The Vex IQ Ball Bearing holder

The best method to give robots faster and tighter turns

Team 5 by 5 #53535A

Defining the Problem

Anyone who builds Vex IQ robots for VEX competitions knows they need their robot to have fast , tight, and reliable turns because throughout the one minute long match , every second counts. Having speedy , concise turns can have a large impact on one’s score.

I am a Vex IQ competitor myself so I know how the speed and turning radius of the robot can change one’s score. When practicing driving our team’s robot I noticed that its turns weren’t smooth and the robot has a large turning radius. This frustrated me because I knew the robot could possibly get more points and be easier to maneuver with quick compact turns.

Background Research

Why do robots have trouble turning?

The wheels create friction with the table resisting turning in a phenomenon known as turning scrub. This gives the robot larger and slower turns. To have quick precise turns one must have low friction and high traction with the wheels to the surface the robot is on. Two popular methods of reducing turning friction are to use omni wheels and to use ball bearings.

"9.4: Drivetrain Geometry and Turning." 1.3: What Is the Engineering Design Process? | VEX EDR Curriculum, curriculum.vexrobotics.com/curriculum/drivetrain-design/drivetrain-terminology-and-turning.html.

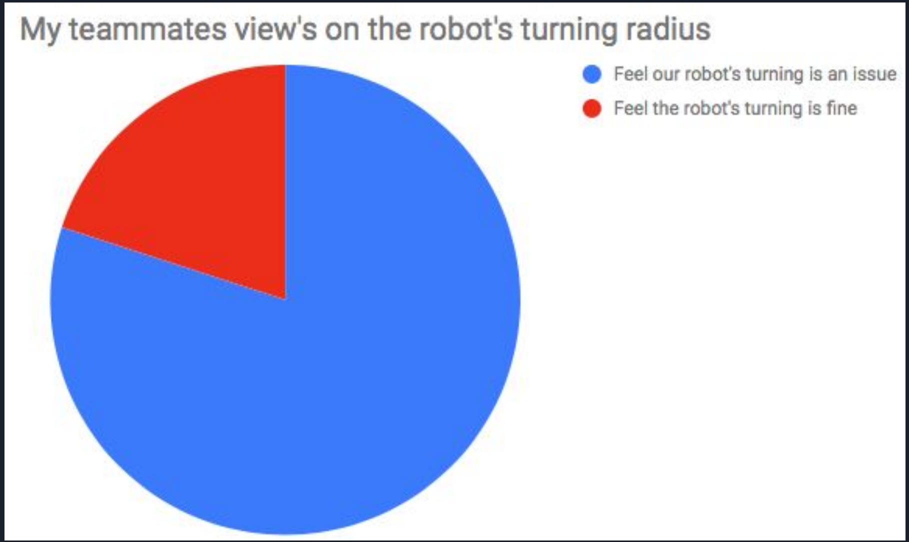
"9.2: Friction and Traction." 1.3: What Is the Engineering Design Process? | VEX EDR Curriculum, curriculum.vexrobotics.com/curriculum/drivetrain-design/friction-and-traction.html.

Education, ExamFear. "Physics Friction Part 10 (Rolling Friction, Ball Bearing) Class 8 VIII." YouTube, YouTube, 24 Sept. 2015, www.youtube.com/watch?v=UsC9RNECrLc.

Background Research

Do others feel this is an important issue?

I took a survey of my team and 2 other teams and found that 80% of them felt the robot’s turning was definitely an issue.



Brainstorm solutions

01. I could design a ball bearing holder that would hold a metal ball bearing and attach to the Vex IQ base since they have extremely little friction and can be quite small. The ball bearing acts in place of a robot's two back wheels and has 2 holes at the top where it attaches to the Vex IQ robot by axles.

02. I could just use Vex IQ omni wheels, even though they are wider than normal wheels (so they are harder to fit on the robot), and have more friction than ball bearings. The omni wheels are shaped like normal wheels but have rubber bits that allow them to slide perpendicular to the direction they turn.

Specify Requirements

Physical requirements

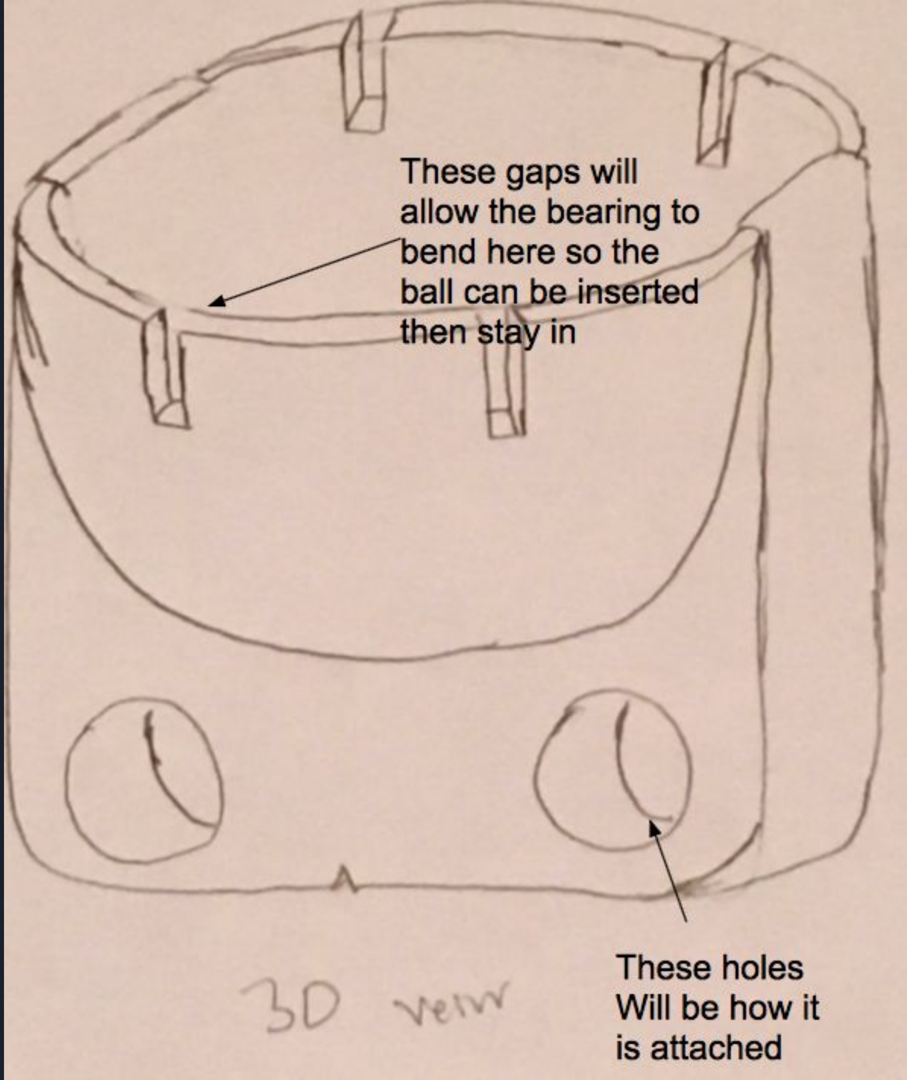
The solution must be small so it can easily be added to the robot and have virtually no friction to improve the robot’s turning.

Choosing the Solution

Since ball bearings are smaller and have less friction then omni wheels I determined they were the better solution and began to design a ball bearing holder to attach one to the back of the robot.

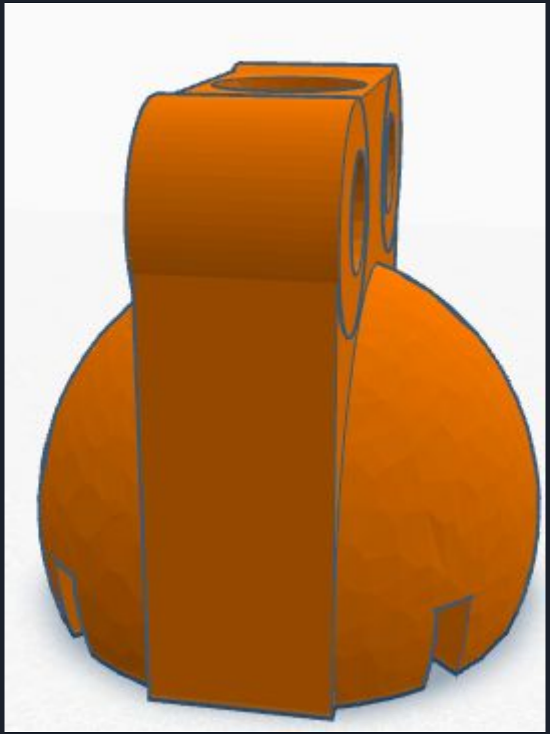
Develop the Solution

I took measurements of the size of holes and spaces between them on Vex IQ parts, and decided to use a 2cm ball bearing. Using this information, I formulated my design to look like this:



Develop the Solution

I then designed it using Tinkercad version 4.4. I designed it by merging a sphere with a rectangle then creating a hole that is the right size to fit a 2 cm diameter ball bearing and to hollow out the sphere and add two holes to the rectangle that are perfectly spaced and just large enough for Vex IQ axles. I added the gaps in the bottom of the half sphere by using rectangular holes. It looked like this:



Develop the Solution

I then printed it out on the 3D printer to find it was slightly too large! The ball bearing fell out each time I placed it in!

Develop the Solution

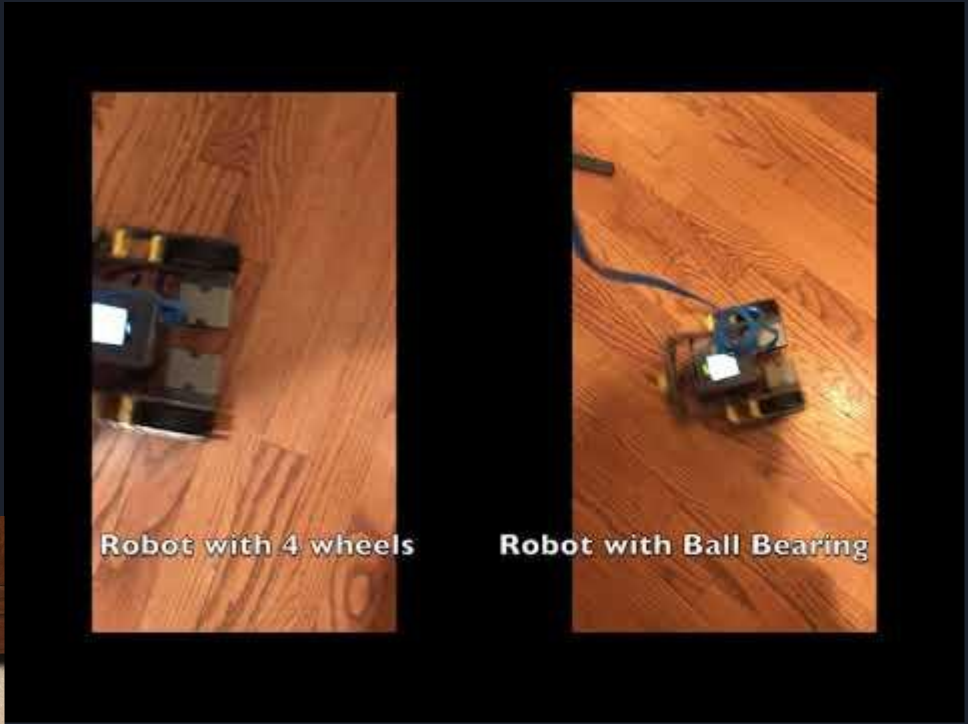
I shrunk my prototype by a millimeter in each direction, and when I printed out this version, it fit the ball bearing perfectly.

Develop the Solution

I placed it on a robot to test it out and to see if it really improved the robots turning speed and preciseness. I attached it by the two holes at top using two hammerhead axles.

Testing the Solution

I created two robots, one with 4 wheels with 2 of them being omni and one using my ball bearing holder and compared the turning speed and radius to find the ball bearing greatly improved the robot's turns.



I created a small simple robot whose interesting task is to deliver tissues to my family. It can also spin in circles.

Conclusion

From doing this project I learned how to operate a 3D printer, design in TinkerCad, apply my knowledge of 3D design to real-world problems, and how to problem solve. I will definitely use 3D design software in the future to solve problems I find in my community. I also had an extremely fun time using the 3D printer and design software. The software I learned how to use will allow me to create new and unique parts for my robotics team and to create solutions to everyday problems as well using filament and a 3D printer. I would like to be an engineer when I grow up, so knowing how to 3D print will be a great help in designing inventions and solutions.