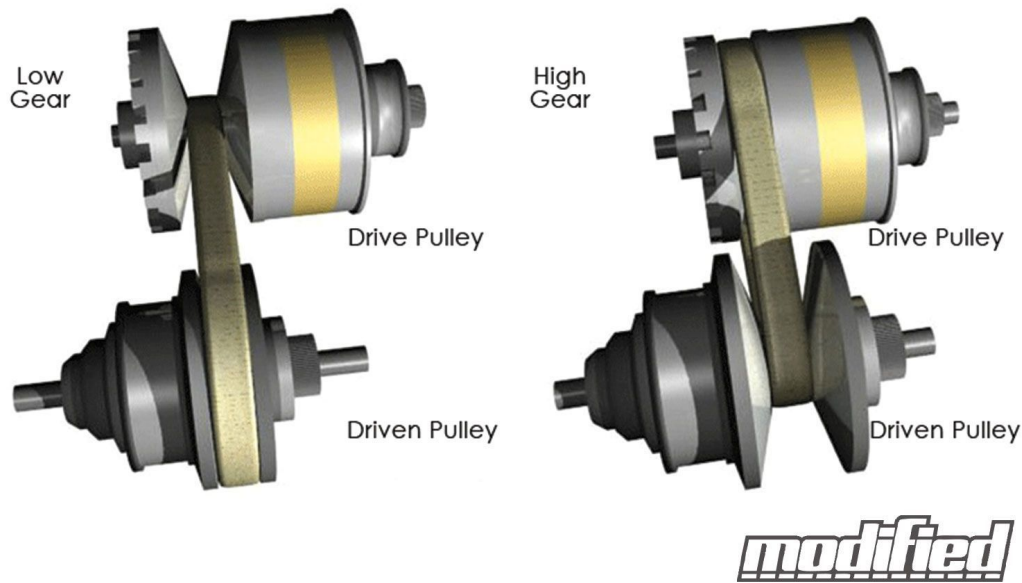
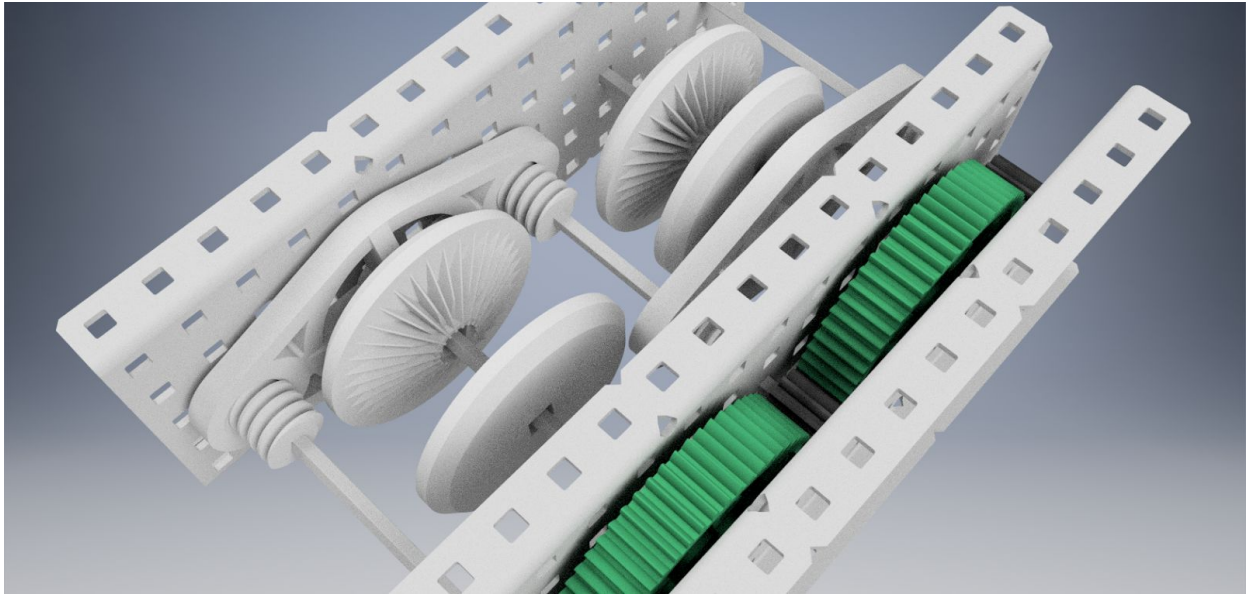


After the VEX Worlds competition in 2016, one of my teammates asked me if I could create a CVT; I said “yes” even without knowing what a CVT was. Later, at the beginning of 2017, I revisited the challenge with more seriousness. The goal was to create a transmission that could change between more than two gear ratios. This way, a drive train could have gears for high speed, high torque, or any in-between.

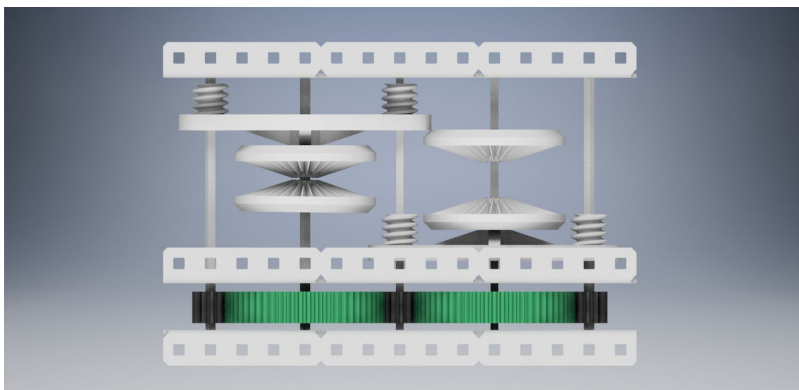


A CVT, or Continuously Variable Transmission, is a transmission that can seamlessly change to any ratio in a continuous range. This way, the engine can maintain its highest efficiency while outputting at a variety of speeds. The most common CVT designs involve a belt and two pulleys. By moving the two halves of each pulley closer or further apart, the belt rides lower or higher on the pulley, changing its effective diameter. Since the length of the belt cannot change, both pulleys must change simultaneously--one must increase while the other must decrease.

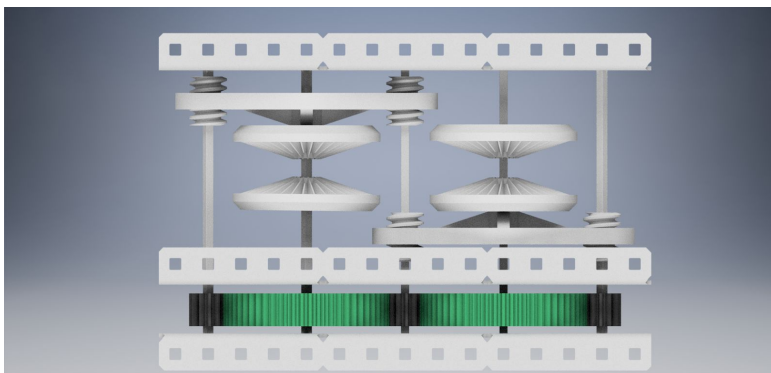
The CVT has only one output, so the best way to utilize it would be to install two on a tank drive. The CVT also requires a motor to turn a shaft to adjust the ratio, but both CVTs can share the same adjustment shaft.



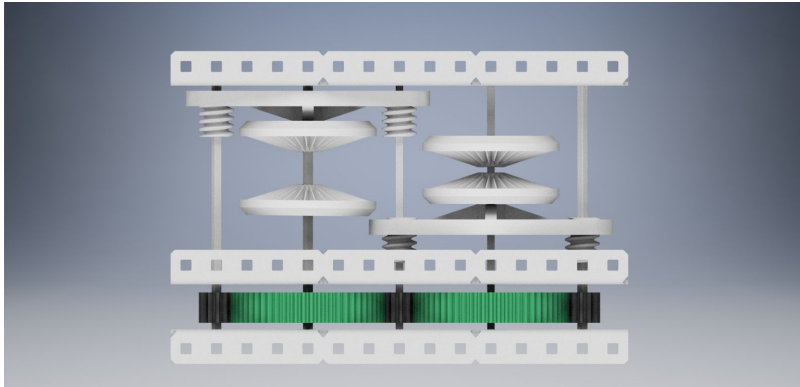
My CVT design consists of three unique parts: Pulley sheave, push plate, and belt. Most of the design and calculation was done on paper before being refined in Autodesk Inventor 2017. The first challenge was figuring out how to move the pulley sheaves closer or further while allowing them to rotate freely. Real CVTs use hydraulics built inside the shafts, but I designed a “push plate” that would mesh with VEX worm screws. Turning the screw causes the push plate to slide parallel to the axis of rotation. Three shafts are geared together with VEX gears so that when turned, four worm screws turn simultaneously, moving both push plates in tandem. This pushes one pulley sheave closer while allowing the other to slide further.



CVT in High Gear

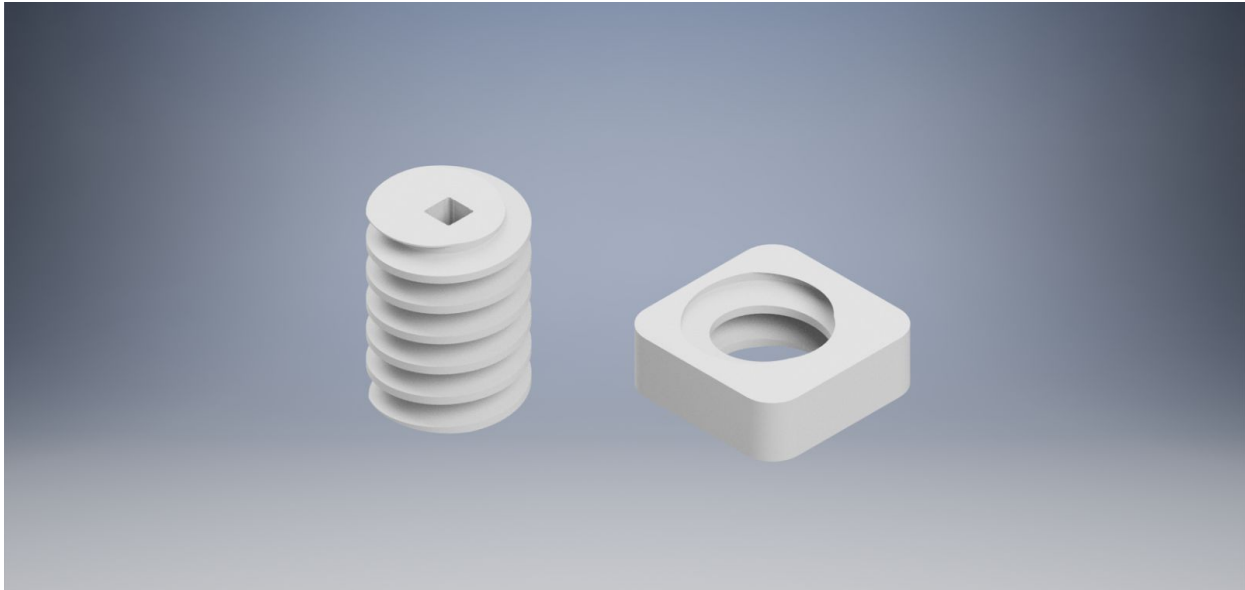


CVT in a 1:1 gear



CVT in low gear

In order to create a threaded hole to interface with a VEX worm screw, I used the intersection between the worm screw CAD model and the part to create a hole. I selectively enlarged the worm screw so that its diameter was larger (but the thread distance remained the same). This created a hole with some tolerance



Another challenge was figuring out how to create a belt that was strong yet flexible. Ninjaflex was the only available flexible material to work with. I came up with a design that linked block “teeth” together with thin bands, giving the belt flexibility while preventing it from crushing between the pulleys. I designed the pulley sheaves accordingly, giving them spokes to catch the teeth to prevent the belt from slipping.

I learned about how to use 3D modeling tools in Inventor as well as how to create certain features using these tools. In addition, I learned how to iterate on previous versions of a part to improve and solve problems. This second point is more important to me, since my future career will focus on computer science, so while 3D design software may not be as useful to me, the engineering process will be.



