Stair Chair: BME 200/300

Dates: 9/20/24-9/26/24

Client: Mr. Daniel Kutschera, PT
Advisor: Dr. James Trevathan

Team:
Matt Sheridan (Leader)
Dan Altschuler (Communicator)
Cody Kryzer (BSAC)
Luke Rosner (BWIG)
Abi Conners (BPAG)

Problem Statement

Create a mechanical device that temporarily handicapped patients can use to ascend and descend 3-5 stairs. The device should be inexpensive to fabricate, as compared to competing powered stair lifts, and be easy to set up and take down, both inside and outside the patient's home.

Brief Status Update

Following our meeting with advisor Dr Trevathan, a decision was made to focus the scope of our project on designing a ratcheting mechanism to allow for upward and downward traversal of a chair on stairs. Given the limited time and resources available this semester, it will be most beneficial for us to focus our efforts on this part of the project to maximize our chances of determining the feasibility of the project as a whole.

Weekly Goals and Accomplishments

- Team
    - Met with an automation engineer to brainstorm and discuss design ideas
    - Created design matrix criteria and decided upon 4 main ideas
- Matt Sheridan
    - Made a SolidWorks design for a counterweight mechanism
    - Brainstormed ideas for initial designs and design matrix criteria
- Dan Altschuler
    - Worked on designing in SolidWorks
    - Met with an automation engineer to come up with ideas for the design matrix
- Cody Kryzer
    - Brainstormed designs for design matrix
    - Worked on sketches and descriptions for design matrix
- Luke Rosner

    - Researched ratcheting mechanisms
    - Worked on sketch for design matrix
    - Updated Lab Archives notebook
- Abi Conners
    - Researched similar designs
    - Brainstormed ideas for design matrix

Upcoming Goals

- Team
    - Create preliminary presentation
    - Make CAD drawings for all ideas and begin to narrow down final design choice
- Matt Sheridan
    - Finalize/prepare for preliminary presentation
    - Help make finalized drawings for all initial designs
- Dan Altschuler
    - Continue working on designs to come up with a final feasible design
- Cody Kryzer
    - Prepare for preliminary presentation
- Luke Rosner
    - Prepare for preliminary presentation
    - Create CAD drawing for designs
- Abi Conners
    - Discuss with group members design for project
    - Help create preliminary presentation and design

Project Timeline

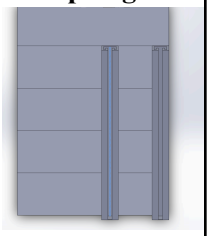
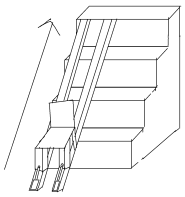
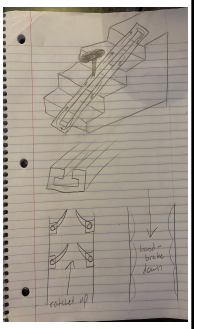
Deliverable	Deadline	People Assigned	Progress
Initial Client Meeting	9/13	ALL	100%
Product Design Specifications (PDS)	9/20	ALL	100%
Individual Research	9/20	ALL	100%
Design Matrix Criteria	9/27	ALL	100%
Design Ideas	9/27	ALL	100%
Preliminary Presentation	10/4	ALL	0%
Individual Research	10/4	ALL	0%
Preliminary Deliverables	10/9	ALL	0%

Decide upon Final Design	10/9	ALL	0%
Finished Model of Final Design	10/25	ALL	0%
Show and Tell	11/1	ALL	0%
Final Prototype Prepared (by Thanksgiving break)	11/26	ALL	0%
Final Presentation	12/6	ALL	0%
Final Deliverables	12/11	ALL	0%

Materials and Expenses

Item	Description	Manufacturer	Mft Pt#	Vendor	Vendor Cat#	Date	QTY	Cost Each	Total	Link
Category 1										
									$0.00	
									$0.00	
Category 2										
									$0.00	
									$0.00	
								TOTAL:	**$0.00**	

Design Ideas

Design Criteria (Weight)	Design 1: Spring 		Design 2: Hydraulic Pump 		Design 3: Counterweight		Design 4: Ratchet 	
Safety (25)								
Speed/Efficiency (20)								
Ease of Use (20) Mounting dismounting operation								
Adaptability (10)								
Weather (10)								
Cost (10)								
Weight (5)								
Total Score (100)								

Safety: Is the user at risk of injury or worsening their injury.

The safety category refers to the risk of injury for a user while operating the stair chair. This category also considers the risk of worsening injuries through accidental mechanical output from the user's wounded lower extremity, either through slipping while operating the device, or total mechanical failure. Given the wide range of patients that the stair chair is hoped to be usable for, and the risks of mechanical failure, the team decided to weigh the safety category highest at 25.

Speed/Efficiency: How fast the user can get from top to bottom of the stairs or vice versa. If the device is inefficient, it won't be worth using

The speed/efficiency category refers to how quickly the user can get from the bottom to the top of the stairs and vice versa. The team recognizes that an inefficient and slow device will not be worth using and that a device that involves significant mechanical output could limit the kind of

patients can operate the device. With this in mind, the team decided to weigh this category the second highest at a 20.

Ease of Use: How easy is the mounting and dismounting of the chair. Is the chair able to swivel for easy on and off.

The ease of use category refers to the simplicity of mounting the chair before use, and then dismounting the chair once a user has reached the top of the stairs. The chair being able to swivel once a user reaches the top is one of the major considerations of this category.

Adaptability: Can the device be usable for varying amounts of stairs. Is the device adjustable for the different patients that need to use it.

The adaptability category refers to how much the device can be altered to fit the needs of the user. Whether the rails must be able to telescope to adjust to different amounts of stairs is one of the major considerations of this category. Also, how much tuning the device may need between patients is another consideration of this category. Given this, the team decided to weigh this category at a 10.

Weather: How well can the design survive the elements.

The weather category refers to how well the design can survive extreme temperatures and severe weather conditions. The device must also be able to withstand general wear and tear from water and sunlight exposure for long periods. Since the device is meant to be usable year-round, and the winters are unpredictable in the Midwestern market, the team decided to weigh this category at a 10.

Cost: How expensive is the device to fabricate. What is the cost to rent for a user.

The cost category refers to how expensive the design is to fabricate and maintain. The major considerations of this category involve the complexity of designs, and also how long those designs can go between major costly repairs. Since keeping the design as inexpensive as possible was a major request from the client, the team decided to weigh this category equally with other client requirements such as the ability to withstand weather and be able to adapt to different amounts of stairs.

Weight: How much does the device weigh. Is it easy to move and set up for those between the 8-10 week non-weight bearing period.

The weight category refers to the weight of the device, and therefore how easy it is to set up on the stairs of each user. Since the device is temporary, it must weigh enough to prevent any tipping or sliding, but also be able to be moved between the homes of users with ease. While the weight category is an important factor to consider, the team decided that other categories

were more deserving of strong consideration for the final design, and therefore weighed this category at just a 5.