Proto-Knights 96744A

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"Make It Real" CAD Engineering Challenge

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P-Lock Chain

This is the "P-Lock Chain" which is a modified chain that has more structural strength than a normal chain. It also has been designed to be more rigid than the high-strength chain so it decreases the chances of the chain breaking when an exterior force or obstruction makes contact with the system.

In this year's competition, Change Up, a lot of chain systems were used throughout the robot to maximize the outputs coming from each motor. There are multiple sets of chains in the tower and two sets of chain and tread mixed together at the feeder in the front. When practicing scoring and scoring the game pieces from one of the goals, we encountered a problem that would prevent our robot from being able to compete. When all the game pieces were removed from the goal and a new ball was ejected from the tower into the top, there was a small chance where it would drop straight down to the bottom of the goal. When this occurred, the game piece would first make contact with the appendages on the chain. This would not be an issue if the appendages were flexible like the paddles, but bolts, stand-offs and paddles were used to make the appendages more rigid to help when pulling the balls out of the goals. The impact of the game piece would cause the rigid appendages to bend the chain perpendicular to the path it is traveling in, so when the unaligned chain came to the sprocket, it would break from the teeth and chains not matching up. Changing all of the chain pieces to tread pieces only made the problem worse by increasing the amount of times it would break.

This new chain is not meant to completely eliminate the use of the current chain, but to be a better alternative to when there is a chain system that has a lot of stress or has frequent external obstacles interfering with it as it will be able to handle the stress more. However, if a flexible chain that can be used on both sides is wanted, then the current high-strength chain would be a better fit for that situation. An example of the P-Lock Chain being applicable would be in this competition's robots when there are feeders with chain systems pulling in the game pieces into the frame. These chain systems experience a lot of stress from the appendages on the chain flexing as it pulls out the game pieces from the goals and the game pieces being dropping from the top of the goals to the bottom. The P-Lock Chain prevents these issues from occurring with its unique locking system. Compared to the high-strength chain which needs to be bent repeatedly to attach and detach links, this chain can be pushed into please, decreasing the warping of the pieces. The outside of the chain has a peanut-shaped ring that surrounds where the pin locks into the slot to connect two links together and this allows the slot to keep its tight shape, even when it is being slightly bent open. The shape is lenient enough to allow the slot to bend, but has enough tension to bring the slot back to its original place.

Fusion360 version V.2.0.9439 was used as the modeling software for all of the iterations of the P-Lock Chain. Replicas of the original high-strength chain were modeled and the important measurements were taken, like the spacing between chain links and the diameter of the chain. After brainstorming various ideas, the best idea that was thought to work was modeled in Fusion360. Sketches were made with all of the measurements so they could be extruded into 3D models. These rough models were then polished with the use of cutting away excessive parts and rounding out some edges with fillet and chamfer commands. After the modelling was complete, the prototype could be 3D-printed to be tested. Once it was tested, the flaws in the

design were documented and the digital model was modified to solve the problem so it could be tested again for problems until the design was effective enough for use.

This project has taught me the value of documentation as it is much easier to look at a past model and modify it with your observations from the experimentation on the previous iteration compared to having to completely redesign the model for every iteration. In Fusion360, it allows this capability which is very helpful and has encouraged me to want to continue using this software in the future for competitions like VEX Robotics as I can brainstorm and design new ideas and systems digitally which can be presented to my team members who may be in another place due to social distancing. Fusion360 can also be applied to other situations where specially designed pieces are needed, including underwater robotics, prosthetics, and drone designing. All of these other fields have practical applications with advancing technology and research, helping disadvantaged members of society, and bringing competitions to a higher level. This is just a handful as it can be applied to almost every known career field because as technology advances, the use of softwares like Fusion360, Inventor and TinkerCAD will be used for everyday tasks as it saves resources and time to create a digital model compared to a physical model. The mental skills of being able to analyze the flaws in prototypes and the perseverance to continue to redesign your 3D models are some of the many 21st Century Skills that employers are looking for as everyone will encounter problems in their jobs, but it is those who know how to overcome them who will stand out in the crowd.