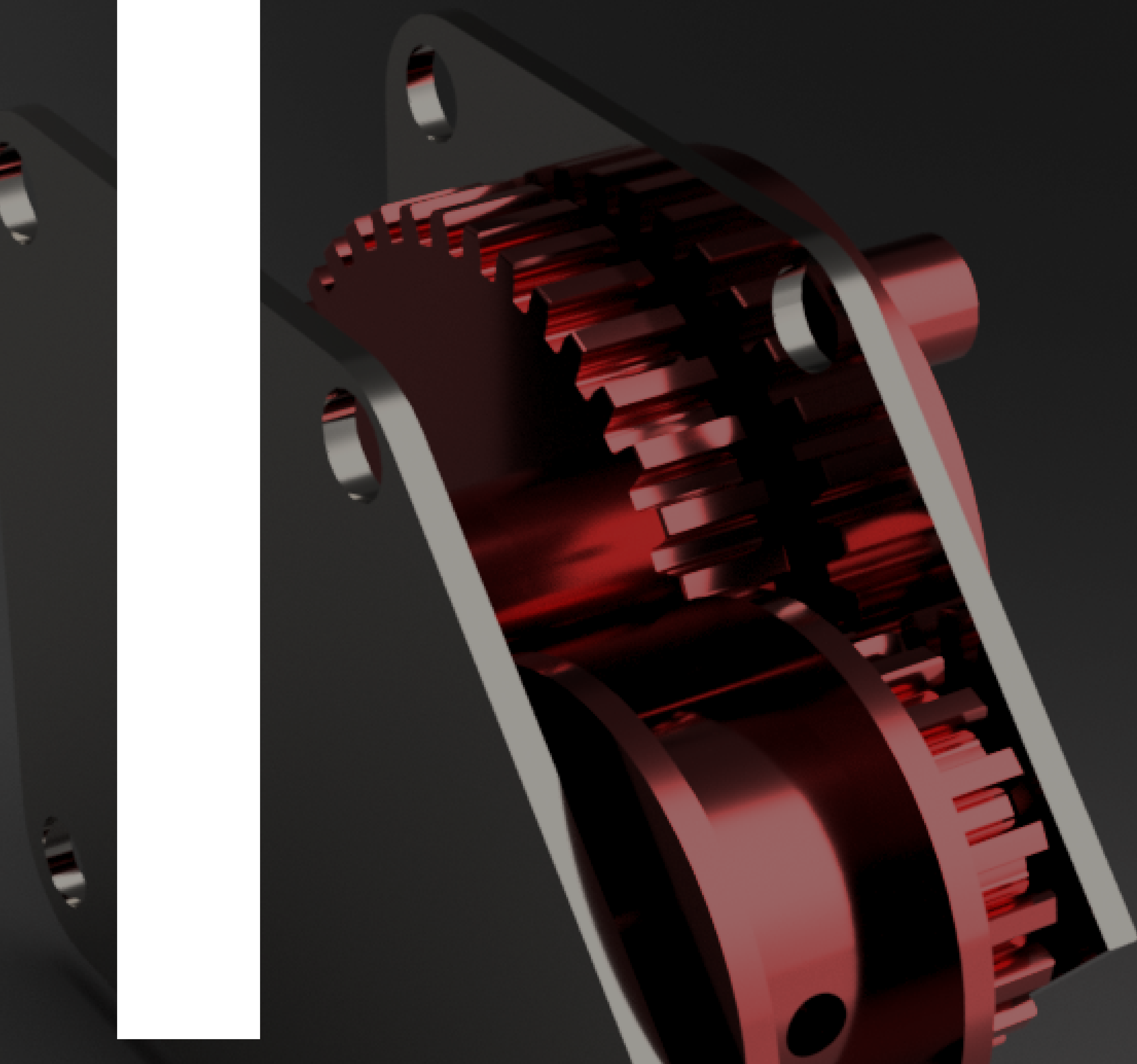

Team 3759X presents

The String Winch

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Introduction

With the introduction of tile contact as endgame in the 2022-2023 game, Spin Up, string launchers became extremely popular as a method of scoring as many tiles as possible. However, with each team having an average of 4-6 strings on their robot, it can take a long time for teams to rewrap their string and respool their mechanisms.

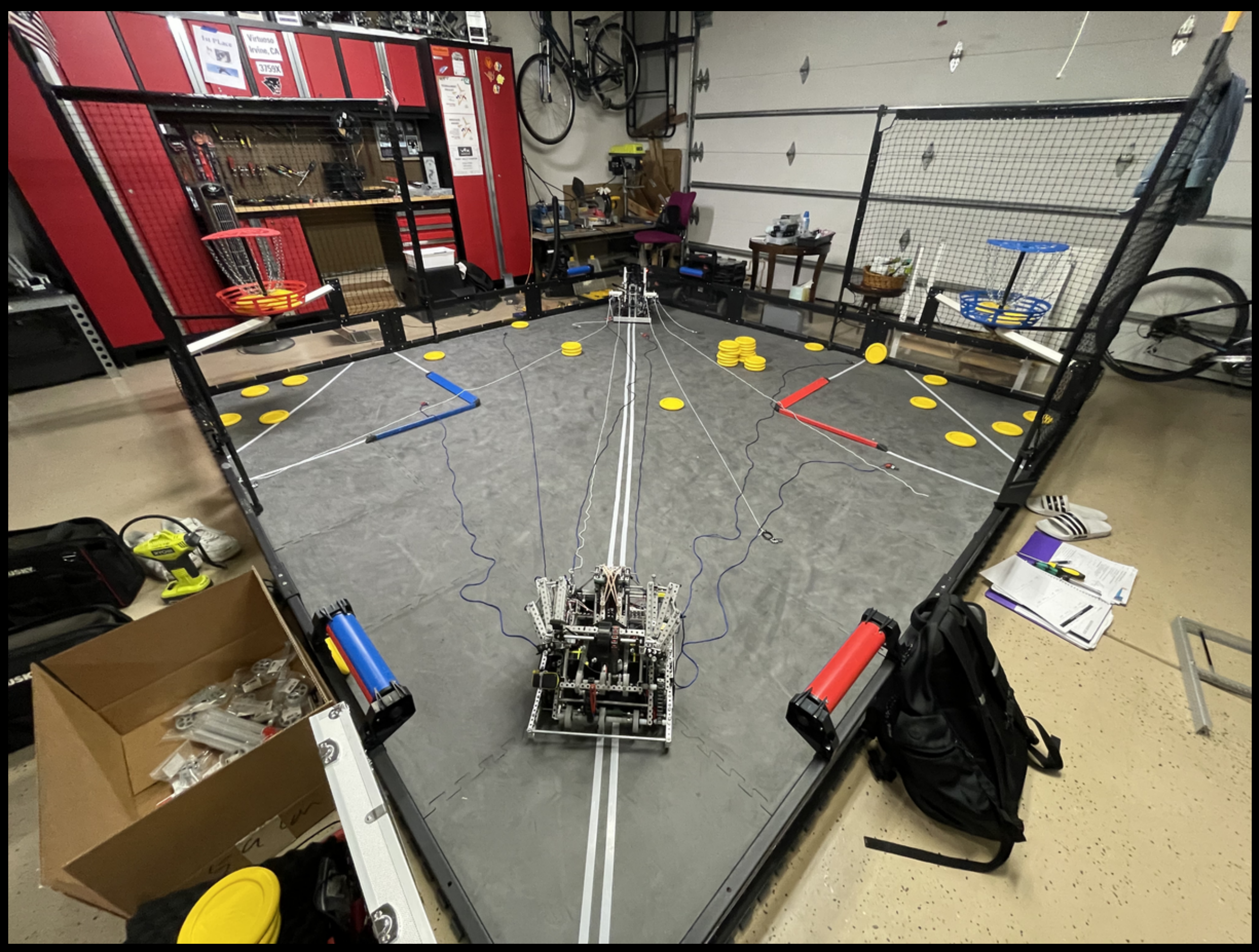


Figure 1: Example of a String Endgame

While teams have a variety of methods to rewrap and store their string, none of them are particular efficient and compact. That is why we decided to create the string winch, which is easily screwed onto a robot and quickly rewraps any string that is shot out very easily and swiftly.

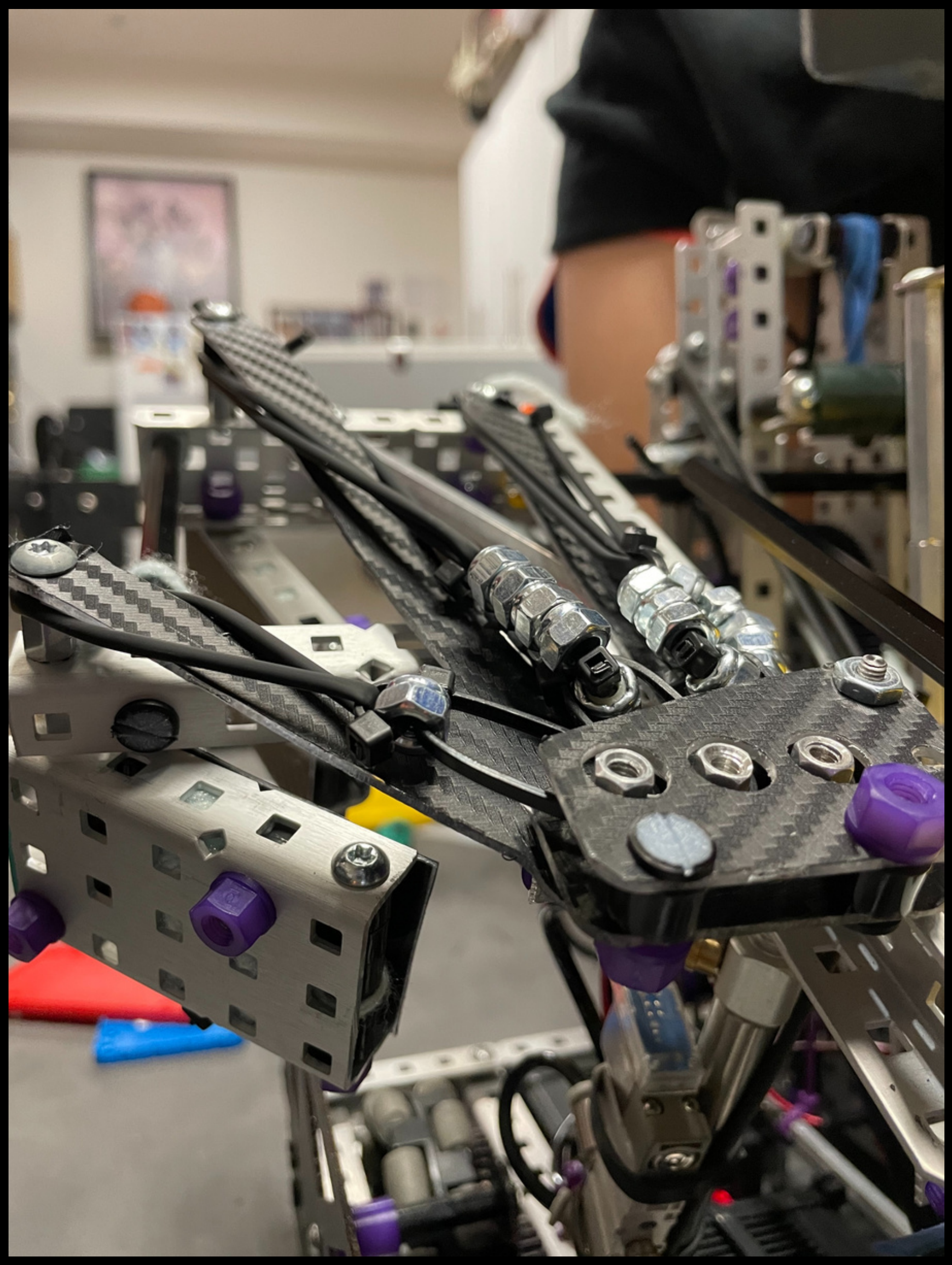


Figure 2 : Team 3759x's String Shooter

The string winch removes the need for large string-storage systems and portable string-wrapping devices, greatly increasing both the cycle and clean-up times between each match. Additionally, it manages to accomplish this in a extremely easy to assemble and slim format, being able to be screwn on and off any robot with ease.

Explanation

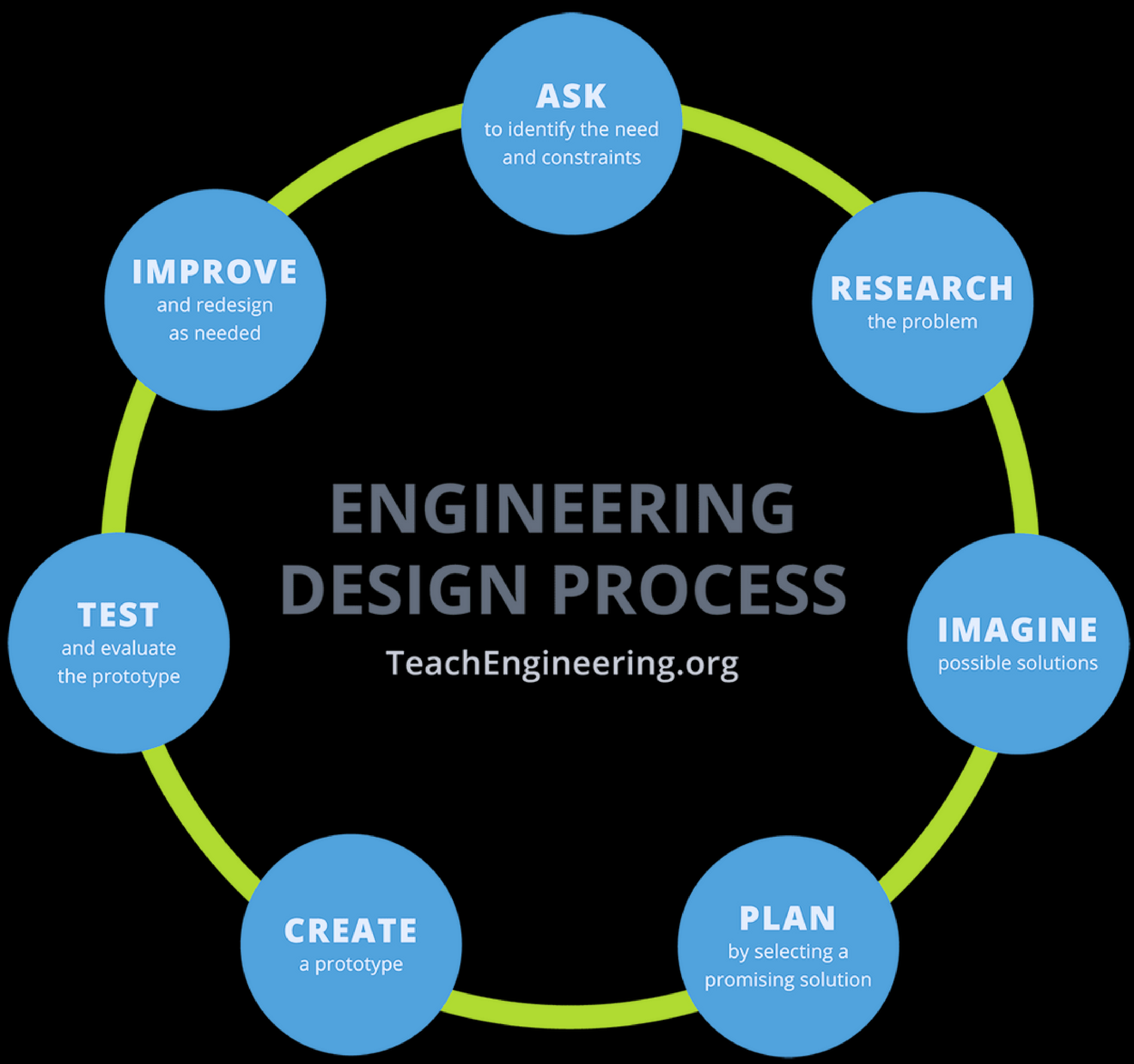


Figure 3: Engineering Deisgn Process

During the design process, we followed the steps above and went through several prototypes in order to achieve our final product. However, before we started designing anything in CAD, we evaluted the problem and thought of possible solutions.

While approaching the problem, we decided that our two main priorities were efficiency and compactness. In order to redefine string storages while achieving both of these goals, we came up with the winch after looking at several scenarios which needed to wrap string.

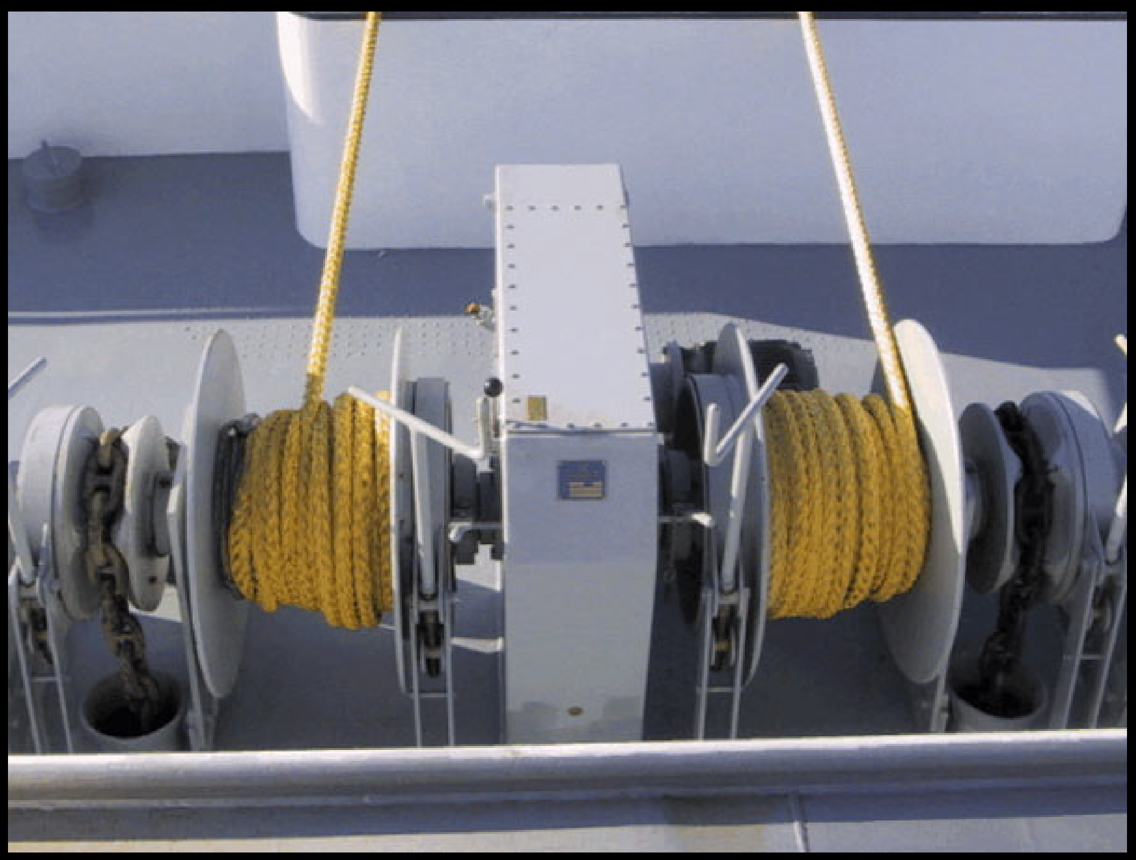


Figure 4: Aicrane Boat Winch

Figure 5: Harken Winch Kit for Climbing

Prototypes/Revisions

For the String Winch, we went through several revisions and trials of testing in order to improve both the user experience and the effectiveness of the winch. During the first few designs, the string winch was very small and measured only 2.5 inches. However, this would cause issues regarding grip for those with smaller hands. In our second prototype, and all further revisions, we increased the size of the overall winch twofold so that it would be easier to grip, and the larger radius of the winch would allow for the string to be winded even quicker.

The Design

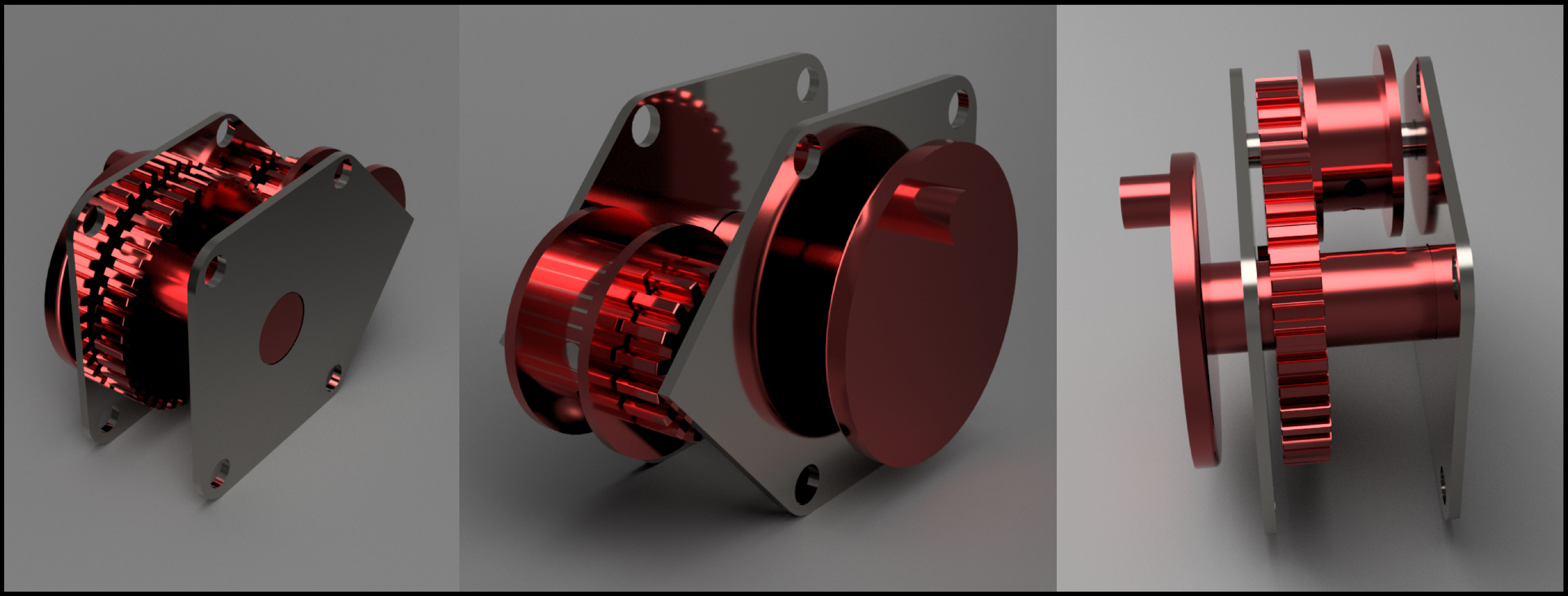


Figure 6: Three Different Perspectives of the String Winch

The final design of the String Winch includes 4 different parts that are screwed together using 4 1.25 inch 8-32 screws and 4 8-32 nuts of any type to fit these screws. While the size can be easily adjusted within any 3-D printing software, the size that we opted for measures around 2.5 inches by 4 inches. We found out that this was a good sweet spot to be both big enough to easily handle but also remain very compact on the overall robot. The winch is attached on dead axle at the end of the two outer plates, and is powered by a hand crank through a 42:18 gear ratio, meaning that every time the crank is spun once, the winch spins 2.33 times. This increases the speed at which string can be winded up.

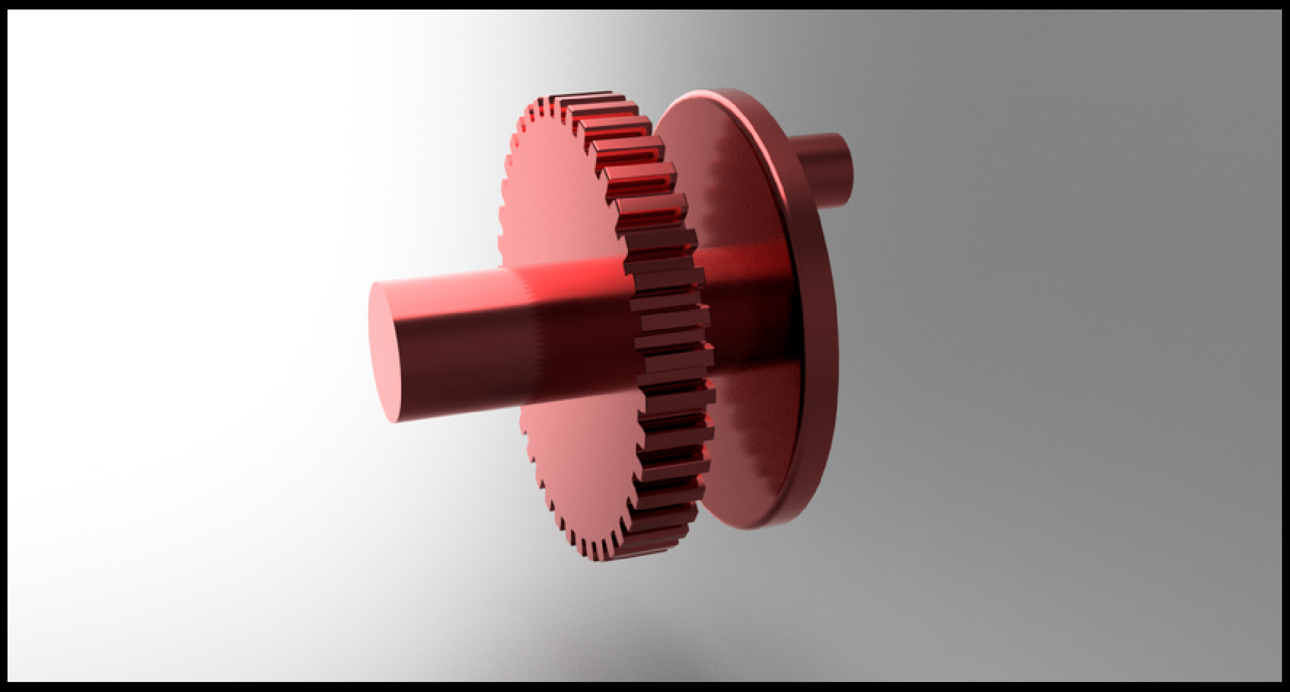


Figure 7: The Crankshaft

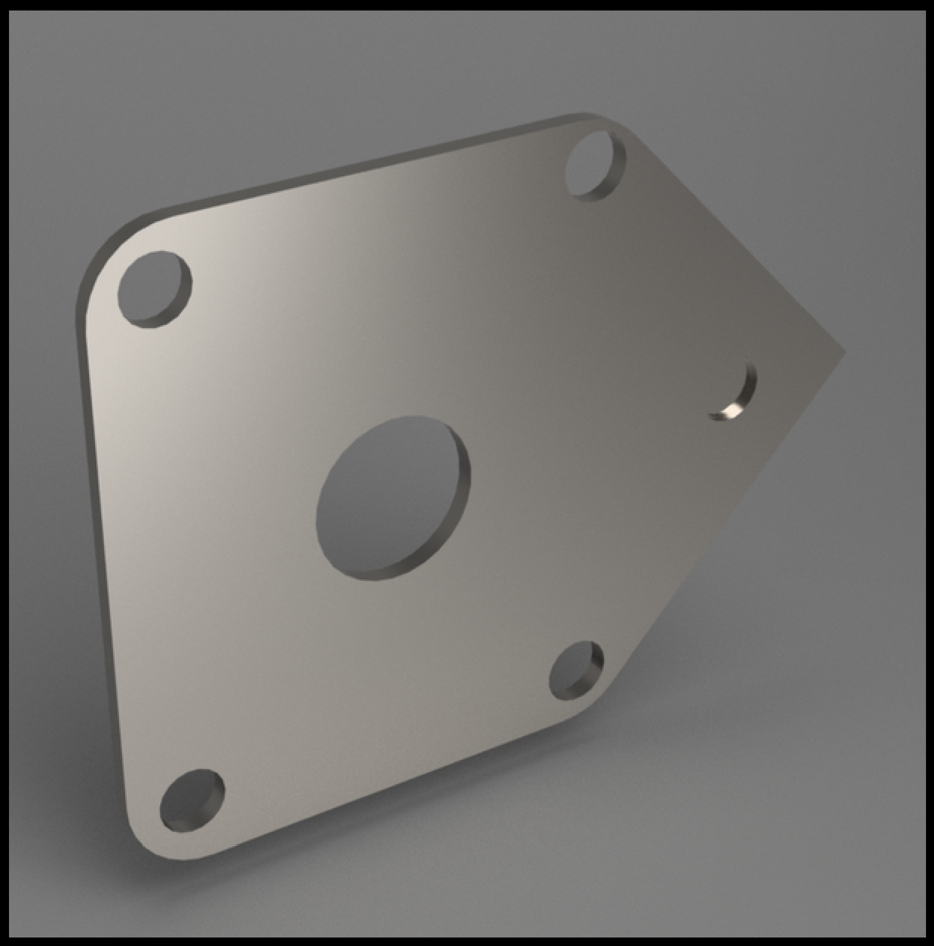


Figure 8: Left Wall

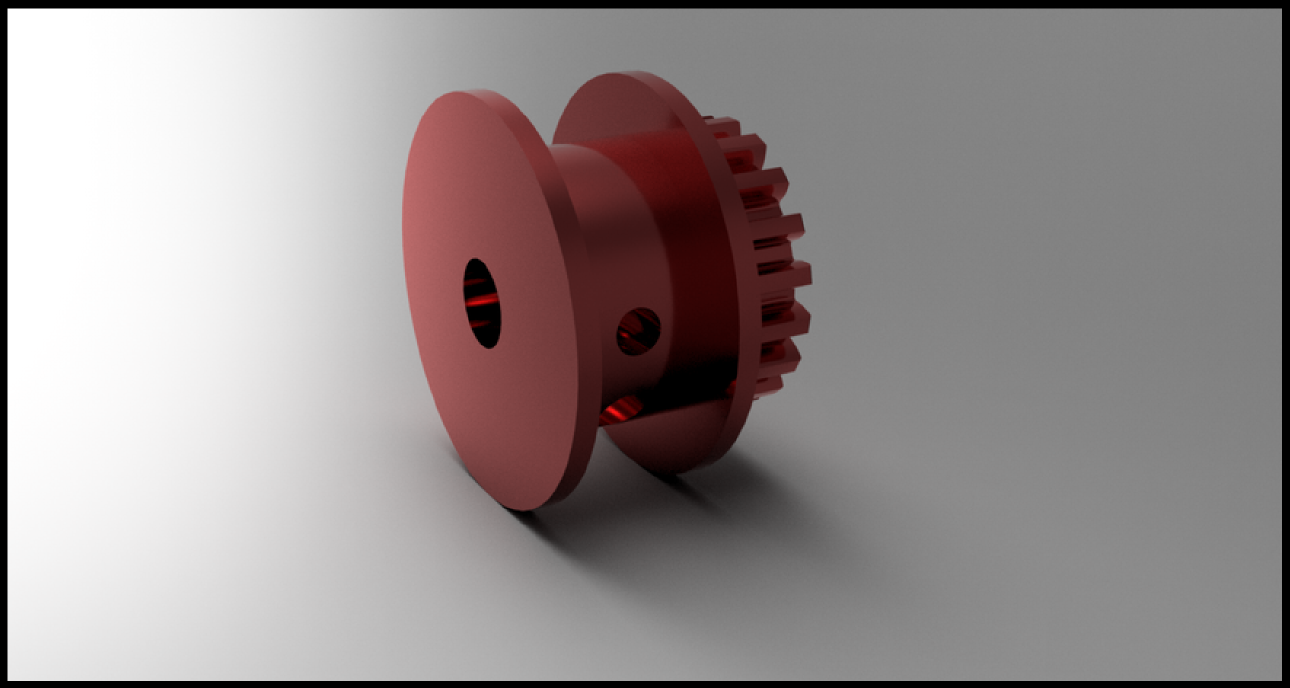


Figure 10: The Winch

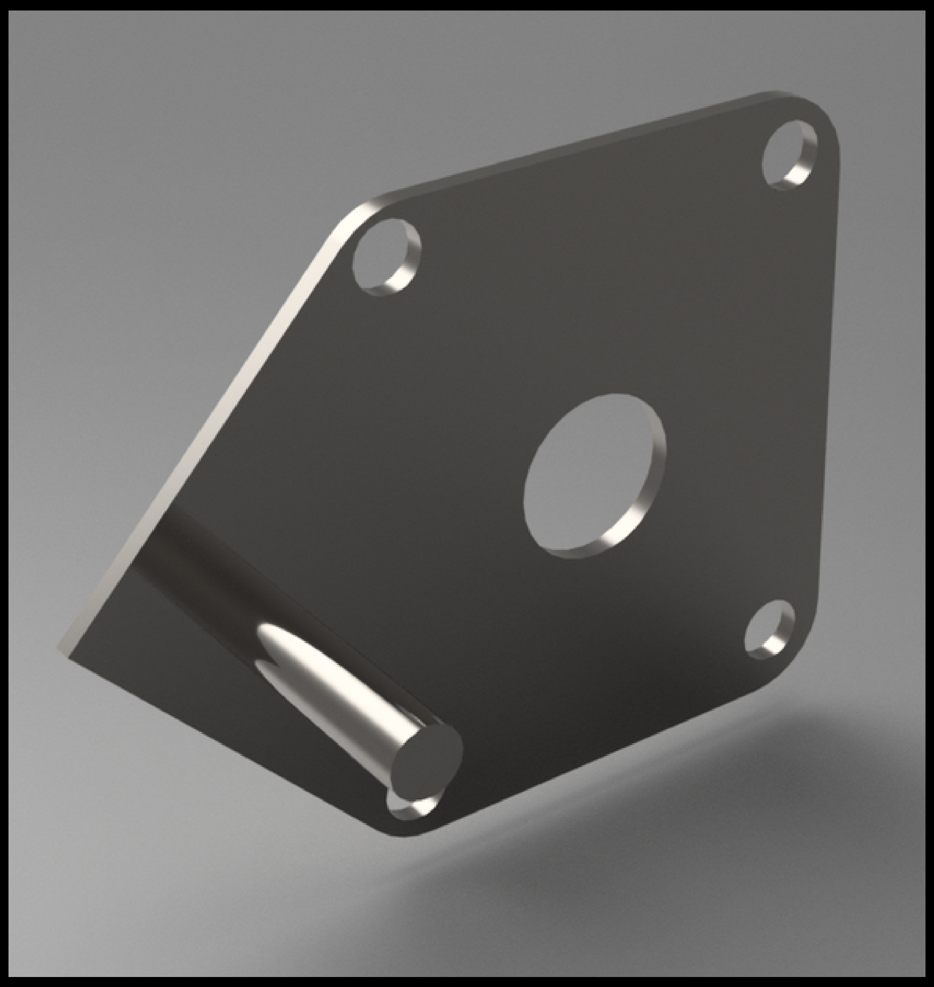


Figure 9: Right Wall

Software

Figure 11: Fusion 360 Logo

The entirely of this design was made through Fusion 360 version 2.0.15050, and all of the renders were made in the render workspace of fusion 360. Throughout the design process, we used a variety of tools to create each aspect of the design. First, we went into the attached McMaster function in Fusion 360 to import a design for the gears. Then, we used the sketch tool to create each of the side walls based on the side of the gear and how much space the two gears side-by-side took. Using the extrude feature, we created each side wall as well as the dead shaft on the right side. Then, using the sketch tool to create a cylinder, we extruded the pulley portion of the winch and merged the two together with the merge tool. Lastly, we created the handwinch through a sketch using the same tools as before. Throughout the course of prototyping, we were able to easily alter the dimensions of the model through **parameters** established at the start of the project. Creating parameter values for things such as hole width, wall height, and more allowed for us to easily adjust the model sizing based on results from testing and made the overall iteration process much quicker and efficient.

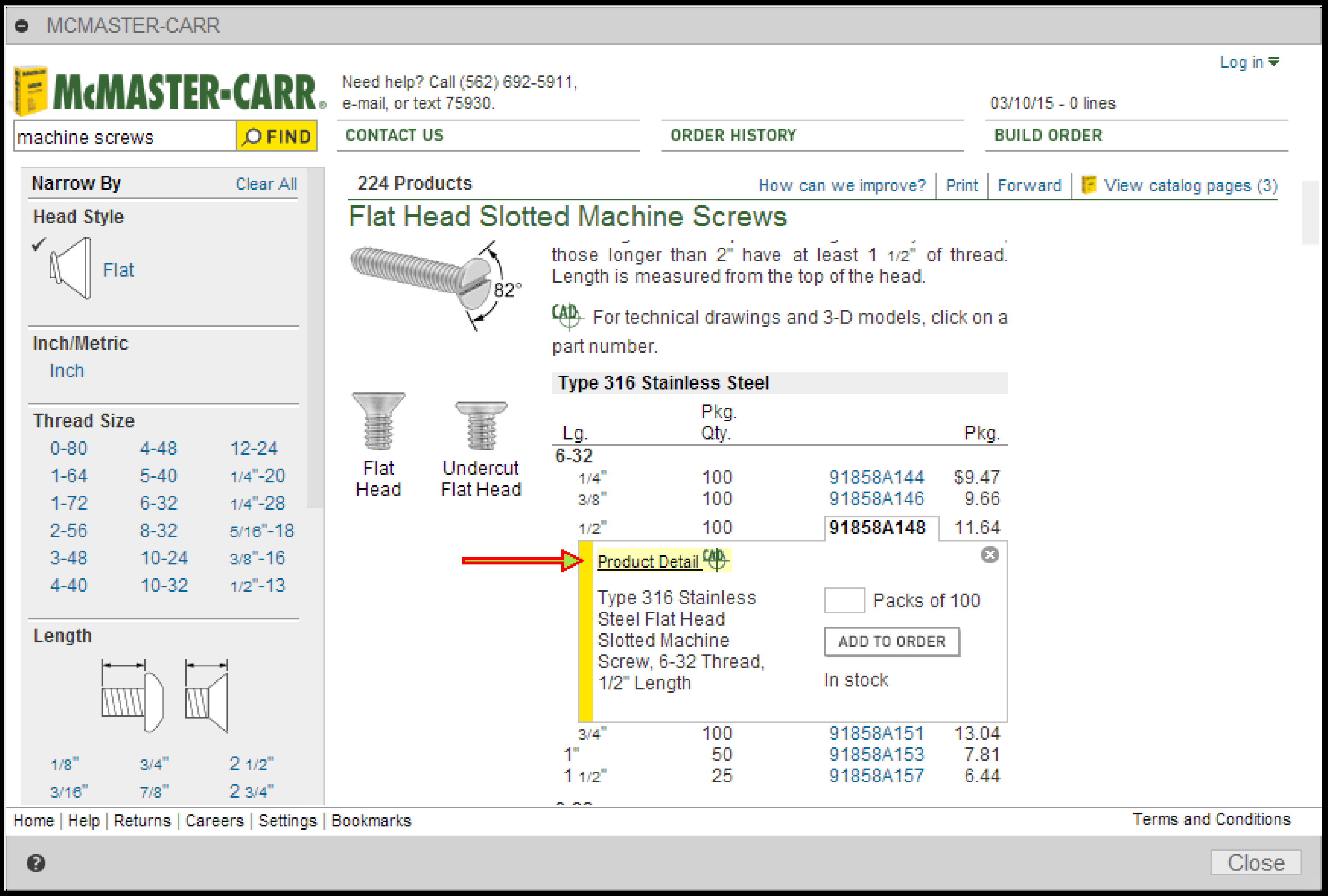


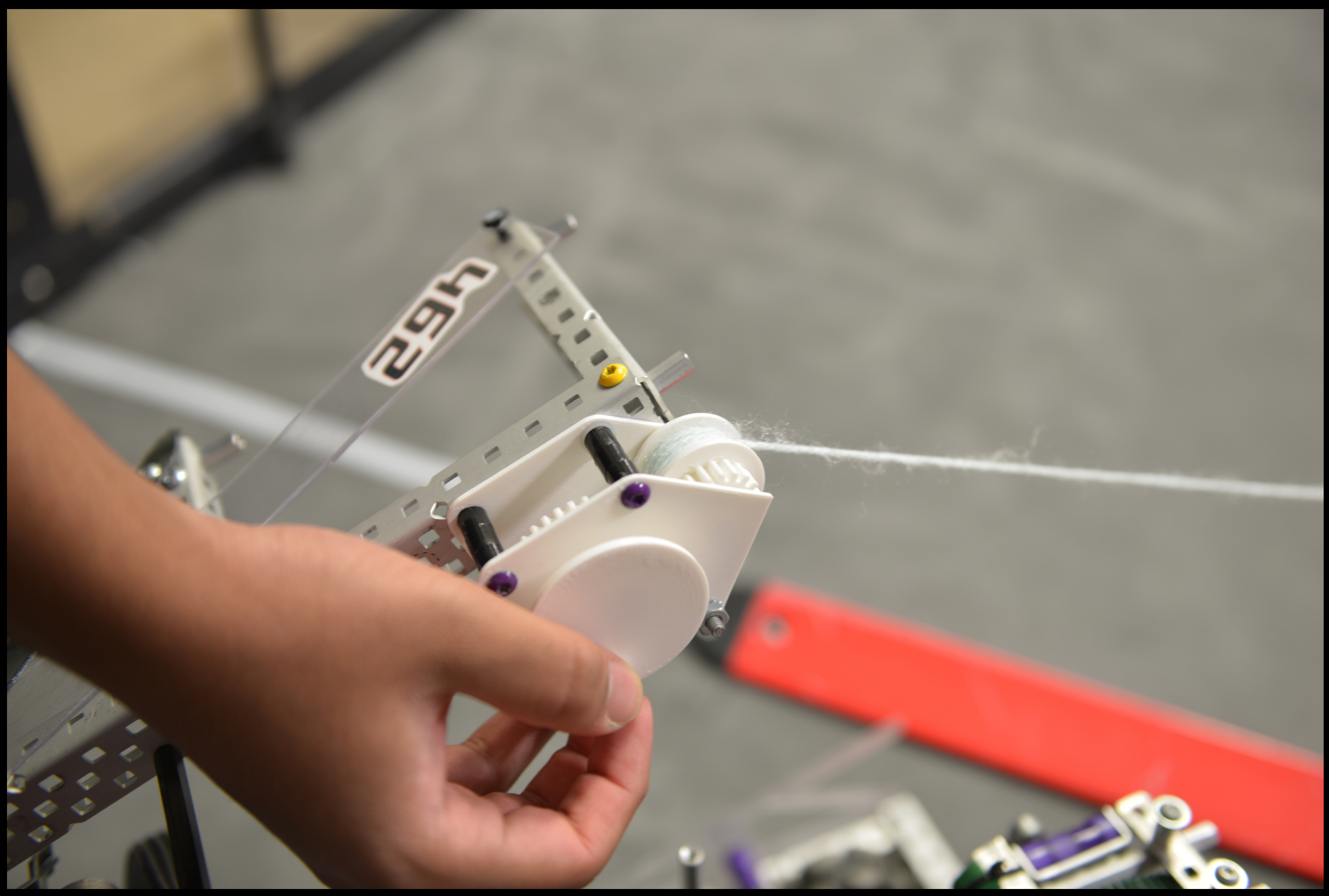
Figure 12: Mcmaster Within Fusion 360

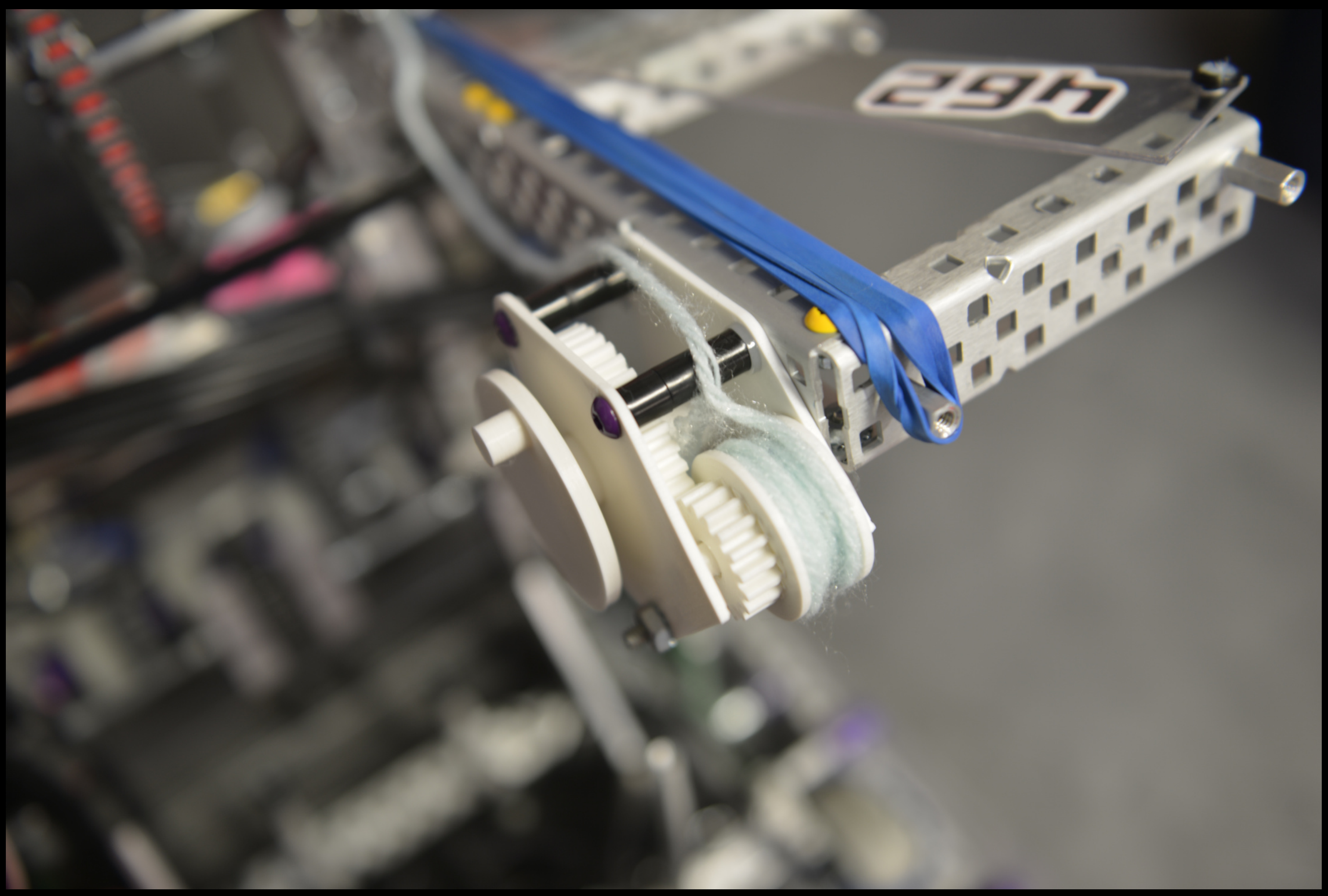
The winch was printed on a Prusa Mk3S+ using PLA. While we did not see the need for a stronger material such as PETG, users may opt for it if they choose to place the String Winch in a particularly vulnerable spot. We sliced the model and generated the G-Code through PrusaSlicer, and the entire print took around 2 hours and 30 minutes to complete.


Figure 13: Prusa Mk3s+ 3D Printer

Testing

After printing out the winch, we mounted it on a robot and began to test. It worked fairly well, being able to store enough yarn for an entire field and was easily pulled out when launching. We ran a few practice rounds with it mounted on the robot, and came up with the revisions stated above in the prototype section based on its performance.





Conclusion

This was the first time any of us had utilized the render portion of fusion 360, and we learned a lot about fine tuning the lighting, the different appearances that could be applied to objects, and altering the environment of a rendered object. Additionally, we were able to improve our design skills within Fusion 360 and repeated revisions/prototypes of models. We experimented a lot more with new features that we previously didn't use, such as parameters and importing parts from external websites directly through a fusion tool. We were able to collaborate together and improve both our teamwork, communication, and design skills while helping to make a design that would improve robots around the world. These skills will prove invaluable in our futures as we move onto collaboration in real-world engineering teams and the communication and problem-solving abilities will continue to prove invaluable in all aspects of our lives.