

Lerner Exoskeleton Actuator

Team: 18F26

Torki Alhaqan

(project Manger)

Fawaz Almubarak

(Document Manager& CAD)

Mohammad Alali

(Web Developer)

Barjes Alenezi

(Client Contact)

Humood Aljabri

(Budget Licenses)

Fawaz

Content:

- ▶ Project Description
- ▶ Designs description
- ▶ Design function
- ▶ Design requirements
- ▶ Schedule & Budget

Project Description

- Design a series elastic actuation system for a robotic lower-extremity exoskeleton
- Cerebral palsy : disease 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 clinical 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



CAD MODEL FOR PROTOTYPE

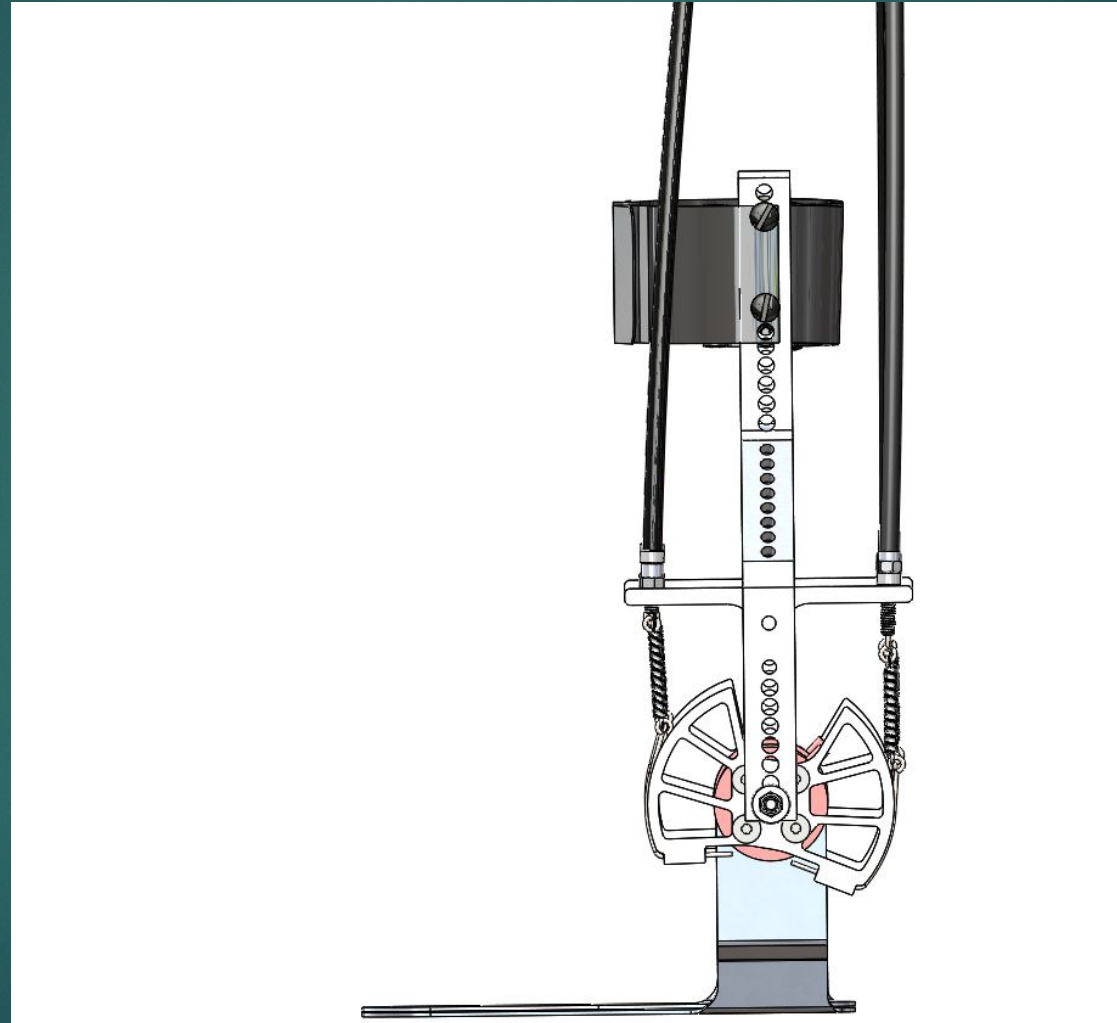


Figure 1: CAD prototype

CAD Model Exploded view

6

12/5/18

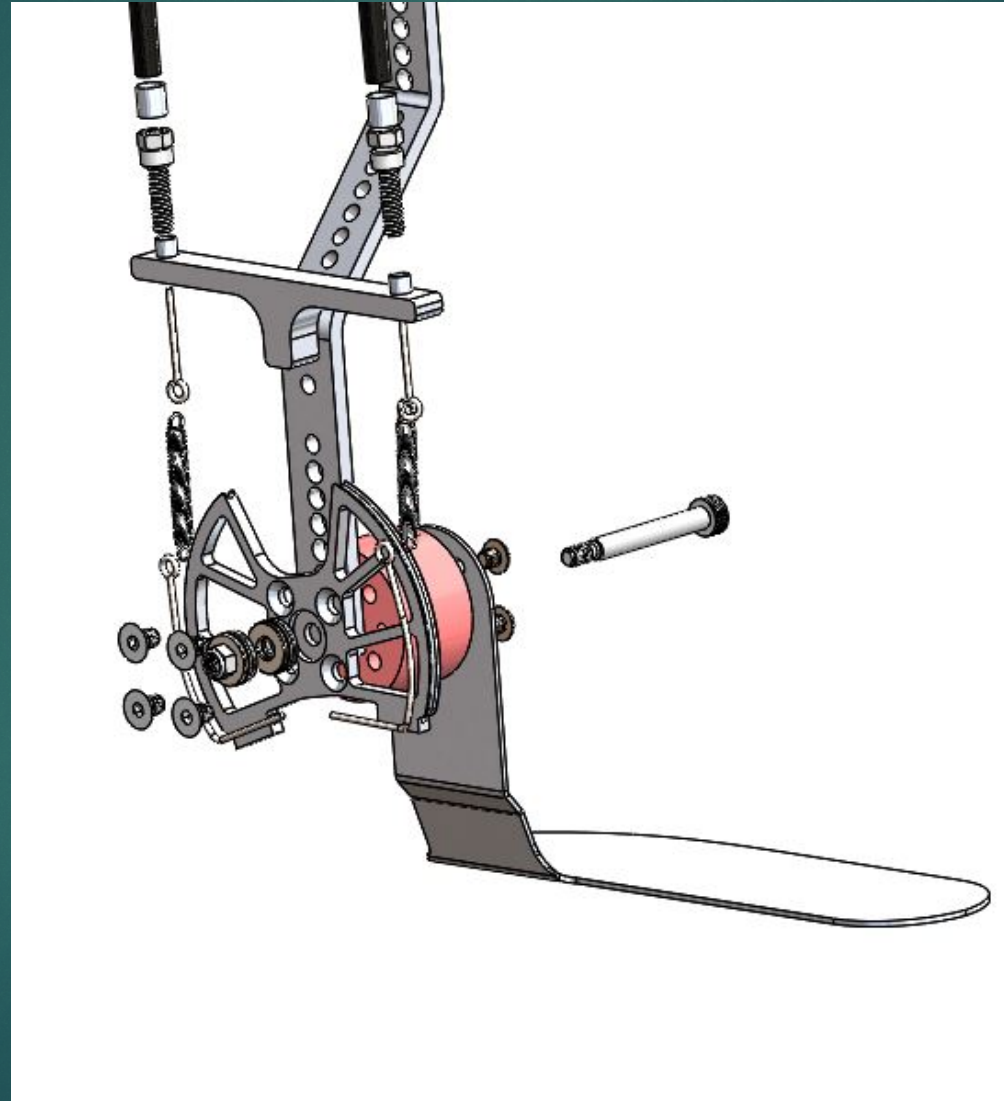


Figure 2: Exploded View

Bill Of Materials for completed design

7

12/5/18

Bill of Materials								
Team				ExAct-18F26				
Part #	Part Name	Qty	Description	Functions	Material	Dimensions	Cost	Link to Cost estimate
1	GP32C 123:1 (PN: 166945)	1	top performance per volume and weight unit		plastic	N/A	\$713.45	https://www.maxonmotor.com/maxon/view/product/311536
2	PN: 438725 (ESCON 50/5)	1	highly efficient control of permanent magnet-activated brushed DC motors		plastic	N/A	\$157.15	https://www.maxonmotor.com/maxon/view/product/control/4-Q-Servokontroller/438725
3	TRT-500	1	mmc ESCON Module 50/8		plastic	1.63X1	\$221.15	https://www.transducertechniques.com/trt-torque-sensor.aspx
4	B000BMRQB8	1	CLARKS Brake Cable Housing and Housing KiCLARKS Brake Cable Housing and Housing Kit		Metal	5-mm x 30-m	\$33.99	https://www.amazon.com/go/product/B000BMRQB8/ref=oh_au_i_search_detailpage?ie=UTF8&psc=1
5	B013BE110G	1	zimo 50pcs Jagwire Bike 5mm Brake Cable Housing Ferrule End Caps		Metal	4.5 x 3.7 x 1.8 inches	\$6.99	https://www.amazon.com/go/product/B013BE110G/ref=oh_au_i_search_detailpage?ie=UTF8&psc=1
6	B077PXTM44	1	Dorisea Extreme Braid 100% Pe Grey Braided Fishing Line 109Yards-2187Yards 6-550Lb		Metal	100m/109Yards 400lb/1.4mm(16Strands)	\$14.98	https://www.amazon.com/go/product/B077PXTM44/ref=oh_au_i_search_detailpage?ie=UTF8&psc=1
7	N/A	N/a	Manufacturing parts (leg bar, pulley,.etc)		aluminum	N/A	N/A	N/A
Total Cost Estimate:							1147.71	

CAD Drawing Sheet

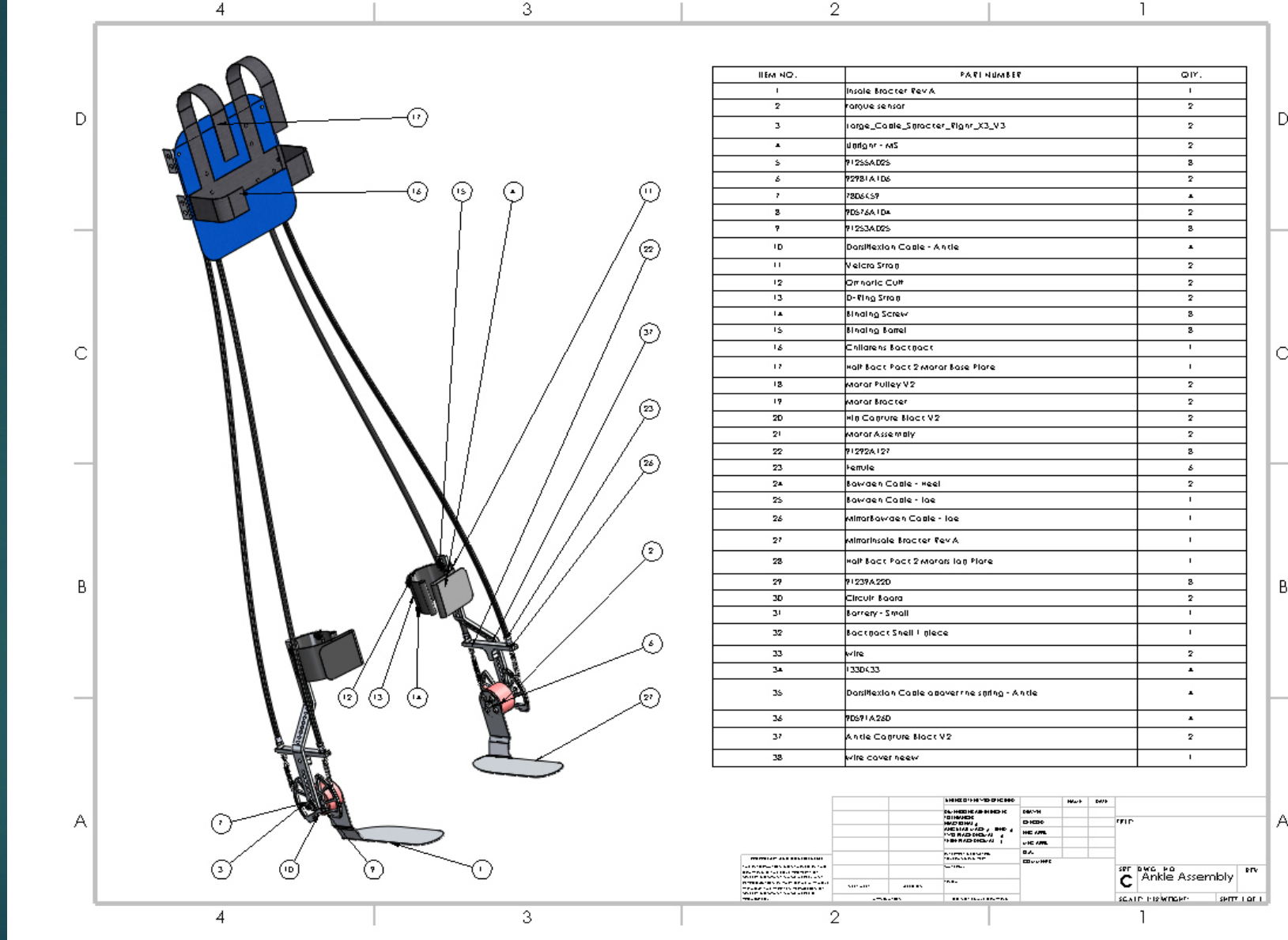
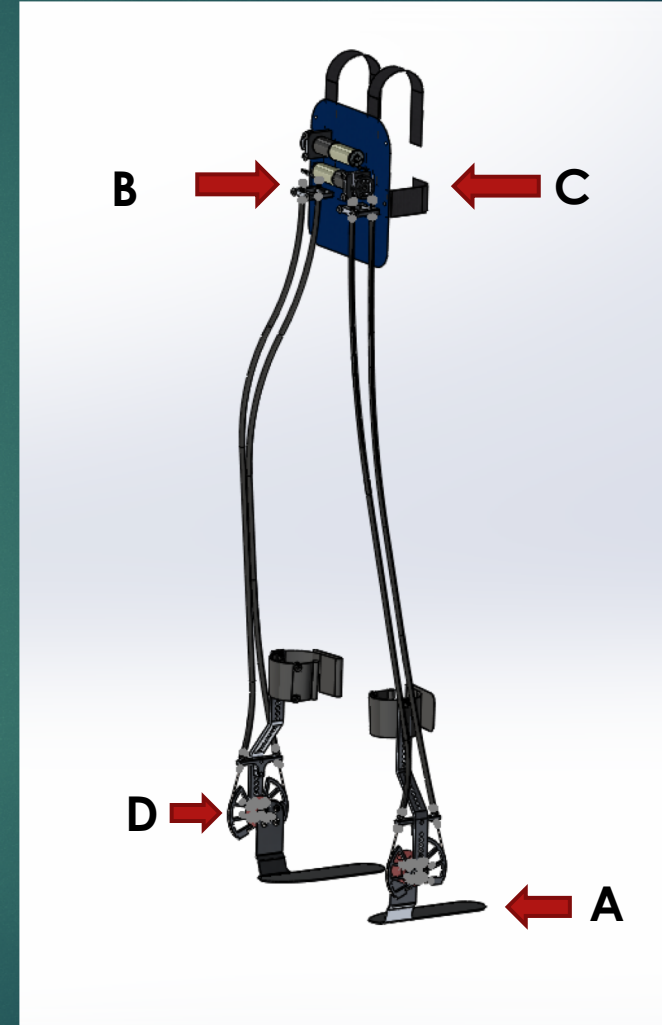


Figure 3:CAD Drawing Sheet

Design Functions

- The pressure on the foot plate will activate the torque sensor.
- The motor will rotate the upper pulley.
- The motion will move the cables up and down simultaneously.
- The lower pulley will rotate.
- The foot plate will rotate.
- The spring will provide a smooth movement to the footplate.



12/5/18

Figure 4: Exoskeleton CAD

Design Requirements

Table [1]

Customer Requirements	Description	Weight
Measure torque	0-7 Nm out of the motor 0-21 Nm out of the pulley	0.429
Weight	Patient 50 lbs-150lbs	0.166
Spring location	design selection for the spring	0.132
Non-invasive	Dose not contact the ankle	0.151
simple	Not complicated design	0.122

Gantt Chart

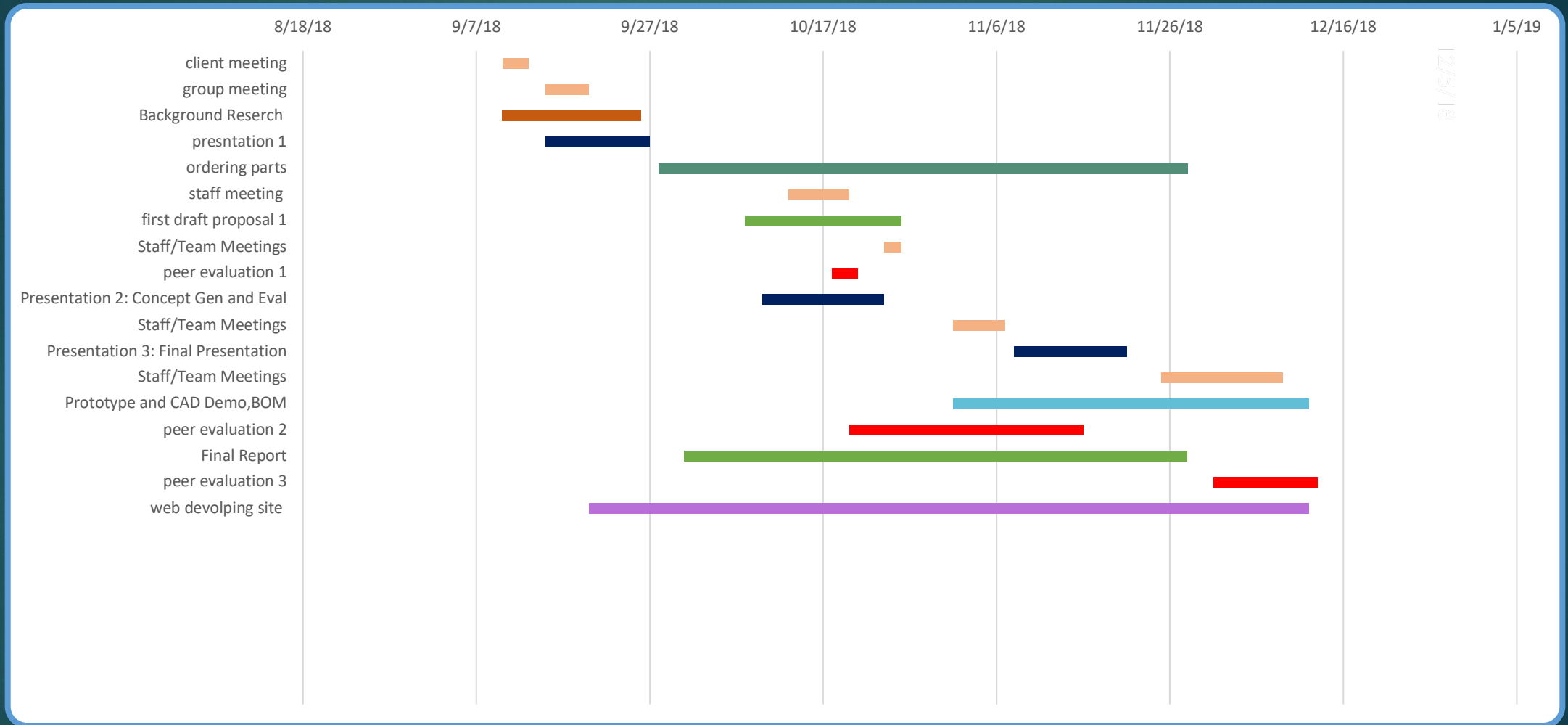


Figure 5: Gantt Figure

Gantt Chart

Table [2]

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

12/5/18

Gantt Chart (spring 2019)

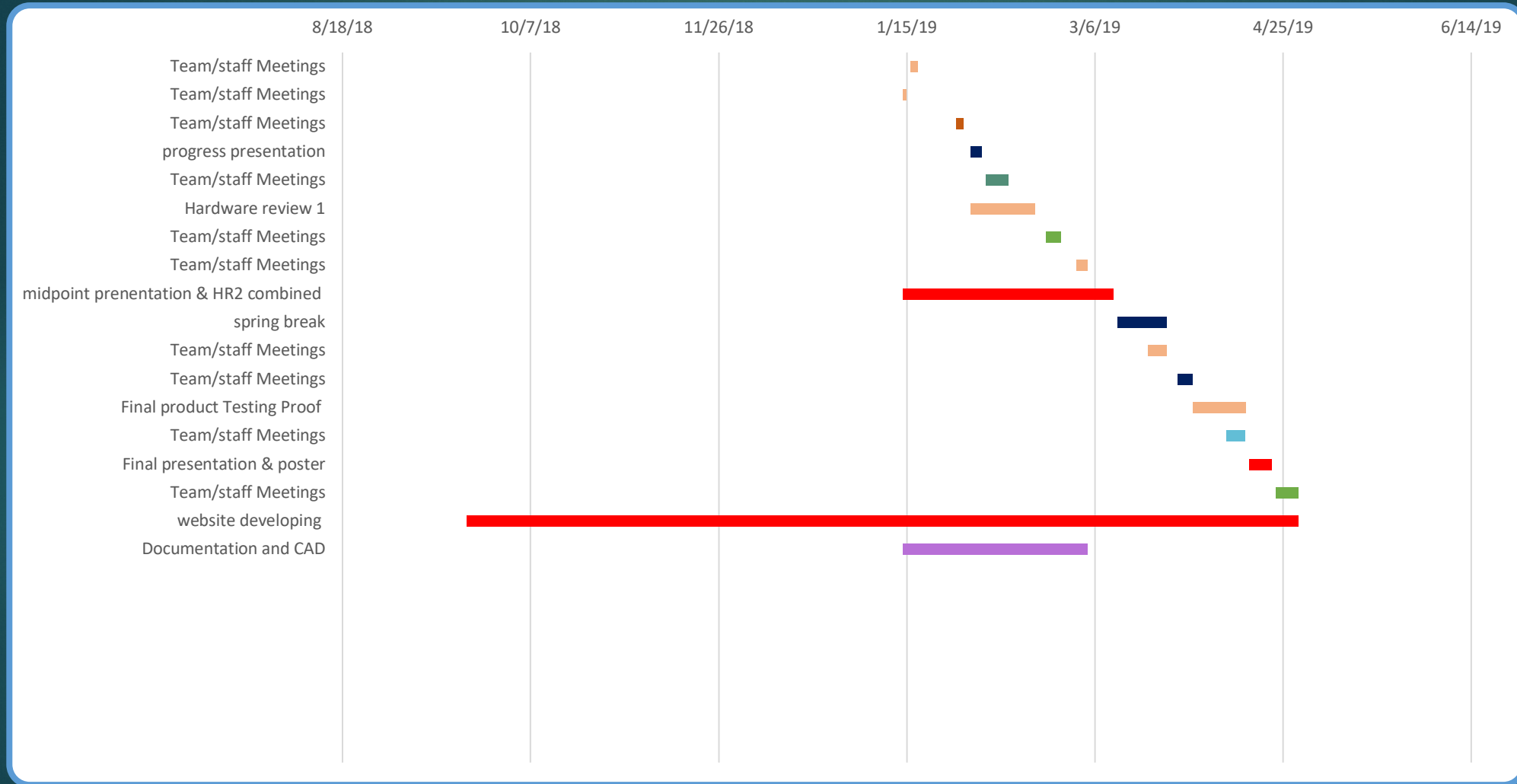


Figure 6: Gantt Figure(spring 2019)

Budget

Table [3]



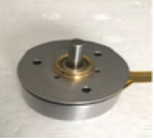
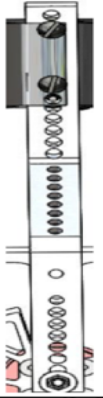


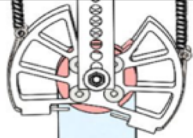
Part	Price	Total
Motor Ec-4pole22(311536)	\$ 713.45	
gear GP32C(166945)	\$ 157.15	\$ 870.60 from \$ 2500
Manufacturing and spring	N/A	
Remaining		\$ 1629.40

Prototype Budget

Table [4]

15

12/5/18

Component Name	Model dimensions	pictures	Cost	link
Flat Head Screw	10-32 x 3125in		Free	Library Nau
Button Head Screw	10-32 x 1875in		Free	Library Nau
Torque Sensor	N/a		\$1.03	Library Nau
Upright Leg Bar	87.6 mm x 58.2mm		\$2.03	Library Nau
Foot Plate	N/a		\$1.34	Library Nau
Bar	N/a		\$2.12	Library Nau
Pulley	N/a		\$3.23	Library Nau

Prototype Budget

Table [5]

16

12/5/18

Extension springs	4mm		\$3.62	Walmart
hook	N/a		Free	Library Nau
Bowden cables	N/a		\$2.12	Walmart
Bearings	N/a		Free	Library Nau
Shaft screw	N/a		\$1.23	Library Nau
TOTAL			\$13.49	

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 ?