Gait Trainer With Treadmill

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Abstract

The aim of this project is to design a system that can securely allow a gait trainer to be used seamlessly with a treadmill. Our client relies on the gait trainer to provide support and weight-bearing assistance while walking, but is unable to utilize the gait trainer outside during the winter. By designing a system that would integrate the gait trainer and treadmill it would allow for our client to continue to maintain their mobility strengthening year-round. Our design will include a detachable aspect and stable attachments that. Our design consists of a ramp and two tracks, disconnected from one another, that can be and clamped onto the treadmill.

Background and Motivation

Gait trainers are large devices that are not designed for indoor use. During periods of inclement weather, it can be difficult for a patient to use the gait trainer, which can have impacts on physical and mental health. Research has shown that there is a positive correlation between the amount of exercise one gets and the happiness one feels [1]. Using a gait trainer on a treadmill during the imperfect weather conditions would improve the overall health of the client as it can lead to greater progress in rehabilitation as well as improving the mental health of the individual.

Competing designs:

- LiteGait 4Home: Height adjustable harness system detached from treadmill [6].
  - Postural support from harness above.
  - Can be used over ground or over treadmill.
- Body-weight Support Treadmill Gait Training System [7].
  - Electrical point control for height adjustment.

Figure 1. LifeGait 4Home

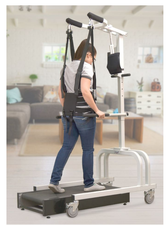
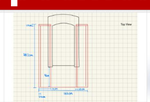
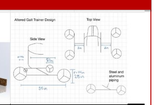


Figure 2. Body-weight Support Treadmill Training System

Design Specifications

- Support client for 15 minutes at 1-3 mph increments.
- Follow ADA ramp recommendations[2] and FDA requirements.
- Withstand the force of approximately weight of 175 lbs[3].
- Withstand various temperatures [4] and last for 10-15 years[5].
- Compatible with the Rifton Pacer Gait Trainer 2022.
- Budget: $500





	Design 1: Ramp and Tracks connected		Design 2: Ramp and Tracks disconnected		Design 3: Altered Gait Trainer	
Criteria (weight)	Score	Weighted Score	Score	Weighted Score	Score	Weighted Score
Safety (25)	4/5	20/25	4/5	20/25	2/5	10/25
Ease of Use (30)	3/5	18/30	4/5	24/30	2/5	12/30
Cost (10)	4/5	8/10	4/5	8/10	2/5	4/10
Ease of Fabrication(15)	4/5	12/15	4/5	12/15	2/5	6/15
Durability (20)	4/5	16/20	4/5	18/20	2/5	12/20
	Sum	74/100	Sum	82/100	Sum	44/100

Figure 3. Design Matrix

Final Design

Initial Design

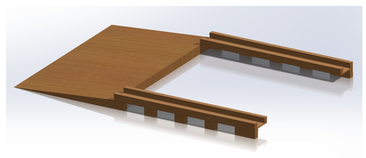


Figure 4. SOLIDWORKs initial design.

Fabricated Design

Figure 5. Fabricated final design

Track Supports

Figure 6. Track supports on along the treadmill

Design Changes

- Aluminum plates were added to base of ramp to resolve the lip from the end of the ramp.
- Additional supports were added to prevent bending in the track base. The original three supports did not support the force of the gait trainer and client.

C Clamp Supports

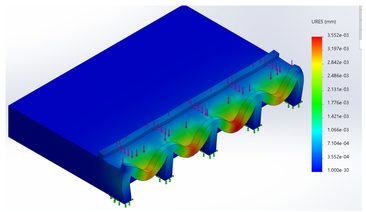
Figure 7. C-Clamp attachments

Utilization of Device

- The back of the tracks are lined up with the edge of the belt on the treadmill by the client.
- The tracks are attached to the metal bar on the sides of treadmill via the C-Clamps on the track supports.
- The ramp is lined up with the tracks to allow for seamless use.
- Finally, the client will walk with the gait trainer up the ramp and onto the tracks

SOLIDWORKS Testing

- SOLIDWORKS testing was done on the tracks where the concentrated force of the gait trainer will rest when ambulating on the treadmill.
- The simulation involved a large block representing the treadmill alongside the tracks.
- This testing was done to determine where any potential points of failure were on the tracks to verify the security and safety of the device.
- SOLIDWORKS testing was also done on the ramp portion of the device.
- A concentrated force was applied to the top face of the ramp with the bottom and sides of the ramp fixed to determine any weak points of the ramp itself.



Name	Type	Min	Max
Factor of Safety	Max von Mises Stress	5.606e+02 Node: 5823	1.082e+07 Node: 10553

Figure 8. SOLIDWORK testing of tracks

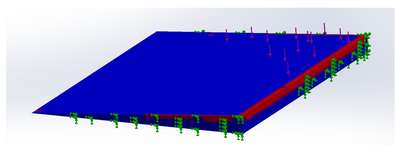


Figure 9. SOLIDWORKS testing of the ramp

Results

- A 900N load was applied to the tracks and the ramp to test the supports since 900 N is higher than the force applied to the device when the weight of the client and gait trainer together are considered.
- Between the support beams of the track a maximum deformation of 3.5e-03 mm was recorded.
- A minimum Factor of Safety of 560 was recorded in the simulation results.
- This overall proves the tracks are incredibly stable, with little deformation and a high level of safety.
- The ramp itself also proved to be very stable with a minimum factor of safety of 24773.
- The potential weak points of the ramp are the edges at connection points.

Survey Testing

A thirteen question survey utilizing the Likert scale [8] was created and sent to our client, asking them to illustrate the safety, feel, and ease of use of the system and the individual components of the system. Highlighted survey results are as followed:

- Satisfaction to the outcome of the device: 10/10
- Ease of use: 9/10
- Security of gait trainer on the treadmill: 9/10
- Overall safety of the device: 10/10
- Durability of the device: 10/10
- All survey questions average: 9.8/10

Client Testing

- Testing using the gait trainer treadmill, and attachment was conducted in the clients home on two separate occasions.
- The stability of the gait trainer on the tracks as well as the deformation of the tracks was documented and tested.

Results

- Device showed little to no deformation when the gait trainer and an additional load was applied
- The device remained on the tracks despite lateral forces being applied.
- Seamless transition onto track and ramps.

Figure 10. Final Design attached to treadmill

Future Work and Conclusion

Future Work

- Implement an adjustable height system for the tracks.
- Increase the variability to be compatible with any treadmill.
- Implement an emergency unlocking system in case of a seizure.
- Complete testing with client to see if there is deformation in the tracks or ramp.
- Create a clamping system with an easier access site to increase the ease of use.
- Design wedges to be fit behind each wheel to ensure no movement while on the tracks.

Conclusion

- Our team initially predicted the tracks would have minor deformations and displacements while in use, after SOLIDWORKS and client testing the tracks were well supported.
- The use of C-Clamps provided major stability for the tracks, although initially we assumed additional attachments would be necessary.
- Although the tracks can only be used with the treadmill, the client has expressed their interest to use the ramp in multiple scenarios.

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Acknowledgements

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