Using Ergonomic Principles in Designing a Reciprocal Walker

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Abstract

Our goal is to design and fabricate a reciprocal walker that naturally inspires reciprocal motion between the arms and legs, particularly for individuals who have suffered a stroke. This will be a proof-of-concept prototype for a walking assist machine that facilitates the rehabilitation of stroke patients back to a natural gait. For this to be possible, we have found that it is crucial to emphasize the reciprocal motion between the arms and legs in order to reestablish neural pathways associated with a natural gait. We will develop and evaluate multiple designs using the V-Model for product design and ergonomic concepts. These designs will then be modeled in Solidworks, a 3D modeling program, before we attempt to construct a functional prototype. Through this project, we gain valuable experience designing products around the people for which they are intended, applying Human Factors principles to develop a more functional technology for stroke patients.

Problem Statement

Our goal is to design and fabricate a reciprocal walker that naturally inspires reciprocal motion between the arms and legs, particularly for individuals who have suffered a stroke. This will be a proof-of-concept prototype for a walking assist machine that facilitates the rehabilitation of stroke patients back to a natural gait. In order for this to be possible, we have found that it is crucial to emphasize the reciprocal motion between the arms and legs in order to reestablish neural pathways associated with a natural gait.

Ergonomic Analysis

Anthropomorphic Data:

Design product to be adjustable for 1st Percentile Elderly Women - 50th Percentile Elderly Man:

- Height is indirectly proportional to an individual's likelihood to suffer from a stroke
- Stature: 54.7" - 69.0"
- Weight: 93lbs - 200lbs
- Arm at Side Grip Height from Ground: 27.4" - 30.5"
- Standing-Seat Support Height: 27.3" - 33"
- Shoulder Height: 42.7" - 54.6"
- Low Reach Height from Ground: 30" - 36.5"
- Easy Reach Radius from Shoulder: 21.7" - 28"
- Hand Length: 6" - 7.5"
- Hand Width: 2.5" - 3.4"
- Grip Angle: 12 degrees

Methodology

Weighted Attribute Chart of Client needs

Attribute	Client 1	Client 2	Cumulative Score	Weight
Safety	100	100	200	0.2
Cost	70	65	135	0.13
Functionality	95	95	190	0.19
Durability	90	90	180	0.18
Weight	85	85	170	0.17
Aesthetic	65	65	130	0.13

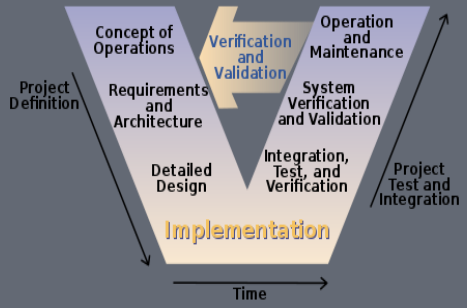
Table 1: Weighting of Client Needs

Benchmarking

Alternatives:	Safety	Cost	Functionality	Durability	Weight	Aesthetic	Weighted Score
Standard Walker	7	6	4	7	6	4	5.74
Buggy	6	3	6	5	4	7	5.22
Folding Reciprocal Walkers	7	5	7	7	6	5	6.31

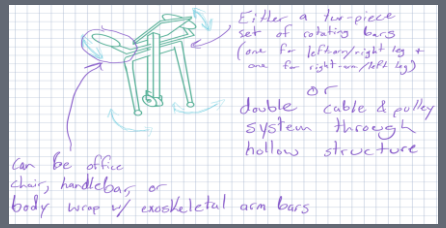
Table 2: Benchmarking of existing products

V - Model for Product Design

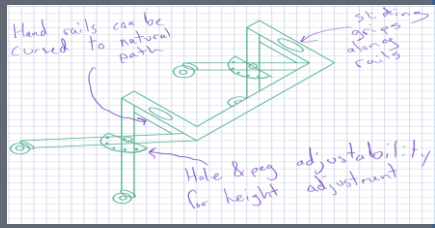


Structural Designs

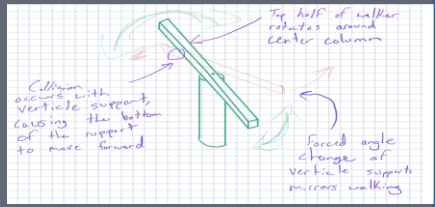
1. Pulley system



2.Rotating levers



3. X-bar roller



	Safety	Cost due to complexity	Functionality	Durability	Aesthetics	Feasibility	Weighted Score:
Pulley System	3	4	5	5	8	4	4.69
Rotating Levers	7	8	8	6	6	9	7.35
X-Bar Roller	8	5	3	7	7	5	5.84

Best Recommendation:

Our best recommendation is to utilize a system of rotating levers that will effectively mimic the reciprocal relationship between the arms and legs. Using the Weighting of Client Needs we established in our Project Proposal and through the use of the decision-making tool, a Value-Score Table. We can quantitatively confirm that this design is optimal given the resources at our disposal, focusing on both cost and time. This design is our top recommendation mainly due to its large, adjustable, interchangeable parts that will sufficiently minimize complexity, time, and costs for the manufacturers, Occupational Therapists, and patients.