FINAL PRODUCT BREAKDOWN

TEAM: 20F11 NAU Psyche Exploration Robot

Due Date: April 23, 2021

Provide several pics of the completed system here:

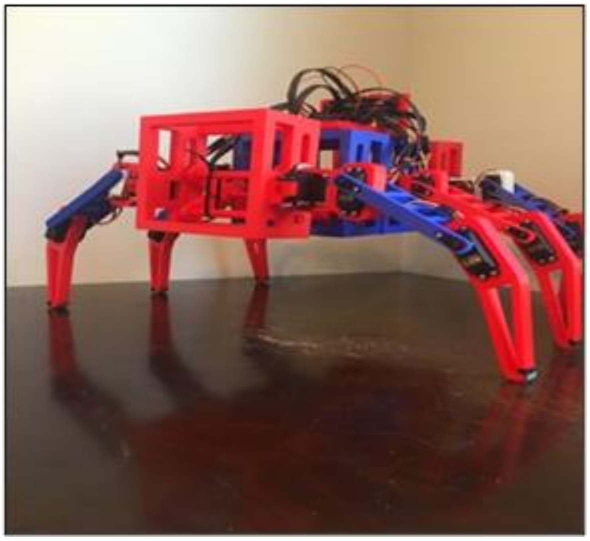


Figure I. Angled View of Small-Scale Model standing in "tpose" position

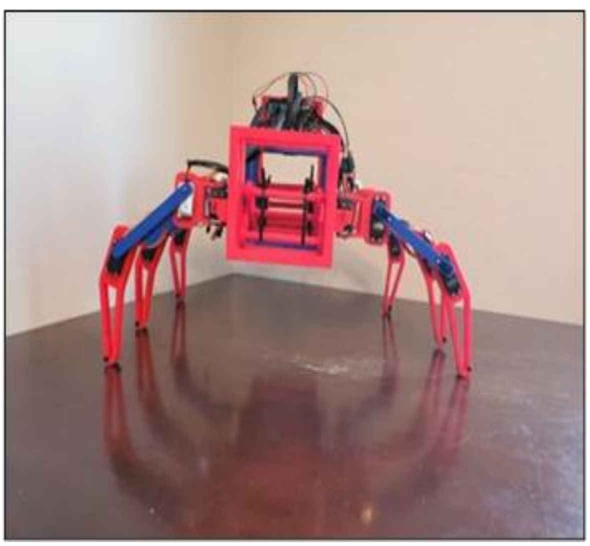


Figure II. Front View of Small-Scale Model standing in "tpose" position

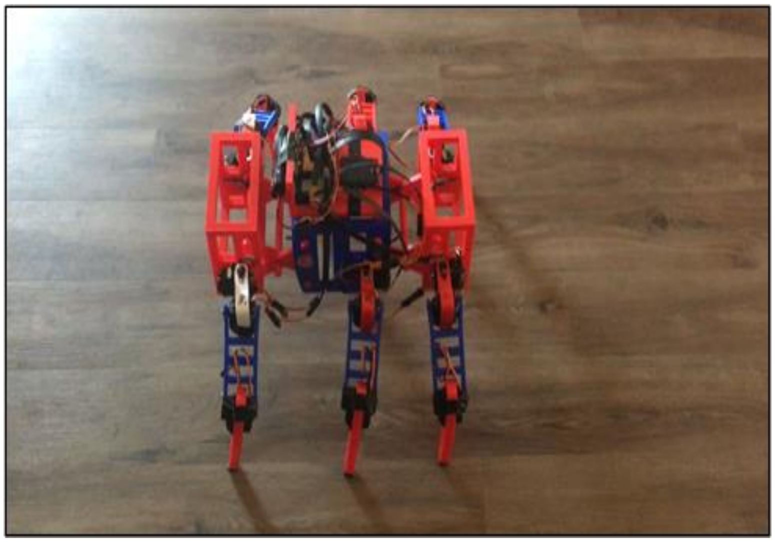


Figure III. Image of Small-Scale Model walking on laminate surface

Figure IV. Image of Small-Scale Model walking on gravel

Figure V. Image of Small-Scale Model walking on sand

Figure VI. Side View of Full-Scale Leg Model

Figure VII. Close-up View of Full-Scale Leg Model claw

The following are the Action Items each person completed between Hardware Review 2 and the completion of the final product:

Team Member: Isaac Anderson

Action Item	Date Completed	Result/Proof of Completion
Finish programming walking sequence for the small-scale model.	4/3/21	Finished working through the angles at which the servos rotate, trial and error. Found the angles that provide the most stability to the model, allowing it to run through the walking sequence. Videos of the small-scale model walking are available in the final presentation (show videos).
Finish testing the small-scale model walking on various surfaces.	4/4/21	The small-scale model was tested on laminate, gravel, sand, concrete, and asphalt. The gravel simulated potential debris ridden areas that could be present on the asteroid. The sand represented finer debris which could also be present on the asteroid. The laminate simulated potentially slick surfaces which could be present on the asteroid.
Finish operations portion on the operation and assembly manual for the small-scale model.	4/13/21	Discussed the primary operations of the small-scale model. Discussed the purpose of the walking program, and how it controls the servos. Also discussed how to operate the model (uploading the program to the Arduino and then running it.)
Finish assembly portion of the operation and assembly manual for the small-scale model.	4/15/21	Provided instructions on how to assemble the small-scale model, given the various pieces. Provided pictures with each step, to ensure the user has little to no difficulty in assembling the model.
Working on Final CAD Package and BOM	4/16-4/22	Developed drawings for each part of the small-scale model. Developed drawing for the full assembly of the model, included BOM of each part made within SW on the model. Turned each drawing into a pdf, just need to combine into one document and order them based on the BOM of the assembly. Will also include the BOM that incorporates prices and hardware not designed within SW.
Working on Final Report	4/19-4/23	Currently have finished the concept generation portion, requirements portion, and benchmarking portion of the report.

Team Member: John Dynda

Action Item	Date Completed	Result/Proof of Completion
Finished the code for the Small-Scale Rover to walk	04/03/2021	Edited the angles for the servos to perfect the walking sequence (Specifically to move the servos either a bit more or less). Proof is in the final presentation where videos are displayed of the rover walking.
Finished the testing portion of the Small-Scale Rover.	04/04/2021	Tested the small-scale model with Isaac on laminate flooring, gravel, and dirt/sandy materials. Also tested on concrete and asphalt, but only have good videos of the laminate, gravel and sand.
Completed the operations and assembly manual for the small-scale rover.	04/16/2021	Completed my portion of the assembly manual as well as editing the operations portion of the manual. Specifically, the electrical components portion and editing the entire document to ensure it had proper formatting and grammar...

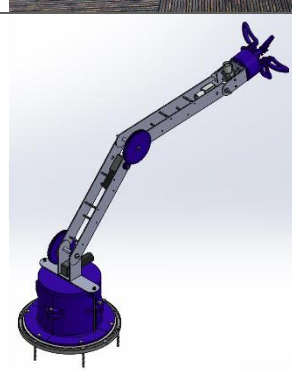
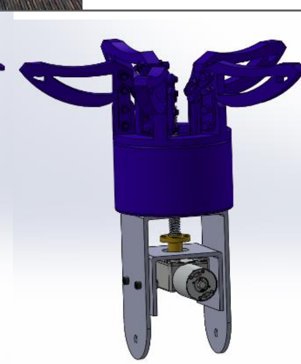
Team Member: Eric "Sean" Sullivan

Action Item	Date Completed	Result/Proof of Completion
Meet with leg group to assemble	03/27/2021	Attached and adjusted the upper arm segment
Meet with leg group to assemble	03/28/2021	Drilled bracket holes to mount motor to lower section of upper arm segment.
Meet with leg group to assemble	03/29/2021	Attached, adjusted and tested the lower arm segment. Drilled the motor mount for the wrist joint.

Print 3d Claw parts	03/30/2021	
Meet with leg group to assemble	03/31/2021	Created first bracket to attach the claw motor and secured the claw in place.
Meet with leg group to assemble	04/01/2021	Issues with bracket. Claw slips off shaft.
Meet with leg group to assemble	04/02/2021	Redesign claw motor bracket
Bend wrist bracket	04/03/2021	Gain access to metal break in Rm119. Thank you Perry.
Reprint 3D claw parts at 100% infill		Reprinted linkages at 100% for claw assembly.

Meet with leg group to assemble	04/04/2021	
Wire the motors	04/06/2021	Testing performed to pick up and move object.

Team Member: Kate Collette

Action Item	Date Completed	Result/Proof of Completion
Meet with leg group to assemble leg (28 hrs)	3/27/21-4/4/21	
Resized CAD files (0.5 hrs)	3/28/21	 

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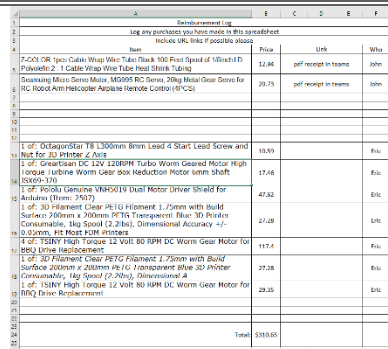
<td>Met with team to detail budget (1 hr)</td>
<td>3/30/21</td>
<td>
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<tr><td colspan="6">Reimbursement Log</td></tr>
<tr><td colspan="6">Log any purchases you have made in this spreadsheet</td></tr>
<tr><td colspan="6">Include URL links if possible please</td></tr>
<tr><th>Item</th><th>Price</th><th colspan="3">Link</th><th>Who</th></tr>
<tr><td>Z-COLOR 1pcs Cable Wrap Wire Tube Black 100 Foot Spool of 1/8inch I.D Polyolefin 2 : 1 Cable Wrap Wire Tube Heat Shrink Tubing</td><td>12.94</td><td colspan="3">pdf receipt in teams</td><td>John</td></tr>
<tr><td>Seamuing Micro Servo Motor, MG995 RC Servo, 20kg Metal Gear Servo for RC Robot Arm Helicopter Airplane Remote Control (4PCS)</td><td>20.73</td><td colspan="3">pdf receipt in teams</td><td>John</td></tr>
<tr><td>1 of: OctagonStar T8 L300mm 8mm Lead 4 Start Lead Screw and Nut for 3D Printer Z Axis</td><td>10.59</td><td colspan="3"></td><td>Eric</td></tr>
<tr><td>1 of: Greartisan DC 12V 120RPM Turbo Worm Geared Motor High Torque Turbine Worm Gear Box Reduction Motor 6mm Shaft JSX69-370</td><td>17.46</td><td colspan="3"></td><td>Eric</td></tr>
<tr><td>1 of: Pololu Genuine VNH5019 Dual Motor Driver Shield for Arduino (Item: 2507)</td><td>47.62</td><td colspan="3"></td><td>Eric</td></tr>
<tr><td>1 of: 3D Filament Clear PETG Filament 1.75mm with Build Surface 200mm x 200mm PETG Transparent Blue 3D Printer Consumable, 1kg Spool (2.2lbs), Dimensional Accuracy +/- 0.05mm, Fit Most FDM Printers</td><td>27.28</td><td colspan="3"></td><td>Eric</td></tr>
<tr><td>4 of: TSINY High Torque 12 Volt 80 RPM DC Worm Gear Motor for BBQ Drive Replacement</td><td>117.4</td><td colspan="3"></td><td>Eric</td></tr>
<tr><td>1 of: 3D Filament Clear PETG Filament 1.75mm with Build Surface 200mm x 200mm PETG Transparent Blue 3D Printer Consumable, 1kg Spool (2.2lbs), Dimensional A</td><td>27.28</td><td colspan="3"></td><td>Eric</td></tr>
<tr><td>1 of: TSINY High Torque 12 Volt 80 RPM DC Worm Gear Motor for BBQ Drive Replacement</td><td>29.35</td><td colspan="3"></td><td>Eric</td></tr>
<tr><td>Total:</td><td>$310.65</td><td colspan="3"></td><td></td></tr>
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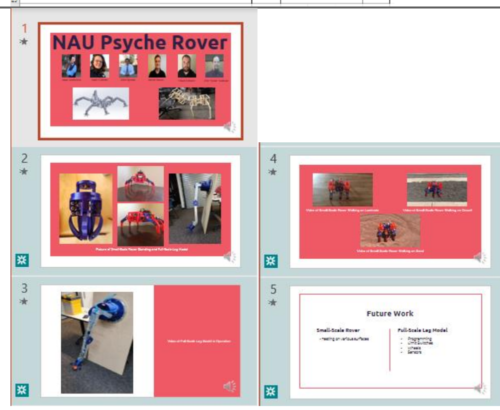
<tr>
<td>Worked on final presentation for client (2.5 hrs)</td>
<td>5/4/21</td>
<td>
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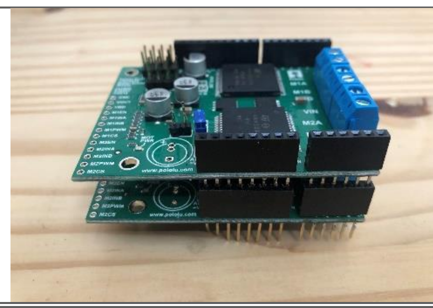
<td>Worked on wiring motor controller for full-scale model (1.5 hrs)</td>
<td>5/6/21</td>
<td></td>
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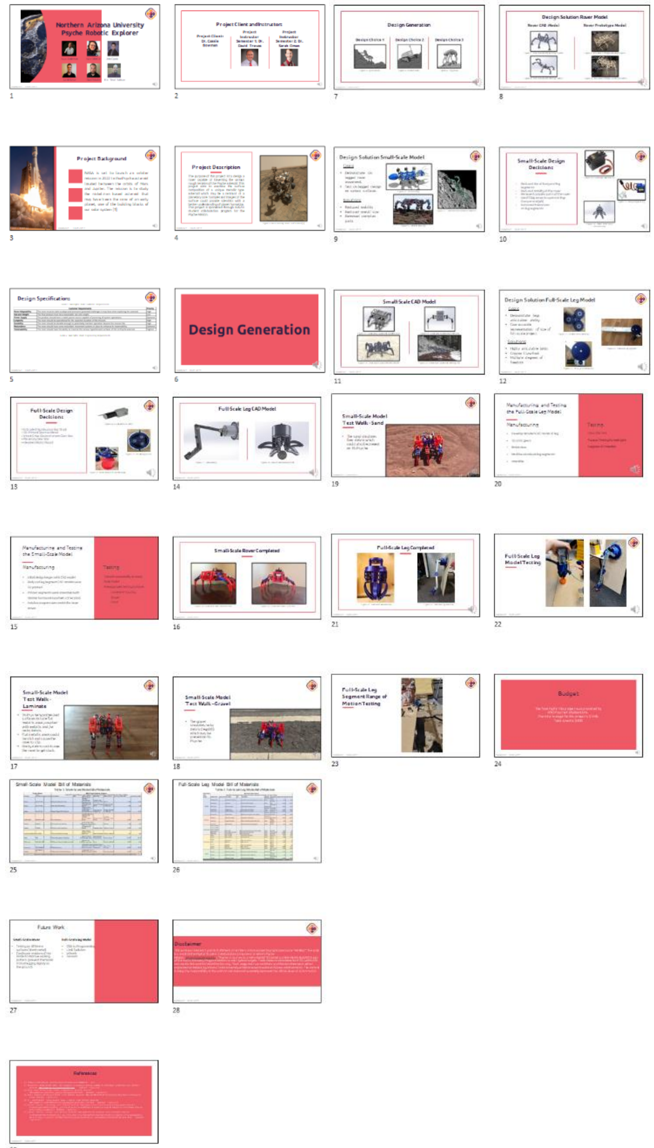
Worked on final presentation for UGRADs (3.5 hrs)	5/7/21	
Edited video for UGRADs (1 hr)	5/8/21	 

Worked on Operations and Assembly Manual (5.5 hrs)	5/11/21-5/16/21	

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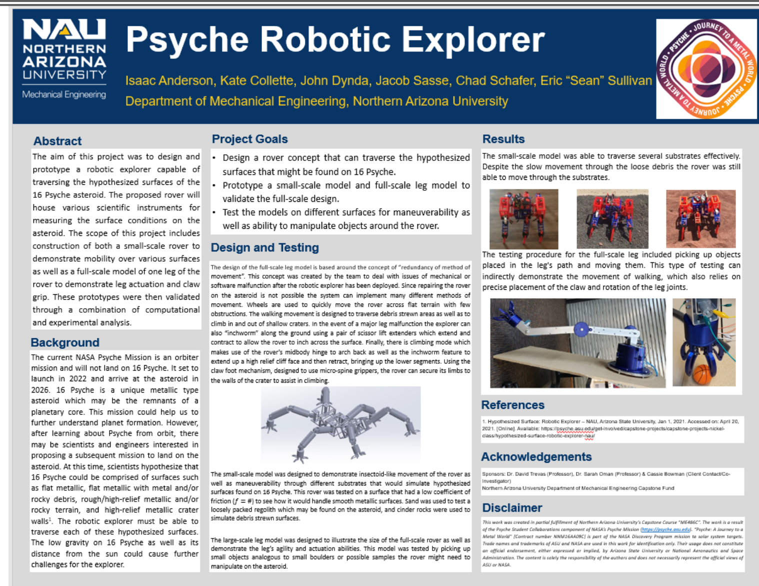
<tr><td>Edited draft of final poster (1 hr)</td><td>5/20/21</td><td>
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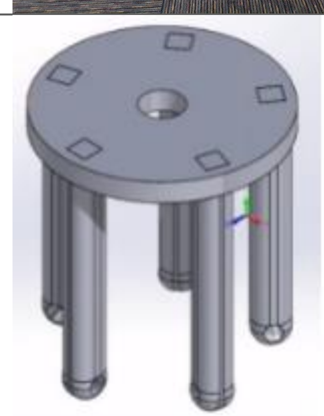
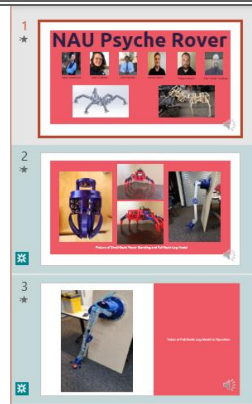
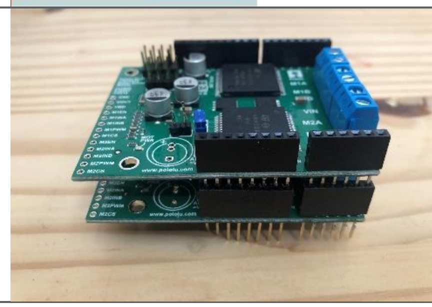
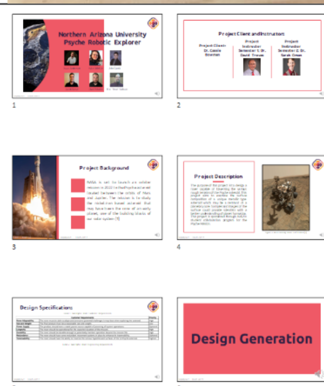
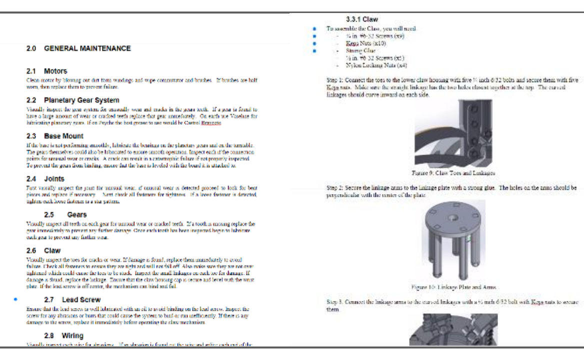
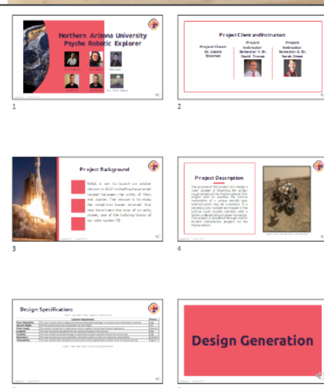
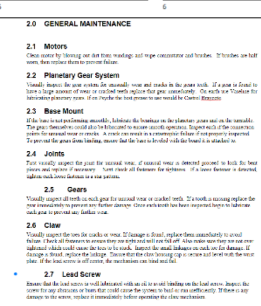
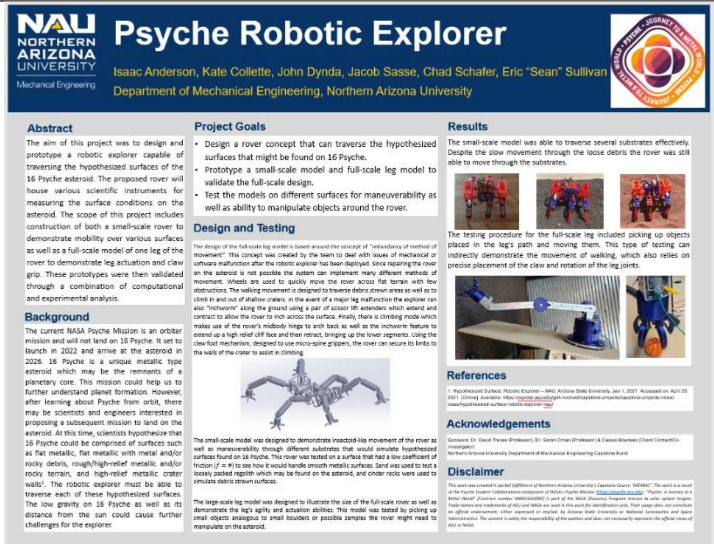
Team Member: Jacob Sasse

Action Item	Date Completed	Result/Proof of Completion
Worked with leg team to assemble the prototype.	3/27/21-4/4/21	
Redesigned parts of the claw to allow for easier 3d printing.	3/28/21	

Worked on presentation for client.	5/4/21	
Worked with leg team on wiring and programing the model.	5/6/21	
Worked with team on the final UGRADS presentation.	5/7/21	
Worked on UGRADS Presentation voice recordings.	5/8/21	Recorded the sections regarding the design generation and the wooden prototype the team built at the beginning of the semester.
Worked on operations and assembly manual.	5/11/21-5/16/21	

Team Member: Chad Schafer

Action Item	Date Completed	Result/Proof of Completion
Worked on assembly of the full-scale leg model	3-27-4-21	
Worked on wiring with team	5-6-21	
Worked on UGRADS prestation	5-7-21	
Worked on operations Manual	5-11-5-26	 **2.0 GENERAL MAINTENANCE** **2.1 Motors** Clean motor by blowing out dirt from windings and wipe commutator and brushes. If brushes are half worn, then replace them to prevent failure. **2.2 Planetary Gear System** Visually inspect the gear system for unusually wear and cracks in the gears teeth. If a gear is found to have a large amount of wear or cracked teeth replace that gear immediately. On earth use Vaseline for lubricating planetary gears. If on Psyche the best grease to use would be Castrol Braycote **2.3 Base Mount** If the base is not performing smoothly, lubricate the bearings on the planetary gears and on the turntable. The gears themselves could also be lubricated to ensure smooth operation. Inspect each of the connection points for unusual wear or cracks. A crack can result in a catastrophic failure if not properly inspected. To prevent the gears from binding, ensure that the base is leveled with the board it is attached to. **2.4 Joints** First visually inspect the joint for unusual wear, if unusual wear is detected proceed to look for bent pieces and replace if necessary. Next check all fasteners for tightness. If a loose fastener is detected, tighten each loose fastener in a star pattern. **2.5 Gears** Visually inspect all teeth on each gear for unusual wear or cracked teeth. If a tooth is missing replace the gear immediately to prevent any further damage. Once each teeth has been inspected begin to lubricate each gear to prevent any further wear. **2.6 Claw** Visually inspect the toes for cracks or wear. If damage is found, replace them immediately to avoid failure. Check all fasteners to ensure they are tight and will not fall off. Also make sure they are not over tightened which could cause the toes to be stuck. Inspect the small linkages on each toe for damage. If damage is found, replace the linkage. Ensure that the claw housing cap is secure and level with the wrist plate. If the lead screw is off center, the mechanism can bind and fail. **2.7 Lead Screw** Ensure that the lead screw is well lubricated with an oil to avoid binding on the lead screw. Inspect the screw for any abrasions or burrs that could cause the system to bind or run inefficiently. If there is any damage to the screw, replace it immediately before operating the claw mechanism. **2.8 Wiring**
Completed voice over UGRADS prestation	5-8-21	Explained each slide by recording

<table>
<tr><td>Worked on final report</td><td>4-20-21</td><td>Updated the final report with all the team's progress.</td></tr>
<tr><td>Read over final poster</td><td>5-20-21</td><td>
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