BiOM Test Fixture
Group 7
ME486C – Section 001

Names:

Hussain Alshammari

Marzouq Alenezi

Saood Alenezi

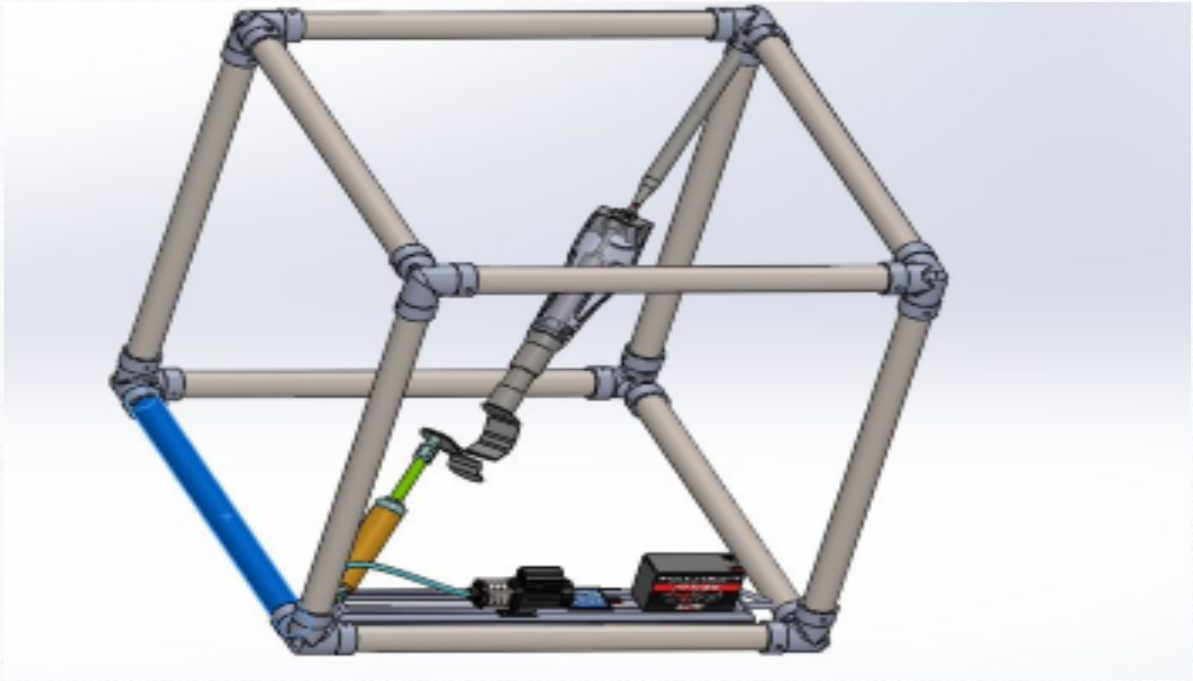
Saoud Alenezi

Naser Alowaihan

Project Review

- The project in hand involved designing a test fixture for the BiOM prosthetic
- The design had to be fully automated and programmable.
- The Test fixture had to meet specific customer requirements when implementing the manufacturing process
- The customer specifications included functionality, ease of transportation, durability, and a torque pressurized hydraulic cylinder
- Engineering requirements of the project had to meet a 15 to 25 minutes testing time , a size of 80 by 40 by 35 centimeters, maximum weight of 15 kilograms and a strong light material for construction.
- The program installed in the microcontroller had to make the foot respond like exactly like a real foot with about 2 degrees of freedom.

CAD Model



Updates

- Since the last presentation we have been able to design the framework for the test fixture that provided mechanical support for the steel frame & hydraulic cylinder
- The corners were resolved by using a 90° elbow pipe fitting to connect the pipes of the test fixture
- 2 bolts will be used to connect the fitting to the pipe on each end of the 3 elbow fitting through the pipes
- Regular steel pipes rather than threaded as it will complicate assembly
- A meeting with our client Dr. Tester was conducted on July 3rd to discuss our progress

Updates

- A more detailed CAD package
- Updated bill of material
- Updated website
- Updated Gantt chart
- Arduino was added to the device

Design Changes

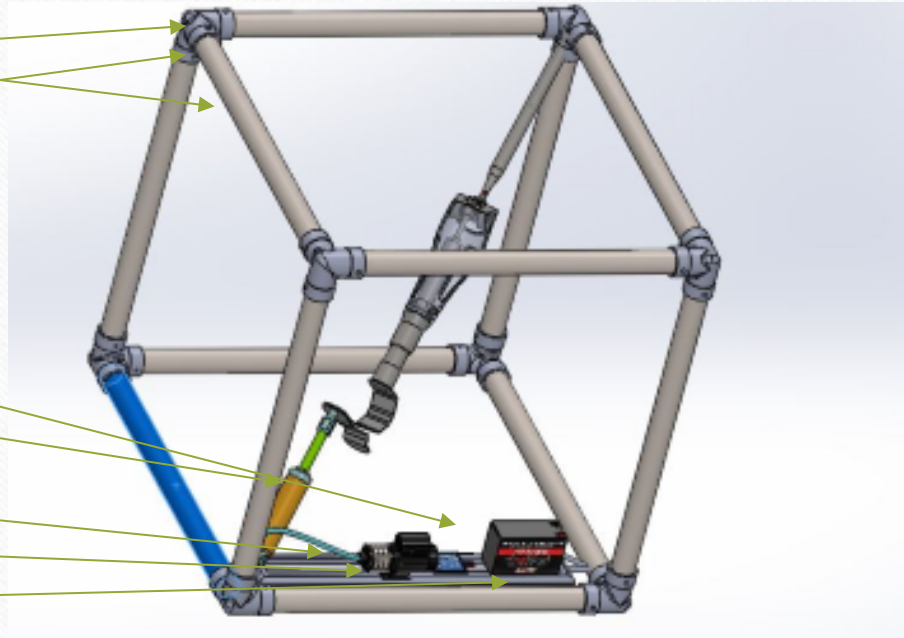
- The original design had our ends connected by welding
- Welding distorted the materials property and would cause alignment difficulties
- 3 sided 90° elbow fitting was used to connect the pipes rather than welding
- 1 bolt was to be inserted at each elbow and steel pipe
- To increase the frame support and increase stability of the fittings on pipe 2 bolts will be used rather than 1

Design Changes

- The original structural frame had two hydraulic cylinders for the power transmission in the body frame
- Since hydraulic cylinders are expensive, we made some changes to lower the total costs
- We connected one hydraulic cylinder at the lower part of the structural frame and the a steel pipe in the upper part

CAD Package Labeled

- Strain Steel
- Bolts
- Fittings
- MTU Controller
- Hydraulic Cylinder
- Cables
- Pump
- Battery



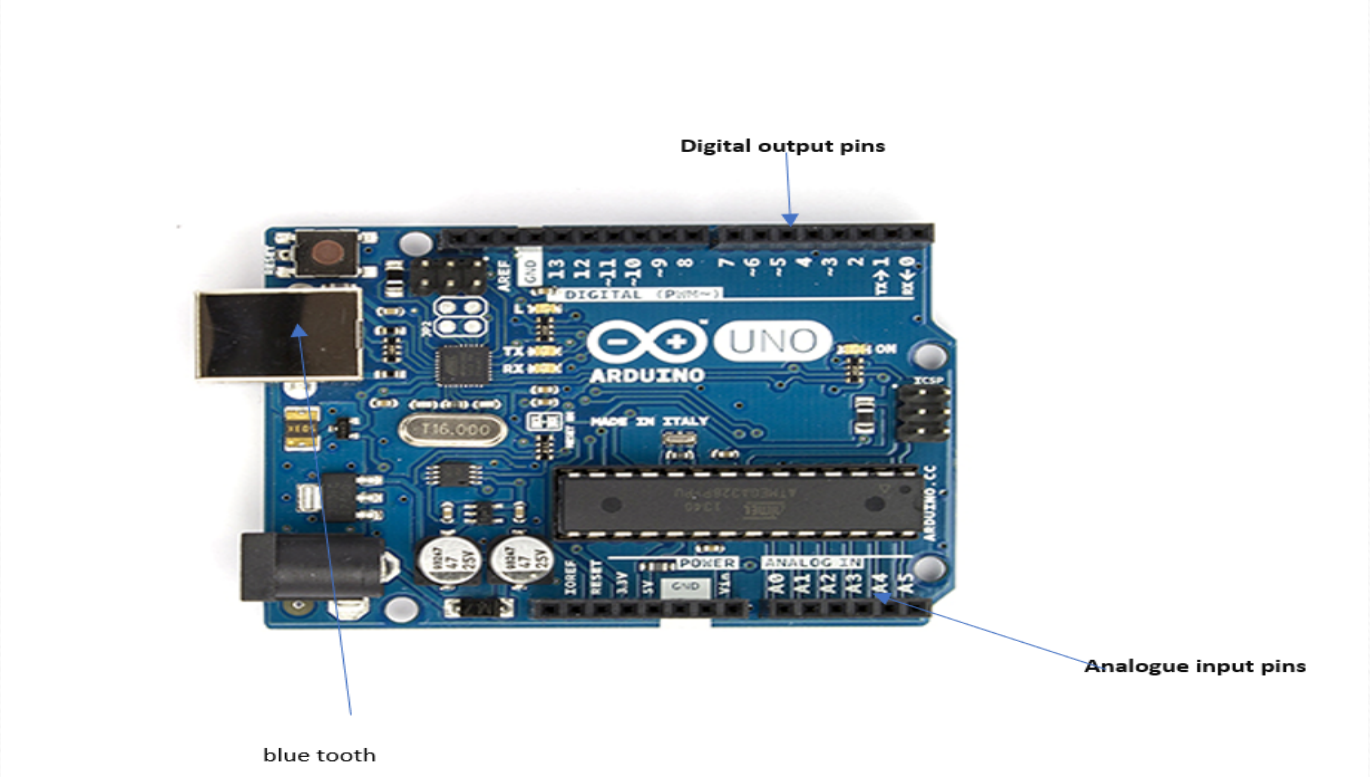
Manufacturing Design Of The Project

- The mechanical systems include a hydraulic cylinder, Steel frame and the bolts and fittings
- The main components in mechanical manufacturing includes the combination of the hydraulic cylinder and the steel frame which are responsible for generating torque that facilitate movements
- The main mechanical systems generate torque by working hand in hand with a electrical motor and sensor cables that helps us meet the programming specification

Mechanical Manufacturing

- The hydraulic cylinder is designed to withstand a weight of 130 kilograms
- To generate hydraulic power, an electric pump driven by motor is installed to help in the movement of the hydraulic cylinder. A tank acts as reservoir for the hydraulic fluid
- The hydraulic cylinder is controlled from the tip of the foot

Arduino Board and Microcontroller



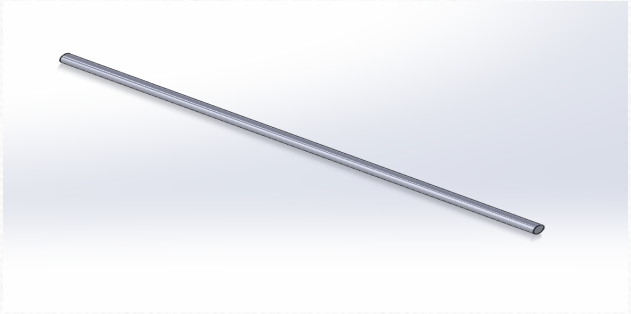
Analytical Analysis

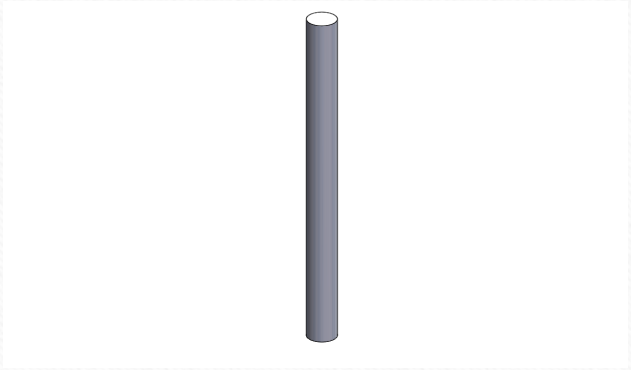
- Types of Materials
- Cost
- Forces acting on the prosthetic leg
- Battery Type
- Hydraulic Cylinder VS Electric motor

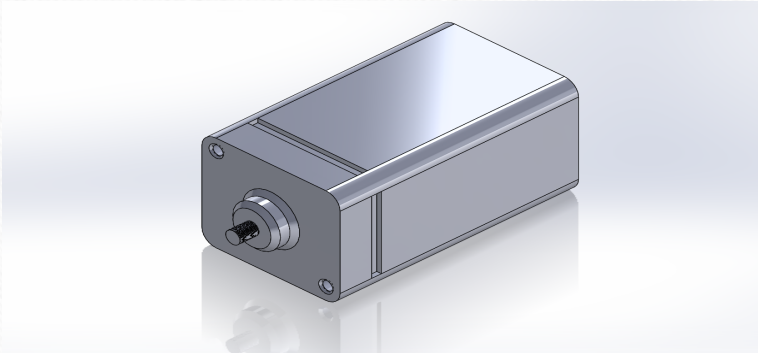
Moving Forward

- CAD package needs to be as precise as possible
- we need to fix the code and make sure that it will be able to control the device
- better understand the assembly of the test fixture
- need to have a precise report explaining the test fixture in detail as this is analytical project
- Find the correct wires and cables to connect all the devices together
- Find a better alternative to how the hydraulic cylinder and the steel pipe will connect on the main frame
- Testing procedures

Hardware 2

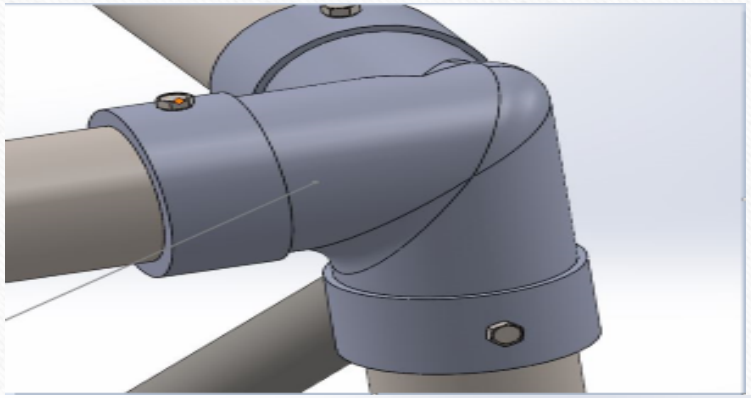


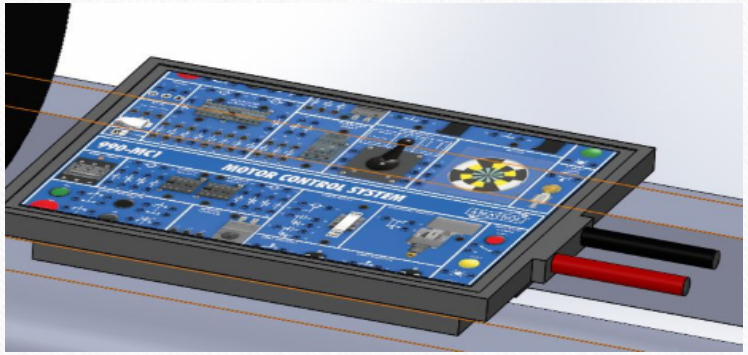


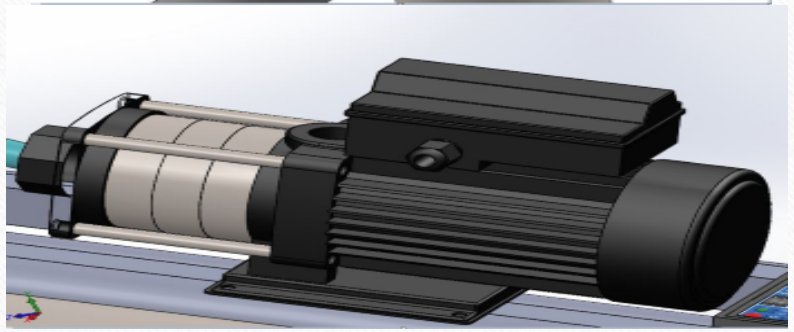



ANTIGRAVITY
LITHIUM-ION BATTERY
ATX-20
WITH
restart
TECHNOLOGY
680
Cranking Amps

Hardware 2







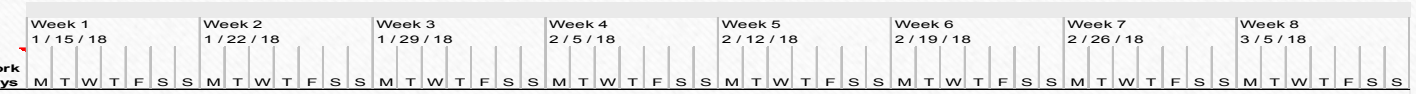
Gantt Chart

Biom Test Fixture

Gantt Chart Template © 2016 by Vertex42.com.
See info on Gantt Chart Template Pro

Project Lead: [John Tester]
Project Start Date: 1/16/2018 (Tuesday)
Display Week: 1

WBS	Task	Lead	Predecessor	Start	End	Cal. Days	% Done	Work Days
1	**[Task Category]**	[Name]						
1.1	Team Charter	[Name]		Tue 1/16/18	Wed 1/24/18	9	100%	7
1.2	Presentation			Fri 2/02/18	Mon 2/05/18	4	100%	2
1.3	Report 1			Tue 2/06/18	Tue 2/13/18	8	100%	6
1.4	Website 1			Tue 2/13/18	Thu 2/15/18	3	100%	3
1.5	Peer Eval 1			Tue 2/20/18	Thu 2/22/18	3	100%	3
1.6	Presentation 2			Mon 2/23/15	Fri 2/27/15	5	100%	5
1.7	Conceptual Report			Mon 2/23/15	Fri 2/27/15	5	100%	5
1.8	Analyses Memo			Mon 3/09/15	Fri 3/13/15	5	100%	5
1	**[Task Category]**							
1.1	Website 2			Wed 3/25/15	Fri 3/27/15	3	100%	3
1.2	Analytical Reports			Sun 3/29/15	Fri 4/03/15	6	100%	5
1.3	Peer Eval 2			Thu 4/09/15	Fri 4/10/15	2	100%	2
1.4	Presentation 3			Mon 4/13/15	Fri 4/17/15	5	100%	5
1	**[Task Category]**							
1.1	Final Report			Mon 4/13/15	Thu 4/23/15	11	100%	9
1.2	Website 3, BOM, CAD			Sun 4/26/15	Fri 5/01/15	6	100%	5
1.3	Peer Eval 3			Fri 5/01/15	Fri 5/01/15	1	100%	1
2	**Summer 2018**							
1.1	*Final Proposal Rewrite*			Mon 6/04/18	Wed 6/06/18	3	100%	3
1.2	*Individual Post Mortern*			Mon 6/04/18	Wed 6/06/18	3	100%	3
1.3	*Website Check 1*			Sat 6/07/18	Wed 6/13/18	7	100%	2
1.4	*HR1 Summary*			Fri 6/15/18	Wed 6/20/18	6	100%	5
1.5	*Peer Eval 1*			Tue 6/19/18	Wed 6/20/18	2	100%	1
1.6	*Individual Analysis II*			Fri 6/22/18	Wed 6/27/18	6	100%	6
1.7	*MidPiont Report*			Thu 6/28/18	Wed 7/06/18	7	100%	7
1.8	*Midsemester Presentation*			Fri 7/06/18	Mon 7/09/18	4	100%	4
1.9	*HR2 Summary*			Sat 7/07/18	Wed 7/11/18	5	0%	4
2	*Peer eval 2*			Tue 7/10/18	Wed 7/11/18	2	0%	1
2.1	*Drafts of poster, operation manual*			Wed 7/11/18	Wed 7/18/18	8	0%	7
2.2	*Website Check 2*			Thu 7/19/18	Wed 7/25/18	7	0%	2
2.3	*Final Poster*			Tue 7/26/18	Wed 8/01/18	7	0%	6
2.4	*Final Report, Website, Peer Eval, CAD*			Wed 8/01/18	Tue 8/07/18	7	50%	7



Student Names:
Marzouq Alenezi
Husain Alshammari
Saood Alenezi
Saoud Alenezi
Naser Alowaihan

Bill of Material

Part	Item	Manufacturer	Use	Retail Cost	Quantity	Total Retail Cost	Link
1	2" Stainless Steel Sch 40 pipes	Metals4UOnline.com[1]	Main body for the frame	$38.40	1	$38.40	https://www.metals4uonline.com/stainless-steel
2	MTU Controller	Amazon	Device embedded to operate the BIOM prototype by controlling the operating forces in the hydraulic cylinder and pneumatic actuator	$6	1	$6	https://www.adafruit.com/product/123
3	Pneumatic Actuator	Amazon	Device that controls mechanical power in the lower limb by using cylinders	$100	1	$100	https://www.amazon.com/DYNAQUIP-AP73SR4-PNEUMATIC-ACTUATOR-PHH28ATS064/dp/B06Y1H8CPY
4	Bolts	Amazon	2 bolts inserted at each end of every fitting to hold the frame togetherand support all loads exerted on the frame. Box of bolts	$32	48	$32	https://www.amazon.com/Deluxe-Hardware-Assortment-Professional-Washers/dp/B076CVQZWG/ref=s
5	Fittings	Amazon	to attach the 2" steel pipes to each other from 3 sides	$38	8	$304	file:///C:/Users/sa2432/AppData/Local/Downloads/B009HULJTK.htm
6	Hydraulic Cylinder	Festo	Pressure operated device connected to the microcontroller to control pressure in the lower limb	$146.45	1	$146.45	https://www.festo.com/cat/en-us_us/products_ADN_AEN_INCH
7	Cables	Amazon	to connect all our diveces together	$5.69	1	$5.69	https://www.amazon.com/Baomain-CS1-G-Magnetic-Pneumatic-Cylinder/dp/B01D9D8IFS/ref=sr_1_15?s
8	Pump	Amazon	Provides energy and forces to the hydraulic cylinder	$37.99	1	$37.99	11e8-8b8e-bbc6d9adcba6&pd_rd_w=pYq8L&pd_rd_wg=DxfDh&pf_rd_i=desktop-dp-sims&pf_rd_m=ATV
9	Arduino	Amazon	A device with a USB input, output pins, and a power jack-pin to provide power the MTU controller.	$14.00	1	$14.00	https://www.amazon.com/Arduino-Uno-R3-Microcontroller-A000066/dp/B008GRTSV6/ref=sr_1_3?ie=UT
10	Electric motor	Amazon	Device that converting electrical energy (current) to mechanical energy (torque)	$19.95	1	$19.95	https://www.amazon.com/KB-Electronics-8811012-Variable-K177-1005/dp/B0775LJCSJ/ref=sr_1_fkmr0_
11	Battery	Alibaba.com	Provides power for the microcontroller and motor	$45.60	1	$45.60	https://www.alibaba.com/product-detail/12-volt-lithium-battery-pack-12ah_60597066776.html?spm=a2
	Grand Total					$750.02	

References

- https://www.google.com/url?sa=i&rct=j&q=&esrc=s&source=images&cd=&ved=2ahUKEwiFz7X1_4rcAhUIwBQKHa1sA8sQ5TV6BAgBEAs&url=http%3A%2F%2Fmech.vub.ac.be%2Fmultibody%2Ftopics%2FProstheticDevices%2FAMP-Foot2.0%2FBioRob12.pdf&psig=AOvVaw1kYmoI4VXZ3p2ValkkfynO&ust=1530984500621030
- c Mak, Arthur FT, Ming Zhang, and David A. Boone. "State-of-the-art research in lower-limb prosthetic biomechanics-socket interface: a review." Journal of rehabilitation research and development 38.2 [2001]: 161-174. [http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.624.2246&rep=rep1&type=pdf]
- Sanders JE, Greve JM, Mitchell SB, Zachariah SG. Material properties of commonly-used interface materials and their static coefficients of friction with skin and socks. J Rehabil Res Dev 1998;35(2):161–76v
- Festo Hydraulic Cylinder selection Catalogue [Online]. Available: https://www.festo.com/cat/en_us/products_CDC?CurrentIDCode1=CDC-80-100-A-P-A-R&CurrentPartNo=543311 [Accessed Apr 23, 2018
- https://www.festo.com/cat/en-gb_gb/data/doc_ENGB/PDF/EN/CDC_EN.PDF [Accessed Apr 23, 2011

Thank You
Any Questions?