Autodesk Make it Real Challenge 2020 Entry - Ratcheting Sprocket

About me:

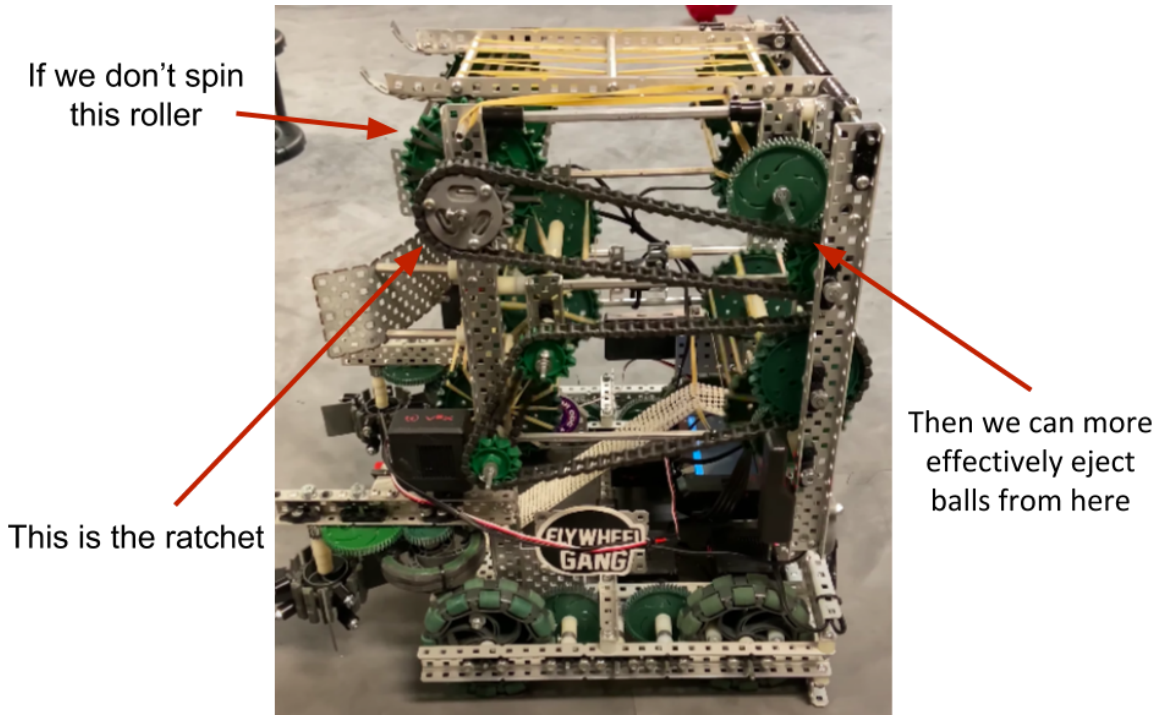
Hello! My name is Ian Brueggeman, and I am a Sophomore at Harrisburg High School in South Dakota. This is my third year in robotics, and I am on team 7686B.

Why I created the part:

Ratchets are an important part of robotics: they allow you to have multiple mechanisms run by a single motor. This has become increasingly important over the years with a smaller motor limit of eight being implemented. What I set out to do was to create an easy-to-implement ratchet for teams to use on their robot. I did this by combining a ratchet with an already well-used part: the sprocket. The sprocket is used commonly to link two different mechanisms together, which is also a ratchet's most common use: to share two mechanisms to the same motor. My new part will allow teams to easily and effectively implement a ratchet into their robot.

How it is used on our robot:

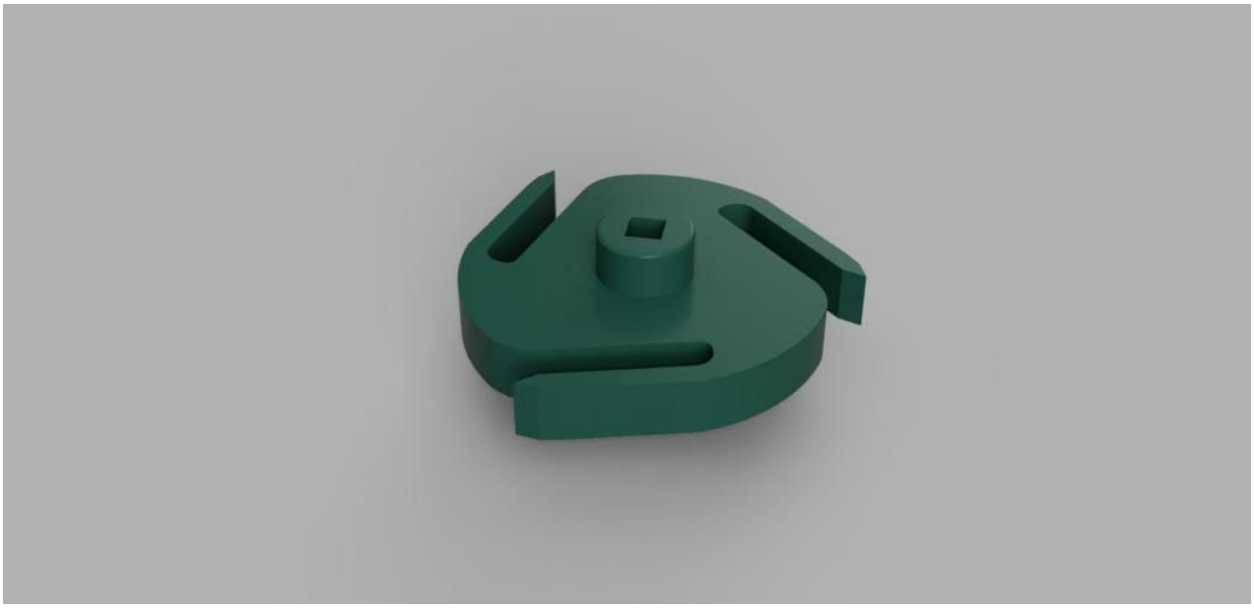
For this year's game, many teams want to have a ball ejector hooked onto their flywheel. This allows for the balls to go out of the back of the robot, rather than them going into the tower. A ratchet would make this mechanism a whole lot easier because the top roller can be stopped when we want to eject a ball out of the back of the robot. Another thing to note is how easily we put the sprocket on our robot. It took us about thirty seconds to swap out a single sprocket, which entirely changes the mechanism to be ratcheting. Here is a picture of what I mean:



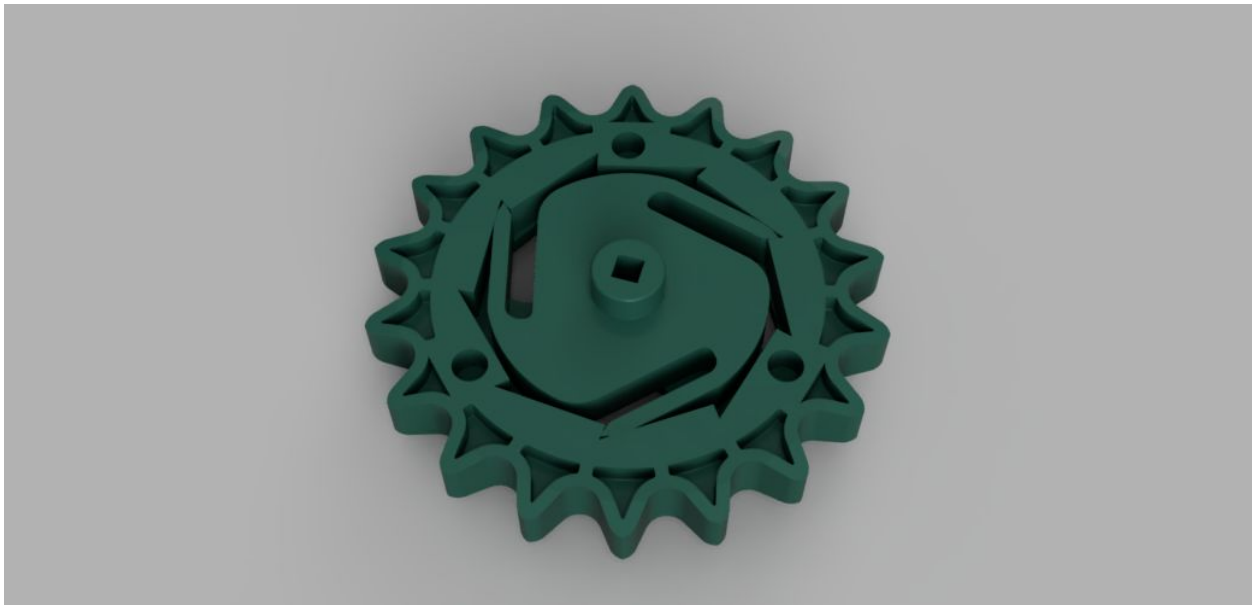
The design:

My Fusion 360 version that I used to create the design is 2.0.9313. I began with a sprocket, then cut out the entire inside. I then designed a toothed system for the middle rotor to catch on in one direction, but slip on the other:

Then, I created the look of the outside. I tried to make it the same thickness as a regular sprocket, and I think I came pretty close. I also, for an added bonus, made both sides symmetrical. I then modeled the rotor that the axle attaches to, which took a couple of prototypes. I eventually settled on a design with three “catches” at three different points:

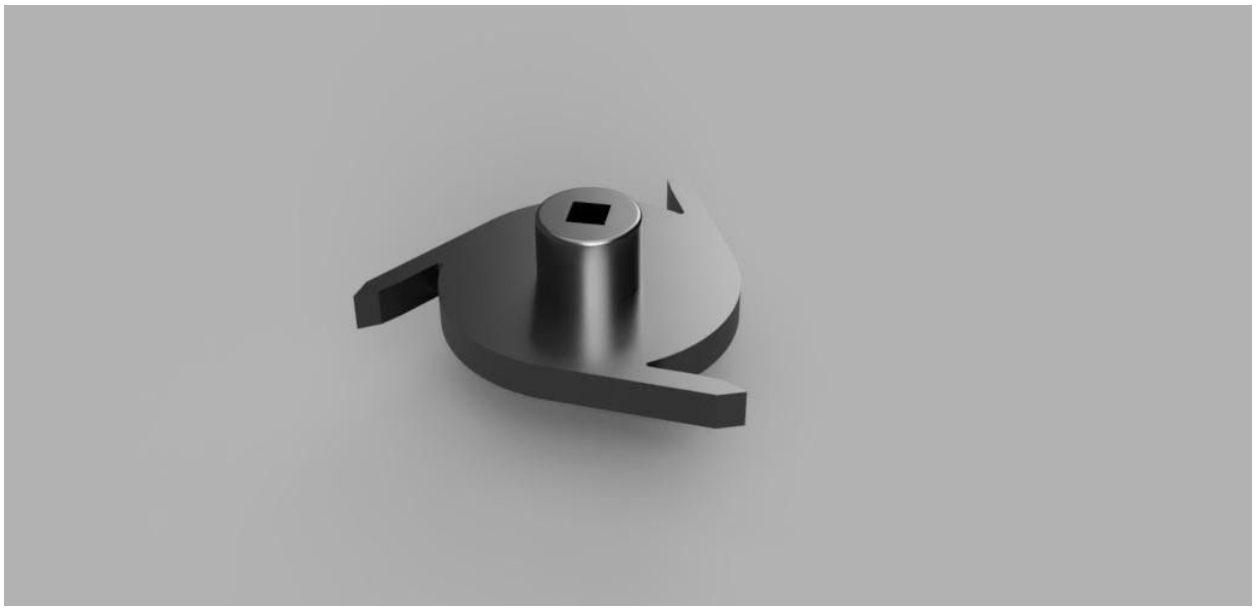


The way the rotor sits in the outer base has been improved over time so it can withstand more load when the sprocket isn't ratcheting. This is how the rotor sits in the outer base in the final design:



Then I designed the top cover. Also, to hold the whole thing together, regular VEX bolts are used. I did this because if one ever strips out, a team will always have extra, since they are used by every team. Another thing I added to the design was a little "B" signaling bottom for easy assembly of the rotor, and I also added a small arrow that points in the direction it doesn't ratchet:

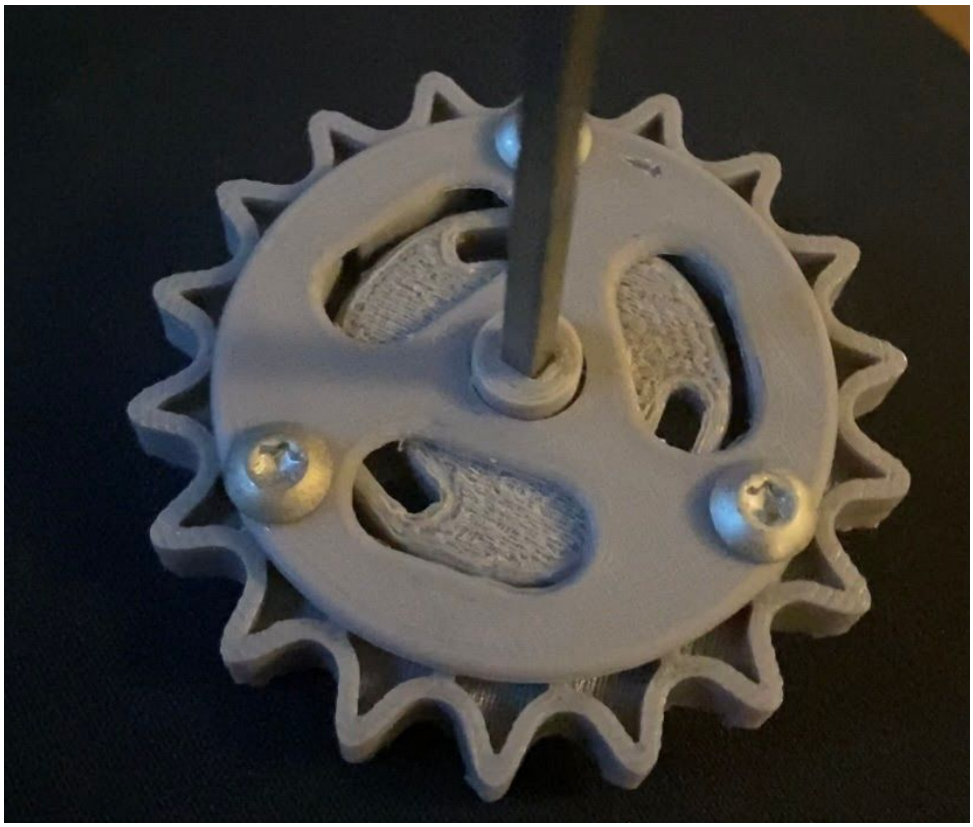
Another thing about the design: I tried to make it as low friction as possible; this is why I printed a couple of different prototypes for the rotor. Here is a picture of an earlier prototype that also doesn't have any material texture:



To simplify the design, the same tooth that catches with the outer-body also acts as a spring. I didn't use this version of the rotor because of how little the teeth flexed, so there was a large amount of friction while ratcheting. You can see in the third video I uploaded how well the final design spins when it is ratcheting. If a team wants the ratchet to go the other way, all they have to do is flip it upside down, and that will change the way it ratchets.

3D Printing:

To 3D Print the design, I used my Creality Ender-3 to print the design in gray PLA. I had to adjust the tolerances, because my printer is not that precise. Here is a picture of it:



Knowledge gained:

What I learned from this project was more features in Fusion 360 that I didn't know existed like the circular pattern feature, which helped me design the rotor. I have also used my knowledge of Fusion 360 outside of robotics when I helped my dad by designing and printing mask extenders for him, which wouldn't have been possible without the knowledge I gained from doing this challenge. I will definitely use Fusion 360 in the future for making my own 3D printable designs, and hopefully as an engineer. I want to be an engineer when I grow up, so I will use computer aided design software for that. Fusion 360 has also helped me create a complete CAD design of our robot, so we could plan out where things were going to go before we even started to build.