VRC "Make It Real" CAD Engineering Challenge







Turntable Motor Adapter



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Summary

We used Autodesk Fusion 360 to create a compact, simple and easy to use part which allows for a seamless and convenient mechanical interface between the VEX 4.25" Turntable Bearing and the VEX V5 Smart Motor.

We are currently using this part on our 24" VAIC Robot and have tested it extensively.



Our 24" VAIC Robot



Introduction

Turntables were added to the VEX Robotics Store on 20 April 2011, and continue to be used in a wide variety of applications eleven years later. Although large and heavy, Turntables offer very high strength, stability and reliability, outperforming other methods of constructing joints or other moving parts in VEX especially when applied to high-stress environments.

However, VEX has come a long way since the introduction of the Turntable Bearing Kit. Nowadays, whenever teams attempt to use a Turntable, they encounter a problem unique to VEX 4.25" Turntables: The Turntables are designed to connect specifically to the now outdated 393 Motors used in the old VEX Cortex System, and there appears to be no stable way to connect the newer V5 Smart Motors to the 4.25" Turntable.

The suggested method proposed by VEX to connect V5 Smart Motors to the 4.25" Turntable is shown below:



Figure 1: VEX V5 Motor Turntable Bearing Instructions

We found that this method of mounting the V5 Smart Motor to the 4.25" Turntable is too weak and flimsy, because Turntables are used in high-stress situations and the motor also needs to be able to withstand high amounts of stress in order to safely power the Turntable. We therefore devised a stronger, simpler and cleaner solution for mounting the V5 Smart Motor to the 4.25" Turntable.



The Process

2.0.11894 Active Plan: Fusion 360, Student macOS 10.15.7 x86_64 (19H1323) on MacBookPro13,1

Figure 2: The Fusion 360 Software Version

Using the Fusion 360 software version as shown above, we first obtained the CAD file for the 4.25" Turntable from the VEX Website, and used it to make a mold for the Turntable Adapter. This allowed us to design the part to perfectly fit inside the 4.25" Turntable, and be sandwiched within the top and bottom halves of the Turntable without being able to move around. The bottom part of the Turntable Adapter acts as a foundation which securely anchors the Turntable Adapter into the 4.25" Turntable.

Process of making the mold:



Figure 3: The initial CAD of the relevant section of the bottom half of the 4.25" Turntable





Figure 4: Using the Turntable as a mold to shape the part



Figure 5: Estabilishing the mounting holes for the V5 Smart Motor to mount to the Turntable





Figure 6: Finalising the bottom half of the part



Figure 7: Extending the part into the upper half of the turntable

The resulting part extends the Turntable's mounting holes upwards into the upper half of the Turntable, and also extends deep into the hollow portions within the bototm half of the Turntable, providing a stronger and more effective solution for screwing the V5 Smart Motor directly to the Turntable while leaving ample space for the VEX 12 tooth Metal Gear to fit inside and power the Turntable's internal gear. This provides a stronger foundation for the V5 Smart Motor to be mounted into the Turntable.



The Final Product



Figure 8.1: A top view of the final Turntable Adapter



Figure 8.2: A side view of the final Turntable Adapter





Figure 8.3: A bottom view of the Turntable Adapter

After being 3D-printed, the final product turned out sturdy and accurate for the dimensions we had modelled in Fusion 360. We were satisfied with this outcome and proceeded to mount it on the Vex Turntable.



How the part is used



Figure 9: Inserting the part into the bottom half of the Turntable



Figure 10: Adding the top half of the Turntable and sandwiching the part between the two halves of the Turntable





Figure 12 - Mounting the V5 Smart Motor to the Turntable

Mounting the V5 Smart Motor to the 4.25" Turntable using the Turntable Adapter is far easier and more convenient than using the method that VEX suggested in Figure 1, because it involves less parts, and there are less steps required to complete the process.

Mounted in this way, the V5 Smart Motor is able to effectively power the Turntable's internal gear in order to spin the Turntable, but is far more resistant to shaking, twisting or bending due to the Turntable Adapter interfacing with a large number of internal surfaces within the Turntable, anchoring the V5 Smart Motor to the Turntable.



Conclusion



We learned a lot about the inbuilt features provided by the Fusion 360 CAD software, such as making a mold using Boolean Operations on 3d bodies, and also becamse more comfortable using the software as we gained experience and became more familiar with its tools.

The use of CAD design softwares such as Fusion 360 really streamline the process of designing parts in 3d, and makes 3d printing ever more accessible and user-friendly, opening up a wide range of possibilities for us. We will certainly continue to apply our growing knowledge of Fusion 360 in order to design even more parts in the future, whether it is to help us design custom parts for competitions such as for VEX VAIC, or for personal use, or hopefully even in our future careers as engineers.

(901 words)

