Lerner Exoskeleton Actuator

Team:18F26

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Project Description

- Design a series elastic actuation system for a robotic lower-extremity exoskeleton
- Cerebral palsy : is a neurological disorder that affects a child's from moving and it is caused by brain damage
- Our device should:
  - Help people with disability
  - Provide clinical gait .

Definition of Exoskeleton:
The Exoskeleton is device used to help and improve the human life.

Where we can use it?
We can use the Exoskeleton on the outer human body.

- Our Goal:
  modify the current Exoskeleton to have a clincal movement for the ankle (using the engineering requirements)

Client

- Zach Lerner, Ph.D.
- Director of NAU's Biomechatronics Lab
- Our Stakeholders are people with disability

- Why is it important?
- To help people with disability needs

Black Box:

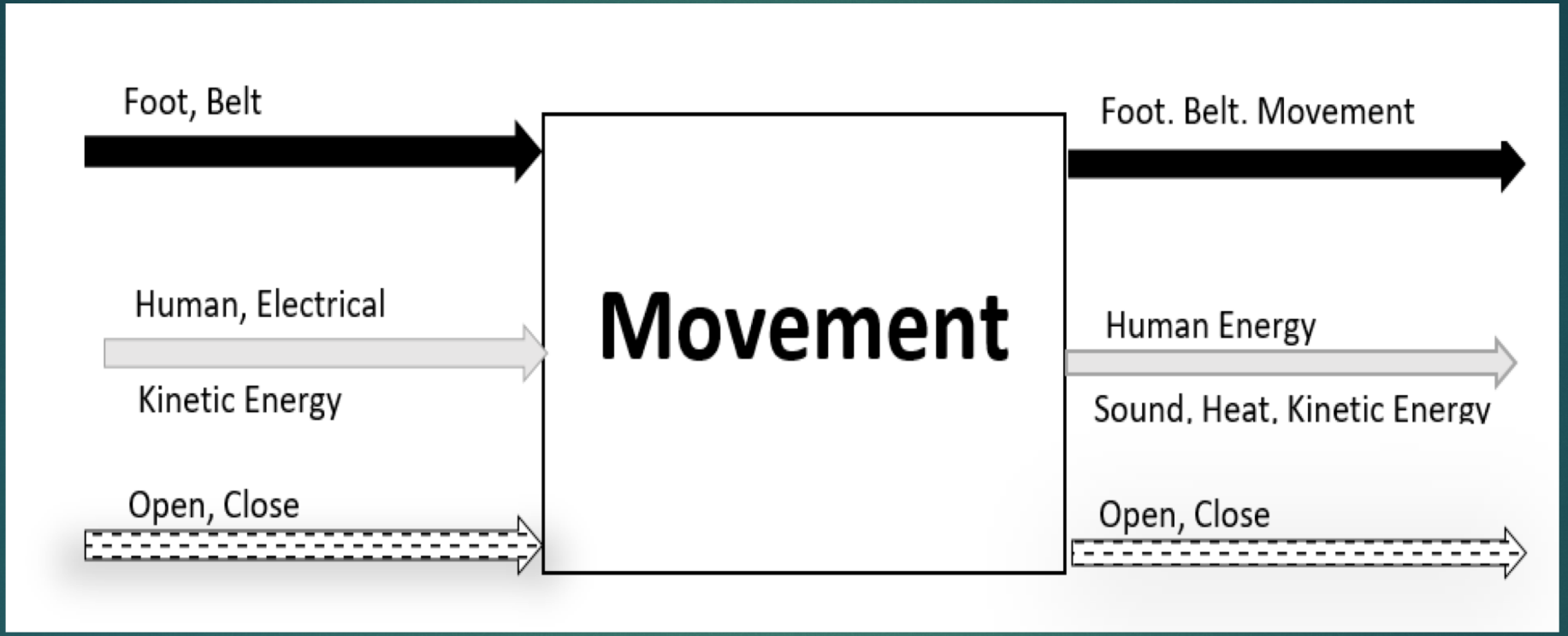

Figure 1: Black Box

Decomposition Model

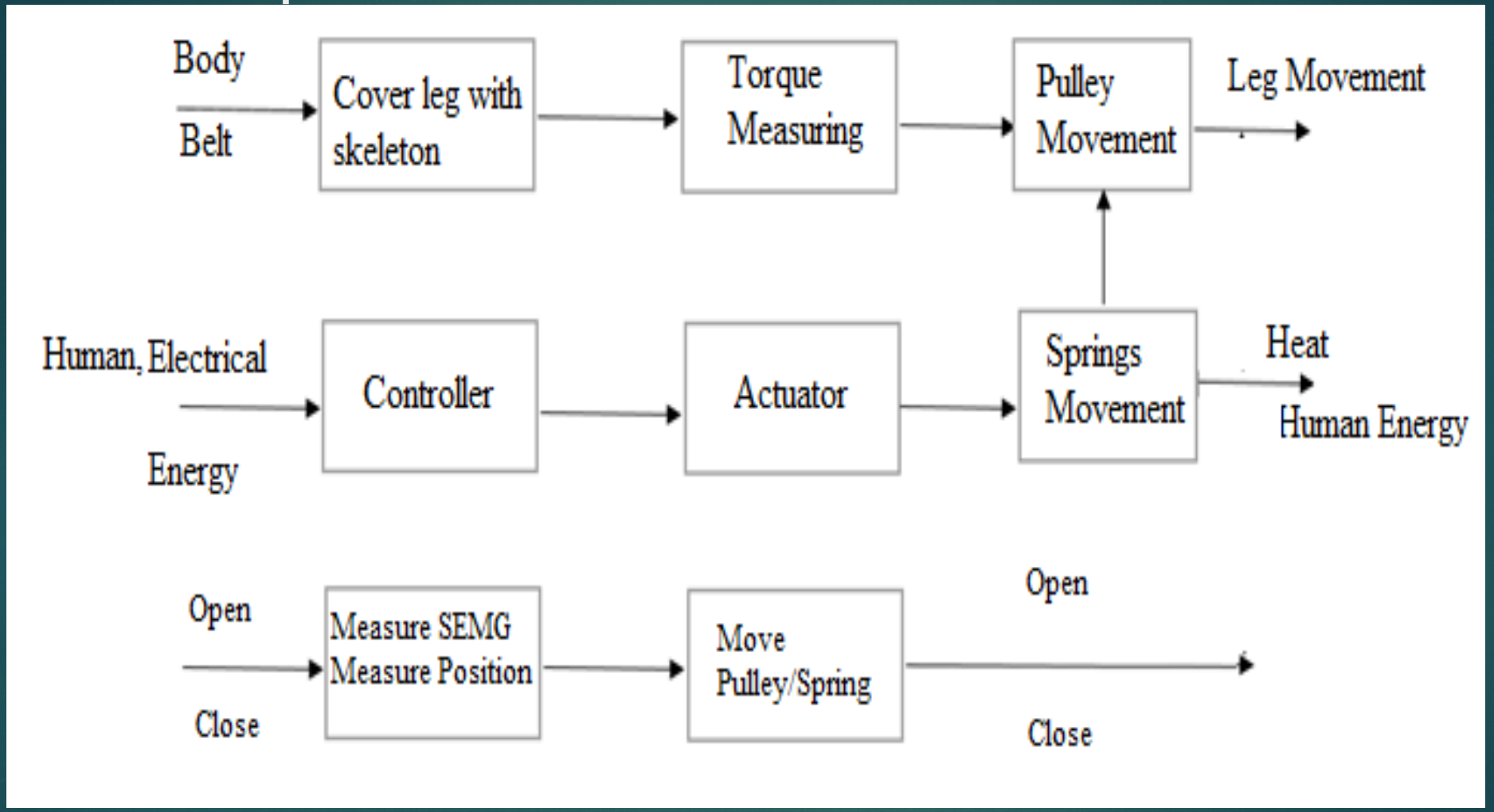

Figure 2: Functional Model

Design Considered #1

- Advantages?
- last for a long time
- can be adjusted easily
- Disadvantage?
- We might add more than one part
- Hard to assemble

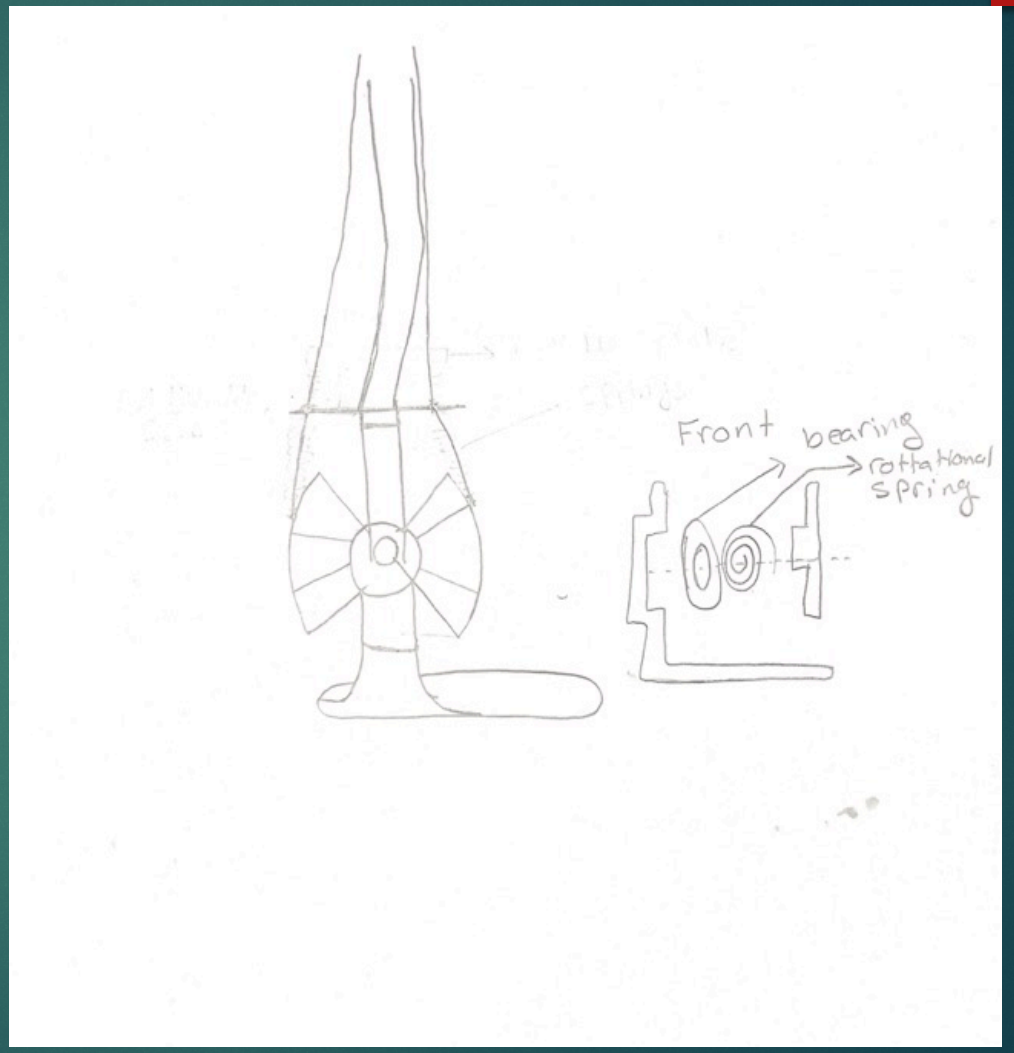

Figure 3: design #1

Design Considered #2

- Advantages?
- it will help the patient when he slips
- it has an adjustable length
- Disadvantage?
- Increasing the design length
- increasing in weight

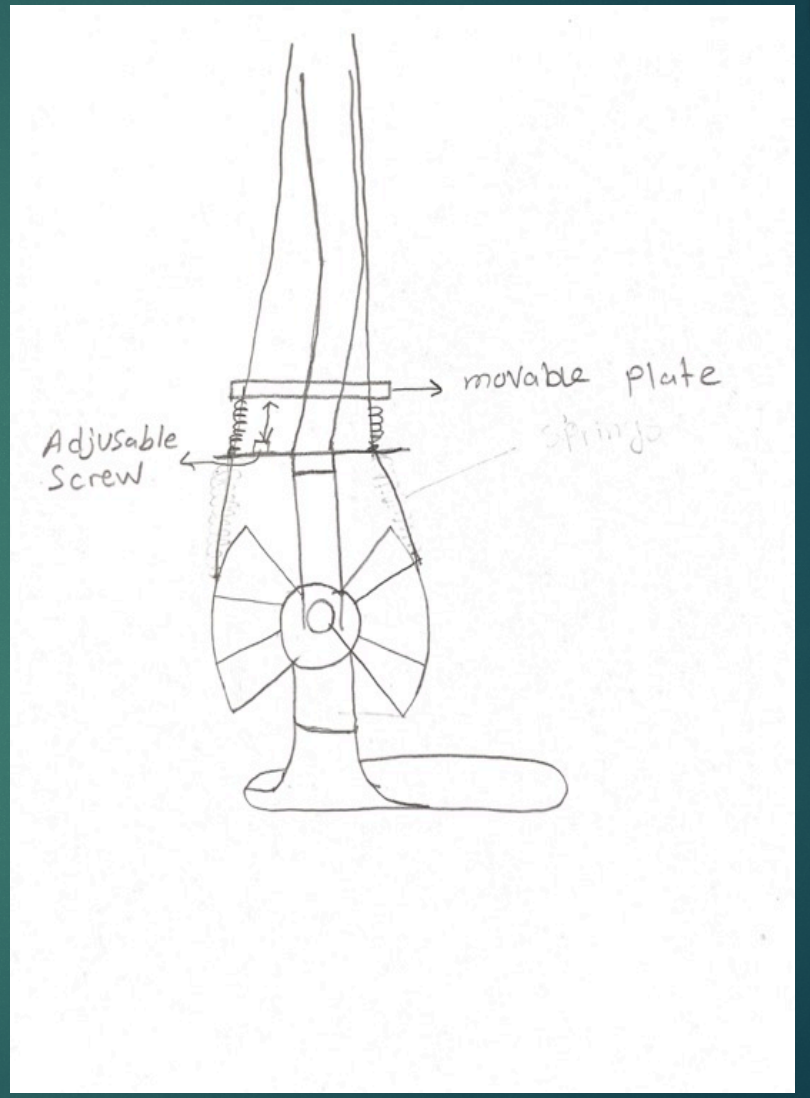

Figure 4: desgin#2

Design Considered #3

- Advantages?
- will not change pulley radius
- More power efficient
- Disadvantages?
- It would work opposite of the thing we are aiming for
- Springs are parallel

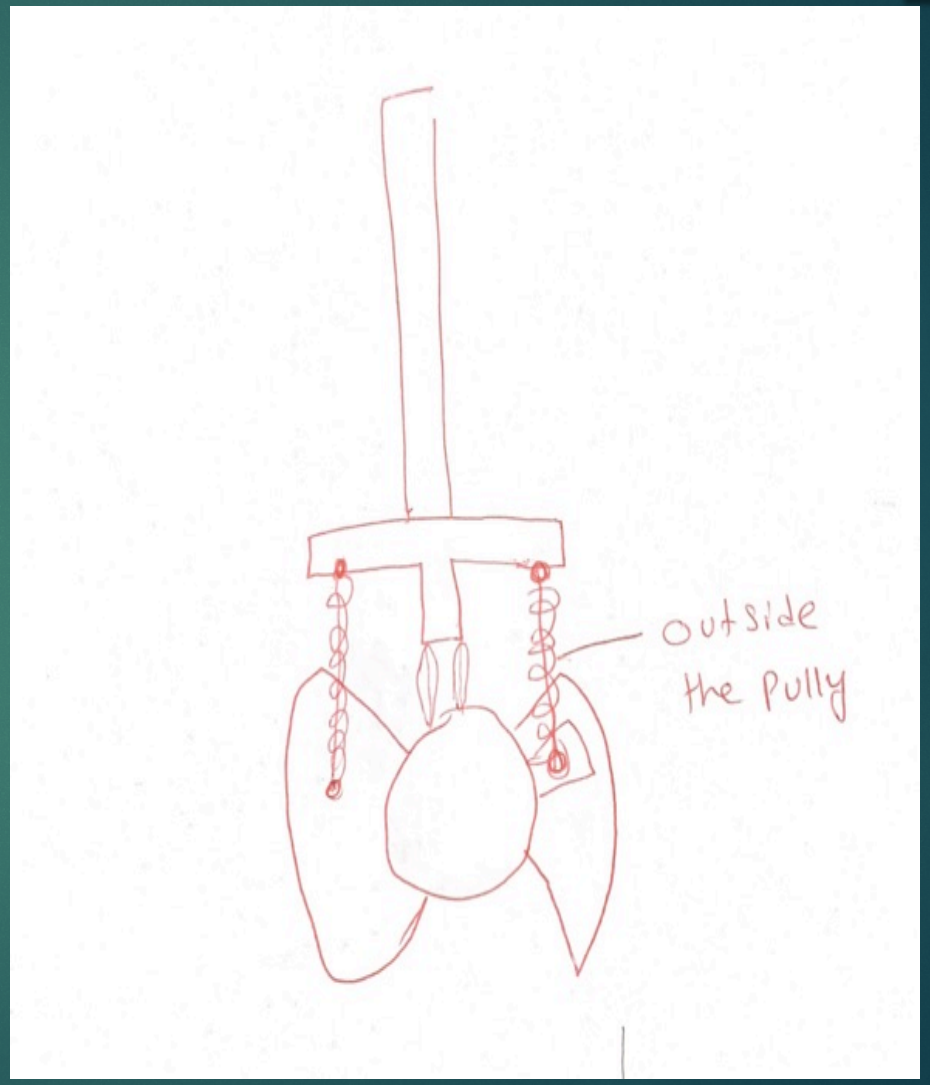

Figure 5: design #3

Pugh Chart

Design 2 is the simplest design, so we chose it to be our datum.

Concept / Criteria	Design 1	Design 2	Design 3	Design 4	Design 5	Design 6	Design 7	Design 8	Design 9	Design 10
Measure torque	S	D	+	-	S	S	+	+	S	+
Lightweight	-	D	S	S	+	-	S	-	S	-
Clinical gait	-	D	+	+	S	S	+	S	+	+
Noninvasive	S	D	+	S	-	+	+	+	+	+
Simple	S	D	+	S	+	S	-	S	-	-
∑ +	0	D	4	1	2	1	3	2	2	3
∑ -	2	D	0	1	1	1	1	1	1	2
∑ S	3	D	1	3	2	3	1	2	2	0

Figure 6:Pugh chart

Decision Matrix

Weight / Criterion		Design 3		Design 7		Design 10	
Provide Torque	.429	90	38.61	70	30.03	83	35.607
Specify Material	.166	75	12.45	82	13.612	79	13.114
Spring Location	.132	80	10.56	90	11.88	85	11.22
Noninvasive	.151	90	13.59	85	12.835	80	12.08
Not complicated design	.122	70	8.54	80	9.76	85	10.37
Totals	1		83.75		78.117		82.391
Relative Rank			1		3		2

Figure 7:Decisison Matrix

Design Selected #1

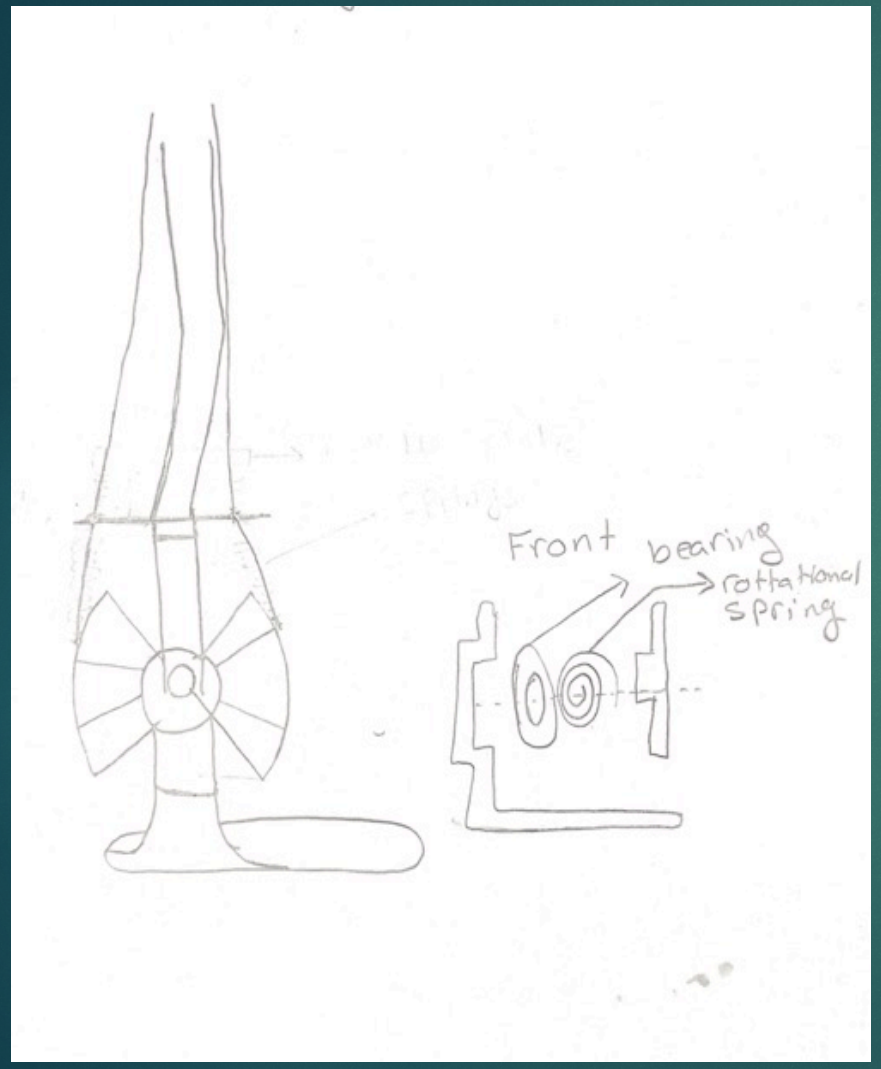

Figure4

Torki

Table [1]

Customer Requirements	Description
Measure torque	0-7 Nm out of the motor 0-21 Nm out of the pulley
Weight	Patient 50 lbs-150lbs
Spring location	design selection for the spring
Non-invasive	Dose not contact the ankle
simple	30% complicated design

Design Selected #2

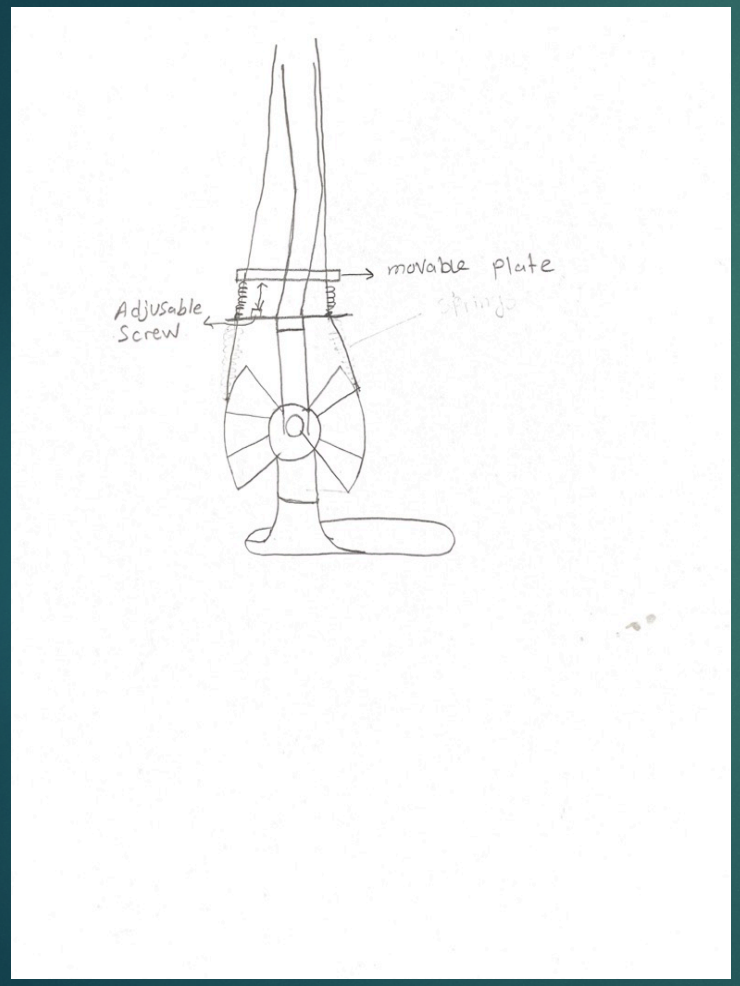

Figure3

Torki

Table [2]

Customer Requirements	Description
Measure torque	0-7 Nm out of the motor 0-21 Nm out of the pulley
Weight	Patient 50 lbs-150lbs
Spring location	design selection for the spring
Non-invasive	Dose not contact the ankle
simple	20% complicated design

Gantt Chart

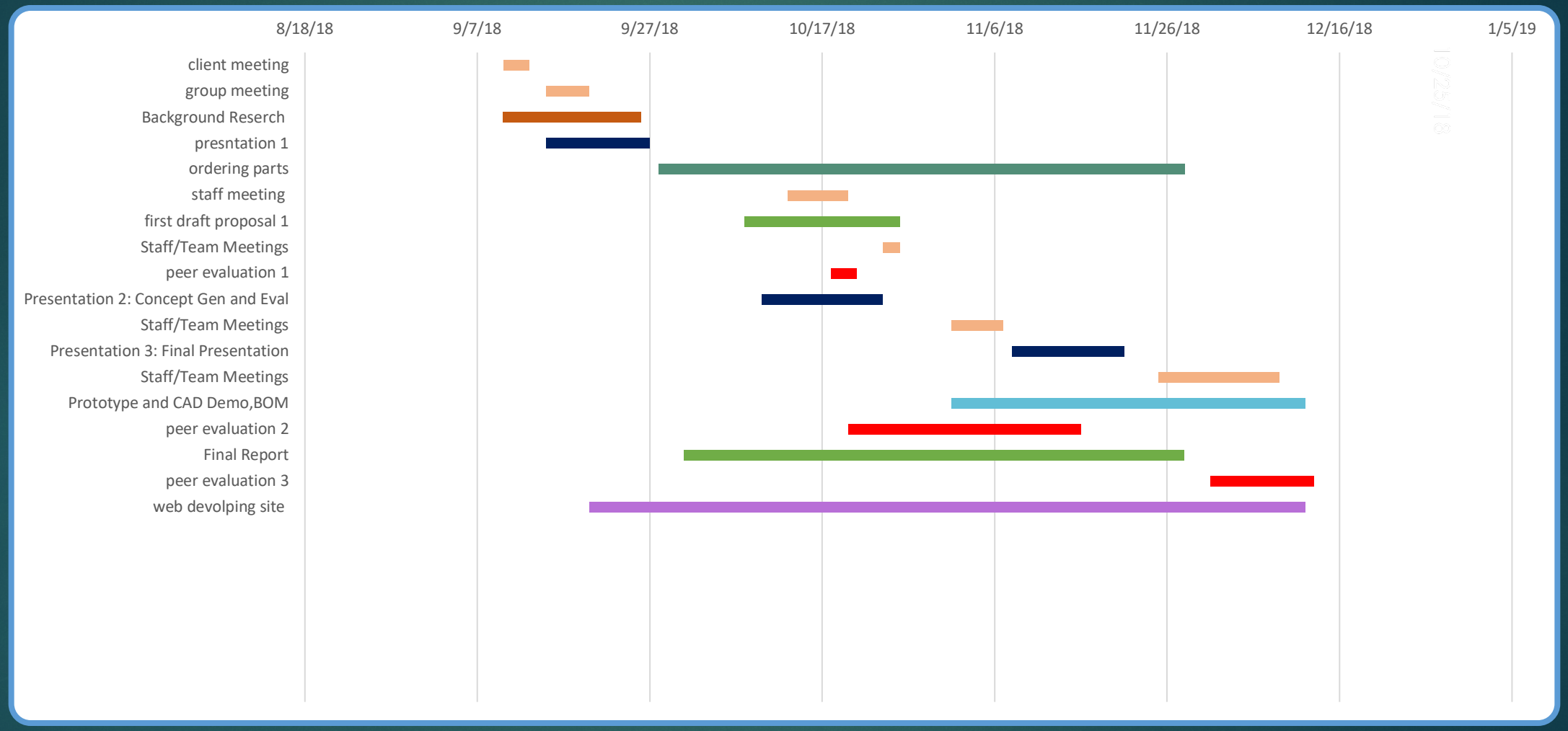

Figure 8: Gantt Figure

Gantt Chart

Table [3]

Task Name	Team member	Start Date	End Date	Duration
client meeting	ALL	9/10/2018	9/13/2018	3
group meeting	ALL	9/15/2018	9/20/2018	5
Background Reserch	ALL	9/10/2018	9/26/2018	16
presntation 1	all	9/15/2018	9/27/2018	12
ordering parts	Barjes&Humood	9/28/2018	10/28/2018	30
staff meeting	All	10/13/2018	10/20/2018	7
first draft proposal 1	ALL	10/8/2018	10/21/2018	13
Staff/Team Meetings	ALL	10/24/2018	10/26/2018	2
peer evaluation 1	individual	10/18/2018	10/21/2018	3
Presentation 2: Concept Gen and Eval	ALL	10/10/2018	10/24/2018	14
Staff/Team Meetings	ALL	11/1/2018	11/7/2018	6
Presentation 3: Final Presentation	ALL	11/8/2018	11/21/2018	13
Staff/Team Meetings	ALL	11/25/2018	11/28/2018	14
Prototype and CAD Demo,BOM	Fawaz &Torki	11/1/2018	12/12/2018	41
peer evaluation 2	individual	11/20/2018	11/21/2018	1
Final Report	ALL	10/1/2018	11/28/2018	58
peer evaluation 3	individual	12/8/2018	12/12/2018	4
web devolping site	Mohammad alali	9/20/2018	12/12/2018	83

Budget

Table [4]

Part	Price	Total
Motor Ec-4pole22(311536)	$713.45	
gear GP32C(166945)	$157.15	$870.60 from $2000
Manufacturing and spring	~$600	$1,470.60

References:

[1] *Small dc motors and drive systems | maxon motor*. [Online]. Available: https://www.maxonmotorusa.com/maxon/view/content/index. [Accessed: 24-Oct-2018].

Any Questions ?