Project Statement and Specifications

Standing Gardener, Sand/Ice Wheelchair Base

Team #2
Peter George, Robert Knapp, Fred Karnas

NSF Project #2

Brenda and Sean Stenglein
34 East Howey Road
Ashford, CT 06278
Phone: 860-429-1059

Steve Moran
Crossroads Physical Therapy
106 Route 66E
Columbia, CT 06273
Phone: 860-228-0194
Statement of Need:

Sean Stenglein is a 10 year old child with Cerebral Palsy that requires a device to assist him in aiding his parents in gardening while standing. Sean’s parents own a gardening business that the entire family helps with. However, because of Sean’s disability, he finds it difficult to participate because he does not have full control over the motor function of his body. It is vital to Sean’s development that he exercises and moves his body in such a way that the muscles and bones grow stronger. This task includes standing in a position where his hips bear most of the weight and moving in such a way that Sean’s bones do not weaken. The device that will aid Sean in helping his parents with the gardening business will have to restrain his hips and lower back, while still allowing him to stand on his own.

Sean also requires a device that can allow him to sit while functioning and moving on ice and sand. Physical participation is vital to Sean’s development. It is a common occurrence Sean wants to participate in the activities of other children, but is restricted by the apparatus that makes him mobile. As an example, a normal wheelchair does not have the capability to go on ice and sand. The task is to design a device that Sean can use to allow him to be mobile under these terrain conditions.

Introduction and Overview:

Sean has the mental and emotional power and capability to do any activity that someone without his condition can do. He wants to participate with others and share his knowledge and skills. However, his condition limits him in his ability to physically move and accomplish the goals he wants to achieve. Sean’s condition is one of Cerebral Palsy only, with no other complications. His mind, ability to learn and think, and mentally accomplish tasks is better than average. His bones and muscles perform as they should. The only complication, due to Cerebral Palsy, is his ability to control his motor functions, or his appendage movement. Sean feels the need to participate, and his participation is vital to his growth, both physical and mental.
Because of Sean’s disability, he finds it hard to coordinate his movements, such as walking and communication. An easy answer to his problem would be to put him in an electric wheelchair for the rest of his life. However, this would hinder his physical development because, over time, his muscles and bones would become so weak to the point that he would have limited use of them. As sharp and ambitious as Sean’s mind is, he deserves to walk and participate in the same activities that others do.

One of these activities is aiding his parents and family in their gardening business. The goal is to create a gardening work station where Sean can be restrained in such a way that he is supporting his own body weight by standing. His arms must be free to move soil, pot plants, change pot sizes, water the plants, but each item must be secured to the station in some way.

The unusual thing about this device is that it must be able to telescopically grow with Sean. No other device on the market can telescopically increase in size to the degree that Sean needs. The standing gardener must be able to support Sean’s weight and height as he grows as well. The device must be treated and built in such a way that it can become dirty and wet and not be compromised.

The purpose of the ice and sand base is to allow Sean to play outside under different terrain and weather conditions. The multi-terrain wheelchair base does not have to be compatible with a wheelchair. It can be separate devices, such as one for normal terrain, one for ice, and one for sand. The finished device will allow Sean to be mobile on ice and sand.

Like the standing gardener, the multi-terrain base must be able to withstand weather changes and dirt (and sand) without being compromised.

Realistic Constraints:

The main realistic constraint that affects this project is economic. There are devices on the market that do similar things as the ones in this project, but they cost upwards of multiple thousands of
dollars. Likewise, some are not covered by insurance, so families have to pay full price for these items. The main goal of this project is to design a device that is affordable and functional.

Comfort is very important to the design of both products, if Sean isn’t comfortable in them he won’t want to use them. Sean will be using these devices for extended periods of time and if he is uncomfortable this could cause him to be sore.

Another major constraint is the portability of the devices. All of these devices have to be reasonably portable, especially the multi-terrain wheelchair base. A problem with most of the devices out there is they are too large and heavy to be easily transported. The Stenglein family has a Yukon XL sport utility vehicle. However, getting the devices in and out of the vehicle must be relatively easy.

The standing gardener can be more of a permanent device. It will be moved from one greenhouse to another occasionally, but the device will most likely not be removed from the area. A solution to this problem would be to allow the standing gardener to be transportable by adding wheels and wheel locks or allow it to disassemble into multiple pieces relatively easily.

Mechanical safety and support is another major constraint. Both the standing gardener and the multi-terrain bases must be extremely safe to restrict the ability of Sean to become injured using them. Since they will be designed to become larger with Sean, they will have to be structurally sound as not to break under increased load as Sean grows. Sean’s health and safety must come first and foremost with the design of these devices.

The last major constraint would be environmental. Both the standing gardener and the multi-terrain bases must be able to endure elemental extremes of hot, cold, and weather changes as these devices will be used outside during weather extremes. They must be made of materials that will not be compromised under environmental extremes, and be able to remain working after years of use.
Other Data:

Some additions to Sean’s standing gardener will be needed since Sean’s disability leads to other problems. Sean tends to get thirsty frequently and has a bottle of water with him most of the time; he will need a holster for a cup or bottle. When watering plants Sean uses a garden hose and may need a place to hold the hose for easy access. Also, Sean gains some control of his body when he has something to hold on to, a bar or handle on his workspace will be needed. Sean is right handed, which means he will probably want to hold on with his left hand and have all other additions on his right.

Also when Sean’s elbows are closer to his body he gains more control which is probably the best position for him to be potting plants. However, Sean can develop contractures or spasm when kept in the same position for an extended period of time. In this case Sean may need to be taken out of the stander quickly and easily. Another way Sean gains some control is sitting in a position where his thighs are 90 degrees or less from his chest, the seat of the wheelchair must meet this requirement.

Sean usually works in an area in the greenhouse that is 8x8 feet which is near the door. As of now he is using a product called a Lecky Free Stander size 2, he is quickly outgrowing it and the family is trying to prevent them from having to buy the next size which he will also outgrow someday. The Lecky Free Stander was difficult for Sean’s parents to move back in forth from the house to the green house. The new gardener will most likely only be kept in the greenhouse, but in the case that it needs to be moved to the house it must be easy.

As for Sean’s capabilities, he is able to use switches. The best design for him to use is a T-switch since he has very little control of his thumbs. Sean’s most difficult tasks involve shoulder movements and balancing. Steve Moran is Sean’s physical therapist and knows Sean’s complete physical specifications of what he can and cannot do.
Questions:

Some questions that might arise pertaining to the standing gardener are:

- Which parts of the standing gardener will have to be telescopically mobile in order to grow as Sean grows, along with being structurally sound?

- How tall will Sean grow to be? If Sean grows too tall will the standing gardener need extra stability supports.

- How will the items needed for gardening be secured to the gardening station, but still allow the station to be fully functional and compatible with all of the items?

- What is the maximum stress and position of the stress that the standing gardener would be under as Sean grows and how can it be accommodated for?

- If Sean has a contracture will this cause tipping of the device when he gets bigger?

Some questions that might arise pertaining to the multi-terrain bases are:

- How will the brakes for both the ice and sand base accommodate for increased friction while slowing motion?

- Will moving joints need to be replaced and how will they be replaced? Could these joints be readily available and acquirable if something does need to be replaced?

- What if a component breaks due to fatigue over time? Could that be replaced easily so the device could still be used?

- If the wheelchair is going to be used in snow and on sand will it require some sort of special cleaning and rust proof treatment to keep it working properly and make its parts last as long as possible?
Technical Specifications:

Standing Gardener

**Physical:**
- Pressure Treated Douglas Fir

**Mechanical:**
- **Size:** frame: 48x28x60 inches (LxWxH) with adjustable height and base.
- **Workspace:** 24x30 inches (LxW)
- **Weight:** 45 pounds (lbs.)

**Electrical:** N/A

**Software:** N/A

**Environmental:**
- **Storage and Use:** -10 - 110 °F

**Safety:** Stability extensions should be locked when standing gardener is in use.

**Maintenance:** Lubrication of moving parts.

Multi-Terrain Wheelchair

**Physical:**
- 316 Stainless Steel

**Mechanical:**
- **Size:** 36x28x42 inches (LxWxH)
- **Weight:** 45 pounds (lbs.)

**Electrical:** N/A

**Software:** N/A

**Environmental:**
- **Storage and Use:** -10 - 110 °F

**Safety:**
- Lock wheels when traveling down slopes and when at rest.
- The device must contain a safety belt that secures riders’ hips.

**Maintenance:** Drying and lubrication of moving parts.