Standing Assist Mobility Device

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Background

The Standing Assist Mobility Device is a vehicle designed for individuals who lack mobility outside of a wheelchair due to an injury or complication, but ultimately leaves the individual a paraplegic. The Standing Assist Mobility Device will raise the paraplegic from a seated position to a standing position and then move them about while remaining balanced. For the user to remain upright and operate the vehicle, they must be able to use a majority of their abdomen muscles to ensure safety and proper control of this device.

This ability is determined by having a T-6 injury or lower on the spine to ensure they have the proper use of abdomen muscles (fig. 1) [1]. This device fits the lifestyle of those who seek to increase their freedom from a traditionally constrained mobility device.

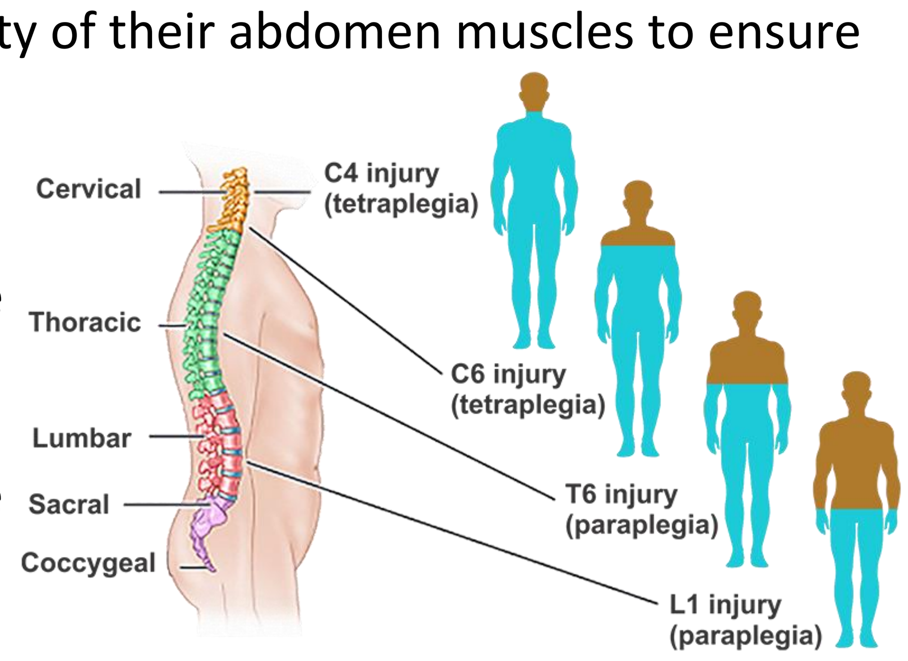

Figure 1. Visual of Spinal Cord Injuries [1]

Purpose

The purpose of the standing assist mobility device is to give paraplegics the opportunity to move about and be at the same level as everyone else, while also keeping their safety and comfort as the biggest priority.

Functional Requirements	Specifications
Take the user from sitting to standing position	Take from a ~90 to ~180 degree position
Sustain little to no damage from weather	Test through simulating different conditions (ex: rust with salt water spray to test material can be measured)
Go anywhere a wheelchair can	The max rise for a ramp is 760 mm. Any ramp slope should be 1:12 (old standard was 1:20)
Rechargeable battery	Can connect to standard 120V outlet to recharge battery
Can function/move at the pace of a normal person	Average walking speed is 1 mile per 15-20 minutes

Process

Throughout the development process, multiple iterations were made to encompass all of the customer requirements. The largest changes came after the scope of the project was altered. Figure 2 shows from left to right the evolution of the design. It began as a self-balancing system and transitioned to an already balanced system.

Data

The expected data was the materials not corroding when it is placed into the salt sprayer, the circuit not being affected by outside signals, and the device continue to work over the time period of at least 2 hours. A cyclic loading test can be used to determine if there is any deformation be having a volunteer sit and stand in the device repeatedly for a specific duration of time. Sandbags would be used to test if the deformation is about 5 percent and if the device can remain in same position while the brake is applied. The device would be sprayed with water to test if the device is splash proof. The material will be rubbed on one of the team members to ensure that the device is biocompatible.

Safety Standards

Standard	Description
ISO 7176-8	Standard that is used for determining the stress for a static, impact, and fatigue strength.
ISO 7176-1	Standard that is used to test the static stability of a wheelchair when the brakes are applied.
ISO 7176-30	Standard that is used to test the ability of the wheelchair to recline, tilt, elevate and stand-up mechanisms
IP04	Standard that is used to test the ability of the device for splash resistance.
ISO 14971	Standard that is used for managing risks that can occur in a medical device.
IEC 60601-1-6	Standard that is used for general safety and performance of a device.
ISO 10993	Standard for biocompatibility in medical devices.
IEC 61000-4-4	Standard that is used to test the electrical portion for resistance to outside signals.

Final Design Overview

Mechanical

The final design for the Standing Assist Mobility Device will have a total of 6 wheels: 2 main wheels and 4 smaller, stabilizing wheels. There are two parts to the harness, an upper and lower. The lower harness will hold the majority of the user's weight while the upper harness will provide comfort, stability, and safety. Batteries will be held under the platform which has plenty of room for them and it will help lower the center of gravity for the entire device.

Electrical

The circuit that would have been used takes the signal from the Arduino and uses it to either open or close the relay driving the motors. The function generators simulate the Arduino and provide the signal so that the relays can be opened or closed to move the motors. The circuit can be seen in Figure 3.

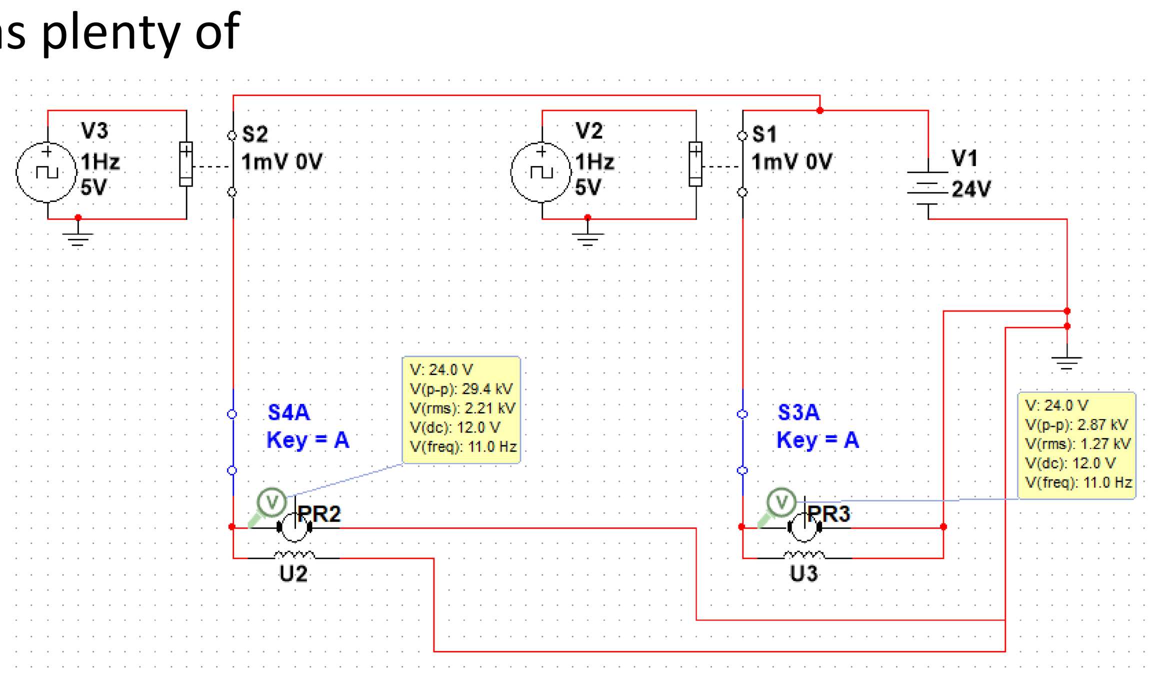

Figure 3. Electrical Schematic

Next Steps

Next, the team would have assembled the device and tested it for the different standards that are mentioned here. The device would then have the circuitry assembled and attached to the device. It would have been tested by the team to ensure that the functional requirements were met.

Figure 2. Progression of the Standing Assist Mobility Device

References

[1] NeuroGen. (n.d.). What is SpinalCord Injury? Retrieved from https://www.neurogen.in/spinal-cord-injury
[2] ADAAG - United States Access Board. (2002). Retrieved from https://www.access-board.gov/guidelines-and-standards/buildings-and-sites/about-the-ada-standards/background/adaag#4.8.
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