

Knee Arthroscopy Manikin

Client: Corinne Henak

Consultants: Corinne Henak, Russ Johnson

Team: Shrey Ramesh (leader) Delaney Reindl (leader)
Jack Thurk (accountant) Connor Dokken (communicator)
Sierra Reschke (admin) Rachel Dallet (admin)

Status

Report Date: 03/14/2024

Next Milestone: Working Prototype

Deadline: 03/15/2024

Status: on schedule (green), deadline at risk (yellow), deadline unachievable (red)

Technical Summary

Important aspects of this past week include meeting with Dr. Johnson to discuss updates on the enclosure assembly and to receive feedback on the progress of each project division, attending BME Outreach, and preparing for Show and Tell 03/20.. For the bone team, both the stress analysis of the bones and the implementation of the wire attachment mechanism are still in progress. For the enclosure team, the first enclosure assembly was completed and the team was able to determine that in order for testing to progress and to have a functioning prototype, larger bags must be used and the femoral side of the enclosure frame needs to be altered. The femoral side of the frame contains a lip at the top that is too wide and tall to permit the bag from covering it. By removing this lip, the bag should fit easier and there should be more slack in the bag allotted for the flexion movement of the model. For the pump team, the reservoir was sealed and the new bubbler attachment was constructed. The reservoir and bubbler will be fasted together in order to test with the nitrogen and dissolved oxygen sensor. Going forward, each team will continue to work towards developing a working prototype that can be tested.

New Tasks

Bone Team

Task Name	Description and Concrete Outcome	Owner	Est. Time
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Update BME and ME websites	Add the progress reports to both the ME and BME websites. Update the project status as well.	RD	0.5 hr
Continue working through stress analysis	Talk to Dr. Henak at this week's meeting about what our next steps should be for the stress analysis.	RD	2 hr
Prepare for and give presentation	Meet with the group to assemble or prototype for our presentation on the 20th. Sierra and I need to find something to act in place of the live tissues. Practice going through our demonstration.	RD	2 hr
Finish outreach deliverables	For outreach, we need a report, activity guide, and presentation to submit to Dr. Puccinelli. Work with the BME side of the team on those items	RD	1.5 hr
Conduct wire testing	Wire testing was performed without the bone models last week. Now, perform wire attachment testing on the bone models. Record and analyze results	SGR	2 hrs
Continue stress analysis	Ask Dr. Henak about our current struggles with stress analysis. Continue to implement next steps and possible solutions.	SGR	1 hr
Find a valve for the probe port	Conduct research to find a one-way valve that will allow the probe to be inserted into the assembly and not allow water to leak.	SGR	1 hr
Prepare and practice presentation	Work with the team to create our demonstration presentation. Finish assembling the initial prototype and prepare a demonstration for peers.	SGR	2 hrs

Enclosure Team

Task Name	Description and Concrete Outcome	Owner	Est. Time
Meet with FC	Meet with Dr. Henak 03/13 to discuss enclosure assembly and design specifications relating to it.	DR	0.5 hr

Work on Outreach Deliverables	Attended Georgia O’Keefe Middle School and gave a presentation/complete biomechanics jumping activity with kids. Now must work to complete the associated deliverables.	DR	2 hr
Update enclosure assembly	Determine what <i>new</i> enclosure bags we want to use for the testing aspect of this project.	DR	0.5 hr
Prepare for Show and Tell Presentation	This presentation will take place on 03/20 and it will function to demonstrate our working prototype to our peers.	DR	3 hr
Connect the enclosure to the reservoir	Coordinate with the pump team to determine how the enclosure handles fluid flow.	SKR	3 hr
Redesign Femur and Tibia Enclosure	Redesign and reprint the femur and tibia enclosures to prevent light from entering at any point and include dedicated ports for scope insertion.	SKR	4 hr

Pump Team

Task Name	Description and Concrete Outcome	Owner	Est. Time
Create flow loop using entire model	Help with changes to the enclosure based on feedback from last week's meetings. Once necessary improvements are made, create the first flow loop using the entire system, including pumps, reservoir, and actual enclosure model.	CD	4 hr
Prepare for presentation	Determine how we plan to represent our model, what level of functionality we plan to show (just the components, all the components together, components together with water flowing, etc.). Practice the demo with the whole team. Presentation is wednesday at 4pm.	CD	2 hr
After testing adjustments	The reservoir will be tested on friday before the meeting with Jingyi. Once tested, there will be things that need to be adjusted and fixed to based on the testing results. Hopefully	JT	4 hr

	only minor fixes will be needed. If larger things need to be fixed, next week tasks will incorporate those tasks. Otherwise this next week will be dedicated to smaller fixes that will increase the reliability of the reservoir.		
Prepare for presentation	With the upcoming presentation this next week. I will help to prepare the pump system for showing our progress throughout the capstone project. I will also attend a peer review to ask questions and give advice for another group.	JT	2hr

Old Tasks

Bone Team

Task Name	Description and Concrete Outcome	Owner	Est. Time
Update BME and ME websites	Add the progress reports to both the ME and BME websites. Update the project status as well.	RD	0.5 hr
Continue working on the stress analysis	After emailing with Dr. Henak, we tried to use Gmesh instead of FEBio. Our computers still don't seem to be working with either software. I might need to go into an engineering lab and do it on one of those computers. I will also try her new suggestions: GIBBON and Tetgen.	RD	2.5 hr
Plan and attend our BME outreach activity	The BME side of the team signed up to run an activity at a local elementary school science fair. Meet with the team to figure out the details on that and go to the school on Tuesday, March 12.	RD	3 hr
Continue working on stress analysis	The .step file I downloaded from the SOLIDWORKS model does not open in either FEBio or gmesh due to the fillets. Dr. Henak suggested trying GIBBON or tetgen, which	SGR	2 hrs

	Rachel and I will both try to implement this week. We will continue to work with Dr. Henak as needed.		
Plan and prepare for outreach	Now that the team has our outreach date planned and have decided on an activity, we will work to write up a detailed outline and plan. We will also need to continue communicating with the event coordinator to ensure the supplies we need are either available or can be borrowed.	SGR	2 hrs
Attachment mechanism wire and prototype assembly	Work to implement the wire for the attachment mechanism and test its functionality. Work with the other teams to hopefully have a full initial prototype assembled for next Friday.	SGR	2 hrs

Enclosure Team

Task Name	Description and Concrete Outcome	Owner	Est. Time
Assist in enclosure assembly	Shrey and I will assemble the enclosure with the materials and frame. This will also involve ensuring the bones fit properly into the model.	DR	2 hrs
Help prepare/plan for outreach	We are deciding on what activity to go forward with for outreach.	DR	1.5 hrs
Attend BME Outreach	We will be attending our BME Outreach on 3/12. At this we will be presenting a biomedical engineering activity to children.	DR	2.5 hrs
Test Enclosure	Put the enclosure through standard use scenarios including bending and applied pressure	SKR	1 hr
Attend Outreach	Attend and participate in outreach at the middle school	SKR	2.5 hrs
Connect the enclosure to the reservoir	Coordinate with the pump team to determine how the enclosure handles fluid flow.	SKR	3 hrs

Pump Team

Task Name	Description and Concrete Outcome	Owner	Est. Time
Finish reservoir and bubbler	Finish sealing reservoir and constructing new bubbler	CD	1.5 hr
Test reservoir and bubbler	Communicate with Dr. Henak and test the reservoir / bubbler to see how long it takes to de-oxygenate water with nitrogen gas using our current bubbler	CD	2 hr
Help setup testing for whole system	Help set up and test the entire enclosure assembly and inserting the ports for the pumps. Set up pumps for testing with enclosure if testing is going well.	CD	2.5 hr
Fasten the bubbler to the bottom of reservoir	To disperse the nitrogen effectively, the bubbler might have to be fastened to the bottom of the reservoir to bubble the PBS from the ground up. To do this, a design, a possible ordering of materials, and a fabrication will be needed to secure the bubbler to the bottom of the reservoir. This task will be most effective once some testing is done with the more permanent bubbler, finished reservoir and Nitrogen testing.	JT	3 hr
Test the reservoir with nitrogen and the dissolved oxygen sensor.	Now that the reservoir has been fabricated, the bubbler will be fastened in a more permanent way to the bottom of the reservoir. Once fastened, the bubbler and reservoir should be tested with the Nitrogen source and Oxygen sensor to make sure that all runs well.	JT	3 hr

Technical Section

Author: Rachel Dallet

Plan and attend our BME outreach activity	The BME side of the team signed up to run an activity at a local elementary school science fair. Meet with the team to figure out the details on that and go to the school on Tuesday, March 12.	RD	3 hr
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The BME side of the group went to an elementary school on Tuesday evening to run through a biomechanics of jumping activity for the kids. Here is a link to our activity:
https://docs.google.com/presentation/d/1_VlxM7N4wZm5IIKgcW2UJVGz_3ZxlDd3nClaMqBGQ20/edit#slide=id.p

Plan and prepare for outreach	Now that the team has our outreach date planned and have decided on an activity, we will work to write up a detailed outline and plan. We will also need to continue communicating with the event coordinator to ensure the supplies we need are either available or can be borrowed.	SGR	2 hrs
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I prepared the last few slides of the presentation attached above, specifically the ones explaining why a higher jump is possible when you bend your knees more and which muscles/joints are used in bent leg jumps vs straight leg jumps. The team went to an elementary school on Tuesday night and interacted with kids for 90 minutes. We focused on having them jump normally, asking how they think they could jump higher, then explaining a brief overview of the biomechanics behind jumping. It was very rewarding to see how engaged they were and how much fun they had seeing how high they could jump.

Author: Delaney Reindl

Assist in enclosure assembly	Shrey and I will assemble the enclosure with the materials and frame. This will also involve ensuring the bones fit properly into the model.	DR	2 hrs
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On Friday 03/08 Shrey and I assembled the enclosure with a strip of silicone, press-to-close bag, and duct clamp. From this initial attempt we were able to determine that the press-to-close bag is too short to cover both lips of the frame, which will cause leakages. From this we were able to

determine that we need to get larger bags and potentially consider reprinting the femoral side of the frame to remove the lip.

Help prepare/plan for outreach	We are deciding on what activity to go forward with for outreach.	DR	1.5 hrs
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Helped work on the BME Outreach presentation that was presented to elementary/middle schoolers. This activity largely focused on displaying and explaining the biomechanics behind jumping.

Attend BME Outreach	We will be attending our BME Outreach on 3/12. At this we will be presenting a biomedical engineering activity to children.	DR	2.5 hrs
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Attended Georgia O'Keeffe Middle School where we had elementary/middle schoolers participate in a jumping activity. We explained the biomechanics behind jump height when legs are at maximum knee flexion vs completely straight.

Finish reservoir and bubbler	Finish sealing reservoir and constructing new bubbler	CD	1.5 hr
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Reservoir was fully sealed and new bubbler was made this week.

Test reservoir and bubbler	Communicate with Dr. Henak and test the reservoir / bubbler to see how long it takes to de-oxygenate water with nitrogen gas using our current bubbler	CD	2 hr
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Marked as green as the reservoir and bubbler will be tested in Dr. Henaks lab tomorrow morning prior to our afternoon meeting.

Test Enclosure	Put the enclosure through standard use scenarios including bending and applied pressure	SKR	1 hr
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The enclosure was assembled with Delaney and underwent preliminary evaluation. We

Redesign and Fabrication	X	X	X	X														
Presentations				X														
Working Prototype Demonstration																		
Redesign						X	X	X										
Fabrication						X	X	X										
Presentation and Demonstration																		
Final Presentation																		
Testing																		
Report																		
Presentation																		

X = Completed Tasks, O = Milestone Deadlines