A Better Vex Bevel Gear

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One day while our team was working on the robot, we needed to connect the drivetrain to a gear that was perpendicular to the axles of the drive. This gear would power the rolling intake that would accumulate balls for the flywheel to shoot. The problem was that the gear needed to rotate with its normal vector coming out of the ground, as opposed to the drive, which rotates with its normal vector to the right of the robot. Although we ended up redesigning the intake to avoid having to change the direction of the gears, it would have been nice to have a bevel gear in our toolkit, which connects shafts at different angles, instead of just in parallel. This would provide much more flexibility in designing drivetrains and any kind of gear system because it would also allow motors to be placed in a more convenient location (for example, pointing at the ground as opposed to in line with the drive shaft, like in most traditional drives).

Although Vex already has a bevel gear in its product lineup, the bevel gear we have created allows axles to be reliably connected at a wider variety of angles, not just at 90 degrees, because of its curved teeth. The curved teeth also provide a larger surface area for each tooth on the gear compared to the standard vex bevel gear, which allows for this bevel gear to mesh better with itself, reducing the chance of gear slipping. On our robot specifically, we would probably use this gear to help balance out the weight on either side of the robot by rerouting axles from motors to different mechanisms using the gear to ensure that an equal number of motors can be on either side of the robot.

We used AutoDesk Inventor 2019, which is available to students for free. We created the gear by sketching the outline of the widest diameter of the gear in a 2D plane. Instead of manually sketching the teeth of the gear around the circular outline, we used the Pattern tool in Inventor to position the teeth in one go. We had to do a calculation to ensure that the width of the teeth and the number of teeth around the gear would result in even spacing between each tooth. After finishing the 2D sketch, we then extruded the sketch into 3D, resulting in a full-size gear.

In addition to designing this gear, we also used Autodesk Inventor to model our robot using the provided parts and models from the VEX website. We've found that it is very helpful to model our robot first because, at times, the spacing between certain parts in the robot becomes very tight. It has been more efficient to figure out washers and spacers inside Inventor than excruciatingly assembling them by hand. It's also useful to have a complete design of the robot because then we can divide up different parts (like the claw from the flywheel) among each individual group member, who can then follow the design exactly when constructing the part so everything is built according to the group's expectations.

3D design is essential because designing and constructing something are almost always fundamentally separate steps in the building process. Learning to use Autodesk Inventor now gives us experience with concepts common to all 3D design software—geometric constraints, 2D sketching, and 3D extruding, assembly individual parts and adding contact restraints to simulate movement.