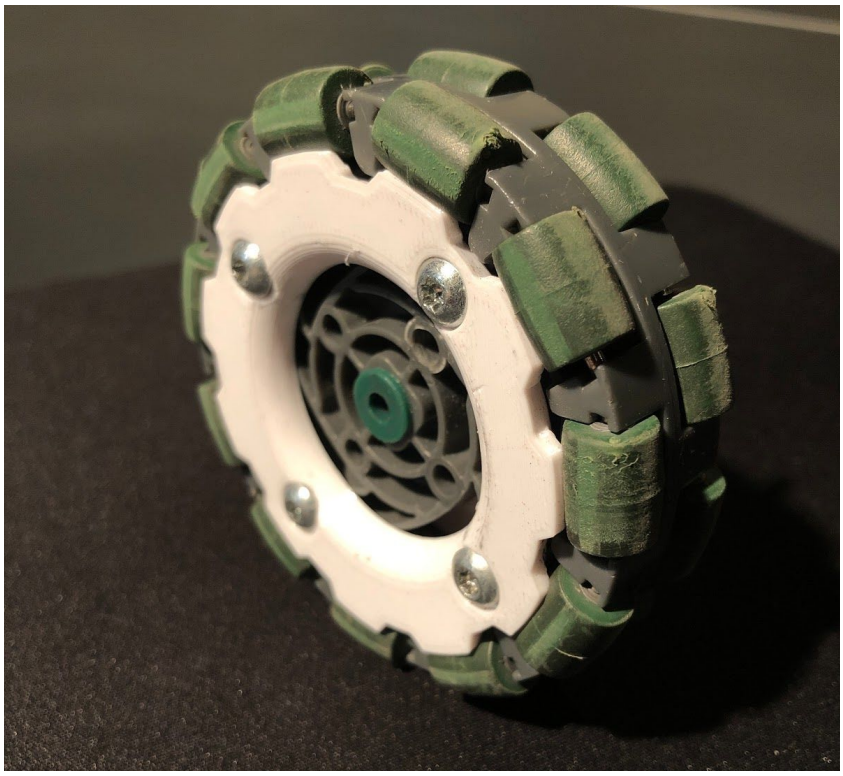
“Make It Real” CAD Engineering Challenge Sponsored by Autodesk®

Omni-Wheel Lockers



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PURDUE SIGBOTS

Introduction

Throughout the many seasons of the Vex Robotics Competition, maximizing your robot's scoring capabilities has often been the ultimate end goal for any competitive team. One strategy to achieve this is to not only maximize your score, but minimize your opponent's score using defensive strategies. In recent seasons, such as the 2018-2019 game Turning Point, robots with more defensive capabilities have become more prevalent. One ability that many defensive robots share is that they are able to resist being pushed from the side. There are many methods to achieve this ability, such as a mechanical brake, but by far the easiest solution to this is to have a wheel on each side of the drivetrain that resists sideways force. Several versions of this type of wheel exist, such as the stock traction wheels sold by Vex, but one of the most effective designs is an omni wheel where the individual rollers are "locked" in place, unable to roll. This design ensures that the wheel is the same diameter as the rest of the omni wheels, retains the same grippiness, and achieves the desired effect of resisting sideways force. The most common approach to "locking" the omni rollers is to wedge a screw between the rubber of the roller and the plastic housing of the wheel, as seen below:

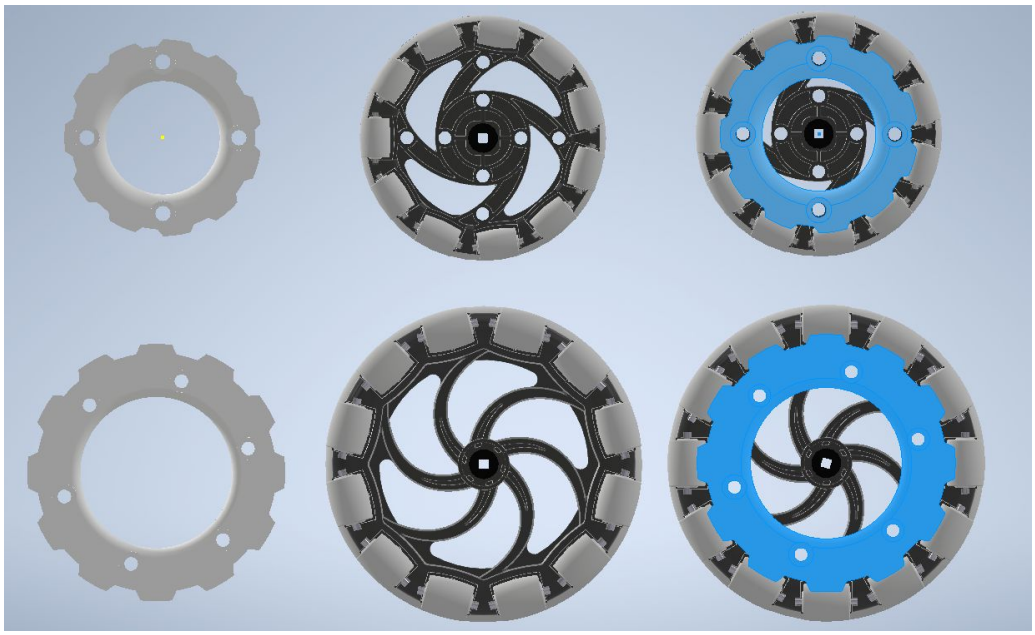
However, this method of "locking" the omni rollers comes with several issues:

- Screws can potentially damage the rubber of the omni rollers
- Screws can potentially fall out of the omni rollers during a match
- Requires a large amount of screws (up to 24 screws for 4" wheels, up to 22 screws for 3.25" wheels)
- Increases the profile of the wheel
- Time consuming to place the individual screws in each wheel

To combat these issues, we created our own part to make the process of creating "locked" omni wheels more streamlined, dependable, and safer for the wheels.

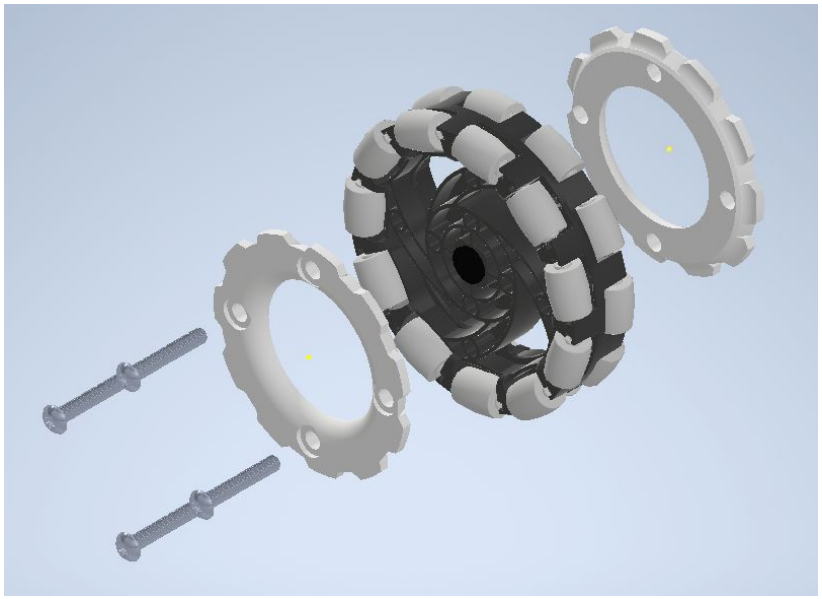
How our part works

Instead of individual screws locking each roller, we developed a ring-shaped piece with multiple flanges sticking out of the edge. When this piece is screwed into the wheel, the flanges are pressed into the rollera, preventing them from spinning. 36 and 60 tooth gears are able to be screwed into these pieces as well, allowing for the use of a drive ratio to work in tandem with these omni lockers.



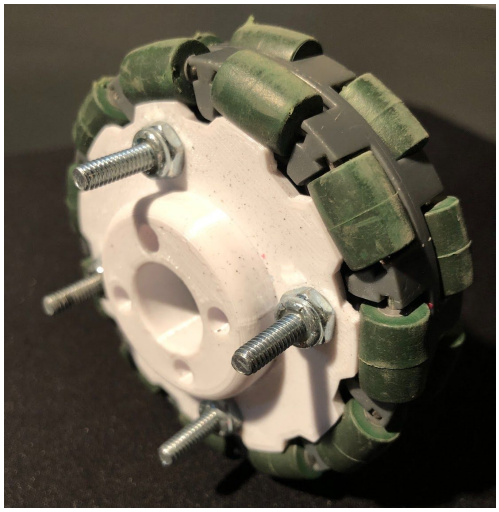
- 3.25” Omni Locker

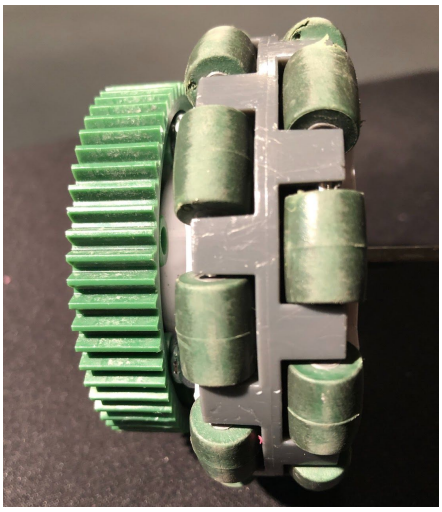
The 3.25” omni wheels can be locked using two identical pieces, one on each side of the wheel



- 3.25” Omni Locker with Gear Spacer

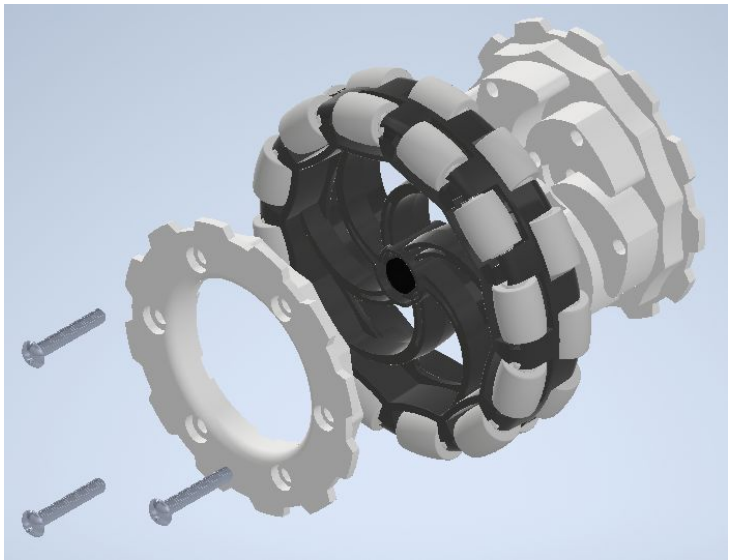
This assembly is identical to the previous assembly, except one side has an extruded hub that allows for 36 and 60 tooth gears to be attached without contacting the omni rollers. This configuration is currently being used on our 24” robot.





- 4” Omni Locker

Because of the spoke design on the 4” omni wheels, the assembly for the 4” Omni Locker consists of two different pieces.



The inside piece is able to slot into the spokes of the omni wheel, which can also reduce slop through the axle when driven with a gear. The outside piece is then able to screw into the holes of the inside piece to keep the assembly together.

How we used Autodesk Inventor

- 3.25” Omni Lockers

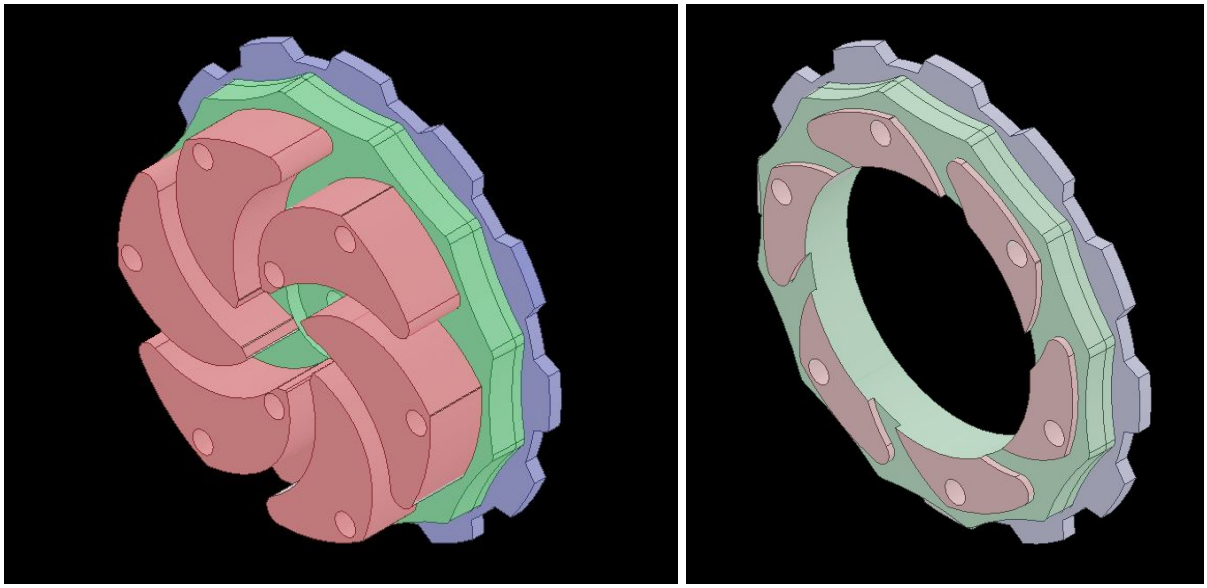
Once an initial ring was extruded from a 2d sketch, small rectangular shapes were negatively extruded into the ring to create the spaces between each individual flange around the edge, and chamfers were made on each side of the flanges so that the corners wouldn’t poke or puncture the rubber of the omni wheels. Several fillets were made to reduce the amount of filament needed and to make the piece fit the wheel better.

- 3.25” Omni Lockers with Gear Spacer

This piece followed a similar construction path as the regular locker, except an extra extrusion was created on one side.

- 4” Omni Lockers

The greatest challenge to designing a 4” locker is that there are no screw holes in the wheels themselves, and the wheel spokes are divided in sextants rather than quadrants. In addition to designing a wheel locker, we had to design a 4” wheel hub that can slide into the wheel.



The 4” version is split up into 3 main extrusions:

- The blue extrusion is the part that contacts the rollers, preventing them from moving. The outer side relative to the other side is offset 15 degrees to match up with the rollers on the other side.

- The green extrusion fits to the inner part of the wheel to reduce slop. A loft was needed to perfectly match the contours of the 4inch wheel.
- The red extrusion fits to the spokes to reduce slop and connects each side to each other. They also have screw holes in a line pattern to support vex gears/sprockets and hexagon pattern to support custom gears/sprockets.

Conclusion

This project has taught us a lot about how 3D design and printing can create simpler and more effective solutions than what is possible with raw materials. These Omni-Lockers are just one example where 3D printing has been implemented to create the most optimal pieces on our robots. We will definitely continue to use 3D design in the future, as it allows us to continue innovating to create the best performing robots possible. The endless possibilities of CAD and 3D printing allow for the solving of complex problems that were previously unsolvable, in both Vex Robotics and in the real world. As the various fields of engineering surge forwards in our new age of technology, more and more complex problems present themselves, calling for the usage of innovations in computer-aided design. With a large portion of our members pursuing careers in engineering, the experience we gain from these projects is invaluable for making an impact on the real world, whether it be in the industry or through personal projects.