39K Rest in Pieces

Make It Real Submission

12/8/2020

The Geneva Mechanism Gear Kit

This year, our team faced a problem: as our robot attempted to spit balls out into the tower, they were too close together and bounced off one another, ultimately leading to either one or both balls missing the goal entirely. We need a timing indexer, that would pause between each ball being shot. However, because of the motor limitations of VRC (8 motors per robot), have a motor dedicated to just this timing would put us at a severe power disadvantage, as we wanted the rest of our intakes to be able to keep spinning to maximize efficiency. This is where a Geneva Mechanism comes in, a type of gearing that mechanically allows for alternate timing of motion. For every rotation of the drive gear, the driven gear is locked in place for the first ⅔ of rotation. Then, the driven gear is rapidly turned for the remaining ⅓. This type of mechanism is perfect for our robot, as we can continuously spin the intakes, and the balls will be stopped by the mechanism's pause.

We decided the easiest way to implement this mechanism was in the form of 2 gears: a drive gear (smaller and colored black) and a driven gear (larger and green). This would keep consistent with vex's other gearing mechanisms, and we specifically designed the gears to fit the standard vex spacing. This would allow teams to use them as easily as any other vex gear. This part's use isn't limited to this year's game, as indexing is a common task both in VRC and real world applications.

In order to make both parts, we chose to use Autodesk Inventor 2021 (Build 245, Version 2021.1) for a few key reasons. The ability to make lines with specific angles, fillet and extrusion features, and render tools were helpful throughout the design process. This design posed the unique challenge of needing extremely precise geometry, as it had to fit the standard vex spacing as well as have a unique geometric shape in order to ensure it turns smoothly and doesn't jam or collide. For this, the tangent lock was especially helpful, as it confirmed all the slots on the driven gear where the correct size for the pin of the drive gear (all this geometry is shown on the design presentation pdf). Finally, we were easily able to properly raise and cut holes using the extrusion commands, and we polished the corners and holes using the fillet command. At the end of the process, we used the stress test features in Inventor to determine what material would hold up under pressure, as well as being cheap and light. This feature confirmed the two gears could be made with the standard vex plastic, meaning our design wasn't putting excessive stress on itself.

From this project, we learned how to better maximize all of the features available in Inventor, including learning how to use the extrusion, fillet, stress test, and material features. We also learned how to better present our designs with annotated drawings and using ray tracing renders for a clean final presentation. In the future, we will be using Inventor as a step in the design process of all of our robot's subsystems. The software helps us ensure all the subsystems work with each other and stays within all of the constraints that VEX sets out. Adding CAD as a step in our design process will save us time in the lab, as we will essentially have a blueprint to build from. It also saves resources because it allows us to catch mistakes earlier on before we build the robot. Learning these things in robotics and while using Inventor will help our team get into a wide range of careers, from architecture to mechanical engineering. In these fields, Inventor and other similar CAD software are commonly used, and this project helped lay a solid foundation in them.