Team Meeting 1

September 10th, 2018
Meeting Time: 1pm-2pm
Where: EGR
Members Present: Abdulla, Ebrahim, Leah, Dominic

1pm
The team met at 1pm in the engineering building to discuss the first assignment due on September 12th - Project Team Charter assignment.

1:05pm
The team formulated the first email with the client about times to meet and what is to be discussed in the first meeting with the client. This included project description, budget, customer requirements, and deliverables the client will need throughout the course of the project.

1:15pm
The team then looked over the team charter and reviewed what was the next deliverable - presentation.

2pm
The next meeting is scheduled for tonight after the capstone lecture

Team Meeting 2

September 10th, 2018
Meeting Time: 6:30pm-7pm
Where: EGR 108
Members Present: Abdulla, Ebrahim, Leah, Dominic

Monday night CAPSTONE class meeting with Oman

6:30pm
Discussed what needed to be included in the upcoming client presentation such as customer requirements, engineering requirements, house of quality.

6:45pm
Some customer needs the team discussed was:

Customer Requirements	**Engineering Requirements**
weight restriction	Less than 1 kg
comfortable/minimize skin irritations	Materials, distributed pressure, material must yield this much, friction
quick/easy attachment/detachment	30 or so seconds
Height adjustment	0.5 feet depending on patient/tester
durability	Strength of material, force it can withstand
portable	Does it come apart, dimensions
Bio compatible	
Made from hypoallergenic materials	
budget	$$$

6:55pm
The next meeting is scheduled for September 15th at 5pm.

Team Meeting 3

September 15th, 2018
Meeting Time: 5pm-5:45pm
Where: EGR 108
Members Present: Abdulla, Ebrahim, Leah, Dominic

5pm
The team met in engineering at 5pm to discuss guidelines for the upcoming presentation. The team looked at the rubric and organized the presentation slides.

5:10pm
The team split up each slide and tasks. The slides are as follows:
Client Stakeholder slide: Abdulla
Project Description: Ebrahim
Background and Benchmarking: Dominic
Customer and Engineering Requirements: Leah
House of Quality: Abdulla
Schedule and Budget: Ebrahim

5:10-7pm
The team met for 2 hours and worked on the powerpoint as a team, outlining and organizing all the information. The team decided to work on individual slides after the meeting and agreed to meet up again on the 16th to discuss the presentation and practice.

Team Meeting 4

September 16th, 2018
Meeting Time: 5pm-6pm
Where: EGR 108
Members Present: Abdulla, Ebrahim, Leah, Dominic

5pm
The team met at 5pm in the Engineering building to discuss the presentation. The QFD/House of Quality was finalized.

5:45pm
The team practiced the presentation and assigned group members to talking about certain slides

Client/Stakeholder: Abdulla
Project Description: Abdulla
Background and Benchmarking: Dominic
Design Requirements: Dominic
Customer requirements/Engineering Requirements: Leah
QFD: Leah
Schedule and Budget: Ebrahim

Team Meeting 5

September 28th, 2018
Meeting Time: 10am-11am
Where: DuB
Members Present: Abdulla, Ebrahim, Leah, Dominic

The team met at the Dub friday morning at 10 am. The team discussed upcoming assignments such as the peer eval due next friday and the upcoming report.

10:10am
The team is to come up with 20 different concepts for a possible Biom Prosthesis adaptor. At least two ideas are supposed to be bio inspired design. The team has decided to all come up with five different concepts over the weekend and come to the weekly monday meeting with all five concepts where they will be organized and talked about. The team will then take part in coming up with concepts as a group using a modified 6-3-5 method. The goal is to have all 20 or so concepts by monday so the team can start to narrow down the concept ideas through the use of a Pugh chart and Decision matrix.

10:20am
The different things the team needs to complete and have documented in the report include:

- Project Description
- Customer and Engineering requirements
- Testing Procedures
- House of Quality (HoQ)
- Existing designs and benchmarking research
- 20 different concepts: 10 top concepts located in the report
- Functional Decomposition: Black Box Model and Functional Model
- State and explain why the final design was chosen

10:30am
The upcoming presentation will require:

- Black box model and functional model
- Samples of designs
- Overview of designs, build model of best design and list advantages and disadvantages of design
- Show pugh chart and decision matrix
- Update schedule and budget.

The team has decided to work first on the presentation and then relay designs and information to the report. This meeting was to outline the next few weeks and to organize all the tasks that need to be completed for the preliminary report and presentation.

Things to be completed before next meeting include coming up with 5 concepts over the weekend and sketching them out so they the team is able to start using a pugh chart and decision matrix to narrow down concepts.

10:45pm
After outlining the next few weeks and organizing team tasks, the team started a rough draft of the black box models so members have a rough idea of what the device is to do when they brainstorm concepts before the next meeting.

Figure 1 shows the rough draft black box model the team brainstormed during the meeting.

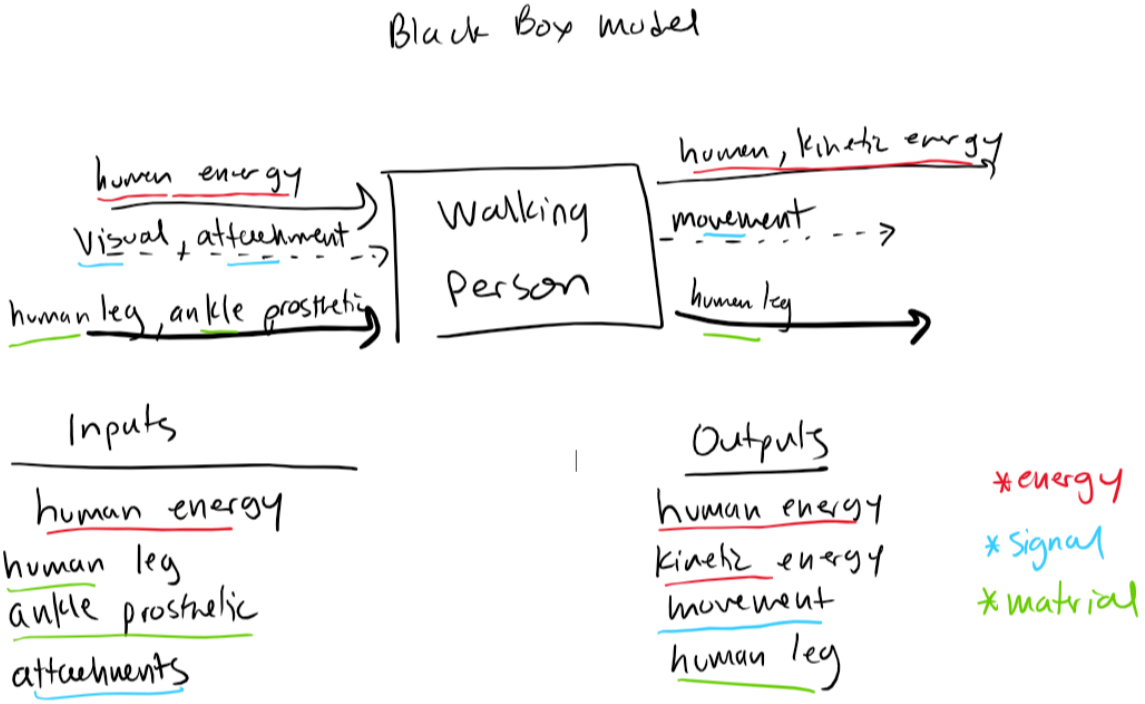


Figure 1: Rough draft of the black box model for material, signal, and energy.

The team met for roughly an hour and outlined the next few weeks in terms of concept generation, black box and functional model, and outlining the report and presentation.

Team Meeting 6

October 5th, 2018
Meeting Time: 1pm-2pm
Where: EGR 108
Members Present: Abdulla, Ebrahim, Leah, Dominic

1pm
The team met at 1pm to discuss the concepts generated and start the elimination process. Everyone in the team came up with 5 different concepts and brought them to the meeting. The team met for the first 20 minutes outside to brainstorm bio-inspired design concepts, then took the meeting indoors to start the pugh chart and decision matrix.

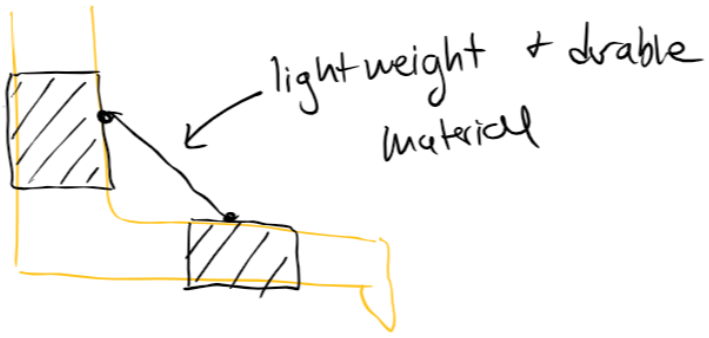
1:20pm
The team used a 4-3-3 method and split the design up into 3 components - Pylon/leg attachment and how the pylon will attach to the socket, Adjustable pylon, and the socket. Each member of the group came up with 3-4 ideas and then put the different ideas in a Pugh chart to determine what concepts would be best for the 3 specified categories.

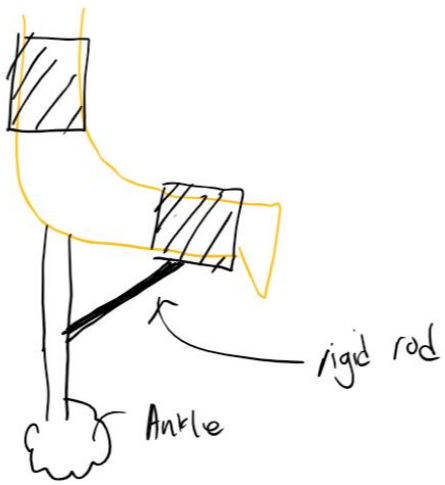
1:45pm
Over the weekend, the team has split up tasks to be completed before the Monday meeting. Dominic will research and complete the benchmarking for the upcoming report and presentation, Ebrahim complete the Pugh Chart, Abdulla will complete the Decision matrix, and Leah will work on the black box and functional model.

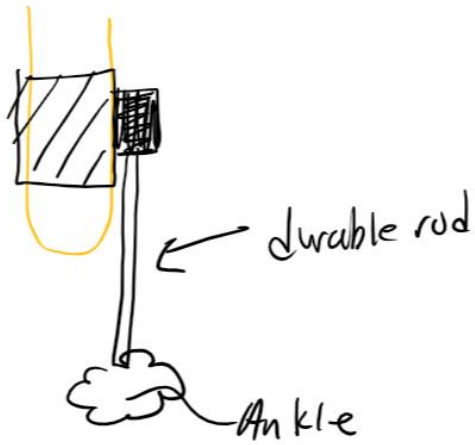
The goal is to have all individual/team tasks done by the next team meeting (October 8th).

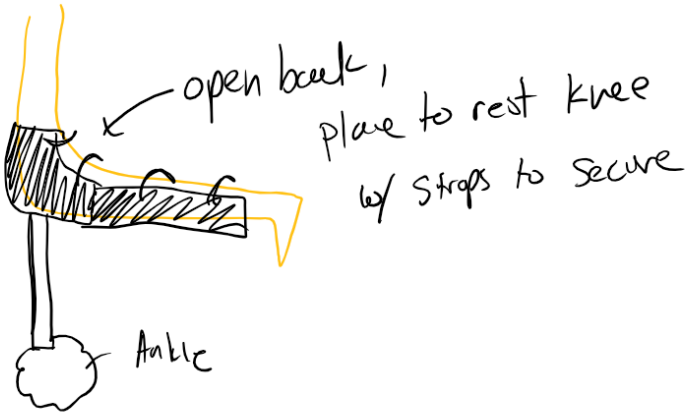
Separate designs from team members are shown below in the figures.

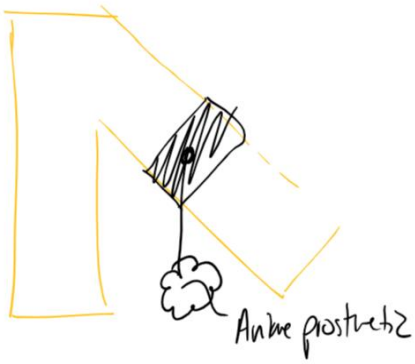
Leah full designs

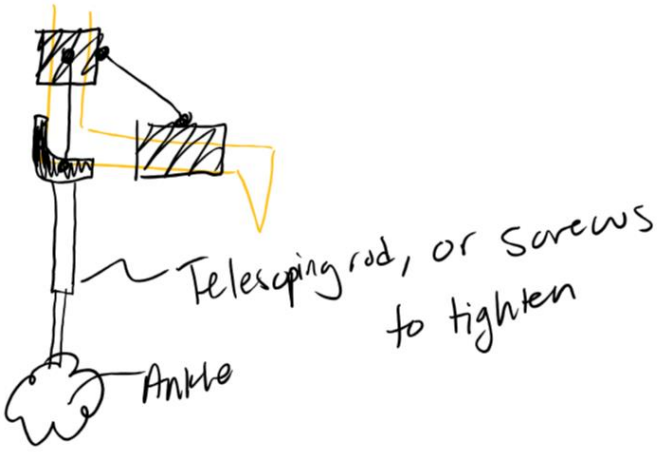


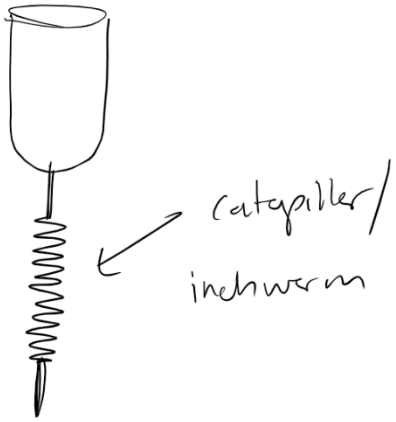

rigid rod
Ankle

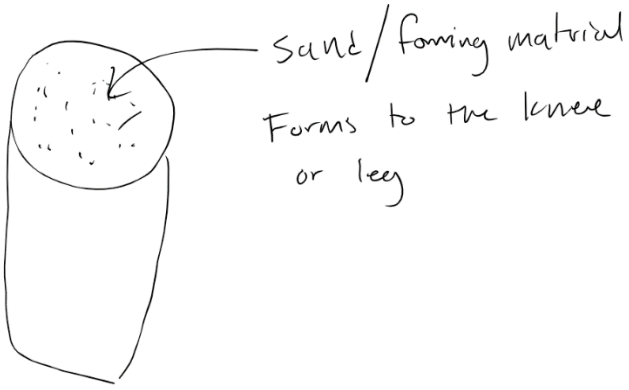

durable rod
Ankle

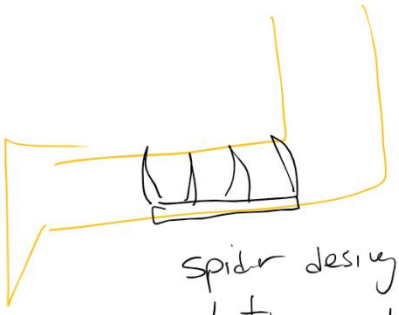

open back,
place to rest knee
w/ straps to secure
Ankle


Ankle prosthesis

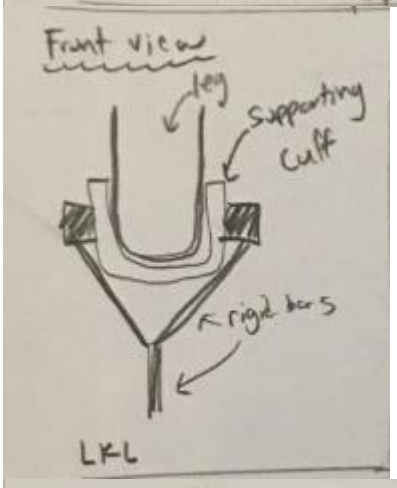

Telescoping rod, or screws
to tighten
Ankle

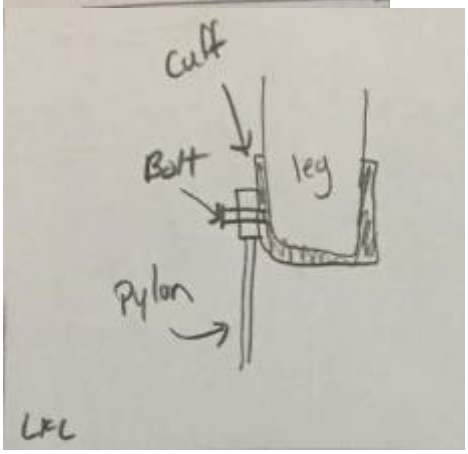

caterpiller/
inchworm

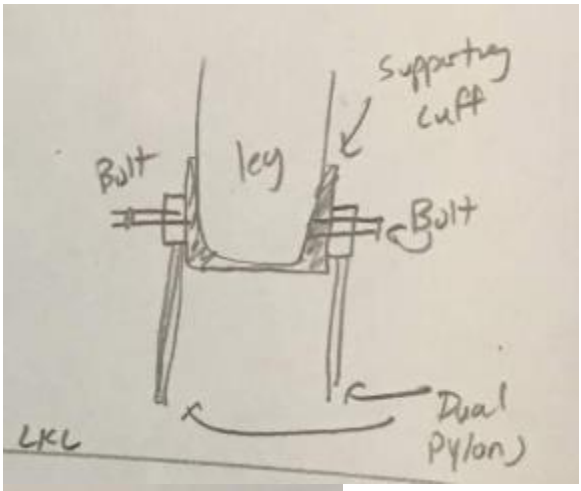

Sand/foaming material
Forms to the knee
or leg

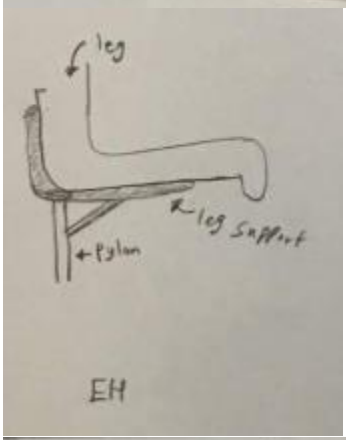

spider design.
Latch on to leg

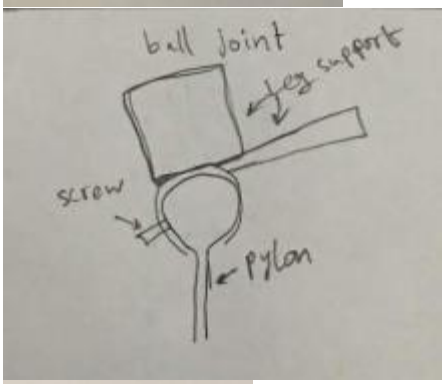

leg
leg support
pylon

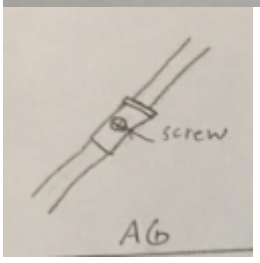

Front view
leg
Supporting Cuff
right bars
LKL

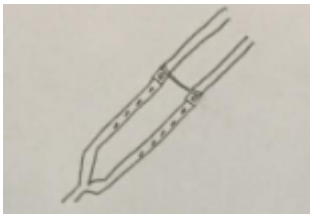

Cuff
Bolt
leg
Pylon
LKL

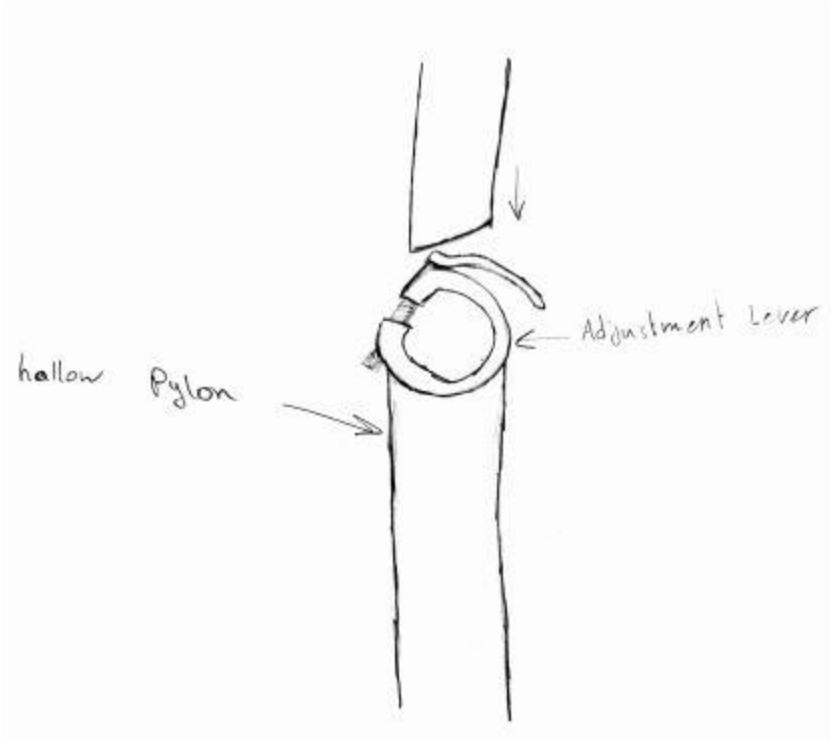

Supporting cuff
Bolt
leg
Bolt
Dual Pylon)
LKL

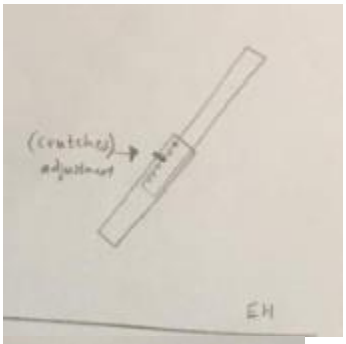

leg
leg support
Pylon
EH


ball joint
leg support
screw
Pylon

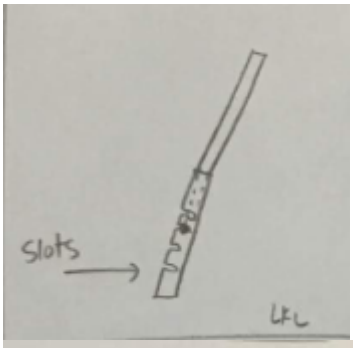

screw
AG

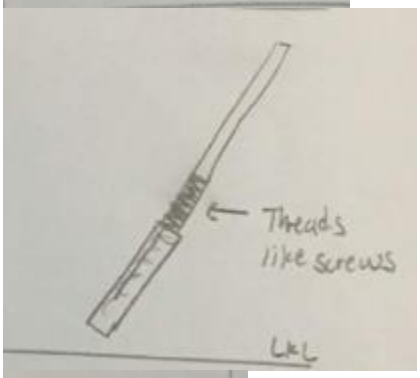


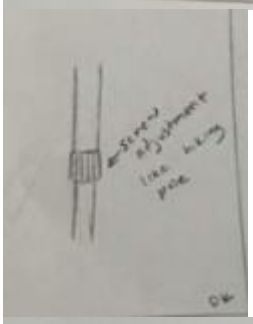

hollow Pylon
Adjustment Lever

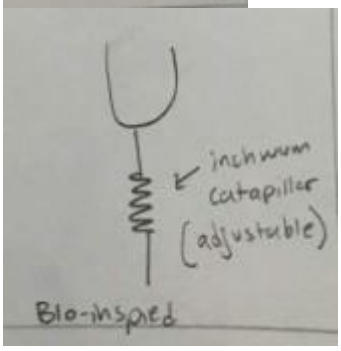

(crutches) adjustment
EH

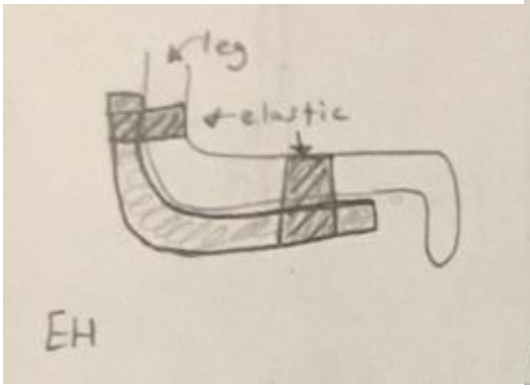

Telescoping rod
(curtains)


Slots
LFL

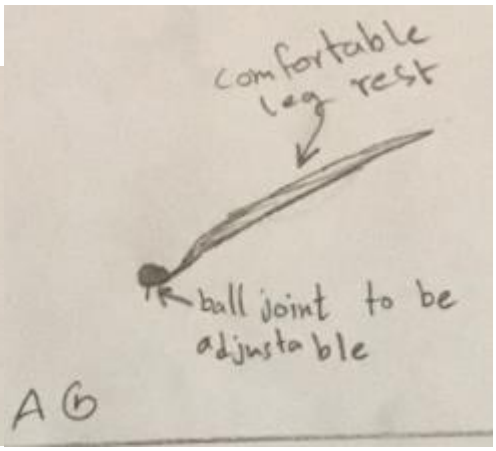

Threads like screws
LKL


Screw adjustment like pole
OK

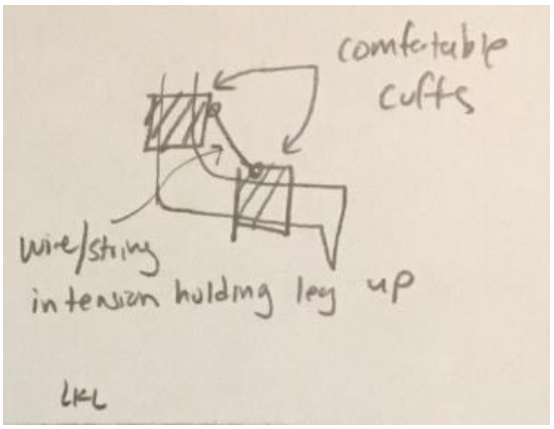

inchworm catapiller (adjustable)
Bio-inspied


leg
elastic

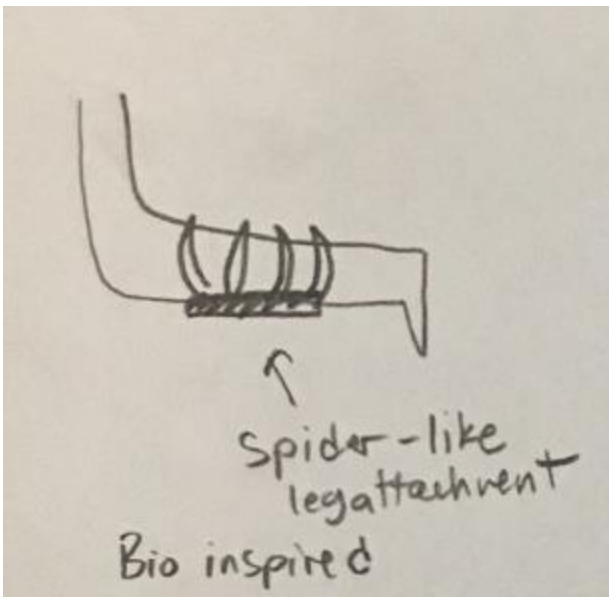
EH

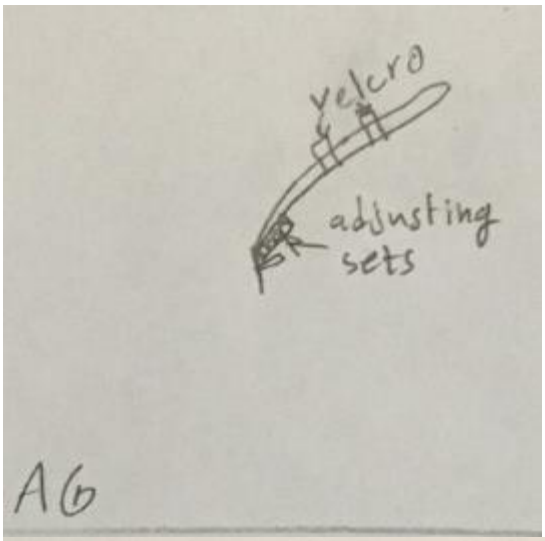

comfortable leg rest
ball joint to be adjustable

AG

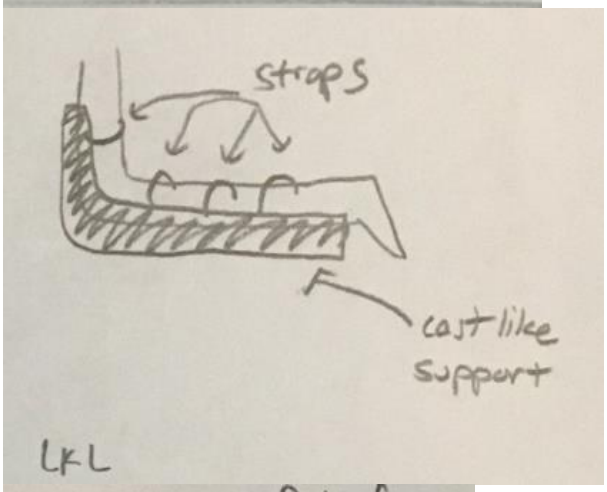

comfortable cuffs
wire/string in tension holding leg up

LKL

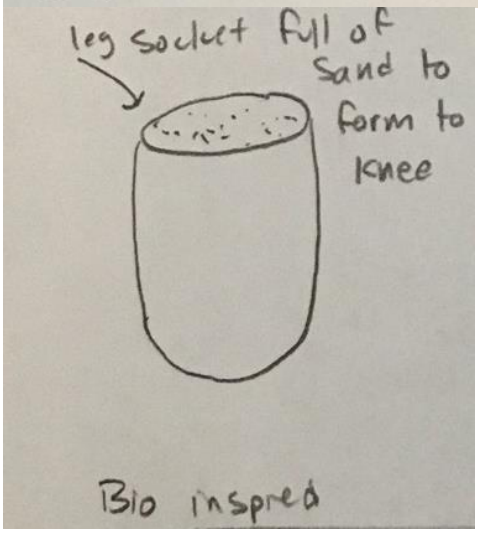

spider-like leg attachment
Bio inspired



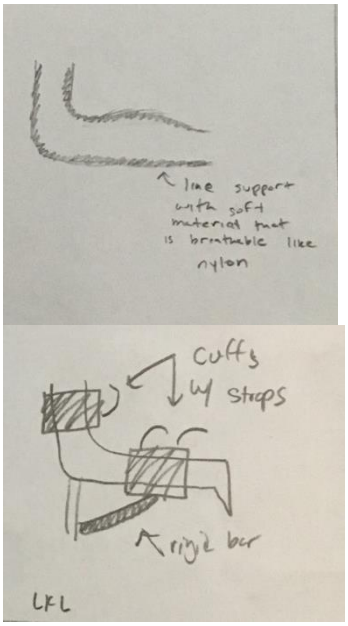
AG



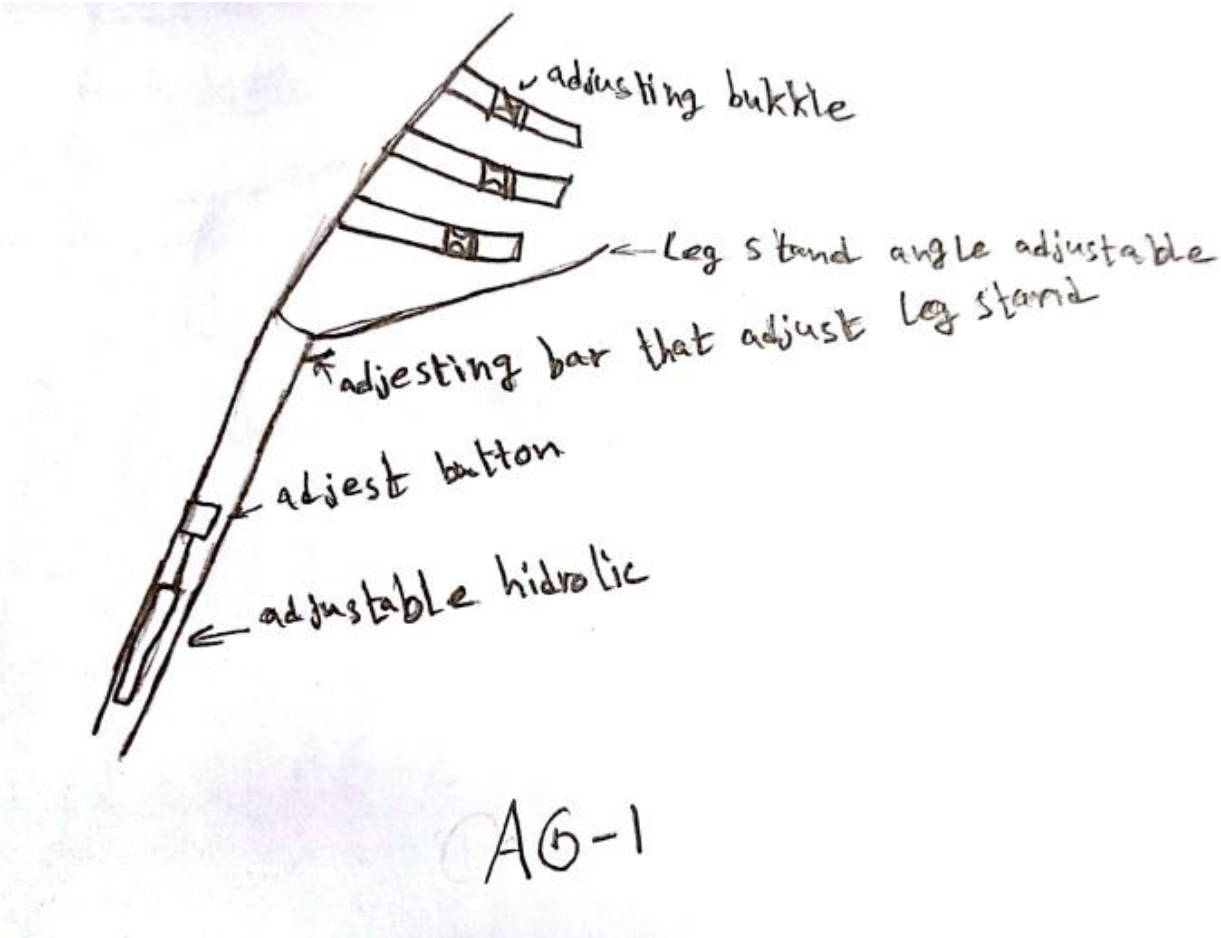
LKL



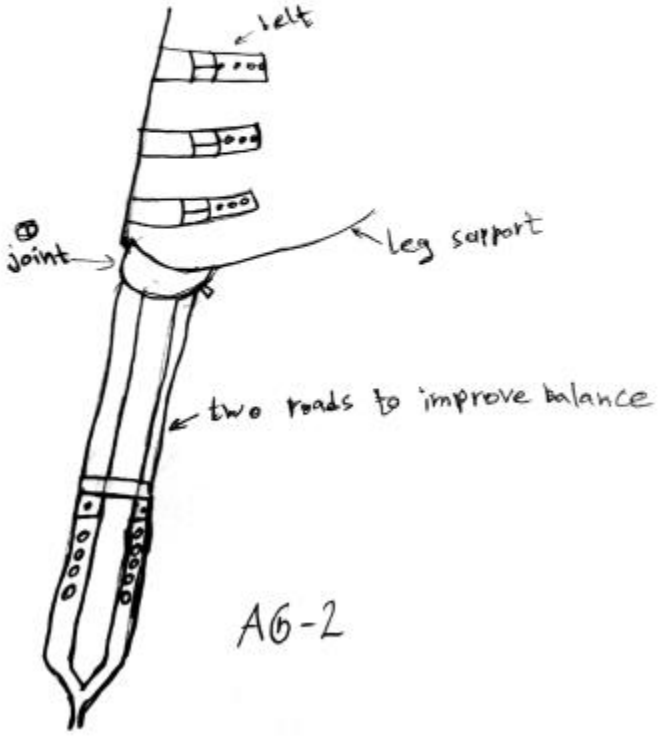
Bio inspred



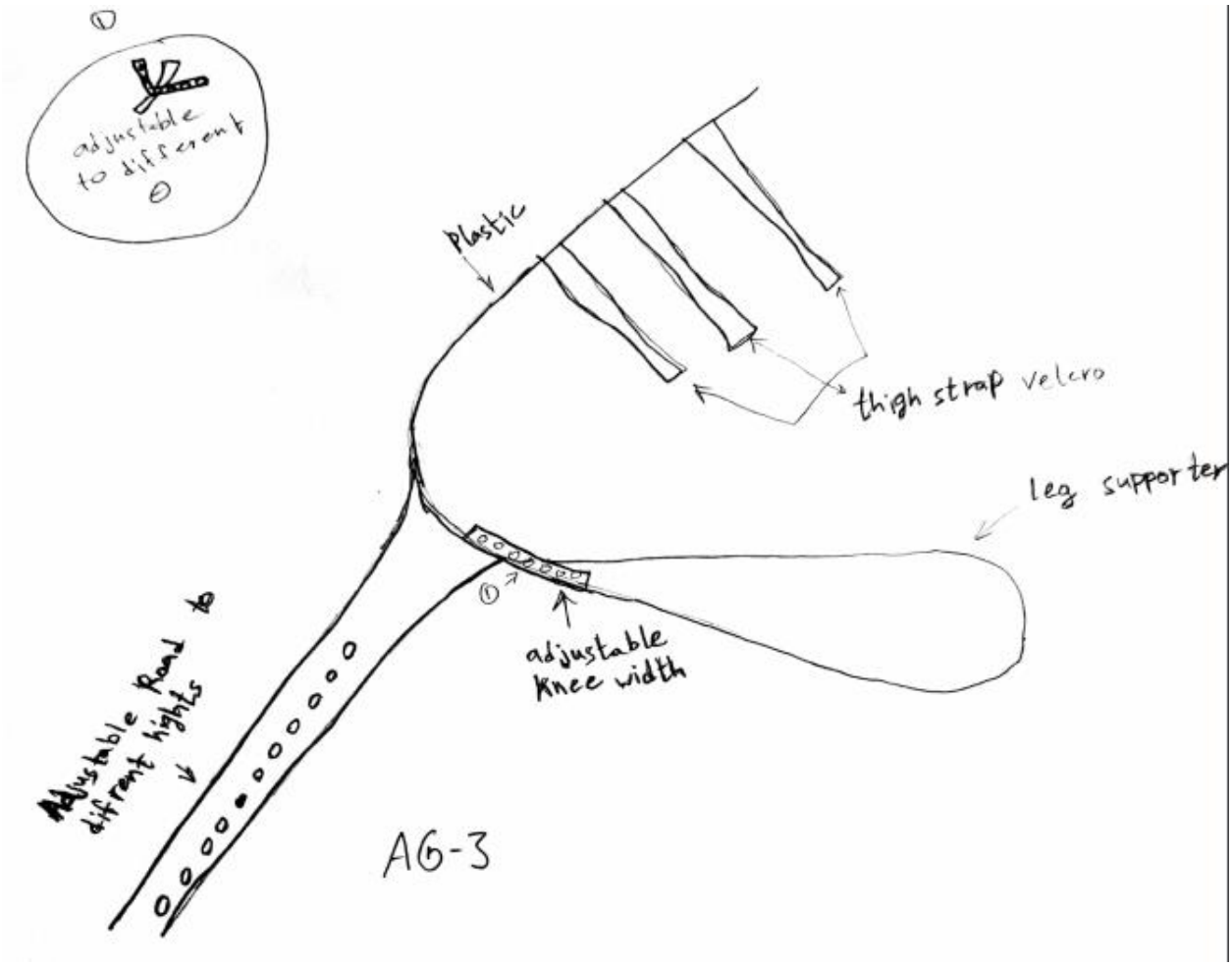
Abddulla full designs

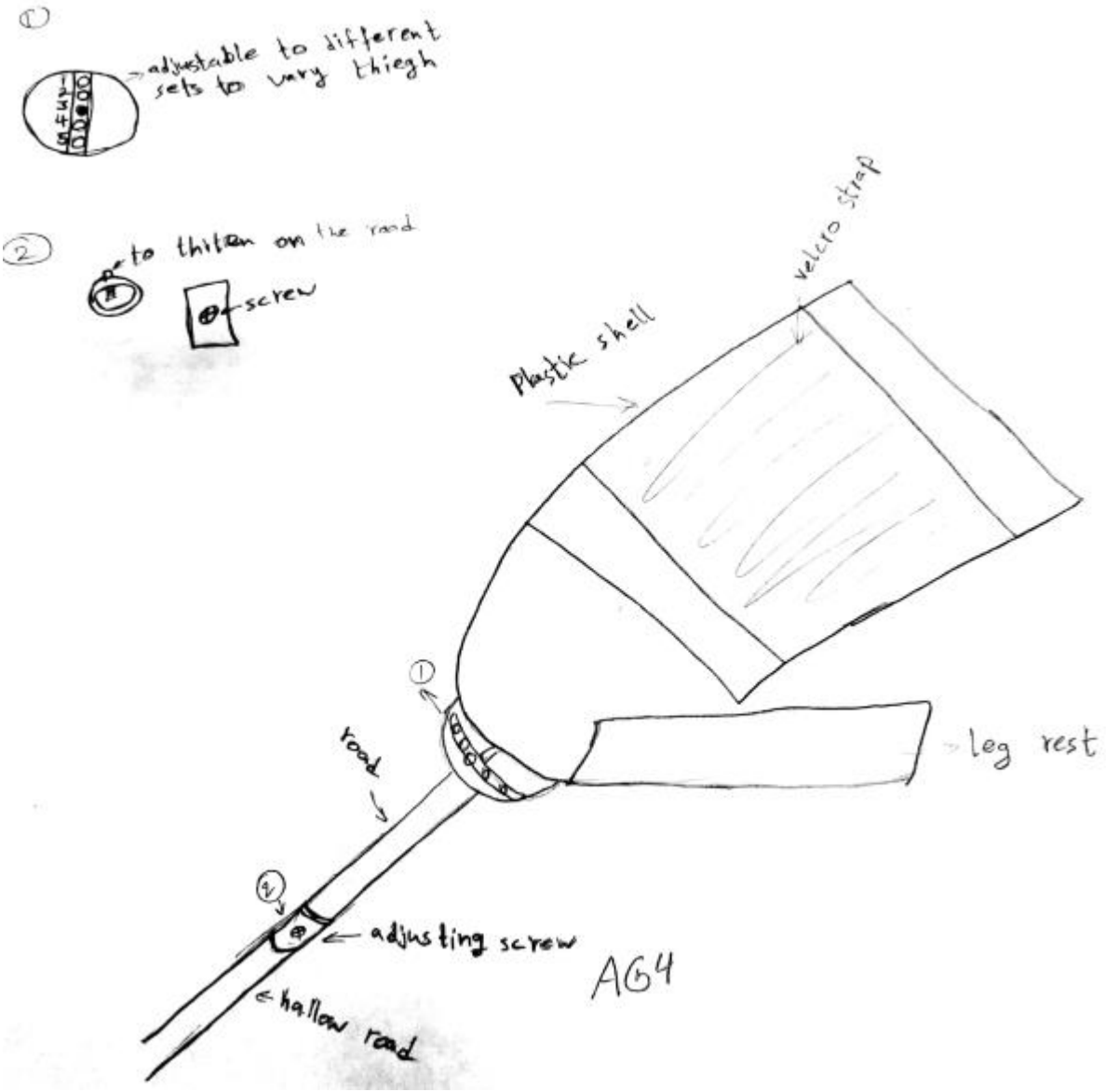

adjusting bukkle
Leg stand angle adjustable
adjesting bar that adjust leg stand
adjest button
adjustable hidrolic

AG-1

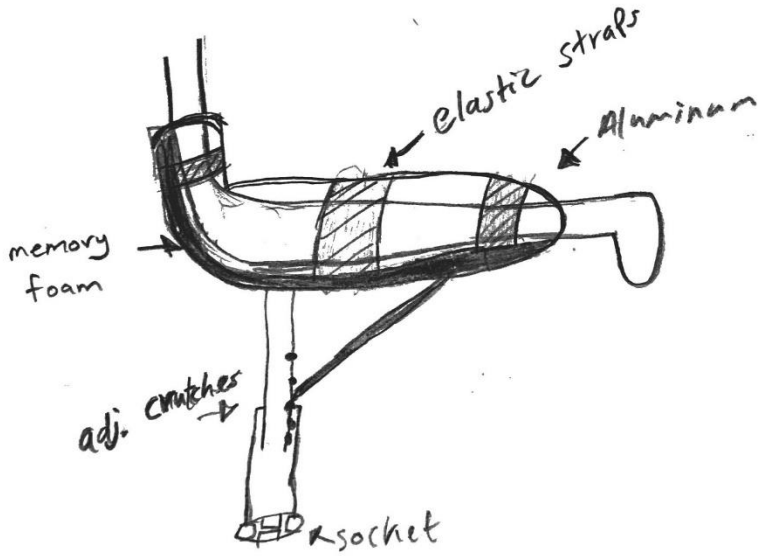


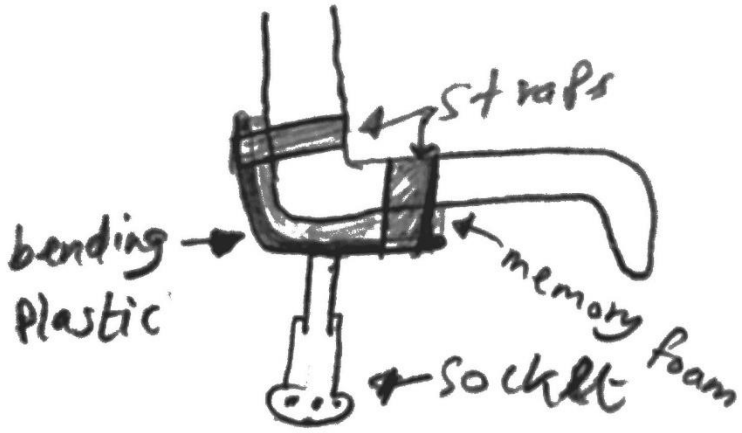
A6-2

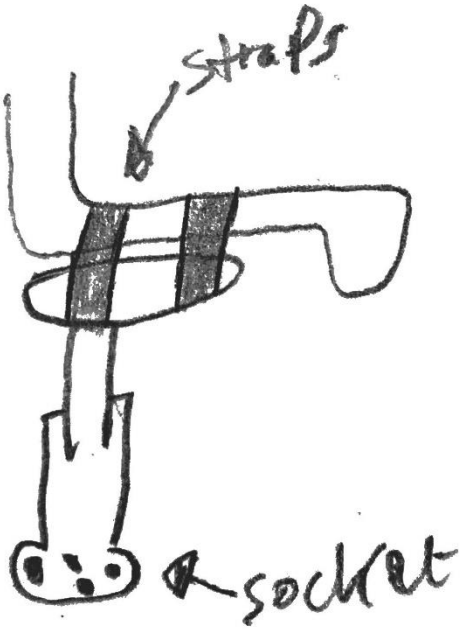

①
adjustable
to different
②
Plastic
thigh strap velcro
leg supporter
①
adjustable
Knee width
Adjustable Band to
diffrent hights
AG-3

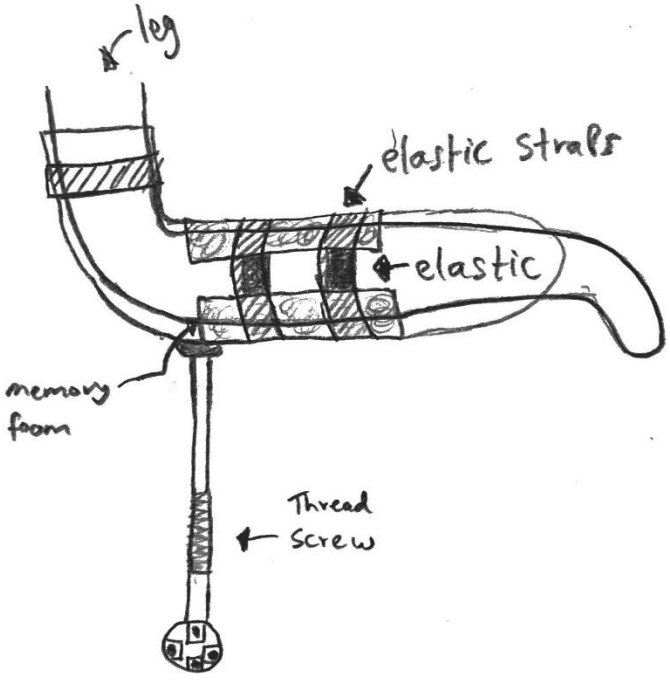


Ebrahim full designs


elastic straps
Aluminum
memory foam
adj. crutches
socket


straps
bending Plastic
memory foam
socket


straps
socket


leg
elastic straps
elastic
memory foam
Thread screw

Team Meeting 7

October 9th, 2018
Meeting Time: 2pm-4pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Leah

2pm
The team met at the Biomechatronics lab. Ebrahim, Abdulla, and Leah were present during the meeting. The meeting was from 2-4pm on October 9th. The team started out by listing possible analysis ideas and sketching a couple extra concepts to include in the decision matrix. The analysis ideas included:

2:10pm
Comparing the attachment of the pylon to the socket being coincident and being parallel to the leg.

- Manufacturing process
- Material analysis for the socket to make sure material can be flexible yet strong enough to support a human leg (very in depth, compare different materials)
- Stress analysis on the pylon to make sure it won't collapse under the persons load
    - Stress of screw in the pylon height adjustment using the bike seat adjustment lever (in depth, loading, assumptions, worst case scenario, weight, height, etc, maximum)
    - Unique sets of equations
- Analysis of side support vs under knee support (look at moments and forces on knee, possible for 2 people)

2:30pm
The team then worked on creating 3 different Pugh Charts for the 3 different sub-categories of the design, the pylon, attachment, and socket. The Pugh Charts were completed by the end of the meeting and the 3 decision matrices were split up among the three group members to be completed before next meeting and then reviewed by the other group members.

3:45pm
Abdulla, Ebrahim, and Leah will set up the decision matrices from Pugh Chart 3, 2, and 1 respectively. These decision matrices will be completed before the next meeting which is scheduled for the 10th.

Team Meeting 8

October 10th, 2018
Meeting Time: 1pm-2pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Leah, Dominic

1pm
The team met on October 10th to discuss the decision matrix and input values for the different concepts.

1:10pm
The top choices for the Attachment, Pylon, and Leg Support were Sketch 21, Sketch 17, and Sketch 2 respectively. The team has decided to combine the top ideas in each sub category to design five finalized designs. A decision matrix will be made up with these top five concepts to choose a final design.

1:20pm
Attachment: Sketch 21, Sketch 22, Sketch 23
Attachment off to side, attachment on both sides, rigid beam between pylon and leg support

Pylon: Sketch 17, Sketch 12, Sketch 13
Bike screw, crutches, crutch like pylon

Leg Support: Sketch 2, Sketch 3, Sketch 8
Two cuffs that are adjustable, adjustable cast like plate, cast like support with straps

Ebrahim will continue to combine and sketch the top concepts together, Dominic will set up a Decision matrix for the new and finalized concepts before next meeting.

1:50pm
Leah will attend Dr. Oman's office hours tomorrow to discuss the functional model and discuss the analytical analysis ideas to determine which analysis could be done for the team members.

The next meeting is scheduled for Friday October 12th in the afternoon.

Team Meeting 9

October 12th, 2018
Meeting Time: 1pm-2pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Leah, Dominic

1pm
The team met at 1pm to discuss the upcoming preliminary presentation, report, and analytical analysis memo. The goals for this meeting is to complete the preliminary presentation and assign slides to group members, pick what analysis team members would like to do and write up the memo and submit the analytical analysis team memo before the end of the meeting, and set up the preliminary report so group members can work on individual sections over the weekend before the team's next meeting.

1:05pm
The team started the meeting with discussing the analytical analysis memo and figuring out which group members would like to do what analysis. Abdulla is going to do an analysis of the pylon and the material (i.e. material weight, dimensions such as thickness, height, hollow or solid shaft), Leah and Ebrahim will both do analysis of the support attachment of the pylon to the leg support. Leah will be doing an analysis of the side support attachment and Ebrahim will do an analysis for the under knee support attachment and then they will compare which attachment will be more beneficial after the analysis is complete. Dominic will do an analysis on the manufacturing process and will talk to Dr. Oman about what aspect of the BiOM Prosthesis Adapter could benefit most from a manufacturing analysis. After the team decided which technical analyses were to be done, Leah drafted the memo to submit.

1:20pm
The team worked on populating the preliminary presentation with all the charts, decision matrices, and finalized concepts.

1:40pm
Table 1 shows the top designs from the sub system decision matrices. The matrices will be included in the prelim presentation and the rest of the decision matrix for each sub system will be included in the appendix of the presentation.

Table 1: Top Designs from sub system decision matrices

Attachment				Pylon Decision Matrix				Leg Support			
SET 1		Sketch 23		SET 2		Sketch 17		SET 3		Sketch 3	
Criteria	Weight (%)	Score	Weighted Score	Criteria	Weight (%)	Score	Weighted Score	Criteria	Weight (%)	Score	Weighted Score
Safety	25%	90	22.5	Safety	23%	100	23	Safety	15%	100	15
Durable	17%	60	10.2	Durable	25%	70	17.5	Durable	15%	90	13.5
Quick Attachment	15%	70	10.5	Lightweight	20%	90	18	Lightweight	10%	40	4
Lightweight	18%	50	9	Adjustable	22%	90	19.8	Adjustable	19%	50	9.5
Stability	25%	80	20	Quick attachment	10%	80	8	Quick attachment	19%	90	17.1
Total	**100%**		72.2	**Total**	**100%**		86.3	comfortable	22%	90	19.8
								Total	**100%**		78.9

1:55pm
The team will split up sections of the report to complete over the weekend before the Monday meeting. Dominic will take on all the benchmarking associated with the project, Ebrahim will focus on the background section and the House of Quality sections, Abdulla will work on the final design report selection section, and Leah will take on the function decomposition section.

The next meeting is scheduled for 10/14 (Sunday) at 1 pm to discuss the presentation.

Team Meeting 10

October 14th, 2018
Meeting Time: 1:30pm-3:30pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Leah, Dominic

1:30pm
The team met at 1:30 pm on Sunday, October 14th to discuss the upcoming presentation. The teams' goal for this meeting is to finalize the presentation and assign slides to group members.

1:45pm
Leah will be presenting the first three slides which include project description, black box model, and the functional model. Abdulla will be presenting the decision matrices and the designs considered. Dominic will be presenting the designs considered decision matrix which also includes the chosen design, and Ebrahim will be presenting on the schedule and budget for the project.

3:15pm
The meeting lasted a total of two hours. The next team meeting is scheduled for Monday, October 15th at 1pm.

Team Meeting 11

October 15th, 2018
Meeting Time: 1pm-2pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Leah, Dominic

1pm
The team met in the engineering building at 1pm for the weekly group meeting. This meeting was geared toward going over the presentation and finalizing slides.

1:10pm
The team added a few more slides to the presentation then did a dry run through of the presentation to make sure the team understood when they needed to talk and what they were talking about and how long their slides took. The team also went over the different parts of the report. And made sure everyone was on track for the report and made sure everyone understood what they were writing about.

1:50pm
The next meeting is scheduled for tomorrow, Tuesday October 16th. The meeting will focus on finalizing the report and getting it submitted for review.

Team Meeting 12

October 22nd, 2018
Meeting Time: 1:30pm-2pm
Where: EGR 108
Members Present: Abdulla, Ebrahim, Leah

1:30pm
The team met at 1:30pm on Monday, October 22nd in the capstone room. Everyone was present except Dominic. The goal of this meeting was to touch base on the progress of the project and discuss the past preliminary report and what could be improved for next time.

1:35pm
The team started with discussing how the preliminary report could be improved. The team decided to next time, everything in the document is going to be completed no less than five days before the due date. The team did not to a good job of this for the last report.

1:45pm
The team then went on to discuss the upcoming tasks and the timeline for the next four weeks. The final presentation will be on November 12th, the final report will be due on November 23rd. It has been decided that the team will meet up with Thomas to discuss the possible concepts, and come up with a final design.

The team also discussed the timeline for the CAD package due at the end of the semester and what was to be accomplished. The drafted CAD package will be done at least a week before the final presentation, November 5th. From November 5th to November 12th, the team will focus mainly on the final presentation and finishing up the drafted final report.

1:55pm
The next meeting will be scheduled for Wednesday night at 6pm to discuss the upcoming final report and meeting with the client.

Team Meeting 13

October 25th, 2018
Meeting Time: 9:30am-10:30am
Where: EGR 108
Members Present: Abdulla, Ebrahim, Leah, Dominic

9:30am
The team met Thursday morning at 9:30am to discuss the report and to discuss what needs to be completed prior to the report. Everyone was present and the meeting was scheduled for 30 minutes.

9:35am
For the Final Proposal report, the team will implement and update the preliminary sections individually for each members respective sections.

The following sections are to be included in the final proposal:
Section 2.3: Testing Procedures -- Dominic
Section 5.1: Design Selected -- Leah
Section 5.2: Design Description -- Leah
Section 6: Proposed Design -- Ebrahim
CAD Package -- Abdulla

The team split up different parts of the report to have completed. Dominic will focus on the testing procedures, Leah will focus on the Design Selected and Design Description, Ebrahim will focus on the Proposed Design, and Abdulla will be taking on the CAD Package. The group will discuss each section at all team meetings and work together on all other deliverables.

9:50am
The team then discussed upcoming schedule for the next 3 weeks. Abdulla is currently focusing on the upcoming website check. Abdulla is on schedule for the website, which is due November 2nd. The individual technical analyses are due on November 9th, and the team will have a meeting to discuss the different technical analyses after all group members have completed the individual analysis. The final presentation is on November 12nd. Abdulla will focus on completing the CAD package prior to the presentation, other group members will be prepared to help if needed. The final presentation is to be completed no later than November 9th. The final report is due November 25th. The team has decided to have all sections of the report done no later than November 12th. This will give the team 5 days to receive feedback and update the report. The Final Report will be submitted no later than the 19th.

10am
Abdulla, Ebrahim, and Leah then went to the advisors office to discuss the last presentation and get feedback on the assignment. The point of this meeting was to get clarification on the meeting minutes format and website upload. The functional model was discussed and how it could be improved. The font needed to be increased and split up. The box that included putting everything together needs to be split up into three different boxes and updated.

10:25am
The next team meeting is scheduled for Monday at 1pm. Every member is to complete their technical analysis and start the sections of the report by Monday.

Team Meeting 14

October 29th, 2018
Meeting Time: 1pm-1:30pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Leah, Dominic

1pm
The team met in the Biomechatronics lab to discuss the report and update the team on the individual analytical analysis.

1:10pm
The team worked on the analytical analyses during the team meeting and collaborate with each other to determine which design would be best. All group members were not finished with the technical analysis due to unforeseen complications. This also included revisiting the customer requirements and engineering requirements to make sure everyone was on the same page and understood the constraints for the analysis.

1:20pm
After discussing progress on the technical analysis, the team clarified what sections of the reports were needed for the final report. This also included discussing the different subsections each team member was responsible for.

1:30pm
The next meeting is scheduled for after lecture tonight (Monday) around 6:30pm to discuss the team's progress with the advisor.

Team Meeting 15

October 31st, 2018
Meeting Time: 1pm-1:30pm
Where: Online Meeting
Members Present: Abdulla, Ebrahim, Leah, Dominic

1pm
The team was not able to meet in person as previously discussed, so the team had an online meeting. The goal of this meeting was to work on the sections of report that needed to be completed, and discuss progress on the individual technical analyses.

1:05pm
The team discussed the individual technical analyses through the online group chat through google drives. Ebrahim and Leah worked together to discuss the scope of their technical analyses, which included analyzing how the forces of the person would affect the stress of the pylon and all the possible points the attachment could break. Abdulla and Dominic discussed different materials possible for the pylon, and the team discussed the possible scope for Dominic's manufacturing individual technical analysis.

1:25pm
The team wrapped up what they were doing and planned the next meeting for Monday November 5th at 1pm. This was to discuss the completed technical analyses and define the finalized concept.

Team Meeting 16

November 9th, 2018
Meeting Time: 1pm-1:30pm
Where: Online Meeting
Members Present: Abdulla, Ebrahim, Leah, Dominic

1pm
The team scheduled a time to meet online since no group members were able to meet in person. The meeting was to discuss the completed technical analysis, and comments on the preliminary report.

1:05pm
The team talked about the different technical analyses. Leah did her analysis on the side attachment and how the side attachment would affect the stress in the pylon. Her analysis determined that if a side attachment was used, a hollow aluminum rod would need to be used. She found that the most beneficial design for the pylon was made from 2024 T3 Aluminum pipe that had a 1.5" outer diameter and a thickness of 0.035"which resulted in a weight of 0.311 pounds.

Abdulla's analysis was determining the material to be used for the pylon by comparing two different materials, steel and aluminum. He found that aluminum 6061 would be the best material because of the amount of material needed for the pylon.

Ebrahim's analysis focused on the attachment to the leg from below the knee. He found that the total stress over the leg support has to be 831.92 pounds per feet squared.

Dominic's analysis has not been completed yet due to the extension and change of concept generations.

1:25pm
The comments were back from the report and the team quickly viewed the comments. Everyone is to go through the report and update the report for the final report based off the comments. This is to be done over the weekend and uploaded to the drive when completed.

Team Meeting 17

November 13th, 2018
Meeting Time: 2pm-4pm
Where: Biomechatronics lab
Members Present: Abdulla, Ebrahim, Leah, Dominic

2pm
The team met in the Biomechatronics lab to discuss new concepts and prototyping. To just reiterate what was learned from last meeting, the team went around and gave background on what their technical analysis was and how it would benefit the team.

2:10pm
The team then discussed and brainstormed different ideas that would be more beneficial to the client and meet the customer requirements and scope of the project. The brainstormed ideas can be seen in Figure 1 below.

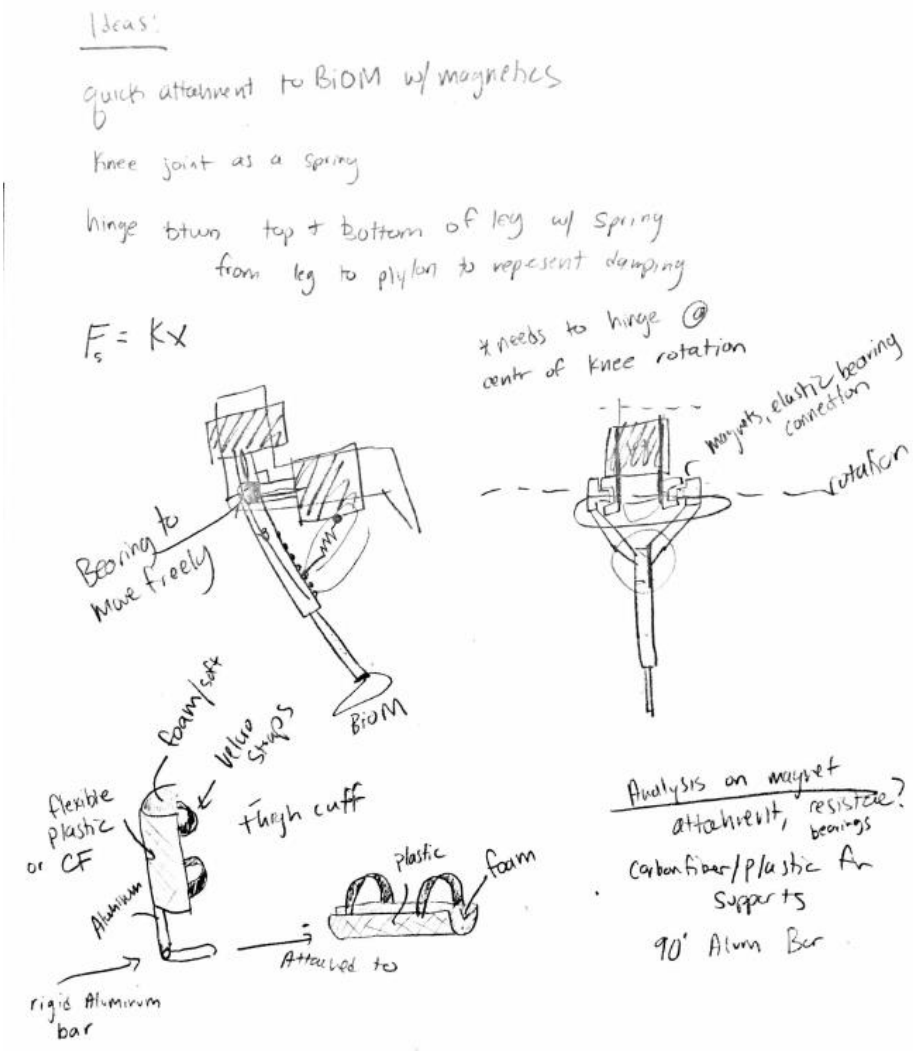


Figure 1: Brainstormed ideas for new concept generation

Shown in Figure 1 is the new concept ideas. It was determined that the leg should be at a fixed 90 degree angle which was a requirement from the customer in the last meeting. The customer also wanted the knee to accurately represent a knee joint as a spring. A spring was then brainstormed to be applied to the concept by being placed between the pylon and the bottom leg support so the leg could swing back and forth when stepping. There was to be two leg supports, one for the upper leg and one for the lower leg, both attached by a 90 degree rigid bar made of aluminum or carbon fiber. The 90 degree rigid bar would have a hole at the elbow so that the entire leg support system would be able to attach to the pylon. The adapter was also update so that the adapter would attach at the knee hinge at the elbow of the 90 degree rigid support and would taper down below the knee to meet the pylon. This design seemed useful because it would more accurately represent someone walking opposed to attaching the pylong from the side. The attachment to the leg supports would be strong magnets or a bearing design so the pylon can swing freely like a knee joint.

3pm
Leah brought some old thigh supports from her lab and aluminum bars so the team could more accurately determine materials for the prototype and see if the design would conceptually work. It was determined by students working in the Biomechatronics lab that the team would be able to use the old thigh supports for the prototype, and Leah could obtain the aluminum bars from the scrap bin. This prototype would determine if this design will work.

3:50pm
The next meeting will be Friday afternoon with Dr. Lerner to discuss concepts generated in this meeting and to get feedback on the design.

Team Meeting 18

November 16th, 2018
Meeting Time: 12:45 pm-1:30 pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Dominic, Leah

12:45 pm
The team met up in the biomechatronics lab after talking with the client to discuss the next steps for the project. In the next week the team has to complete a rough draft of the CAD package, a physical model of the system for the upcoming presentation, and the final proposal report.

1 pm
After the team discussed the design changes proposed by the client which included using two springs, the team re-analyzed the system. The team would add on an extra support below the knee that would attach at the center of rotation of the knee with pins where both the leg supports would also be attached and would be the center of everything attaching to the pylon. Since the meeting took place in the biomechatronics lab, Leah obtained some scrap aluminum and leg cuffs for a physical model needed in the presentation. The team brainstormed different ways of how to build the prototype and determined what materials would be best.

1:20 pm
Since the team has very little time to complete a lot of tasks, the tasks were split up among group members. Leah will be out of town this weekend so she will be unable to help with the prototype. She will instead work on the report and integrate comments in the final proposal report that were given from the preliminary report. She will also work on writing the new sections needed and gathering all information for the report and will then meet with Amy to discuss what would need improvement. Abdulla and Ebrahim will work on the CAD package and prototype together this weekend since both tasks are very demanding. As of now, the prototype will be made of a cardboard tubing for the pylon and aluminum scraps for the rest of the system along with anything else they are able to find at home depot. Dominic will work on the presentation for Monday and read over the report that Leah will be working on.

The next meeting is scheduled for next Monday, November 19th at 1pm to discuss the presentation.

Team Meeting 19

November 19th, 2018
Meeting Time: 1 pm-2 pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Dominic, Leah

1 pm
The team met up to discuss the upcoming presentation and figure out who is doing what slides. The team will run through the presentation for tonight and discuss the progress on the report, CAD model, and prototype.

1:15pm
The team discussed the pros and cons of the prototype and made sure it fit Leah for the presentation later today. The main things learned from building the prototype was the pylon needs to have some degree of freedom so it does not act like a pegleg. The prototype also does not rotate about the knee joint. For the main design, the team will construct the device using a rotating axis about the knee

1:30pm
The team then worked on the presentation to make sure everyone knew what they were presenting on and the team practiced the presentation.

1:50pm
Leah is scheduled to meet up with the advisor tomorrow to discuss the final proposal report. The next meeting is scheduled to be online over the Thanksgiving break.

Team Meeting 20

November 24th, 2018
Meeting Time: 12 pm-1 pm
Where: Online
Members Present: Abdulla, Ebrahim, Leah

12pm
Since it is a holiday weekend, the team decided to have an online meeting to finalize the final report. Abdulla and Ebrahim worked on the CAD model to put in the report and Leah went through the report and edited the comments and wrote the last few sections of the report.

12:30pm
Abdulla and Ebrahim uploaded pictures of the prototype and CAD model drawings. All three team members added their technical analyses to the document and discussed how they were used in the adapter design. The three team members finished formatting and writing and editing the report.

1pm
It was decided that everyone in the team should look at the report before the deadline tomorrow. The next meeting will be monday at 1pm in the Biomechatronics lab.

Team Meeting 21

November 26th, 2018
Meeting Time: 1 pm-1:30 pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Dominic, Leah

1pm
The goal of this meeting is to discuss the report and progress on the final CAD Package. Abdulla will work on finalizing the CAD Package, and Leah will help with the CAD Package report.

1:15pm
The team has decided to make another updated prototype before the end of the semester. This would be based on the Final CAD Package with the spring. The team discussed different ways to get the spring to attach to the CAD Assembly model, and Abdulla laid out what his plan was when working on the CAD Package and parts he may need assistance on when developing the final CAD Model.

1:25pm
The team will work together on developing the drawings for the CAD Package. The next meeting is scheduled for Friday to finalize the CAD package, BOM, and Prototype summary.

Team Meeting 22

November 30th, 2018
Meeting Time: 12:20 pm-1 pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Dominic, Leah

12:20 pm
The goal of this meeting is to have a team talk and reassess the team charter. The team charter will be updated and roles will be reassigned due to some conflict within the team. The different tasks for the upcoming CAD and BOM assignment will be discussed along with the prototype and prototype summary.

12:25 pm
The team redefined roles within the team. Leah will now fill the role of Team Manager and Dominic will fill the role of document manager. No other assigning of roles were made. This decision to redefine roles will help the team stay on track and complete the project for high quality.

12:35 pm
After the team discussed the team roles, Abdulla showed the team the completed CAD package with attached drawings. For this upcoming assignment, Dominic will work on the prototype summary while Leah will finalize the prototype. Ebrahim and Abdulla will work on the CAD package and BOM.

12:55 pm
The team will meet again at 1 pm on Monday before the last CAPSTONE Class. This will be to discuss the final projects for the semester.

Team Meeting 23

December 3rd, 2018
Meeting Time: 1:15 pm-2 pm
Where: Biomechatronics Lab
Members Present: Abdulla, Ebrahim, Dominic, Leah

1:15 pm
The goal for this meeting is to discuss what has been completed, test the prototype, and look over the CAD Package before the final due dates later this week.

1:20 pm
The team went around and discussed the progress on everything over the weekend. For lecture today, the team needs to have the hard copy of the CAD package and BOM, along with the prototype and prototype summary. The professor and TA will go through the different packages and provide comments to the team to update before the final submission earlier this week.

Abdulla and Ebrahim worked to finish up the CAD Package an BOM. Dominic has not started on the prototype summary but says it will be complete before the lecture. The prototype was completed last Friday during the meeting.

1:40 pm
The rest of the meeting consisted of Dominic working on the prototype summary, Abdulla sending the CAD Package to the team to print, and Ebrahim worked on finishing up the BOM.

1:50 pm
The next meeting is scheduled for Tuesday from 3-4pm to make sure the team has all documents completed for the semester.

Team Meeting 24

January 14th, 2019
Meeting Time: 5:30 pm-6:30 pm
Where: Engineering room 321
Members Present: Abdulla, Ebrahim, Leah, Dominic, Dr. Sarah Oman, Amy Swartz

5:30
The team met in engineering room 321 to talk to Dr. Oman and Amy about project progress and what the semester will look like for the team. It was determined that the final proposal rewrite is not due until the midterm report and therefore the team will focus on the post mortem documents. The website check 1 is due February 4th, the Hardware Review 1 is due February 18th, Individual analysis due February 25th, and the Midpoint report is due March 11th.

5:45
The team spent some time comparing schedules and class work to determine the best time for everyone to meet. It was determined that the team could meet Monday between 2 and 4, Tuesday after 6, Wednesday 5-6, Thursday 11-12:30 and Friday 10:30-11:30 or after 1:30. The most popular time was the Wednesday 5-6 time or anytime Friday.

5:50
For the next week, everyone in the team had action items to complete. They are as follows. Dominic will work on the report rewrite to get it done as soon as possible so there will be less work to put in during the midpoint report. One team member needs to be shop trained for welding or the team will need to find someone to weld parts for us. Dominic will focus on finding the information for that as well. The Bill of Materials will need to be completed to order materials, which Leah will work on before the next meeting. Prototyping with the current prototype and determining weak points in the system will be Abdulla and Ebrahim. The team still needs to figure out the two spring system which was taken on by Dominic last semester.

6:05
Materials will need to be ordered as soon as possible, so the team listed out the materials to be purchased in the first order and second order respectively. The first order materials include carbon fiber, gummy tape for the vacuum bags, vacuum/oven bags, velcro straps, thermoplastic, and foam. The second order will include springs and elastic (including small springs to be fit over the shoulder bolts), pylons, BiOM attachment, bike clamp, and bolts, nuts, and shoulder bolts.

6:20
The team talked to Dr. Oman and Amy about the previous things such as action items and material needed along with discussing the analytical analysis. A couple ideas for an analytical analysis include figuring out how many layers of carbon fiber are needed to be strong enough in the U bar system to support a fully grown person, testing the springs including buying different types and testing all of them to determine the best ones for the system, stress on the shoulder bolt at the knee hinge, a stress analysis of the pylon using an FEA program, or using dampeners for the system. The different analyses are summarized below.

1. Carbon fiber layers in U bar
2. Spring testing with multiple springs
3. Stress on shoulder bolt at knee hinge
4. Stress analysis of pylon using FEA software
5. Use of dampeners for the spring system

6:30
The next team meeting will take place Wednesday, January 16th, at 5 pm in the engineering capstone room to discuss progress on the materials and upcoming action items.

Team Meeting 25

January 16th, 2019
Meeting Time: 4:45 pm-5:30 pm
Where: Engineering room 108
Members Present: Abdulla, Ebrahim, Leah, Dominic

4:45
The team met in the engineering capstone room to discuss the materials needed for the upcoming shipment order. Leah took on the task of completing the BOM with the attached weblinks and purchase request. The team determined they needed to buy carbon fiber and gummy tape from Rockwest composites, Thermoplastic from plastics 2000, velcro, foam, and oven bags from Amazon. Leah is to compile all the materials into an excel sheet containing all the required information for the purchase request and bring to Dr. Oman's office hours tomorrow morning to get it checked over and submitted before the weekend.

5:15
Once the team determined material in the order for tomorrow and where to obtain it from, they needed to determine the size and quantity of the material. This required the team to take a short trip to the Biomechatronics lab to scope out current materials used to ensure the final product would be able to be repaired or modified if needed. The team decided they needed two types of foam, one ¼" and the other ⅜" for different parts of the leg supports. The ⅜" will be used under the knee support and the ¼" wil be used for the other two leg supports. It was also determined that the team did not know what thickness of thermoplastics to get. Because of this, they decided to purchase multiple types of thermoplastics to determine the best thickness for the calf and thigh cuffs. The team also decided they would need about 5 - 4 square inch sheets of carbon fiber for both leg supports and the U bar.

5:45
Leah will complete the excel sheet with the extra materials, send the completed carts to the front desk of engineering, and complete and turn in the purchase request tomorrow morning. There is no scheduled meeting as of yet. The next major steps of the project to complete include the materials ordered.

Team Meeting 26

January 25th, 2019
Meeting Time: 10:45 am-11:30 am
Where: Biomechatronics lab
Members Present: Abdulla, Ebrahim, Leah, Dominic

10:45
The team received most of everything ordered last week. Everything was received except the gummy tape to secure the vacuum bags for carbon fiber curing. The team opened the boxes and reviewed all the material to determine it was up to par with everything they would need for the second phase of the project. In the next few weeks, the team will construct the entire leg support and put different parts of the leg support through testing.

11:00
Each team member is to have more action items for the upcoming week. This will include Dominic working on finishing the report corrections and the spring analysis that is to be done before the second order of materials, Abdulla working on the CAD Package and updating the new parts such as foam and new bearings along with preparing for the upcoming website check. Ebrahim will talk to Dr. Tester about the BiOM attachment to determine if the team can have the specs in order to manufacture or order the system instead of design an entire new attachment. Leah's main focus will be the carbon fiber layering which will include laying up the carbon fiber leg supports and completing the technical analysis for the U bar layers of carbon fiber.

11:20
The team then discussed possible analysis ideas. Dominic will focus his analysis on a structural analysis of the system to determine weak points and possible failure points within the system. Abdulla will determine what bearings will be the best for our system and why, including how much stress they can withstand and the types of loading they can hold. Ebrahim will focus on the attachment design if the team needs to determine a new design for the BiOM attachment, or the screw analysis of the attachment and the U bar support to determine if the screws would fail. Leah will determine how many layers of carbon fiber will be needed for the U bar to support a fully grown person without failure.

11:30
The next meeting is scheduled for Monday at 5:30 pm with Dr. Oman and Amy. This will be a staff meeting to inform the advisors of project updates since the last staff meeting.

Team Meeting 27

February 1st, 2019
Meeting Time: 2:15 pm - 4 pm
Where: Biomechatronics lab
Members Present: Abdulla, Ebrahim, Leah, Dominic

The team met in the Biomechatronics Lab to discuss the current and future action items. This included the attachment, bearings, and second order of materials

2:20 pm
Ebrahim showed the team the attachments obtained from the past week. The team now has access to three different types of attachments to attach the adapter to the BiOM. Dimensions of the attachment were taken. The inner diameter of the attachment is about 25mm.

2:35 pm
The team received some guidance from a graduate student in Dr. Lerner's lab about bearings currently used for the exoskeletons. He informed the team of the different types of bearings used and the pros and cons of each type and why they were using a specific type. It was decided the team would be using two bearings for the system with shoulder bolts as the shaft.

2:50 pm
To determine what bearing was needed, the team needed to determine what the maximum force applied on the bearing would be, radially. Leah obtained experimental data from the Biomechatronics lab determining the maximum force applied during the gate cycle of a 45.3 kg person to be about 503 N. From this data, she was able to calculate the maximum force applied by a 200 pound person. See calculations below in Figure 1.

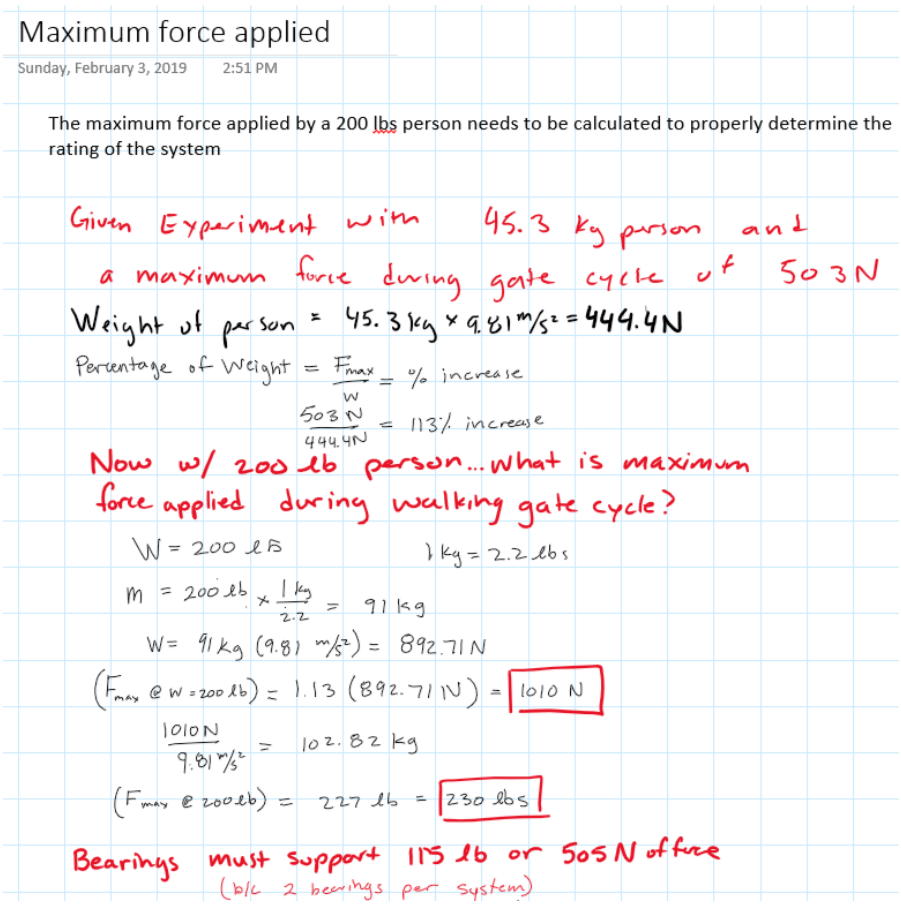


Figure 1: Maximum Applied Force

3:30 pm
It was found that the bearings must support at least 115 pounds radially to not fail in the system. The team then discussed materials that would need to be in the second order. Since Leah cannot complete her carbon fiber action item due to missing material, she will construct the new purchase request and try to obtain the vacuum bagging sealant tape. The second order must included:

- Bike clamp
- Two pylons (large and small)
- Vacuum bag sealant tape
- Bearings (2 to support 115 pounds)
- Shoulder bolts
- locknuts
- Springs (one compression and one extension upon completion of spring analysis)
- Little springs

4 pm
The team will submit action items at 5 pm on Monday and meet at 5:15 pm to discuss completed action items.