Project Statement

Low Center of Gravity All-Terrain Power Chair

Team #2

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Project #6 for Annalee Hughes
Statement of Need

This project aims to create a power chair for Annalee Hughes with a low center of gravity so that she may operate it over hills and rocks in her yard. Annalee has cerebral palsy which affects her ability to sit up straight and stand. Previously when operating her power chair in her family’s yard, she has tipped the chair over due to the hills and rocks present. Annalee does not have the core strength necessary to get upright by herself if this happens, which is why it is necessary to alter the chair to be able to traverse this landscape.

Introduction and Overview

Our client, Annalee, has Cerebral Palsy, which is a disorder that affects nerve functions. Her muscles are therefore not as strong, but she is able to do some things unassisted. She cannot walk or stand without aid and needs supports to sit safely. She has poor trunk strength and therefore tends to lean forward. However, she is adventurous and likes to go around her yard. However this leads to the problem, as the client's yard is rocky and hilly, and she has even flipped her chair which is very dangerous. That is why she needs a power chair better suited for her yard.

The purpose of this project is to create power chair that is capable of traversing any terrain that is on the family’s property. The yard contains three acres of hilly, rocky, uneven terrain. She would like to be able to get to various parts of the yard such as the barn, pond and the brush where she can pick blueberries. There is also a long unpaved and uneven driveway to which the client would like access. The chair that she uses now has a clearance of 8 inches; however, due to various brush and rocks the clearance may need to be increased accordingly.

Safety is the primary concern for this project. The design of the chair should be similar to the design of her previous chair by maintaining a similar restraint system. However, due to the nature of use, in an all-terrain manner, safety must be increased further. Prior to this project, Annalee has tipped over in her chair, which is very dangerous. Thus better safety precautions must be met. First the chair needs to be rigged differently so that there is an auto-braking mechanism if she does not want to move. She sometimes brakes too late and cannot stop in time, and therefore the auto brake system will be beneficial. When passing through the hills, sometimes a hill may be too steep and therefore a mechanism that alerts the client that the hill is too steep would also benefit her. Also, to prevent injury from possible flipping of the chair a roll bar will be implemented. A kill switch will also be necessary in case she loses control of the device.

Though the chair will mainly be used in the yard, the chair must be able to get into the house for storage purposes. Her parents will be there to get her into the chair but after that she is on her own. She will control the chair by herself and be free to explore and enjoy the yard as she wishes.
Realistic Constraints

There are several realistic constraints that can affect this project such as economic, environmental, sustainability, manufacturability, ethical, health, safety, social and political. Health and safety is the major realistic constraint, as the primary purpose of the device is to keep Annalee safe. This device should support Annalee in a proper way, allow her to control the device comfortably and it should not risk tipping over or getting stuck. In addition to the safety of client, the safety of the workers is also very important. Issues such as the use of hazardous material or a machine which has a noise which might cause hearing loss or blindness may arise for the workers. The clients’ and the worker’s health and safety must come first and foremost while designing this device.

Sustainability constraints are another issue in designing this device. Currently Annalee uses a power chair which is compact in shape, which results in the center of gravity to easily deviate from the upright position. She ultimately loses her balance on slightly hillside surfaces, which leads to the idea of reliability and durability of the device. In designing the device all parts need to have a similar designed life span under the assumed normal operation condition.

The actual environmental and social factors are the key constraints to think about. The device should be applicable in extreme working temperature whether it is hot or cold. The device should not tear up lawn when it is in use. To minimize air pollution the device should be operated with electric engine or hybrid engine. The social constraint is to make sure Annalee can enjoy outdoors activities, rather than creating a device that confines her as her current power chair does. Another social constraint is the device should not be noisy and disturb the surrounding rural neighborhood while it is in use.

Economic constraints and manufacturing constraints are very important in designing the device. Knowing the budget will help determine what kind of material we need to use in order to manufacture the device. In addition to this, having the knowledge of similar product in the market will be a good guide to estimate our budget. Realizing the potential impact on the country’s economy is also an essential factor. In manufacturing the device we have to know the availability of chosen material. It is also important to consider low maintenance cost and parts easy to replace for the user.

The last major constraints are political and ethical. The manufacturing of a product that might be physically and/or mentally destructive for clients and workers is a key political constraint. Also, designing the device without considering safety and health of the client, workers and/or the public is a major ethical constraint.

Other Data

The family owns a house in Maine they visit, and the current power chair works well there, however, it would be helpful if the new device is transportable enough to bring it there. The family also goes to Harkness State Park on the Connecticut coastline, where Annalee enjoys the sand and water. The state park provides power chairs, but again, it would be useful for the new device to have portability.
Due to a weak upper back, Annalee tends to hunch over at the shoulders; however the proper posture for her would be to maintain a straight, elongated neck with the chin tucked. She can sit up properly for ten to fifteen seconds, but then returns to the hunched position. When she sits up, she tends to fight against gravity and exhibit motion from all parts of the body. She lacks protective reactions, such as catching herself as she falls forward or backward, and her knees tend to cross while in the stationary sitting position.

Overall, she is a bright girl who can read, learn and respond to input. She can stand when assisted or when holding something stationary, and she can pivot her hips slightly to assist in location transfers. In order to eliminate the body movements when being seated in the chair, the pelvis will have to be secured first.

Questions

What is our budget?

What will be our source(s) for materials?

What will be the top speed and turning radius of the chair?

How big can the base of the chair be without compromising portability?

What will be the nature of the slope-warning mechanism?

What circuitry is necessary for the device to operate?

What will the battery life of the device be?

Is there anything else we can implement that makes the device as safe as possible for Annalee?