Project Statement & Specifications
Treadmill Support

TEAM 11
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Project for Dominic Gondreau

Client Contact:
Gondreau Family
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STATEMENT OF NEED

People with debilitating diseases such as Cerebral Palsy find it next to impossible to exercise on a regular basis. Most people who can run on a treadmill for a workout in the comfort of their own home. However, people with this disability are unable to do this, mainly from the fact that they can’t support themselves on their own. Our client, Dominic, is experiencing this first hand. He is looking to exercise to stay physically fit, but is unable to use a treadmill on his own. He needs a device that will fully support him while he walks along the treadmill. The device should be built such that it accommodates his growth. In addition, it should fully support and stabilize Dominic on its own, without the help of an outside force. Last, the device needs to allow for full range of motion of the client’s legs.

INTRODUCTION AND OVERVIEW

The project entails adapting a treadmill for Dominic Gondreau, a child of 6 years with Cerebral Palsy. While we have not yet been able to contact the Gondreau family, the following describes the modifications we believe will enable Dominic to utilize the treadmill properly. The first problem involves properly stabilizing Dominic while he is using the treadmill. We believe that some type of harness would be best suited for this function. Most treadmills have two looping bars which protrude from the beams supporting the main controls of the treadmill itself. By removing these bars and replacing them with walls, such that three sides of the treadmill are completely enclosed, the treadmill should be able to support a harness which can carry the entirety of Dominic’s weight. The harness itself will be required to keep Dominic stabilized and upright while he is using the machine. By utilizing a fourth pole in the back of the treadmill placed such that Dominic can still be placed in the treadmill without the pole being in the way, a strap from his harness could be attached to a support at every 90 degree turn from his harness. In other words, four straps would be running from his harness to supports, holding him in place from all sides. The second modification to the treadmill may involve some safety features shutting the treadmill off should Dominic become tired. If sensors were placed in either wall of the treadmill in order to detect the rate of Dominic’s legs moving, they would be able to predict when he was tired by the slowing of his movements. Should Dominic’s leg speed fall below a critical rate, the treadmill would shut off and Dominic could be removed from the treadmill in order to recover from his fatigue. A further modification may be made to the treadmill in order to allow Dominic greater use of his legs as he grows stronger. When Dominic first begins use of the treadmill, he will likely not be able to support any of his weight, but with continued use, the muscles in his legs may strengthen. As his legs grow stronger, he may be able to use them to support more of his weight. If an apparatus were installed in the treadmill which released tension in the harness such that Dominic’s parents could control the percentage of his body weight supported by the harness, Dominic would be able to strength train his legs at a reasonable rate, and perhaps one day, gain significant leg function. Finally, further safety features should be installed into the treadmill in order to prevent injury to Dominic should failure of any of the treadmill’s features occur. The main most catastrophic failure on this treadmill would occur in the harness. Devices must be installed into the treadmill in order to sense even the smallest differences between the actual tension in the harness and the tension in the harness programmed into the control panel of the
treadmill. Should the actual tension in the harness differ from the programmed tension, the treadmill would shut off in order to prevent injury to Dominic. Upon meeting with the Gondreau family, further modifications may need to be made to the treadmill. Our team has based the preceding precautions solely on predictions. Once a deeper understanding of Dominic’s needs is achieved, the level of modifications applied to the treadmill can be properly assessed.

REALISTIC CONSTRAINTS

It is difficult to describe the constraints surrounding the treadmill for Dominic because we have not yet been able to contact the Gondreau family. Once again, constraints may be found in the modification of the treadmill, more so than the pool lift due to the fact that it is much more complicated. The implementation of our own electronics in the system will likely pose the greatest challenge. Modification of the existing control panel and the addition of more controls will also likely be quite difficult. The Gondreau family may also want to use the treadmill when Dominic is not. This may constrain how we are able to design the harness and support system. A quick release system for the harness and perhaps a collapsible support system would function well in this situation. Perhaps the most important constraint on the system will be the implementation of extremely well designed safety features. Obviously a treadmill built for a child with limited mobility will require many of these safety features, some of which are described above.

The final major constraint on the project will be the budget we are supplied with. Since the project requires the purchase of a major component followed by the implementation of significant modifications, we must ensure that our money is well spent. Moreover, we will need to ensure that the majority of our time is spent designing the important components of the project. The most important portions of the project will likely be the safety features, as the means of exercise is potentially quite dangerous for children with Cerebral Palsy. We must ensure that enough money is budgeted for completely failsafe materials in these cases.

OTHER INFORMATION

At this point in the project, there is no other information available because we have not been able to meet with the client yet.

QUESTIONS

- What is our budget?
- What is the client’s current weight and size as well as the average growth rate of patients affected by Cerebral Palsy?
• Should the support allow for movement in the horizontal direction, back and forth along the treadmill?
• Can the muscle control of patients with Cerebral Palsy improve over time?
• How accessible should the treadmill be to other people without disabilities that would have an interest in using it?
• Should the support be designed so that it can easily be removed?
• Are there space constraints with the support? Does it need to be kept within the existing dimensions of the treadmill?
• Should the design include having the support sense the speed of the patient's legs and adjust the speed of the treadmill accordingly?
• Should the device attach to the patient while he is in his wheelchair, to help transfer him onto the treadmill?
• Should the support be completely rigid, completely flexible, or a combination?
• Is there a device similar to this already on the market for physical therapy purposes?

TECHNICAL SPECIFICATIONS

Existing Treadmill
• Box Dimensions: 78" L x 35" W x 13" H
• Foot Print: 73" L x 31" W
• Unit Weight: 195lbs
• Max User Weight: 300lbs
• Speed Range: 0.5mph - 10mph
• Incline Levels: 0 - 15
• Motor Horsepower: 2.5 CHP
• Walking Surface: 20" x 60"
• Roller Size: 2"
• Frame Type: Folding

Support System
• Frame material: Hot-rolled carbon steel tubing
  1) 2” x 4” x 16’ Steel Tubing (1/4 in. thickness)
  2) 2” x 5” x 2’ Steel Tubing (1/4 in. thickness)
  3) 4” x 4” x 6’ Steel Tubing (1/4 in. thickness)
  4) 4.5” x 4.5” x 3.5’ Steel Tubing (1/4 in. thickness)
  5) 2” x 2” x 6’ Steel Tubing (1/4 in. thickness)
  6) 2.25” radius x 6’ Steel Tubing (1/4 in. thickness)
  7) 12” x 12” Steel Plate (1/2 in. thickness)
• Harness Material / Type: ASTM Safe Solid Nylon Straps
• Casters: 4” Synthetic Rubber Plus, 300lb capacity each
  1) 2x Rigid
  2) 2x Swivel with total lock brakes
• Hydraulic cylinder: Maxim Tie-Rod Cylinder
  1) Stroke: 6"
  2) Bore: 2", 2500psi
  3) Length: 16.25" to 22.25"
  4) Column Load: 7850lbs

These specifications are subject to change upon finalizing our decision on what treadmill to purchase and modify. More information concerning the actual support system on the treadmill will be added after we can meet with the client. The preceding are simply common specifications found for this product.