VEXU - CAD Engineering Challenge 2023
Sponsored by Autodesk

Tracking Wheel Mount

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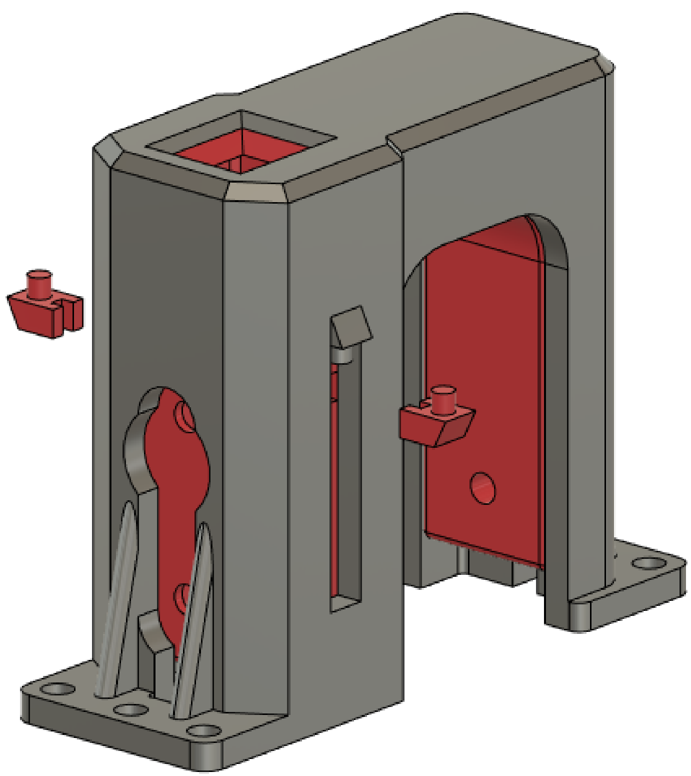
Location: Melbourne, Australia



Introduction

In the autonomous period of VEX competitions, performance often relies on the accuracy of the position data of the robots. Tracking wheels are passive wheels independent from motors that accurately detect the distance a robot has traveled by the amount that it has rotated.

A tracking wheel is usually an omni-directional wheel on an axle attached to a rotation sensor. For the tracking wheel to consistently detect movement, they must contact the ground at all times. To account for the robot lifting off the ground, the omni-directional wheel and sensor are usually attached to a pivoting beam that is forced into the ground with an elastic band.

When programming the odometry for the robot for the VEX U competition 2022-2023 season, we found that the built-in rotary encoders on the drive train motors were unsatisfactory as they were severely affected by the tolerances on the gears, so we decided to use tracking wheels. The problem was that there was limited space on our robots leading us to create a tracking wheel mount to house a smaller mechanism for pushing the tracking wheel into the ground. In addition, having a tracking wheel mount that takes minimal space and weight would be beneficial for any future robots.

Our team will be using this on both of our robots for this season and the future to save space and time when mounting a tracking wheel.

Design Process

Fusion 360 version 2.014569 was used for the design of the tracking wheel mount. The first part of the design process was defining restrictions. The purpose of the tracking wheel mount was to hold the parts needed for a working tracking wheel and to push it downwards to maintain contact between the tracking wheel and the ground. Due to the size of our robots, the design was restricted to 4 inches (101.6 mm) in height. The existing parts we used were a VEX V5 2.75” Omni-Directional Wheel (SKU#: 276-1902) attached using a 3-inch drive shaft with the VEX V5 Rotation Sensor (SKU#: 276-6050) using 4 High Strength Shaft Adapters.

The next step was deciding on the primary mechanism. We decided on a sliding mechanism as opposed to the traditional pivot since that would take less room. 2 small compression springs were to be used to supply the downward force for the inner casing.

The inner casing was designed to house all the moving parts necessary for the tracking wheel. The first sketches were done by Wara to define the side and bottom of the inner casing so that the rotation sensor could slide into the casing from the bottom and be fixed in place by a screw with a hex nut and a drive shaft, and the drive shaft is supported on either side of the omni-directional wheel. The side sketch was extruded to create a new body while the bottom sketch was used to create a hole for the rotation sensor via an intersection extrusion. Bevels were added at the end.

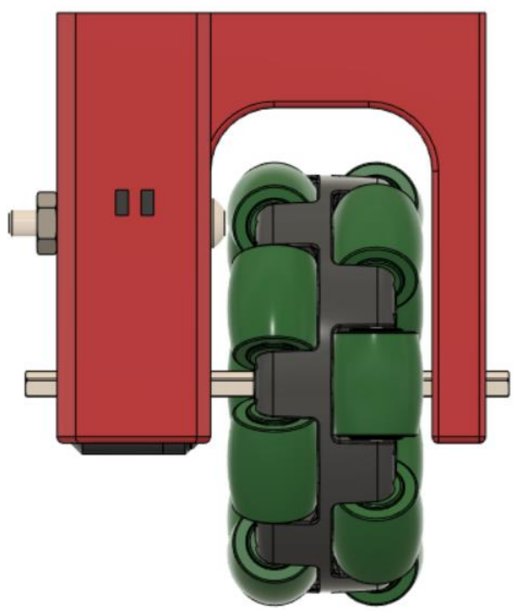


Figure 1: Inner casing assembly side view

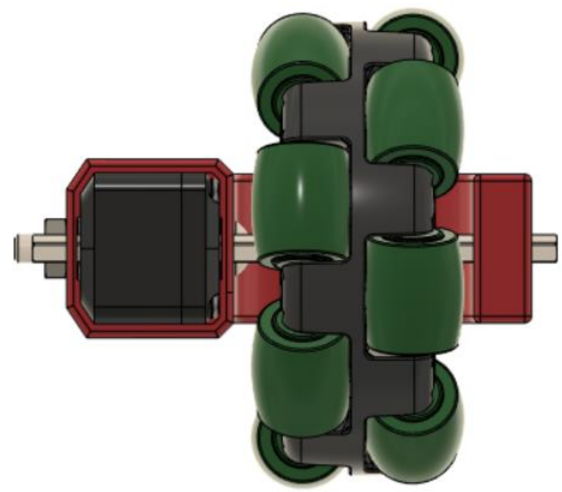


Figure 2: Inner casing assembly bottom view

The outer casing was created by Katherine by extruding a new body from the inner casing and cutting holes to prevent the screw and drive shaft from interfering with the sliding motion. Tabs were added at the bottom with holes aligning to a grid with the same spacing as the VEX C-Channels (12.7 mm apart).

The inner casing needed to slide out the outer casing completely to make the tracking wheel easy to assemble. The last parts required were plugs that attach to either side of the inner casing by friction for the compression springs.

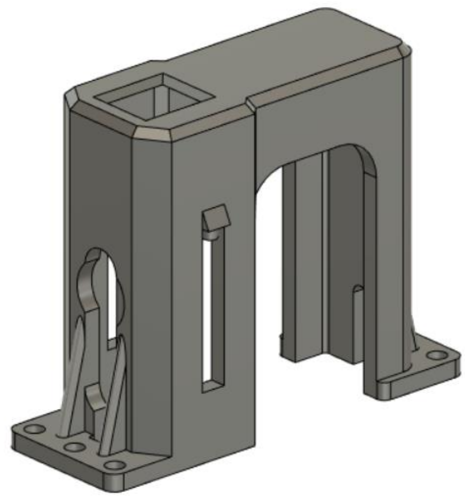


Figure 3: Outer casing

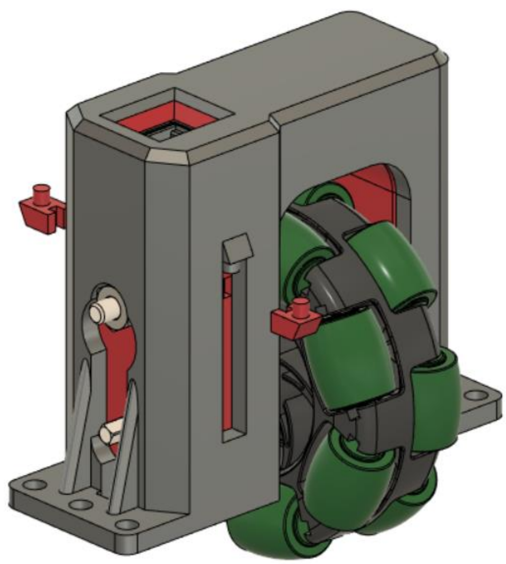


Figure 4: Tracking wheel mount assembly with pegs detached

The colors of the parts were taken from the VEX V5 visual identity guidelines with the red color used on the inner casing and gray color the outer casing.

How the Part is Used

The part is designed to be 3D printed with PETG in 4 separate parts: The inner casing, outer casing and 2 plugs for compression springs. First, 2 High Strength Shaft Adapters are placed into either side of the rotation sensor, then inserted at the bottom of the inner casing. Next, a screw and nut fixes the rotation sensor in place, and a 3-inch drive shaft is inserted through. An omni-wheel with a High Strength Shaft Adapter on each side is placed within the inner casing and the drive shaft is passed through. The inner casing slides into the outer casing and the smart cable is attached to the rotation sensor. The 2 plugs are then inserted into each side of the inner casing, along with two compression springs that are 4 mm in diameter and at least 27.85 mm in length.

The tracking wheel mount attaches to a robot via tabs with upward-facing holes on either side which are designed to screw onto C Channels. The vertical range of motion is 27.85 mm.

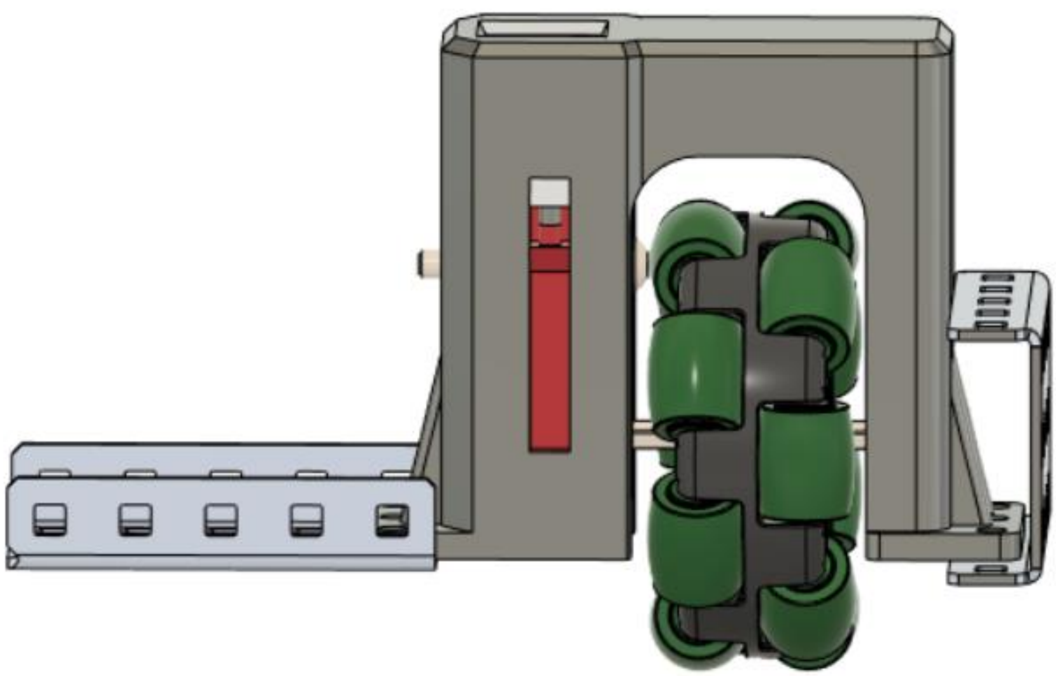


Figure 5: Tracking wheel mount with C Channel orientation

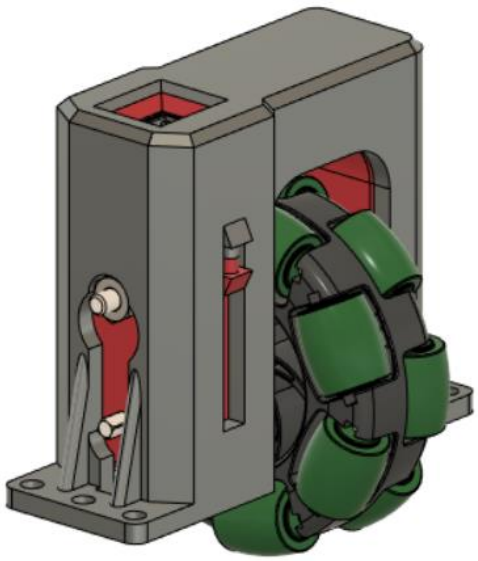


Figure 6: Tracking wheel mount upper position

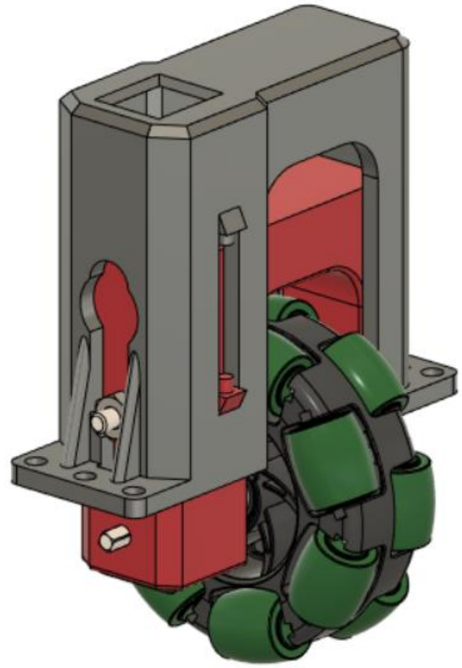


Figure 7: Tracking wheel mount downward position

What we Learned

Wara learned how to use the joints in Fusion 360 to fix parts in an assembly and create animations of moving parts. In the tracking wheel mount, the existing VEX V5 rotation sensor, 1-inch screw and hex nut, 3-inch drive shaft and omni-directional wheel were fixed to the part via rigid joints. He also improved with the extrude tools, learning about extrusion with the intersect operation which was necessary for the inner casing.

Katherine learned that it was possible to select the middle of the square holes of the Shaft Adapters and wheels when creating joints. This made creating joints between the parts driven by the drive shaft more efficient.