

Design of a non-invasive Hip Exoskeleton





Team Members:

- ► Lahdan Alfihan
- ► Meshal Alghammas
- ► Abdullah Almarri
- ▶ Mohammed Janshah



Project Description

- The goal of the project
- Who can use it.
- Budget
- $\bullet \, {\rm Sponser}$
- Client
- Mentor





Figure 1: Picture of the design

Meshal Alghammas Hip Exoskeleton (2) April 24, 2020



Design Description

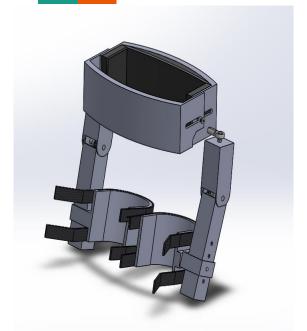


Figure 2: CAD Isometric View



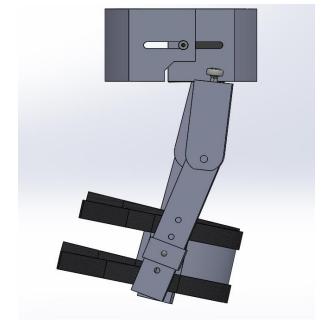


Figure 3: CAD Right View







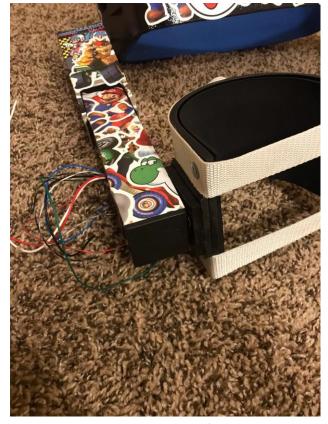


Figure 5: Wiring outlet from the tube

Mohammed Janshah Hip Exoskeleton (4) April 24, 2020







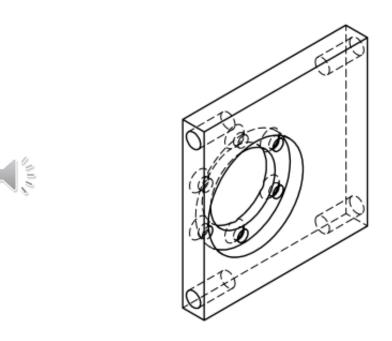


Figure 7: Motor mount (inside the lower tube)

Mohammed Janshah Hip Exoskeleton (5) April 24, 2020

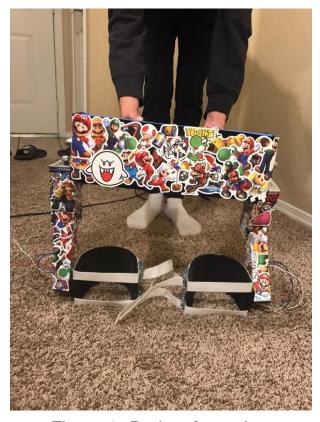


Figure 8: Project front view



Figure 9: Project side view

Hip Exoskeleton (6)



Figure 9: Foam to gives user comfort



Figure 10: Foam to gives user comfort

Mohammed Janshah Hip Exoskeleton (7) April 24, 2020



Current State of System



Table [1]

| Engineering Requirements (ERs) | Met or Not yet | | | | |
|--------------------------------------|----------------|--|--|--|--|
| Material Strength | Met | | | | |
| Cost (Under \$2250) | Met | | | | |
| Fitment (Children 6 to 14 years old) | Met | | | | |
| Non-invasive | Met | | | | |
| Torque (8-15 Nm out of the motor) | Not yet | | | | |
| Weight (Under 7 lb) | Met | | | | |





Bill of Materials

Budget: \$2250

Spent: \$1810.14

Left: \$439.86

Table [2]

| i abic [2] | | | | | | |
|------------|--------------------|-------------------------|-----------------|--|--|--|
| Part # | Qty | Cost \$ | | | | |
| 1 | 2 | Motors&Gears \$1,259.2 | | | | |
| 3 | 1 | 1 Frame (lower) \$20.09 | | | | |
| 2 | 2 | ` ' | | | | |
| 3 | 1 | Frame (upper) | \$ 29.28 | | | |
| 5 | 2 | Ball Joint | \$20.53 | | | |
| 6 | 2 | Ball Joint Bolt | \$6 | | | |
| 7 | 2 | hip brace bolt | \$8.06 | | | |
| 8 | 2 | hip brace nut | \$4.49 | | | |
| 9 | 2 | Lashing Strap \$10 | | | | |
| 10 | 1 sticker 1 Pad | | \$10 \$11.59 | | | |
| 11 | | | | | | |
| 12 | 1 | double sided tape | \$5 | | | |
| 13 | 1 | ABS Black plastic | \$64 | | | |
| 14 | 1 | bearing \$7 | | | | |
| 15 | 2 shaft \$7.24 | | \$7.24 | | | |
| | \$1,810.14 | | | | | |

^{*}See full BOM in Appendix A





Implementation Plan

- Plan for manufacturing and designing the final product.
- Design and material changes.
- Tasks owner: Thigh braces, Hip brace, Supporting frames, Motors and gears.
- Future action items.

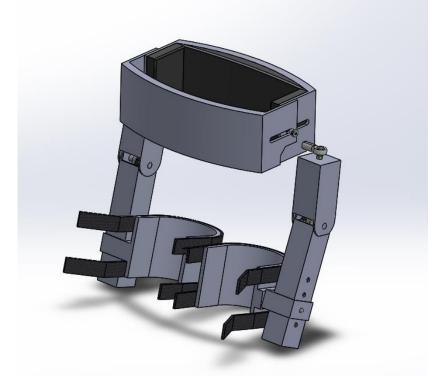


Figure 9: Cad Isometric View





Manufacturing Plan

Table [3]

| Manufacturing Project Tasks | Tasks Due | | | |
|-----------------------------|------------|--|--|--|
| Thigh Braces | 02/14/2020 | | | |
| Hip Brace | 02/21/2020 | | | |
| Supporting Frames | 02/28/2020 | | | |
| Place The motors | 03/20/2020 | | | |
| Testing The project | 03/20/2020 | | | |



Testing Plan



| Tests to be performed | Status | | | | |
|-----------------------|-----------------|--|--|--|--|
| Weight | 6.83 lbs. | | | | |
| Strength | To be completed | | | | |
| Range of motion | To be completed | | | | |
| Coast | \$1810.14 | | | | |
| Force | To be completed | | | | |
| Torque | To be completed | | | | |



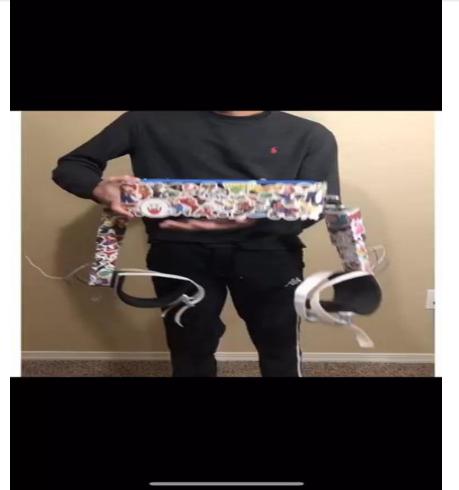
Conclusion



• Deliver a design that meets all the customer and engineering requirements.

• Staying within the budget.

Project Video Pitch



Appendix A: Bill of Materials

| | | | | Bill of Materials | | | | | |
|----------|-------------------|-----|--|---|----------------------------|---------------------|------------------------|---|--|
| | î | | Team | | | | Team Aip Exoskeleton A | | |
| Part # | Part Name | Qty | Description | Description Functions Material Dimensions | | | Cost \$ | Link to Cost estimate | |
| 1 | Motors&Gears | 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/planetar v/qp22/370782 | |
| 2 | controller | 2 | ESCON Module 50/5 4-Q servocontroller for DC/EC | Controller | Electrical | | \$341.00 | https://www.maxongroup.com/maxon/view/product/motor/ecmotor/ec4pole/323218 | |
| 3 | Frame (Lower) | 1 | frame connect the thigh beace with the upper frame | support thigh brace | aluminum | 2" x 2", 1/8" x 24" | \$20.09 | https://www.amazon.com/6063-Aluminum-Hollow-Rectangular- Temper/dp/B000H9JJB0?th=1 | |
| 4 | 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 17keywords=6063- t52%2Bsquare%2Btubing%2C%2Bastm&qid=1582934364&sr=8 -1&th=1 | |
| 5 | 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 | |
| 6 | 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 | |
| 7 | 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 | |
| 8 | hip brace nut | 2 | nut to adjust hip size | adjustment of hip size | 18-8 stainless steel | 7/16" x 1/2" | \$4.49 | https://www.mcmaster.com/91833a125 | |
| 9 | Lashing Strap | 2 | 2 in each thigh brace to fit user size (comes in 2 pack) | thigh fitment | Fabric | 8' x 1" | \$16.46 | https://www.amazon.com/Keeper-85243-Lashing-Strap- Pack/dp/B004PL4H0O/ref=lp_256400011_1_15?s=industrial&ie =UTF8&qid=1583297512&sr=1-15 | |
| 10 | Pad | 1 | pads in the hip brace to ensure comfort for the user | comfort | foam | 12"x54"x1/8" | \$11.59 | https://www.amazon.com/Dualplex-Neoprene-Perfect-Cosplay- Padding/dp/B07WDSMVB2 | |
| 11 | ABS Black plastic | 1 | Thermoplastic sheet for hip and thigh brace | thigh & hip brace | Thermoplastic | 1/4''*24''*48'' | \$64 | https://www.amazon.com/ABS-Plastic-Textured-Vacuum- Forming/dp/B07BX4GW6L | |
| 12 | sticker | 1 | stickers to improve the outside appearance of the project | appearance | Plastic | N/A | \$10 | https://www.amazon.com/gp/product/B07QLMZDHS/ref=ppx_yo_ dt_b_asin_title_o02_s01?ie=UTF8&psc=1 | |
| 13 | double sided tape | 1 | to tape foam pads to the hip and thigh brace | attach | plastic | 15 ft x 2-1/2 in | \$5 | https://www.walmart.com/ip/Roberts-15-ft-x-2-1-2-in-Double- Sided-Carpet-Tape-50-605-12/170529477 | |
| 14 | bearing | 1 | thrust bearing between the upper and lower frames | reduce friction | steel | 8x16x5mm | \$7 | https://www.amazon.com/gp/product/B0192SOXN0/ref=ppx_yo_ dt_b_asin_title_o01_s00?ie=UTF8&psc=1 | |
| 15 shaft | | 2 | two needed 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: | | | | \$1,810.14 | | |

Annendix B: Cantt Chart



| | Appena | IX E | 3 : (| san | itt Chart | | | |
|----|--|-------------|--------------|------------|---|--|---------------------------------|--|
| | Task Name | | Finish + | Task Owner | January 2020 29 1 4 7 10 13 16 19 22 25 28 3 | February 2020 31 3 6 9 12 15 18 21 24 2 | March 2020 27 1 4 7 10 13 16 | April 2020 May 2020 5 19 22 25 28 31 3 6 9 12 15 18 21 24 27 30 3 |
| 1 | First Day of Class | Mon 1/13/20 | Thu 1/16/20 | Dr, Trevas | | | | |
| 2 | Post Mortem Memo | Mon 1/13/20 | Fri 1/17/20 | Mohammed | | | | |
| 3 | Self-Learning | Mon 1/20/20 | Fri 1/24/20 | Individual | A | | | |
| 4 | Hardware Review | Mon 2/3/20 | Fri 2/7/20 | Abdullah | | | | |
| 5 | ERs and TPs revamp memo | Mon 1/27/20 | Fri 2/14/20 | Meshal | A | A | | |
| 6 | Website Check 1 | Mon 2/17/20 | Fri 2/21/20 | Mohammed | | A | | |
| 7 | Implementation memo | Sun 2/23/20 | Fri 2/28/20 | Abdullah | | A | A | |
| 8 | Midpoint Presentation and Hardware Review 2 | Sun 3/1/20 | Fri 3/6/20 | Lahdan | | | | |
| 9 | Individual Analysis II | Sat 2/29/20 | Fri 3/13/20 | Individual | | | A | |
| 10 | Draft of poster | Sun 3/8/20 | Fri 3/13/20 | Meshal | | | 6 6 | |
| 11 | Website Check 2 | Sun 3/22/20 | Fri 3/27/20 | Mohammed | | | | A |
| 12 | Final Poster, Implementation Memo 2 | Sun 3/29/20 | Fri 4/3/20 | Abdullah | | | | |
| 13 | Testing Proof Report | Sun 4/5/20 | Fri 4/10/20 | Lahdan | | | | |
| 14 | Final Presentation | Sun 4/12/20 | Thu 4/16/20 | Lahdan | | | | |
| 15 | UGRADs, Poster Presentation | Sun 4/19/20 | Fri 4/24/20 | Abdullah | | | | |
| 16 | Final Report and Op/Assem | Sun 4/26/20 | Fri 5/1/20 | Lahdan | | | | A |
| 17 | Client Project Handoff | Mon 1/13/20 | Wed 5/6/20 | Mohammed | A | | | |
| 18 | CAD nackage Website Check 2 | Mon 2/17/20 | Sat 5/2/20 | Mochal | | | | |

Any Questions?