

Mechanical Hip Prosthetic

Project Management Assignment

Aiden Camisa, Project Manager | CAD Lead
Quinn O'Neill, Website Designer | Machinist
Matt Martinez, Fundraising Lead | Anatomical & ANSYS Lead
Victoria Lyon, Budget Liaison | Anatomical Lead

Fall 2025-Spring 2026



Project Sponsor: NextStep Prosthetics
Faculty Advisor & Sponsor Mentor: Dr. Dante Archangeli, Dr. Reza Razavian
Instructor: Professor David Willy

Reflection

• Project Management - Successes:

- Making connections with useful industry experts, clinics, and patients. Keeping these connections with project updates.
- Individuals in team were proactive with meeting with advisors for guidance and help during the project.
- Team meetings were usually set spontaneously and frequently, to ensure there was accountability and progress being made.
- Work delegation was effective and ensured each individual had something to do.
- Cost management during prototyping and components....

• Project Management - Room for Improvements/Action Items:

- Members were not always aware of individual meetings and new information.
 1. **That information will be more promptly relayed back to the team as opposed to next team meetings.**
- Inconsistent time management and intrinsic deadlines were rarely met.
 1. **More collaboration with project schedule**
 2. **Create week-to-week schedules that are regularly reviewed**
 3. **STICKING TO DEADLINES.**
- Decisions needed by advisors were usually shaky or uncertain
 1. **The team will be more decisive and firmer with decisions, so time is maintained.**
- Procurement of components were either late or last minute.
 1. **Sticking to and updating schedules, as well as creating a purchasing plan early, will ensure components are available when needed.**

• Remaining Design Efforts:

- Back-plate for prosthesis to provide more structural stability and protection
- Socket attachment design change for easier socket integration, and that is anatomically ergonomic.
- Power, control, and sensor placement
- Material finalization
- Machine element optimization

Gantt Chart

This is the team's updated Gantt Chart, which shows the major tasks and subtasks that have been or are expected to be completed by the first Hardware Status Update. The black line shows the amount of progress each task has made on it.

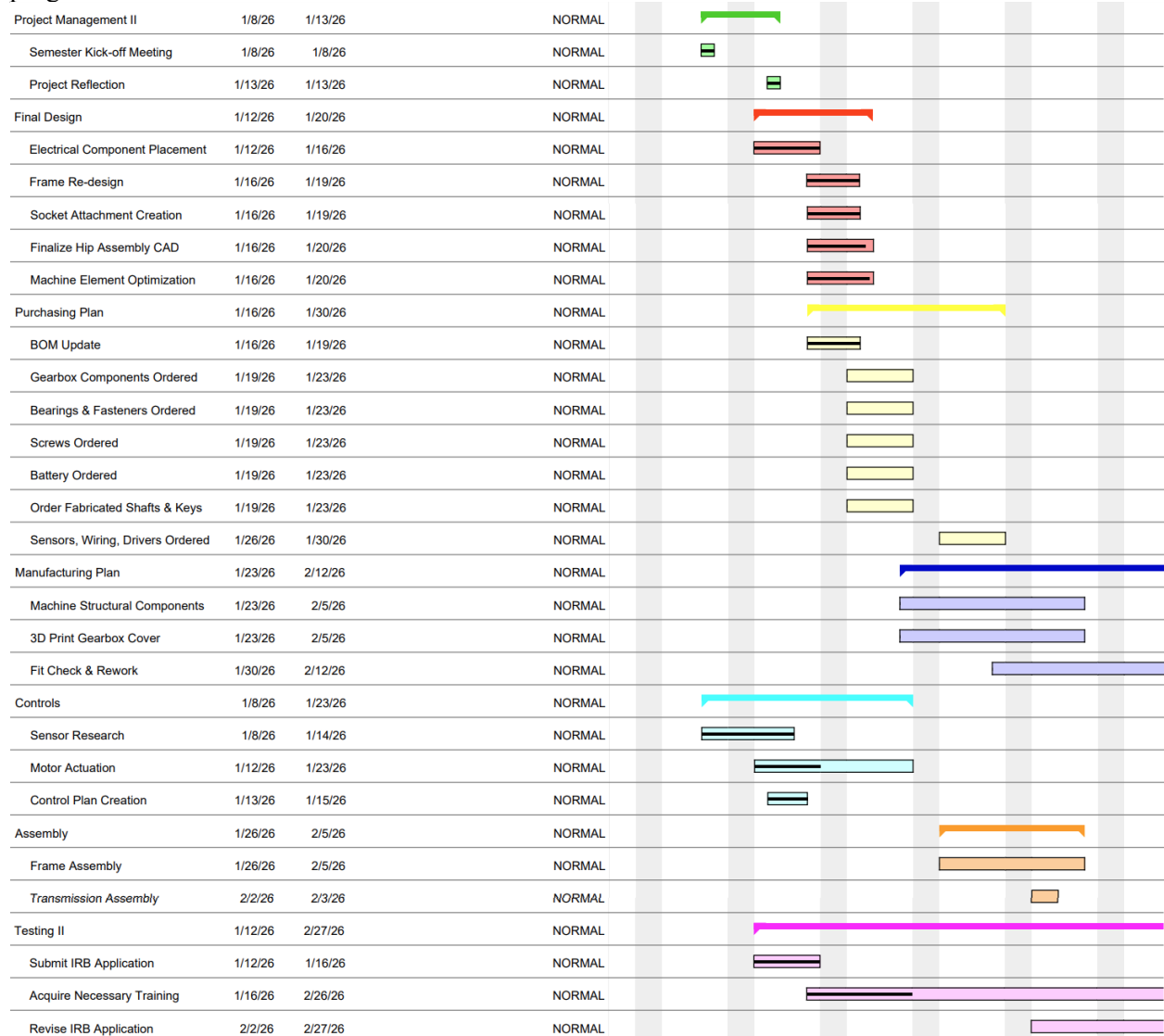


Figure 1: Gantt Chart Until First Hardware Status Update

● Project Management II	1/8/26	1/13/26	Normal
● Semester Kick-off Meeting	1/8/26	1/8/26	Normal
● Project Reflection	1/13/26	1/13/26	Normal
● Final Design	1/12/26	1/20/26	Normal
● Electrical Component Placement	1/12/26	1/16/26	Normal
● Frame Re-design	1/16/26	1/19/26	Normal
● Socket Attachment Creation	1/16/26	1/19/26	Normal
● Finalize Hip Assembly CAD	1/16/26	1/20/26	Normal
● Machine Element Optimization	1/16/26	1/20/26	Normal
● Purchasing Plan	1/16/26	1/30/26	Normal
● BOM Update	1/16/26	1/19/26	Normal
● Gearbox Components Ordered	1/19/26	1/23/26	Normal
● Bearings & Fasteners Ordered	1/19/26	1/23/26	Normal
● Screws Ordered	1/19/26	1/23/26	Normal
● Battery Ordered	1/19/26	1/23/26	Normal
● Order Fabricated Shafts & Keys	1/19/26	1/23/26	Normal
● Sensors, Wiring, Drivers Ordered	1/26/26	1/30/26	Normal
● Manufacturing Plan	1/23/26	2/12/26	Normal
● Machine Structural Components	1/23/26	2/5/26	Normal
● 3D Print Gearbox Cover	1/23/26	2/5/26	Normal
● Fit Check & Rework	1/30/26	2/12/26	Normal
● Controls	1/8/26	1/23/26	Normal
● Sensor Research	1/8/26	1/14/26	Normal
● Motor Actuation	1/12/26	1/23/26	Normal
● Control Plan Creation	1/13/26	1/15/26	Normal
● Assembly	1/26/26	2/5/26	Normal
● Frame Assembly	1/26/26	2/5/26	Normal
● Transmission Assembly	2/2/26	2/3/26	Normal
● Testing II	1/12/26	2/27/26	Normal
● Submit IRB Application	1/12/26	1/16/26	Normal
● Acquire Necessary Training	1/16/26	2/26/26	Normal
● Revise IRB Application	2/2/26	2/27/26	Normal

Figure 2: Focused Work Breakdown Structure

Top Level Finances

Budget Overview				
Budget		\$ 4,500.00		
Fundraising		\$ 1,750.00		
Expenses		\$ 2,118.53		
Available Balance		\$ 2,381.47		
FUNDRAISING LOG				
Date	Source	Amount (\$)	Type	Notes
Pending	i-Corp Aspire Course	\$ 3,000.00	Monetary	On hold, not included
10/29/2025	NextStep Prosthetics	\$ 1,500.00	In-Kind	Physical Lower Leg
11/5/2025	NextStep Prosthetics	\$ 50.00	In-Kind	3D Printing
11/24/2026	Professor Willy	\$ 200.00	In-Kind	Loaned 3D Printer and donated roll of filament for prototyping
EXPENSE LOG				
Date	Item	Amount (\$)	Vendor	Notes
PURCHASED				
10/27/2025	Adapter	\$ 3.21	NAU Surplus	
10/27/2025	Micro HDMI cable	\$ 31.81	BestBuy	
11/14/2025	AK80-64 Kv80 Motor	\$ 911.77	CubeMars	With driver board. Discount code
11/14/2025	RUBIK Link V2.0	\$ 40.00	CubeMars	Discount code
11/18/2025	CAN Bus HAT	\$ 39.99	Waveshare	
11/25/2025	36V Battery	\$ 32.83	Amazon	
11/26/2025	Battery Adapter	\$ 5.82	Amazon	
12/2/2025	Customs Fee	\$ 395.93	DHL	:(
Purpose	Item	Amount (\$)	Vendor	Notes
FUTURE PURCHASES				
Final Prototype (Physical)	7203 BTN1 Bearing	\$ 157.00	MiMotion	
	10H15L Gear	\$ 70.43	MRO Supply	
	10H15R Gear	\$ 70.43	MRO Supply	
	Upper Shaft		TBD	
	Lower Shaft		TBD	
	Retaining Ring	\$ 3.11	HomeDepot	
	Shaft Key		McMaster-Carr	
	Frame (Motor Side)	\$ 46.01	McMaster-Carr	
	Frame (Bearing Side)	\$ 31.55	McMaster-Carr	
	Mounting Bracket	\$ 21.83	McMaster-Carr	
	Bottom Bracket	\$ 16.02	McMaster-Carr	
	Male Pyramid Adapter	\$ 25.00	NextStep Prosthetics	
	Structure Enforcing Bar		McMaster-Carr	
Motor Testing	Power Supply	\$ 72.00	Amazon	
Final Prototype (Electrical)	Raspberry Pi	\$ 49.50	Adafruit	
	Adafruit CAN Controller	\$ 19.95	Adafruit	
	MicroSD Card	\$ 27.38	Adafruit	x2
	Buck Converter	\$ 15.99	Walmart	
	MPU Sensor	\$ 6.99	Amazon	
Testing & Programming	Breadboard Jumper Wire	\$ 10.99	Amazon	
	USB-C to USB-C	\$ 5.00	Amazon	
	USB to USB-C	\$ 7.99	Amazon	

Figure 3: Horizon Hip Current Budget

The figure above depicts the current budget, spending, and fundraising completed and planned by our team. The competition we will be participating in is not held in person, but rather a virtual submission and therefore does not incur any further costs.

Purchasing Plan

Hip Prosthetic Bill of Materials									
Main Assembly									
Item No.	Description	Primary Vendor	Unit Price	Quantity	Make/Buy	Manufacturer	Lead Time	Part Status	Link
1	AK80-64 KV80 Motor	CubeMars	\$ 911.77	1	Buy	CubeMars		Delivered	https://www.cubemars.com/
2	RUBIK Link V2.0	CubeMars	\$ 40.00	1	Make	CubeMars		Delivered	https://www.cubemars.com/
3	CAN Bus HAT	Waveshare	\$ 39.99	1	Buy	Waveshare		Delivered	
4	36V Battery	Amazon	\$ 32.83	1	Buy	Amazon		Delivered	
5	Battery Adapter	Amazon	\$ 5.82	1	Buy	Amazon		Delivered	
6	Adapter	NAU Surplus	\$ 3.21	1	Buy	N/A		Delivered	
7	Micro HDMI cable	BestBuy	\$ 31.81	1	Buy	Best Buy		Delivered	
8	7203 BTN1 Bearing	MiMotion	\$ 53.32	3	Buy	Timken	3-4 Weeks	TBO	https://www.motion.com/
9	10H15L Gear	MRO Supply	\$ 70.43	1	Buy	Boston Gears	2-3 Weeks	TBO	https://www.mrosupply.com/
10	10H15R Gear	MRO Supply	\$ 70.43	1	Buy	Boston Gears	2-3 Weeks	TBO	https://www.mrosupply.com/
11	Upper Shaft	TBD	Custom	1	Buy	TBD		TBO	
12	Lower Shaft	TBD	Custom	1	Buy	TBD		TBO	
13	Retaining Ring	HomeDepot	\$ 3.11	2	Buy	Hillman	1 Week	TBO	https://www.homedepot.com/
14	Shaft Key	McMaster-Carr		2	Make	NAU Machine Shop	3-4 Weeks	TBO	
15	Frame (Motor Side)	McMaster-Carr	\$ 46.01	1	Make	NAU Machine Shop	3-4 Weeks	TBO	https://www.mcmaster.com/
16	Frame (Bearing Side)	McMaster-Carr	\$ 31.55	1	Make	NAU Machine Shop	3-4 Weeks	TBO	https://www.mcmaster.com/
17	Mounting Bracket	McMaster-Carr	\$ 21.83	1	Buy	NAU Machine Shop	3-4 Weeks	TBO	https://www.mcmaster.com/
18	Bottom Bracket	McMaster-Carr	\$ 16.02	1	Make	NAU Machine Shop	3-4 Weeks	TBO	https://www.mcmaster.com/
19	Male Pyramid Adapter	NextStep Prosthetics	Donation	1	Buy	Donated	N/A	Delivered	
20	Structure Enforcing Bar	McMaster-Carr		1	Make	NAU Machine Shop	3-4 Weeks	TBO	
Hardware									
Item No.	Description	Primary Vendor	Unit Price	Quantity	Make/Buy	Manufacturer	Lead Time	Part Status	Link
1	M6-1x25 Bolt	HomeDepot	\$ 3.75	2 bags (4 bolts)	Buy	Everbilt	1 Week	TBO	https://www.homedepot.com/
2	M6-1x20 Connector Bolt	ACCU	\$ 0.89	2	Buy	ACCU	10 days	TBO	https://accu-compon.com/
3	M3x12 Socket Cap Head Screw	ACCU	\$ 0.23	8	Buy	ACCU	10 days	TBO	https://accu-compon.com/
4	M4x10 Socket Cap Head Screw	ACCU	\$ 0.24	6	Buy	ACCU	10 days	TBO	https://accu-compon.com/
5	M6x15 Countersunk Screw	ACCU	\$ 0.84	2	Buy	ACCU	10 days	TBO	https://accu-compon.com/
6	M3x20 Countersunk Screw	ACCU	\$ 0.68	4	Buy	ACCU	10 days	TBO	https://accu-compon.com/
Controls & Testing									
Item No.	Description	Primary Vendor	Unit Price	Quantity	Make/Buy	Manufacturer	Lead Time	Part Status	Link
1	Power Supply 60 V, 5A	Amazon	\$ 71.99	1	Buy	Jesverty	5 days	TBO	https://www.amazon.com/
2	Raspberry Pi	Adafruit	\$ 49.50	1	Buy	Adafruit	4 Weeks	TBO	https://www.adafruit.com/
3	Adafruit CAN Controller	Adafruit	\$ 19.95	1	Buy	Adafruit	2-3 Weeks	TBO	https://www.adafruit.com/
4	MicroSD Card	Adafruit	\$ 13.69	2	Buy	Adafruit	2-3 Weeks	TBO	https://www.adafruit.com/
5	Buck Converter	Walmart	\$ 15.99	1	Buy	YABOANG	1 Week	TBO	https://www.walmart.com/
6	Breadboard Jumper Wire	Amazon	\$ 10.99	1	Buy	TODOELEC	5 days	TBO	https://www.amazon.com/
7	MPU Sensor	Amazon	\$ 6.99	1	Buy	HiLetgo	5 days	TBO	https://www.amazon.com/
8	USB-C to USB-C	Amazon	\$ 5.00	1	Buy	Orseoose	5 days	TBO	https://www.amazon.com/
9	USB to USB-C	Amazon	\$ 7.99	1	Buy	Basesailor	5 days	TBO	https://www.amazon.com/

Figure 4: Horizon Hip Bill of Materials

Shown above is a comprehensive list of each component identified as necessary in order to be successful in manufacturing and testing our design. Items with the part status defined as delivered are in-hand and were previously purchased in 476C. Items with the status TBO (To Be Ordered) have not yet been purchased. Additionally, the BOM currently includes parts that are either factory-made or are to be made/manufactured by our team, indicated by the “Make/Buy” column. The cost of raw material is used for parts that are going to be made.

Based on the BOM, our team has identified the following key planning pieces:

1. Manufacturing planning and raw material purchasing
 - a. Coordinating Machine Shop Training, manufacturing and machining dates
2. Custom parts manufacturing
 - a. Small, complex parts are to be custom ordered for accuracy (upper and lower shafts)
 - b. Must research and obtain quotes from various manufacturers, accounting for lead times
3. Purchase electrical components as soon as possible
 - a. Necessary for motor control and programming, which is ongoing.

Manufacturing Plan

The manufacturing plan for this device will follow the steps and action items outlined below. It is important to recognize that these items are for right now and will adjust and change according to the time line of the purchase and shipping of the materials.

Total Sorted: Bill of Materials

Bill of Material	Description	Primary Vendor	Unit Price	Quantity	Make/Buy	Manufacturer	Start Date	Lead Time	Part Status	Link
1	AK80-64 KV80 Motor	CubeMars	\$ 911.77	1	Buy	CubeMars			Delivered	https://www.cubemars.com/
2	RUBIK Link V2.0	CubeMars	\$ 40.00	1	Buy	CubeMars			Delivered	https://www.cubemars.com/
3	CAN Bus HAT	Waveshare	\$ 39.99	1	Buy	Waveshare			Delivered	
4	36V Battery	Amazon	\$ 32.83	1	Buy	Amazon			Delivered	
5	Battery Adapter	Amazon	\$ 5.82	1	Buy	Amazon			Delivered	
6	Adapter	NAU Surplus	\$ 3.21	1	Buy	N/A			Delivered	
7	Micro HDMI cable	BestBuy	\$ 31.81	1	Buy	Best Buy			Delivered	
8	7203 BTN1 Bearing	MiMotion	\$ 53.32	3	Buy	Timken		3-4 Weeks	TBO	https://www.mimotion.com/
9	10H15L Gear	MRO Supply	\$ 70.43	1	Buy	Boston Gears	1/22/2026	2-3 Weeks	TBO	https://www.bostongears.com/
10	10H15R Gear	MRO Supply	\$ 70.43	1	Buy	Boston Gears	1/23/2026	2-3 Weeks	TBO	https://www.bostongears.com/
11	Upper Shaft	TBD	Custom	1	Buy	TBD	1/22/2026		TBO	
12	Lower Shaft	TBD	Custom	1	Buy	TBD	1/22/2026		TBO	
13	Retaining Ring	HomeDepot	\$ 3.11	2	Buy	Hillman	1/23/2026	1 Week	TBO	https://www.hillman.com/
14	Shaft Key	McMaster-Carr		2	Make	NAU Machine Shop	1/23/2026	3-4 Weeks	TBO	
15	Frame (Motor Side)	McMaster-Carr	\$ 46.01	1	Make	NAU Machine Shop	1/29/2026	3-4 Weeks	TBO	https://www.mcmaster.com/
16	Frame (Bearing Side)	McMaster-Carr	\$ 31.55	1	Make	NAU Machine Shop	1/30/2026	3-4 Weeks	TBO	https://www.mcmaster.com/
17	Mounting Bracket	McMaster-Carr	\$ 21.83	1	Buy	NAU Machine Shop	2/2/2026	3-4 Weeks	TBO	https://www.mcmaster.com/
18	Bottom Bracket	McMaster-Carr	\$ 16.02	1	Make	NAU Machine Shop	2/3/2026	3-4 Weeks	TBO	https://www.mcmaster.com/
19	Male Pyramid Adapter	NextStep Prosthetics	Donation	1	Buy	Donated		N/A	Delivered	
20	Structure Enforcing Bar	McMaster-Carr		1	Make	NAU Machine Shop	2/4/2026	3-4 Weeks	TBO	
21	M6-1x25 Bolt	HomeDepot	\$ 3.75	2 bags (4 bolts)	Buy	Everbilt		1 Week	TBO	https://www.homedepot.com/
22	M6-1x20 Connector Bolt	ACCU	\$ 0.89	2	Buy	ACCU		10 days	TBO	https://accu-components.com/
23	M3x12 Socket Cap Head Screw	ACCU	\$ 0.23	8	Buy	ACCU		10 days	TBO	https://accu-components.com/
24	M4x10 Socket Cap Head Screw	ACCU	\$ 0.24	6	Buy	ACCU		10 days	TBO	https://accu-components.com/
25	M6x15 Countersunk Screw	ACCU	\$ 0.84	2	Buy	ACCU		10 days	TBO	https://accu-components.com/
26	M3x20 Countersunk Screw	ACCU	\$ 0.68	4	Buy	ACCU		10 days	TBO	https://accu-components.com/
27	Power Supply 60 V, 5A	Amazon	\$ 71.99	1	Buy	Jesverty		5 days	TBO	https://www.amazon.com/
28	Raspberry Pi	Adafruit	\$ 49.50	1	Buy	Adafruit		4 Weeks	TBO	https://www.adafruit.com/
29	Adafruit CAN Controller	Adafruit	\$ 19.95	1	Buy	Adafruit		2-3 Weeks	TBO	https://www.adafruit.com/
30	MicroSD Card	Adafruit	\$ 13.69	2	Buy	Adafruit		2-3 Weeks	TBO	https://www.adafruit.com/
31	Buck Converter	Walmart	\$ 15.99	1	Buy	YABOANG		1 Week	TBO	https://www.walmart.com/
32	Breadboard Jumper Wire	Amazon	\$ 10.99	1	Buy	TODOLEC		5 days	TBO	https://www.amazon.com/
33	MPU Sensor	Amazon	\$ 6.99	1	Buy	HiLetgo		5 days	TBO	https://www.amazon.com/
34	USB-C to USB-C	Amazon	\$ 5.00	1	Buy	Orseoose		5 days	TBO	https://www.amazon.com/
35	USB to USB-C	Amazon	\$ 7.99	1	Buy	Basesailor		5 days	TBO	https://www.amazon.com/

Above this table is the total bill of materials put within a table, so you can sort the table as needed.

Just Manufactured Parts

Bill of Material	Description	Primary Vendor	Unit Price	Quantity	Make/Buy	Manufacturer	Start Date	Lead Time	Part Status	Link
14	Shaft Key	McMaster-Carr		2	Make	NAU Machine Shop	1/23/2026	3-4 Weeks	TBO	
15	Frame (Motor Side)	McMaster-Carr	\$ 46.01	1	Make	NAU Machine Shop	1/29/2026	3-4 Weeks	TBO	https://www.mcmaster.com/
16	Frame (Bearing Side)	McMaster-Carr	\$ 31.55	1	Make	NAU Machine Shop	1/30/2026	3-4 Weeks	TBO	https://www.mcmaster.com/
18	Bottom Bracket	McMaster-Carr	\$ 16.02	1	Make	NAU Machine Shop	2/3/2026	3-4 Weeks	TBO	https://www.mcmaster.com/
20	Structure Enforcing Bar	McMaster-Carr		1	Make	NAU Machine Shop	2/4/2026	3-4 Weeks	TBO	

Above in this table are just the manufacturing parts. This includes the frame for the motor and non-motor side, the shaft keys for our shafts, the bottom bracket, and the structural enforcing bar. Below in the elbow we can see a bullet list of what we may need additional focus and planning.

Additional Planning

- Multiple shaft keys for each shaft part
- Threading for each part of the frame.
- Structural Design of the enforcing bar and the attachments to the frame.
- Manufacturing of cutting the gears.
- Bottom bracket and possible load cell placement
- Upper half of the frame and possible IMU placement

- IMU could be placed on adjacent normal leg as a possible place as well
- Structure enforcing bar and making sure threads are correctly orientated.

Action Items

Number	Item	Individual	Date of expected completion
1	Order all parts that aren't ordered	Victoria	1/22/2026
2	Continuing electrical systems work	Quinn and Aiden	1/20/2026
3	Continue programing and decoding motor commands	Aiden and Quinn	1/20/2026
4	Communicate with vendors and manufacturers on possible prices and timeframe	Matt, Victoria, and others as needed.	1/20/2026
5	Talk to Perry Wood about design and making sure it is possible within the machine shop.	Matt	1/21/2026
6	Continuing shop training	All	1/20/2026
7	Divide up parts and manufacture them	All	2/13/2026

DEBUT Competition:

Our team intends to compete in the 2026 Design by Biomedical Undergraduate Teams (DEBUT) Challenge. The organizers have not posted any rules for this year's challenge as of yet, but our team will be basing our Capstone plan after last years posted rules. As this challenge is meant for undergraduate teams such as ourselves, our team doesn't have to change much of our Capstone II deliverables. Our team already meets the challenge requirements of being an undergraduate team of the right size that is working on a biomedical device. The only thing we will have to do is create a video showing off our team, our goal, and our working prototype.