Alternative Designs Report
Treadmill Support System
&
Pool Lift Mounts
By
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Team 11

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Design 1: Strap to Treadmill Bar Design

The only major modifications on the treadmill will be electrical modifications. The interface and wiring must be changed in order to allow the user to change the amount of weight which is supported by the harness. The variation in design possibilities resides in the harness system itself. In the first design, the user is supported by a harness which attaches to modified treadmill handle bars. The design is advantageous because it minimizes modifications and is easy to use. It also allows Dominic to adjust the amount of support he requires and the quick release of the straps allows for other family members to use the treadmill as well. Four straps, each placed at a 90 degree angle, will be implemented to ensure complete stability while the treadmill is in use. Dominic can put on the harness while still in his wheelchair, and then attach the straps using quick release clips. However, some sort of ramp would need to be designed so that his chair could be wheeled onto the treadmill before he puts on the harness.

By feeding the straps into winch mechanisms on the modified treadmill handle bars, Dominic can adjust the strap tension to provide the optimal amount of support, maximizing exercise while minimizing the risk of injury. The harness itself will utilize a rigid support piece running along Dominic’s back to support his head and neck. Heavy duty nylon straps will be strapped across his chest to secure the back brace. More nylon straps can be utilized to wrap

![Figure 1: Direct bar strap design](image)
around his legs and midsection. This design would be similar to a rock climbing harness or some similar design created to support full body weight.

**Design 2: Collapsible Rollaway Harness**

This design utilizes a collapsible frame to support Dominic while he uses the treadmill. The legs of the frame will be fully collapsible, so that the harness can be removed from the treadmill when Dominic is not using it. This design is non-invasive and it allows other family members to use the treadmill. Furthermore, it is easy to use and provides adjustable support, but it also eliminates the need for a ramp to push Dominic’s wheelchair onto the treadmill before he puts on the harness.

Figure 2 displays the harness floating in the middle of the support apparatus. The nylon harness will be suspended by two nylon straps (not shown) which run up to two winches on the frame. The system sits on four, lockable wheels. Two will only provide linear motion while the final two will not be restricted. The legs of the frame will be extended and locked into place with heavy duty pins capable of supporting Dominic’s full weight while the support system is in use. Next, the frame will be rolled over Dominic’s wheelchair. Once he has put on the harness, the tension in the straps can be adjusted to hoist him out of his wheelchair. The support system can then be rolled over the treadmill system.

![Figure 2: Collapsible Rollaway Harness](image-url)
Dominic is finished using the treadmill, this process can be reversed to move Dominic back into his wheelchair.

**Design 3: Robotic Leg Design**

The final design for the treadmill support system for Dominic Gondreau involves using robotic leg braces (a type of orthosis) in addition to a harness system. The harness system will be similar to one of the systems previously described, with slight modifications. First, the harness would no longer require winches to adjust the weight support experienced by Dominic, as the orthosis mechanism will account for this. Once Dominic has put on one of the existing harnesses, he could put on the legs while suspended in the support system.

The robotic legs would be connected to a unit that houses the power supply, motors, processing equipment, and other equipment necessary for proper execution of the orthosis. The orthosis would begin at hip level, and adjust for different heights. It would extend out to the center of each hip of the patient. From there, it would follow each leg down to the ankle. There would be one joint at the knee for flexion. Additionally, there would be two straps for each leg, one at the thigh and one at mid-calf level. The apparatus can be seen in Figure 3. These would ensure proper leg support is given, with the majority of the patient's weight being supported by
the harness system. The robotic legs would guide the patient's legs in a gait motion to assist with exercise.

The orthosis would have active sensors in it that would feedback to the processing unit. Here, the system would be able to monitor the amount of assistance that should be supplied to the legs. For instance, as the client grows stronger and can use his legs more on his own, the orthosis will sense this and allow for more movement on Dominic's end. However, in the early stages of using the treadmill, it will be able to provide more locomotion assistance for Dominic.

**Pool Lift Alternative Design 1:**

For the alternate designs concerning the pool lift for Zak, three separate mounting systems were determined. The first consists of securing the pool lift to the ground via a cement base. A hole with the appropriate dimensions in accordance with Connecticut laws would be dug in the ground near the pool. A metal frame, as seen in Figure 4, would then be placed into the hole and filled with cement. The lift would then be placed inside the center cylinder protruding from the base and secured via screws. It could be removed from the base as needed and stored. This option will be difficult to implement, as the cement would require hiring a contractor, rather than doing it ourselves. Furthermore, the expansion and contraction of the cement block with the change of seasons may damage the metal housing.
**Pool Lift Alternative Design 2:**

The second option involves mounting the pool lift directly to the pool deck. The mount would be securely fastened to the deck with large nuts and bolts in its four corners, as seen in Figure 5. The lift would then slide into the center pole of the mount, and be secured with screws. The deck mount would be set off to the side of the deck and be somewhat permanent, but the lift could be removed as needed, for times such as storage in the winter.

![Figure 5: Deck Mount](image)

**Pool Lift Alternative Design 3:**

The third option is very similar to the one previously described, however instead of mounting to the pool deck, it will be on wheels and be mobile. With this design, a counterweight should be implemented to ensure the lift will not tip over when lifting the client. Also for more stability, the base will extend farther in the direction that the boom arm of the lift is located.

![Figure 6: Mobile Pool Lift Mount](image)