	15
Durability (15)	4/5	12	3/5	9	3/5	9
Safety (10)	3/5	6	2/5	4	4/5	8
Weight (5)	1/5	1	4/5	4	3/5	3
Cost (5)	3/5	3	4/5	4	2/5	2
Total (100)	62		58		71	

Design Ratings:

Car Jack

The Car Jack design did not end up being the most effective design the team came up with. The design performed pretty well in effectiveness, but struggled in most of the other categories. This design received a low rating of two out of five for comfortability because it would sit quite high on the wheelchair, leading to an uncomfortable sitting arrangement for the user. The design received a high rating for ease of fabrication because it is feasible for a user to build themselves if they have the appropriate tools on hand. Next, this design received a low rating for ease of use because the user would need to ratchet themselves up with arm strength, which may be pretty difficult to do while sitting in the wheelchair. This design did pretty well in the durability category because car jacks are designed to hoist cars, which weigh much more than 113 kg (250 lbs). Therefore, lifting 113 kg (250 lbs) repeatedly should be of little problem for this design. This design did not perform well in the safety category because operating the lift with the user's muscles can be quite strenuous and possibly cause an injury. This led the team to a three out of five score for the Car Jack design in this category. Finally, Car Jacks tend to be extremely heavy and relatively expensive, which could cause issues for the user with moving the wheelchair and purchasing materials. Overall, the Car Jack design did pretty well in the Effectiveness, Ease of Fabrication, and Durability categories, but struggled to stay on pace in the rest.

Gas Spring

The gas spring is not the most effective design idea that the team came up with. While it has a four out of five for effectiveness, this design falls short for many of the other categories. It would sit fairly high on top of the wheelchair, causing it to be uncomfortable and unsafe. The user would also have to apply some pressure to the ground in order to operate it. This might not be safe for the user's health. The ease of use is ranked low as well due to the user having to apply physical pressure with the floor. The weight and cost of this design ranked better than the other two, but this was overshadowed by the low scores on each of the other categories. Our team will keep this design and its features into consideration.

Scissor Lift

Overall, the scissor lift rated out as the best design. It graded out as being extremely easy to use, because it will be controlled by a button, and overall comfortable for the user to sit in. The device is expected to be extremely effective in what it does because it starts and stops at a push of a button, allowing more easy transfer positions. Concerns over the durability of the device and the cost of fabrication are issues the team will need to cope with in order to make an effective device. Durability was a concern because of all the moving parts in the design, increasing the

chances of failure. Also, the cost of the actuators provides a major fiscal concern due to the fact that two large scale actuators would cut into the majority of the allotted team budget. Ease of fabrication was also rated lowly because of the multitude of moving parts in the design. If this device were to breakdown, repair would be difficult. Finally, the weight of the device was not considered an issue so the device received a moderate grade, neither helping or hurting its final score. Altogether, the scissor design in the design the team will be moving forward with due its many benefits outweighing its slight inconveniences.