Preliminary Design Report

Gait Trainer With Treadmill

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Abstract

The aim of this project is to design a system that can securely attach and detach a gait trainer to a treadmill. Our client suffers from a neurological disorder, resulting in them being severely prone to seizures and has extreme mobility impairment. Our client relies on the gait trainer to provide support and weight-bearing assistance while walking outdoors, but is unable to utilize the gait trainer during the winters due to the bulky nature of a gait trainer and the restricted space inside their home. By attaching a gait trainer to a treadmill it would allow for our client to continue to get their physical exercise and mobility strengthening all year round. Multiple designs already exist but they do not provide the detachable aspect or stability access that the client wishes for8. To resolve this, our solution consists of a ramps and track disconnected system that can be screwed and clamped onto the treadmill, allowing the gait trainer to easily slide up and be stabilized in the tracks system. Through the use of durability and strength tests, the materials used will be assessed, and a budget of $500 has been allocated to ensure that this design is safe and comfortable for the client to use.

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I. Introduction

Motivation and Global Impact

Gait trainers are used to assist and support those who have issues with significant mobility impairments and are unable to walk on their own. A gait trainer provides extensive support and carries some of the body weight of the individual, reducing the weight felt by the legs, allowing individuals to be able to get some form of exercise during their rehabilitation process. Gait trainers are designed to help maintain proper posture and gait patterns, as well as improve balance, coordination, and motor skills, and are quite frequently used by individuals who have suffered injury which affect these skills [1].

Gait trainers are relatively large devices, resembling that of a walker, and are an impractical aid to be used indoors. This results in individuals only being able to utilize their gait trainer outside, which leads to inconsistent usage as it can also be used whenever weather permits. Especially during the winters, it is difficult to utilize the gait trainer outside. This inconsistent use of the gait trainer due to the lack of opportunity can result in users suffering significant damage to physical and mental health, as a lack of physical exercise can lead to such issues. Research has shown that there is a positive correlation between the amount of exercise one gets and the happiness one feels[2]. Additionally, any progress already made in terms of rehabilitation and mobility strengthening could be reversed with inconsistent use. If one were able to use a gait trainer on a treadmill, indoors during the imperfect weather conditions, it 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.

Existing Devices

All current systems of a gait trainer attached to a treadmill have support beams and a harness hanging from a pole attached to the front of the treadmill. These designs were created with the intent of being a permanent system. These systems are either a body-weight system or one where an individual can use the bars as support beams and body-weight support. While these designs are not detachable, if some alterations were to be made one would be able to make it a detachable system.

One popular design is the Body-Weight Treadmill Gait Training System[3]. This design has a sling and harness to reduce the bearing capacity of the individual and act as a body-weight support. It included an electrical point control as its mode of operation, meaning that an electrical component is used to adjust the height of the harness. A wheeled system with a large pole is centered around the treadmill, with the pole being behind the front of the treadmill. The harness hangs over the treadmill track and once the individual is on the treadmill, they can adjust themselves into the harness. This system however is not feasible for those who struggle to get

onto the treadmill in the first place as no ramp system is installed in addition to the harness system.

Another design, the LiteGate 4 Home follows a similar design pattern as the Body-Weight Treadmill Gait Training System in that it has the support systems in place, however instead of a harness it has support beams that are placed where one would rest their arms[4]. Within this design there are attachments that can be added based on the individual, making it a more personalized solution. Attachment harnesses could be included, as well as attachment cables and straps. This system is a detachable system as the system is on wheels and can easily be maneuvered around the treadmill when not in use.

Problem Statement

Gait trainers are used to assist and support those who have issues with significant mobility impairments. They play a critical role in the rehabilitation process and help in improving a patient's quality of life by allowing them to get some physical exercise in their day-to-day routine. Gait trainers are meant for outdoor use and are not suitable to be used indoors, thus during winter times or whenever the weather may be bad, patients are unable to get their physical exercise in, which can affect them mentally and physically. Thus a system in which a gait trainer can be attached and detached to a treadmill is a critical solution and can ensure that the rehabilitation process does not stop simply due to inclement weather conditions.

II. Background

Amanda Parjeski is an occupational therapist at continuum therapy in Madison, Wisconsin. Parjeski has a client with significant mobility impairment and seizure disorder which requires support moving due to poor postural strength and high seizure risks.

The requirements for the design of the project will revolve around varios client requirements and background research. The client uses the Rifton Pacer Gait Trainer 2022[5], so it is essential that the design is built around the dimension of the Rifton pacer gait trainer. The client will use the device on the Horizon T101 treadmill. The dimensions must apply to the Horizon T101 of 71" x 34" x 57"[6] as well as be applicable to other competing treadmills with similar dimensions for versatility. The design should support the client on the treadmill in the gait trainer for 10-15 minute increments at 1-3 miles per hour. While the design is in use, the client may be prone to a seizure, in case of emergency, there should be an emergency unlocking system within the design. Due to the clients mobility impairments and seizure disorder, there will be additional forces to account for in the design. The design should be able to withstand the weight of a 30-year-old woman of about 174.9 lbs [7]and 57.9 lbs of the gait trainer[8]. The design must last for a sustainable amount of time at various temperatures[9], approximately

10-15 years[10]. The device must follow FDA regulations and in the use of a ramp in the design, should allow ADA ramp recommendations[11]. Overall, the project should be completed within a $500 budget. To see full product design specifications, see Appendix A: PDS.

After reviewing the design requirements, background information is necessary in order to execute the design properly. The first aspet to understand in order to execute the design is seizures and neurological disorders that inhibit seizures. During seizures, there are various symptoms that can happen sensorly and physically. Sensory, the subject can suffer from blurry vision, flashing light, hallucinations, out of body sensations, and loss of awareness[12]. The physical changes can include difficulty talking, unable to swallow, repeated non-purposeful movements, convulsion, difficulty breathing, and heart racing[12]. Because of these intense symptoms, it is essential that the design be compliant to support the client during a seizure and allow for exit from the design in case of emergency.

The use of gait trainers is useful and essential for supported movement within the client's mobility limits. The use of gait trainers can assist in aiding mobility. The gait trainer can be used to correct asymmetry, which supports the lower level of postural control of the client. Additionally, the gait trainer can be used to induce and increase mobility in many patients. The use of walking with the gait trainer can improve body balance, exercise duration, frequency and subjective health such as health status and satisfaction. [13]Through this preliminary research, it is essential to understand the importance of gait training and walking for the client's health.

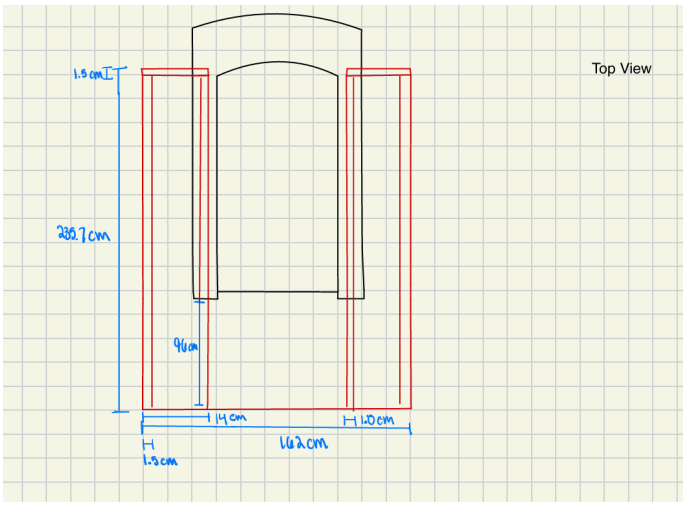
Looking into competing designs is required to create a well rounded design. The first competing design is the body-weight support treadmill gait training system[3]. The system is placed around the treadmill and support is suspended onto the treadmill. Harnesses on the system hold the user via straps to allow increased mobility. Additionally, the system has an electrical point control operation which allows for adjustments continuously. For the second competing design, the LifeGait 4 Home[4] was found. The system is customized to the user's height and weight. The system is as overhead straps and harness. Additionally, the straps are able to lift the user onto the treadmill or throughout walking on ground. Both designs have similar structures. There are large rods that tower over the user and hold them via harnesses. Using the research, gave the team necessary direction to follow a grounded approach of design.

III. Preliminary Designs

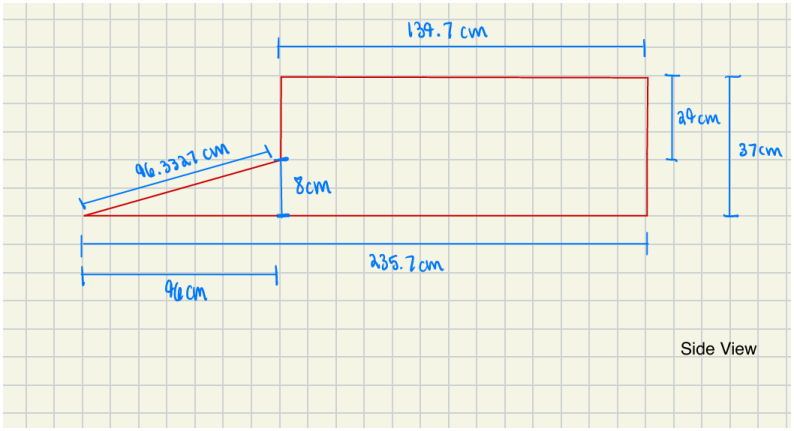
Design 1: Ramp and Tracks Connected Design

The ramp and track connected design is a concept with a ramp and a train-track inspired locking system. There are two tracks that are connected to the ramp to create one full piece. The tracks and ramp are fabricated together, so no necessary connection is needed between the sections. Due to the orientation of the wheels on the gait trainer, there are grooves within the tracks to allow correct positioning of the gait trainer. Additionally, there are elevated edges on the tracks to create an extra level of security for the wheels. The edges will be 29 cm to safely secure the gait trainer into place. There will be two grooves within the tracks themselves, due to

the different sizes and orientation of the wheels on the gait trainer. The grooves will be 5 cm and 2 cm wide.

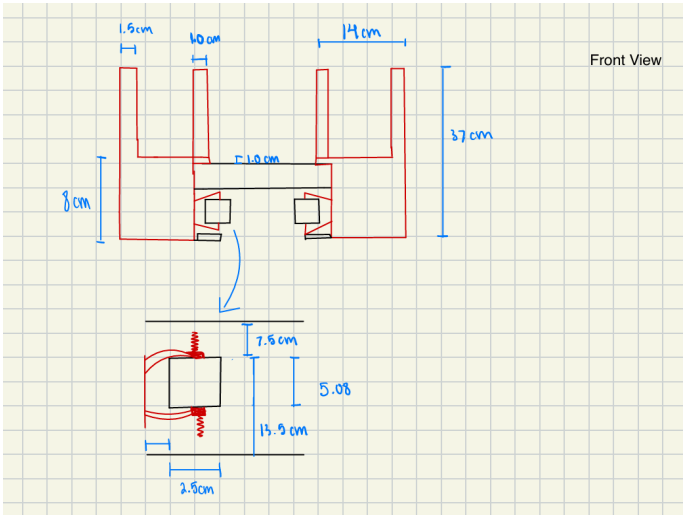


Figure[1]. Top View of Ramp and Tracks Connected Design



Figure[2]. Side view of the Ramp and Tracks Connected Design

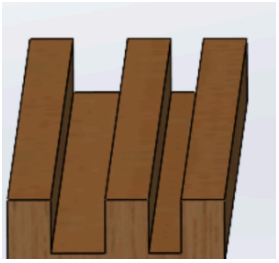
The system itself is connected to the treadmill via C Clamps. There will be various C Clamps placed on the inside of the design itself. There will be 3 placed on the inside of each track. The C Clamps will screw into the treadmill to allow full security.



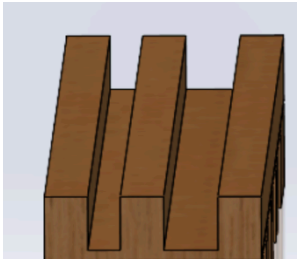
Figure[3]. Front View of Ramp and Tracks Design

Design 2: Ramp and Tracks Disconnected Design

This design is a three part system that includes a ramp, a right track, and a left track. Each of the tracks include long, deep grooves that extend along the entire length of the tracks to fully support and secure the wheels of the gait trainer, as well as to ensure that the gait trainer is correctly positioned on the treadmill. The right track and the left track are mirror images of one another. Given the shape and orientation of the wheels on the gait trainer, there will be two grooves per track. The groove on the outer edge of the track will be approximately 5 cm thick to accommodate the larger outside wheel of the gait trainer. The groove on the inner edge of the track will be approximately 2 cm thick to accommodate the thin, inner wheel of the gait trainer. The two grooves will be 3 cm apart, and all grooves will be 5 cm deep, with 1 cm of space under the grooves.



Figure[4]: Front View Left Track



Figure[5]: Front View RightTrack

The two tracks will be attached to the treadmill via multiple C-Clamps. Each track will have three C-Clamps attached to its outside edge. These clamps will be able to screw into the side edge of the treadmill and secure the tracks.

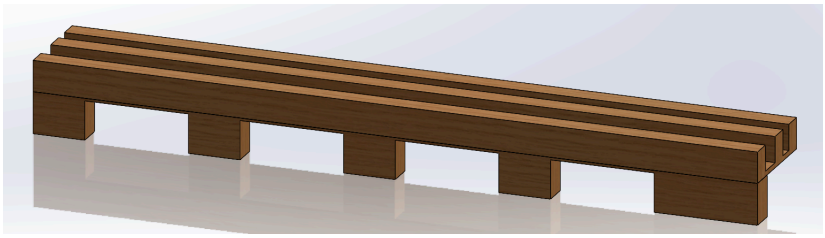


Figure [6]: Side view of track

Figure [7]: C-Clamp Example

This design will include a ramp that is also separate from the two tracks. The ramp will be a standard wooden ramp that is equal in length to the two tracks and the treadmill. The ramp will be the same height as the treadmill track which is approximately 8 cm tall. The ramp will be easily attachable and detachable from the tracks and the treadmill via the usage of a simple hook and loop system.

Figure [8]: Ramp of device

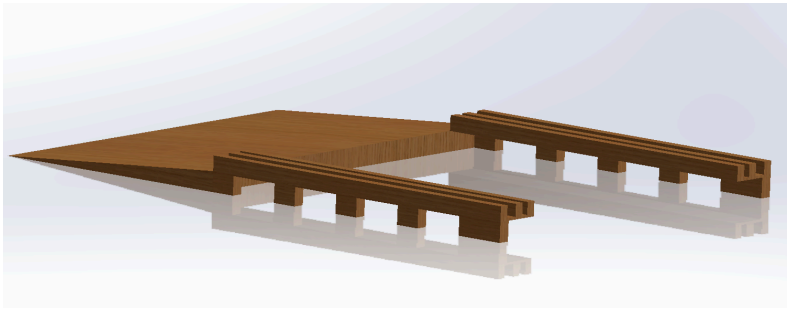


Figure [9]: Full view of device

Design 3: Altered Gait Trainer

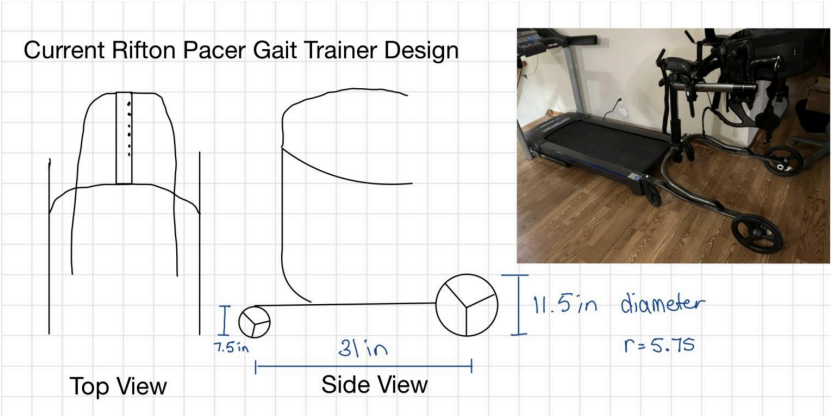


Figure [10]: Current Gait Trainer Model

The current gait trainer design is shown in figure [10] above, illustrates that the base is too narrow to fit around the frame of the treadmill. As a result, the gait trainer and treadmill are incompatible together in their current configuration.

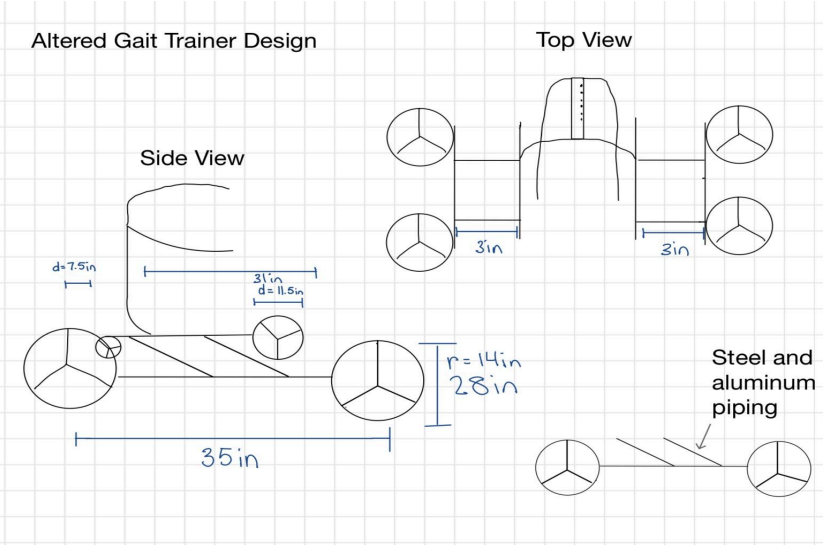
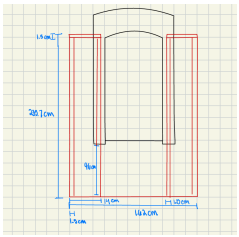
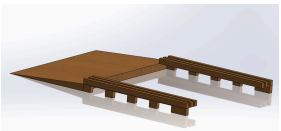
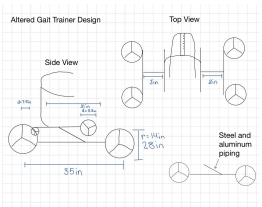


Figure [11]: Altered Gait Trainer Design

Our third design offers a new approach to the challenge of integrating the gait trainer with the treadmill. By modifying the gait trainer we are able to make it compatible to use with any standard size treadmill with measurements no larger than 84 inches long and 36 inches wide[14]. Aluminum steel rods extend outward by three inches on each side allowing the base to fit around the treadmill frame. Additionally 28-inch diameter wheels are added, slightly elevating the entire gait trainer allowing it to hover just above the treadmill belt for stability. The aluminum steel attachments are screwed into the current base for stability and support. When looking into this design, testing must be done on these attachments to ensure they can support the weight of the gait trainer and client. The horizontal attachments must be able to withhold the shear force acting on the screws. The client's safety, especially in the occurrence of a seizure is our biggest priority looking at this design.

IV. Preliminary Design Evaluation

Design Matrix

Criteria	**Ramp and Tracks Connected** 		**Ramp and Tracks Disconnected** 		**Altered Gait Trainer** 	
Safety(25)	4/5	20/25	4/5	20/25	2/5	20/25
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	16/20	2/5	12/20
Score (100)	74/100		80/100		44/100	

Design Matrix Criteria Analysis

To effectively evaluate the design concepts, the Preliminary Design Specifications were referenced in order to develop 5 distinct criteria: Safety, Ease of Use, Cost, Ease of Fabrication, and Durability. These criteria were chosen and weighted to highlight the more crucial aspects of the design while ensuring that the less significant categories had a limited impact on the final score.

The highest weighted category is Ease of Use. This is because it is important that the client can easily use the gait trainer on the treadmill whenever the weather does not permit her to use the gait trainer outside. The Ramp and Tracks Disconnected design scored well in this category because the set up for this design is minimal with only taking a couple clamps, and it is a smooth ride up to the treadmill. The Ramp and Tracks Connected Design scored slightly lower because of the sheer bulkiness of the design. With this design being one piece, it would be difficult to make small adjustments.The Altered Gait Trainer design scored the lowest in this category because it would be difficult to get the client to switch bases just to walk on the treadmill. Safety was also a heavily weighted factor. Both Ramp and Track designs scored well in this category due to their ability to stay securely on the treadmill while also being able to get off safely in emergency situations. The other design fell short in this category because it would include about a seven inch difference in walking planes to be at the height of the treadmill. The next most important factor was Durability. The two Ramp and Tracks systems scored well in this category because they use very high yield strength materials. The other design scored low in this category because it does not use the treadmill for support, and therefore the materials will be subjected to more strain overtime. Ease of fabrication was weighted lower because we did not want a challenging fabrication process to stand in the way of a good product. The two Ramp and Tracks systems scored well in this category because they use designs with easier fabrication techniques. The Altered Gait Trainer did not score well in this category because it uses techniques that take a long time to become proficient. Lastly, Cost was weighted the lowest category because this is a custom project with a fairly large budget. The Altered Gait Trainer design scored low on this design because it is estimated to be at the upper end of our budget. The Ramp and Tracks designs scored well in this category because they do not take up too much space in our budget.

Proposed Final Design

Based on the design matrix, the most effective design is the Ramp and Tracks Disconnected design. This is because it scored the highest in all of the categories. This design promotes an easy walk through simple preparation, as well as having the ability to walk up the ramp into the waking position to begin the walk. It also provides great safety because of its support from both the treadmill and the floor along with the stable locking mechanisms to keep

the gait trainer in place. On top of this it uses materials that are high yield in durability and cost effective, plus the techniques that are used in fabrication are fairly easy. The only drawback is that it is not as easily transferable to other treadmills as the altered gait trainer design.

V. Fabrication

Materials

The materials that are to be used in the device can be separated into three sections. Due to the multiple components of the design, different criteria are used to determine which different materials are to be used. The three sections of the device to be considered are the tracksand ramp, the locking mechanisms to secure the tracks and ramp, and the nonslip elements needed to ensure the safety of the client. The materials that are to be used are wood, nails, c-clamps, and non-slip materials,

The ramp and track will both be constructed out of wood, nails, fasteners, and bolts. The type of wood that is to be used is treated wood, specifically ACQ labeled wood that has been pressure treated to withstand pressure and time.[15] As this ramp will be stored indoors and will not be exposed to the weather, it does not need to be completely waterproofed or freeze resistant. For this reason, ACQ wood is an effective, reasonably priced type of treated wood to be used for the device. ACQ or alkaline copper quaternary is a water-based wood preservative that is used to prevent decay from insects, mold, fungus, and more.[16] It is most commonly used in wood for residential applications, and is a common wood type used in medical ramps.[15] The nails, fasteners and bolts that are to be used in the ramp and tracks will be made of either hot-dipped galvanized or stainless steel. Since the wood is treated with a copper substance, normal nails and bolts cannot be used, as many of them are made of steel and copper can cause steel metals to corrode very rapidly which would be detrimental for the device[15].

The tracks and ramp will be connected to the treadmill with several C-Clamps and hooks. These C-Clamps will be platform C-Clamps that are manufactured specifically for usage with wood. The clamp that will be used in the device will be the CAMVATE Universal C-Clamp.[17] This clamp is made of stainless steel and aluminum, as well as vinyl coating surrounding the parts of the clamp that will be in contact with the treadmill[17].The stainless steel is extremely durable, which is important for this device, and it will also not corrode when put in contact with the copper treated wood. The vinyl coating on the clamp is also important as it protects the frame of the treadmill and the wood from damages.[17] The clamps will be attached to the treated wood using the same steel nails and bolt mentioned previously.

As this device is to be used for someone with severe mobility constraints, safety is a number one priority. For this reason, non-slip elements are to be included in the final design. On top of the ramp itself, a rubber material cover will be placed to protect against slipping of the gait trainer wheels and/or the clients feet while walking up the ramp. A rubber ramp cover not only makes the ramp safer, but it also makes it more durable in the long run.[18] Additionally, the bottom of the ramp and tracks will be equipped with non-slip, silicone tape to further ensure that the ramp and tracks stay put the entire time they are in use. [19]

Methods

As previously mentioned in the materials section, the final design will be made using a combination of wood, nails, bolts, non-slip elements, clamps and hooks. These materials will all be ordered, or purchased from the UW Machine Shop, then combined to create the device. SOLIDWORKS renderings of the design are displayed in the appendix [A].

The ramp and tracks will be fabricated using bandsaws, handsaws, and drills. The wood will be cut by the team into the correct shapes and sizes in the TeamLab. The wood pieces will then be put together using nails, screws, and bolts. The ramp and each track will all be built separately due to the disconnected nature of the final design. The two tracks will be mirror images of one another and will consist of multiple wood blocks drilled into one another to reach the desired shape. All wood elements will be sanded at the end of fabrication to prevent splintering and/or injury to the client or her caregivers.

The clamps will be ordered to ensure their stability and safety. They will then be drilled into the tracks and ramp and secured with nails, bolts and screws. There will be three C-Clamps per track, located on the outer edge of the tracks. The ramp will also be secured to the tracks using stainless steel hooks which will also be ordered. These hooks will be attached to the ends of the tracks via screws and bolts, and will be able to hook into small loops that have been drilled into the sides of the ramps. All drilling, cutting, sanding, screwing, etc will be completed in one of the two UW MAdison engineering fabrication labs. Finally, the non-slip elements of the device require the least amount of fabrication. Both the rubber mat and the non-slip silicone tape will both be ordered. The rubber mat will be cut to the size of the ramp and placed on top when in use. The silicone tape will be cut in several strips and stuck to the bottom side of both the ramp, and both tracks.

Testing

There will be two phases of testing for this device. The first phase will be electronic testing using force and loading simulations on SOLIDWORKS. A SOLIDWORKS rendition of the final design, using the materials that are to be used in the device has been created and will be tested by applying various forces to various points on the device. Each piece of the device was

created separately on SOLIDWORKS to ensure that each individual section can be tested under different conditions. These SOLIDWORKS tests will reveal any potential weak points of the device before fabrication begins so that the team is able to revisit the design if needed and make any necessary changes.

The second phase of testing will be physical testing of the materials themselves. Before the device is even built, the team will conduct force and stress testing on the different materials that are to be used in the device. This will include testing the wood, the metal elements such as the nails and bolts, as well as the clamps. In this phase of testing the team will also test the device as a whole once it is built. This will include testing each of the sections of the device separately, meaning the ramp and two tracks, as well as testing all three sections together. Each of the sections will be put under various weights and forces to ensure that the device can completely hold the client's weight without bending, or breakage. As per the product design specifications, the device needs to be able to fully support the weight of a 30 year old woman, with the average weight of 174.9 lbs. [Appendix A] Given that the device will need to support both the weight of the client,and the gait trainer which weighs roughly 22 lbs, the team needs to test to ensure that the device can support over 250 lbs of weight.

VI. Discussion

The SOLIDWORKS testing must confirm that our structure can endure the forces of the gait trainer and the client. If the model fails under forces acting perpendicular to the rails, design adjustments will be necessary to strengthen the structure, as outlined in the testing section above. Additionally, in-person testing will be conducted to ensure that the wheels lock securely in place. The gait trainer must remain stationary in the event of a seizure. Should the wheels shift while the client is walking on the treadmill, design modifications will be required to guarantee safety. A risk assessment will be done before testing. Before our client tests out the design, one of the team members will. Safety precautions such as spotters will be in place to prevent falls or injuries.

When designing the ramp and track we must take into consideration a wide range of weights for it to support. Although we have a certain weight from our client, we must ensure safety of use for weights exceeding that of our client. Our gait trainer treadmill design must be inclusive to all potential clients who may use it. Although our specific client has a seizure disorder, we must consider all those who utilize treadmill gait training. Body-weight supported training is recognized as a promising way to improve ambulation for those with neuromotor disabilities [20]. Those diagnosed with cerebral palsy, stroke, and spinal cord injuries all benefit from treadmill gait training. Finally, when choosing materials we must consider engineering sustainability. Using the least amount of materials possible while maintaining the integrity of our project will keep our project as sustainable as possible. When the product is no longer needed all wood components should be disposed of and properly recycled if possible.

VII. Conclusions

Designing a system that can attach a gait trainer to a treadmill is essential in that it can allow an individual to get the physical exercise they require, all year-round, which can ultimately improve their physical and mental health as well. At present, all current solutions are ones which involve support beams and harness, however a problem with these designs is that it doesn't account for a way for the patient to get onto the treadmill in the first place and are not detachable solutions. In order to solve this issue, a ramp and track disconnected system will be created. The ramp will allow for the patient to walk the gait trainer onto the tracks, and the tracks will lock the wheel in place while the patient wants onto the treadmill track. This system will be detachable while still providing the functionality and safety requested by the client, and accounts for a way for the patient to walk onto the treadmill with support. A budget of $500 will be used to ensure that the design is the most secure and comfortable it can be.

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Appendix

Appendix A: Product Design Specifications

BME 300/200 Design: Gait trainer with Treadmill

Product Design Specifications

September 19, 2024

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Function

Gait trainers are used to assist and support those who have issues with significant mobility impairments. In the winter, it is difficult to utilize the gait trainer outside. Due to the lack of access, users may suffer significant damage to physical and mental health. Utilizing a treadmill during the imperfect weather conditions would allow for increased mobility and less drastic damages to the overall health of the client. Creating a ramp and lock system will provide the fix needed for the client to use her gait trainer while on the treadmill. The ramp and lock system will be subjected to a large amount of force through the gait trainer. The overall system should work together smoothly to prevent the client from falling off the treadmill due to her gait trainer.

Client requirements

- Develop a ramp system that will lock into place onto a treadmill to allow 5 to 15 minute walks at a pace of three miles per hour.
- The lock and ramp system should have an unlocking procedure for caretakers in case of a seizure, as well as follow the ADA ramp recommendations[1].
- The lock and ramp system needs to be detachable in order to store the treadmill.
- The system should be compatible with wood flooring without damaging the flooring.
- For the overall budget, the system should be within $500.
- The lock and ramp system should be compatible with the Rifton Pacer Gait Trainer 2022[2].
- The project should last for a long period of time in order to allow the client to use the product in different seasons.

Design requirements

1. **Physical and Operational Characteristics**
    a. **Performance requirements:**
        i. The gait trainer with treadmill product should be compatible with the width, length, and height of the treadmill. The system should be able to withstand the force of a thirty-year-old woman during a seizure[3] while also having the capability to be easily unlocked during said seizure. The materials used for the ramp must not damage the flooring as well as hold a stagnant position during use. The locking mechanism must be easily adjustable and detachable in case of emergency. The gait trainer must be safely attached to the ramp and treadmill at all times of use. The system must be able to be deconstructed into parts in order to move the treadmill to different locations.
    b. **Safety**
        i. The device must be able to safely support a large amount of force. The locking system must stay into place and support the force of a thirty-year-old woman during a seizure. Additionally, the locking system must remain locked into place until a caretaker is able to unlock the device. The ramp of the device must follow ADA recommended slope rate[1]. The material used in the ramp system must be compatible with wood flooring, as well as withstand the heat and force of the treadmill. All materials used in the device must be FDA approved and follow regulations. The materials must not contain exposed adhesive and latex due to client allergies.
    c. **Accuracy and Reliability**

i. The device must be able to seamlessly and securely lock into the treadmill every time the treadmill is used by the client. The ramp must be stable and capable of supporting the client's weight without bending or warping over repeated usages. The device is to be used every time the client uses the treadmill and needs to have reliable locks and supports that will not wear down with regular usage.

d. **Life in Service**
   i. This will be a multi-use device. The ramp and locking apparatus must remain completely functional for the entire duration of its usage by the client. As the device is to be used multiple times a week, especially in winter months, it will need to be very durable for repeated use. The device must also remain compatible with both the client's gait trainer, and treadmill model, and be capable of minor adjustments if needed in the future. It should also have an approximate life in service of 10-15 years.
e. **Shelf Life**
   i. The device should be kept indoors and at room temperature between 15 and 30℃. The device should not be exposed to hot temperatures (>48℃)[4] for long periods of time, and should be kept in humidity between 30-50% to prevent erosion or damage[5]. The device should also not be in freezing temperatures. If the device is not placed under any extreme stresses it will have a shelf life of 10-15 years[6].
f. **Operating Environmen**t
   i. This device is to be used day-to-day by the client. The operating environment will be in the clients home attached to her treadmill and gait trainer. The device should be relatively easy to carry and install in the clients home, as well as to remove from the treadmill and store compactly in the home. The client's floor is hardwood, so the device needs to be slip resistant and able to be installed and uninstalled without scratching or damaging the floors.
g. **Ergonomics**
   i. The device will not be based on the client’s measurements but on the measurements of the treadmill. The width of the side of the treadmill, length, and height from the ground are all measurements that will have to be taken into account when designing the product.
h. **Size**
   i. The device should be compact and serve its function of attaching and securing the gait trainer to the treadmill. Any product designed will have to be stored away when not in use, and size limitations will be dependent on the dimensions of the storage space in which the device will be kept in when not in use.

i. **Weight**
    i. The device should not be extremely heavy as the product must be designed in such a way that it can be easily removed from the gait trainer and treadmill, and be able to be lifted by the family of the client so that it can be stored away. The device should also be able to hold the force of a thirty-year-old woman. The average weight of a woman at 30 is 174.9 lbs[7].

j. **Materials**
    i. The client experiences adhesive and latex sensitivity. Apart from latex-based and materials with adhesive properties, there is no limitation in terms of the materials that can be used. Durability should be a driving factor when choosing materials. Any materials chosen should have a relatively high yield strength and be able to withstand a large amount of weight, approximately around 174.9lbs[7].

k. **Aesthetics, Appearance, and Finish**
    i. The Gait Trainer with treadmill device should be an easy to put together device with three main components that are easily compatible with the Horizon T101 treadmill [8] and the Rifton Pacer Gait Trainer[9]. The ramp should be made of durable material. The ramp should have a rubber bottom or other material that will be able to dampen impact and keep ramp stagnant while being used. The ramp should have a shallow incline[10] and lead onto tracks that start out wider and lead to a narrow secure fit to the wheels. These tracks lead to locking mechanisms that keep the gait trainer in one spot during walks on the treadmill. All of the components should be black to blend in with the treadmill, with the exception of the start of the tracks, which should be yellow for an easy guild onto the tracks. The ramp should have a rough face to ensure traction, and the tracks should have a smooth finish to let the wheels easily get to and from the locking device. Edges should be smoothed to prevent any possible hazardous sharp edges.

2. **Production Characteristics**

a. **Quantity**
    i. For the purposes of this design, one Gait Trainer with treadmill device will need to be constructed. This will include one ramp to the specific height of the Horizon T101 treadmill. Additionally we will need two tracks for the gate trainer wheels that lead into four locking devices for the wheels.

b. Target Product Cost
    i. The budget for the prototype is $500 or less. The budget will be used for the ramp, tracks, locking devices, and any other materials needed for

prototyping. It will also be applied to any modifications that the treadmill needs to undergo for the project.

3. **Miscellaneous**
    a. **Standards and Specifications**
        i. The Americans with Disabilities Act requires that residential wheelchair ramps have a slope no more than 2:12 (in inches) [11]. The treadmill should not exceed 3 mph when using it with a gait trainer [12]. The device must fit the current treadmill model used in home.
    b. **Customer**
        i. Mrs. Amanda Pajerski, an occupational therapist works with a client affected by a seizure disorder. The client uses a gait trainer along with the support of two people when ambulating. The Wisconsin winters have made it difficult to access safe walking locations forcing the client to walk in circles around the kitchen island.
    c. **Patient-related concerns**
        i. The device must be stable enough in the case of a seizure to stay secure to the treadmill. The gait trainer wheels must remain locked in place while the treadmill is in use but easily have access to an unlocking mechanism.
    d. **Competition**
        i. Wheelchair ramp for treadmill [13].
            - Ramp enables a wheelchair to be pushed onto a treadmill. The ramp clamps on to the back of the treadmill and stays on during treadmill use.
            - The description states this ramp can be used for gait training.
            - This ramp does not allow for the gait trainer to be locked into place.
        ii. LiteGait 4 Home [14].
            - The base of the gait trainer itself is wide and long enough to fit around the base of the treadmill. The gait trainer is able to be used over ground or over a treadmill.
            - The gait trainer consists of an overhead harness design and is customized to the user's height.

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Appendix B: Material Expense Sheet

Item	Description	Manufacturer	Part Number	Date	QTY	Cost Each	Total	Link
Lab Archives Notebook	For Documentation Purposes	LabArchives	N/A	9/6/24	1	$15	$15	https://mynotebook.labarchives.com/MTQyNzgxMi4xfDEwOTgzMTcvMTA5ODMxNy9Ob3RlYm9vay8zMjQxODM0MzUzfDM2MjQ0NDYuMDk5OTk5OTk5Ng==/notebook-dashboard