Alternative Designs

Wheelchair for Abby Miller

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Introduction
As previously proposed, the goal of this project is to provide the client, Abby Miller, and her family with a more comfortable tilt-in-space wheelchair. It is important to develop multiple designs as alternatives to the optimum designs as a secondary plan should the optimum design fail. Each of the alternative design components will be based off of the same wheelchair frame and will incorporate several modifications.

Alternative Design One
One of the main issues with Abby’s current wheelchair is the lack of support and comfort of the seat that she sits in. Due to Abby’s exaggerated tone, she frequently pushes herself into her seat. This causes the seat padding to slide, and often fail. We have proposed that an existing seat from a purchased wheelchair be stripped, re-padded, and angled to help support Abby while providing comfort.

The current design features a seat composed of a double layer of foam padding, a softer layer for comfort two to three inches thick and a dense layer underneath for added support. The dense layer’s purpose is to prevent Abby from pushing through the seat chair. The dense foam will act as a barrier between Abby and the metal frame of the wheelchair, so if she does happen to push through, the dense foam will prevent her body from hitting the metal supports. In addition to the implementation of the foam, the seat cushion will be slightly wedged so that the thickest section of the seat is positioned under her knees. This is an essential component of the design because it will aid in preventing Abby from slipping out of her chair, and pushing down with her feet. Furthermore, the current design entails that the back of the seat have more padding on her back right side due to the weakness in Abby’s core.

If the seat is not able to be constructed in such a way, we have developed an alternative design to ensure that Abby’s needs are met despite any conflict we may find in designing the seat.
The alternate design includes the use of a foam layer with a gel layer underneath. The gel layer will serve the same role as the dense foam layer if we are unable to find dense foam. Gel is a material that has the ability to be sturdy while still maintaining the comfort we desire.

*Figure 1. Gel Padding With a Dense Foam Underlay*

If a wedged seat is incorporated into the design, it may be a permanent feature that Abby may not always want. It may become uncomfortable to have her legs raised at a slight angle at all times. Instead of this feature, we can design the seat to have a reclining feature that will allow the angle between the back of the chair and the seat to be freely adjustable. This component will be controlled with a lever similar to those found on automobile seats. This feature may also have the ability to be motorized as seen in modern cars. With this feature, the seat will have the ability to be adjusted as Abby’s comfort changes.
Alternative Design Two

An alternative to the proposed design for Abbey’s tilt in space wheelchair would be to replace the mechanical tilt in space mechanism with a wired remote control electric tilt in space mechanism. This would allow for effortless change in the position of the chair at anytime by any person.

This design could be achieved by adding a small electric motor and battery component under the seat bottom of the wheelchair, in between the two crescent tracks of the tilt in space mechanism. The motor would turn a little gear with teeth that would be in contact with the crescent track on each side (46 in Figure 3). This would move the tilt in space mechanism so that the chair can tilt to the user’s preferences. A small wired remote would be wired from the motor to the handle bars, similar to a hand brake, but to control the motor. The control would be mounted next to the handle bar and have a up/down click switch to control the motor in forward and reverse (Figure 4).
This design change would increase usability and allow anyone who controls the wheelchair to utilize the tilt in space mechanism with ease, instead of bending down and pulling levers to tilt the chair. This will also allow Abby to adjust the position of her chair.

**Alternative Design Three**

Alternate design three involves modifying the headrest so that it can be contoured to fit and support Abby’s head better. The chassis and other parts of the wheelchair will remain the same but the
headrest will be changed. The headrest will be made to mimic a hand i.e. there will be a base or “palm” which will mainly be used to support her head and the “fingers” will be used to help to stabilize her head in the correct position.

![Figure 5. Headrest Design](image)

The material that will be used to make the headrest frame will be 6061 aluminum. Many joints will have to be incorporated to have the ability to contour to Abby’s head. The headrest will have a mounting bracket on the backside that can be positioned at different heights and will have the ability to move either right or left depending on where the family would like it to be. The bar that the headrest will be mounted on will be made of strong steel so as when Abby pushes back onto the headrest it will not bend.

The joints will have to have the ability to be locked into place. This will be achieved by using a bicycle hub lock pictured in Figure 6 that will be modified to fit the individual joints. The padding that surrounds the metal frame has to be able to withstand the pressure that Abby exerts on it due to her exaggerated tone. First the skeleton has to be wrapped with a durable material that will not tear as to
prevent the metal from becoming exposed. The joints will remain exposed from the rear as to provide access for the family to adjust the headrest if necessary. Then a tough but flexible padding for support will be attached to the metal frame and finally a soft padding will be layered onto the denser padding to provide comfort for Abby. Dense foam padding will be used for the thicker support layer and memory foam padding will be used to make the head rest more comfortable.

![Figure 6. Hub Lock Mechanism](image)

**Conclusion**

Overall, it is important to have several design alternatives to ensure that the client’s needs are met. By having alternative design plans, we can make sure that Abby’s wheelchair will have the upmost comfort and functionality, without sacrificing any element of the optimal design.