NAU NORTHERN ARIZONA UNIVERSITY

Mechanical Engineering

To: Dr. Trevas

From: Team 19F03- Hip Exoskeleton A.

Date: March 6th ,2020

Subject: Hardware Review 2.

The thigh braces offer a support for each of the thighs whose work was equally distributed between the two member groups. It involved design and testing of each of them to fit the given engineering and customer requirements. Among the design requirements for this part include:

- Flexibility to fit onto various limbs for various sizes of user
- Comfort
- Ease of use
- Connection to the frame

By having a concave shape fit to allow the leg a wide range of sizes can fit into the brace. A thermoplastic is used which allows the curve due to its high elasticity.
An inner pad gives a smooth interface between the human body and the machine for comfort ability. That way the user has comfort and is shielded from bruises.
Linen straps are provided to fasten the limbs to position and hence ensuring that the limbs are held in place. The buckle is simplified to make it user friendly.
The leg braces connected to the frame using bolts and screws. Again, these were well fixed to ensure stability and to ensure that they are fastened to position. The structural of the connections is important and hence structural design was ensured.
The frame tube which gives the overall reinforcement for the entire structure was worked on by the entire team of all members. This is attached to the hip brace which whose desired properties are same as those of the thigh brace also worked on jointly by the entire team. A thermoplastic cladded with a soft interior pad was also used for this part for the same reasons as for the thigh brace.
A complete framework was achieved for the hip exoskeleton device. The framework mainly includes the thigh brace a hip brace and a frame tube.
Moving forward, the device will be fitted with a power mechanism that involves the following:

- **Motors**
- **Gears.**

The above parts have been ordered from various suppliers and will be subjected to testing based on the power requirement of the device.
The specifications are according to design calculations for torque and gear ratio for the motor and gears respectively. The originator of the power is a powered motor which relays the motion to the gear which further transforms the rotational motion to linear motion.

Table 1 Summary

Deliverable	Team Members	Scope of work	Desirable characteristics	Results/Proof
Thigh Braces	**Abdullah Almarri**	Right side	1.Comfort 2.Flexibility 3. User Friendliness. 4.ConnectionStability	
	Lahdan Alfihani			
	Meshal Algammas	Left side	1.Comfort 2.Flexibility 3. User Friendliness. 4.ConnectionStability	
	Mohammad Janshah			
Hip brace	**Whole Members Joint Effort**	Hip Part	1.Comfort 2.Flexibility 3. User Friendliness. 4.ConnectionStability	
Supporting frames	**Abdullah Almarri**	Right side	1.Comfort 2.Flexibility 3. User Friendliness. 4.ConnectionStability	
	Lahdan Alfihani			
	Meshal Algammas	Left side		
	Mohammad Janshah			
HR 2 Milestone	A complete framework was achieved for the hip exoskeleton device. The framework mainly includes the thigh brace a hip brace and a frame tube.			
Cause of action	Moving forward, the device will be fitted with a power mechanism that involves the following: • **Motors** • **Gears.** The above parts have been ordered from various suppliers and will be subjected to testing			

	based on the power requirement of the device. The specifications are according to design calculations for torque and gear ratio for the motor and gears respectively. The originator of the power is a powered motor which relays the motion to the gear which further transforms the rotational motion to linear motion.

Appendix A: Bill of materials.

Part #	Part Name	Qty	Description	Functions	Material	Dimensions	Cost	Link to Cost estimate
1	Motors&Gear	2	motor with gearbox in each side (left & right)	actuate thigh movment	Plastic & Metal		$1,259.26	https://www.maxongroup.com/maxon/view/product/gear/planetary/gp22/370782 https://www.maxongroup.com/maxon/view/product/motor/ecmotor/ec4pole/323218
2	controller	2	ESCON Module 50/5 4-Q servocontroller for DC/EC	CONTROLLER			$341.00	https://www.maxongroup.com/maxon/view/product/gear/planetary/gp22/370782 https://www.maxongroup.com/maxon/view/product/motor/ecmotor/ec4pole/323218
3	Frame (upper)	1	frame that support motors and thigh frame (connected to hip joint) (cutting and modification required)	support motors	aluminum	1.125 x 1.25 x 66"	$ 29.28	https://www.amazon.com/Aluminum-6063-T52-Square-Tubing-Length/dp/B000H9OYN8/ref=sr_1_1?keywords=6063-t52%2Bsquare%2Btubing%2C%2Bastm&qid=1582934364&sr=8-1&th=1
5	Bolt	4	bolts to hold the belts	holding belt	18-8 stainless steel	3/8" long; 0-80 thread size	$6.41	https://www.mcmaster.com/92949a312
6	Ball Joint	2	ball joint in each side to provide required angle movment	angle movement	zink-plated alloy steel	1.4" x 1.8"	$20.53	https://www.mcmaster.com/60745k833
7	Ball Joint Bolt	2	bolt to hold the ball joint to the hip brace	holding the ball joint	18-8 stainless steel	3/4"	$6	https://www.mcmaster.com/92949a599
8	hip brace bolt	2	bolts to adjust hip size	adjusment of hip size	grade 5 Titanum	3/4"	$8.06	https://www.mcmaster.com/94081a102
9	hip brace nut	2	nut to adjust hip size	adjusment of hip size	18-8 stainless steel	7/16" x 1/2"	$4.49	https://www.mcmaster.com/91833a125
10	velcro	4	2 in each thigh brace to fit user size	thigh fitment	Nylon	1" x 15'	$6.97	homedepot
11	Pad	3	pads in the hip brace to ensure comfort for the user	comfort	foam	73" x 37" x 1"	$16.56	Amazon
11	ABS Black plastic	1	Thermoplastic sheet for hip and thigh brace	thigh & hip brace	Thermoplastic	1/4""24""48"	$64	Amazon
14	D profile shaft	2	two neede for the lower support frame (cutting required)	hold gear	1045 Carbon Steel	6" x 3/8" (D)	$7.24	https://www.mcmaster.com/8632t133
Total Cost Estimate:							$1,769.80	