Abstract

Loss in mobility as a result of stroke or amputation is one of the most emotionally upsetting events that an individual can undergo. However, providing the patient with prosthesis and specially tailored rehabilitation training not only greatly improves the patient’s functional status but also dramatically improves his or her physique and quality of life. Implementing a system of cables, sensors, controls, and servo motors the rehabilitation device assists patients in restoring natural gait movement and allows our sponsor to conduct further research in this field.

Objectives

- Design and build a system consisting of a supporting frame with servo controlled pulley system to fit around a treadmill in order to assist in active gait rehabilitation.
- Provide assistive or resistive training applications for research and gait restoration purposes.
- Provide safe and comfortable environment for rehabilitation.
- Provide a fully adjustable and reliable working equipment designed to last.
- 110V/220V capability with maximum mobility and adjustability

Final Design Features

1. Frame:
   - Rigid and adjustable frame constructed using 80/20 aluminum extrusion that allows future modifications of the system to be adjusted to fit different individuals. Maximum load capability of 400 lbs., and 6.6” in height.

2. Pulley system:
   - Upper and lower pulleys on both sides of frame allow for front plane movements.

3. Load Cells/Foot Switches:
   - The load cells will determine a variability in force applied by the patient and feedback signals needed to adjust torques to the pulley system. With a maximum capacity of 100 lb. load, the load cells will help determine changes in force applied by the patient.

4. Servomotors:
   - Two servomotors will apply the necessary cable tension using torque sensing and analog feedback.

5. LabVIEW:
   - Programming using LabVIEW; load cells, foot switches and servo drives will be integrated into one dynamic system. LabVIEW will implement step force response at particular load changes.

6. Treadmill:
   - NordiTrack X7i treadmill provides 22” x 60” track, large enough to fit any individual. The treadmill includes a built in kill switch thus allowing a safe and measurable use.

Results and Analysis

Analysis:
The used components designed to provide valuable data to implement the assistive/resistive forces needed. The controls needs to be properly tuned and programmed for specific application in order to provide the servomotors the adequate input for desired timing and tension of the cables. Providing working results using the LabVIEW interface, it is easy to map the basic inputs of each component. The system is heavily secured with safety features that also include emergency kill switches that designed to disable motor axis's and treadmill.

Results:
For demonstration purpose we use simple program just to prove that our design is valid; however, additional features in system performance can be achieved by implementing more advanced programming.

Conclusion

ART team designed and tested working prototype for given application. Using limited resources, most components were fabricated at UTD’s machine shop. We are proud of what we accomplished, but more tests and adjustments need to be done to the software to optimize the system’s performance.

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References:
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