Bevel Gear Bracket 2.0

2018 Make It Real CAD Engineering Challenge
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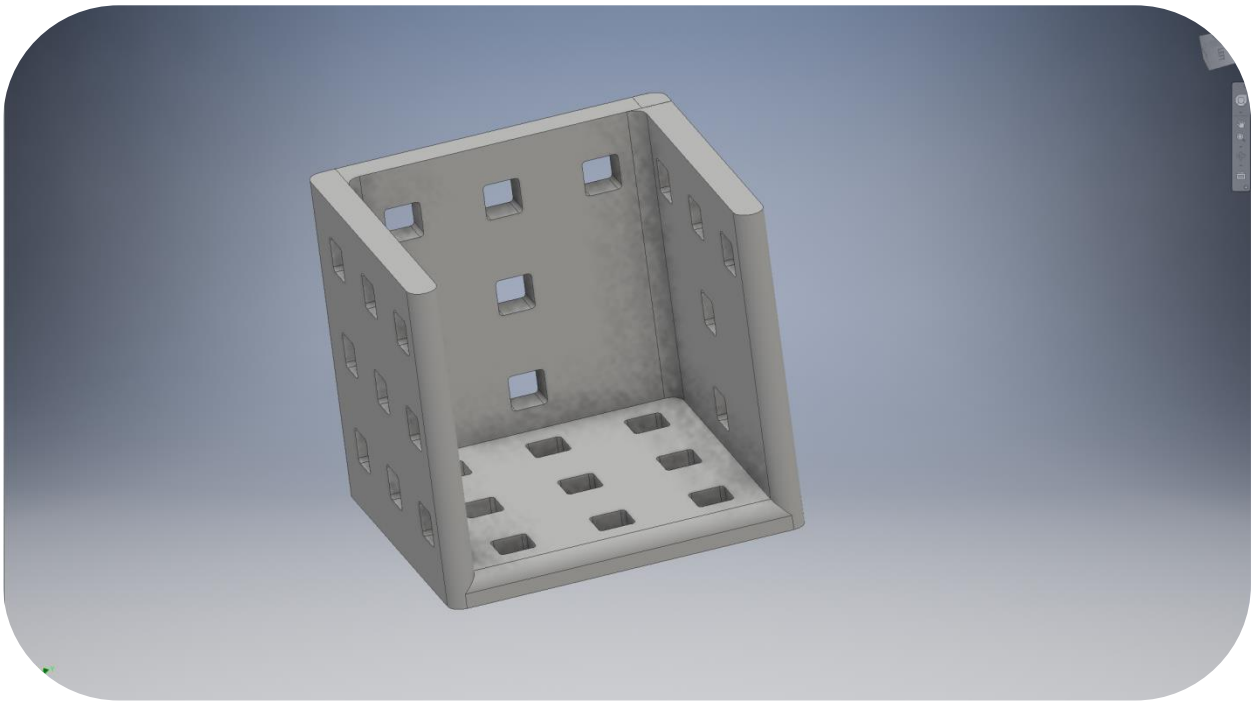

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Introduction

Bevel gears are a very powerful, but under-utilized mechanical component in the VEX Robotics. Our team has created a new bevel gear bracket so that we can increase the complexity and functionality of our robot. By re-modeling the bracket we can improve the current one by reducing weight and allowing the easier mounting of a motor. We are able to position the bracket in almost any direction due to the amount of holes on the bracket. We used Autodesk Inventor 2016 to develop this part.

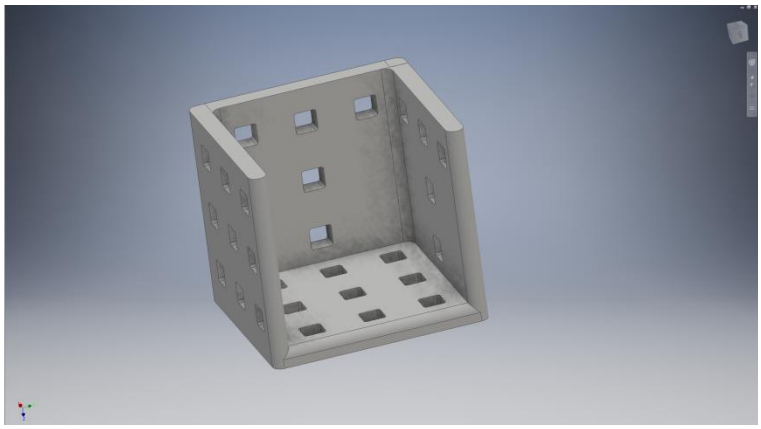

Figure 1 - *Orthographic view of the Bevel Gear Bracket.*

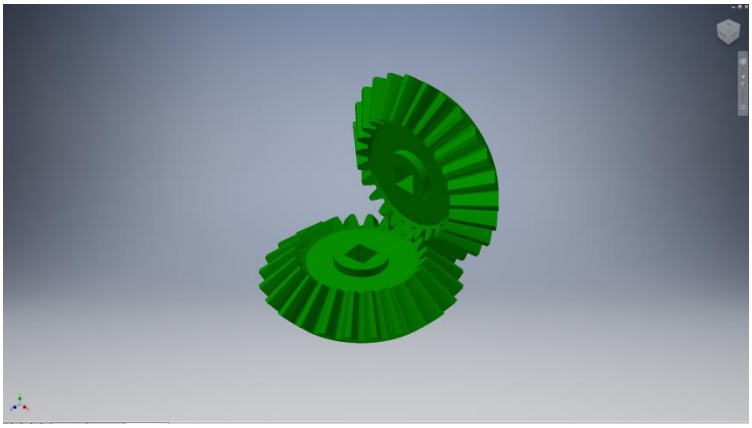

Figure 2 – *45-degree Bevel Gears in assembled in Inventor.*

Functionality

The main function of this bracket is to allow for a motor to be attached to the PLA, which is directly next to the bevel gear. As can be seen in the figures below, the current VEX bracket does not allow a motor to be mounted easily if a bevel is in the middle. The gears must be on the outer set of holes, which lead to spacing issues and increase the overall size of the gear box. It has two sides explicitly for motors, and two sides for motors and/or mounting the bracket to metal. Our new bracket allows for a more compact system that is more lightweight and structurally sound.

The bracket can be placed anywhere on a robot, provided that you need to use a bevel gear. It can be attached via standoffs, or directly to the metal, as the holes are an exact copy of the VEX holes. In order to do this, we opened up a 3Bar, 3Hole piece of metal, created a sketch of the face, and used project geometry to trace the holes. We then copied and pasted the sketch onto the 3D printed part.

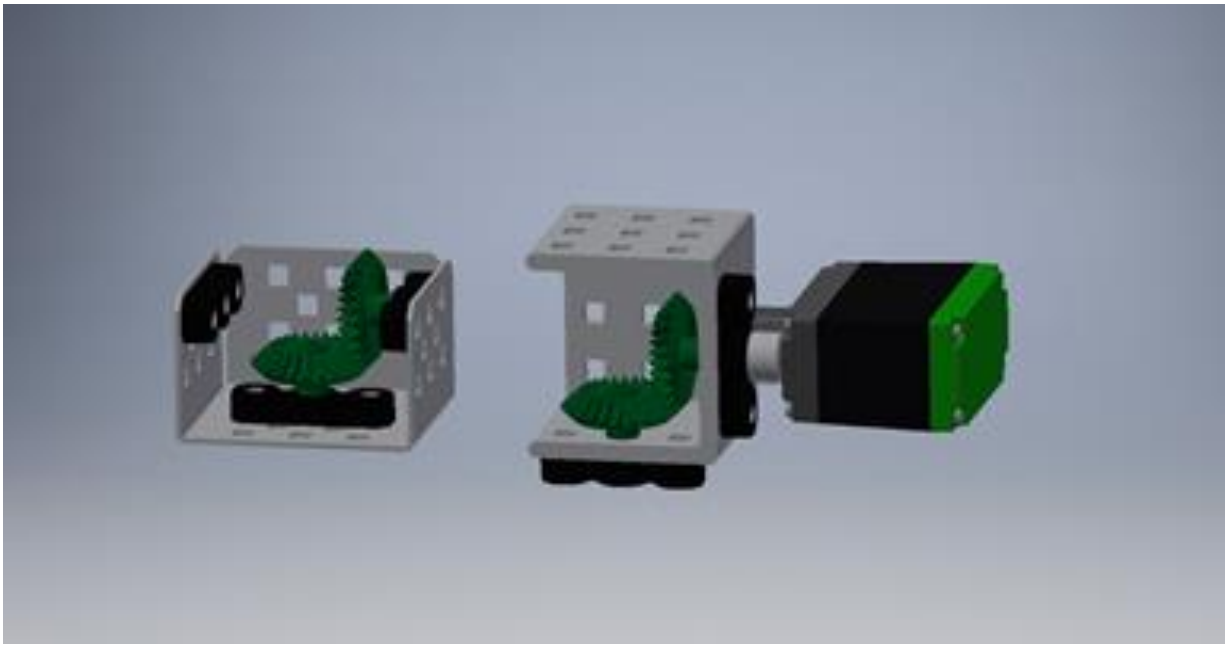

Figure 3- Comparison of the Bevel Gear Brackets

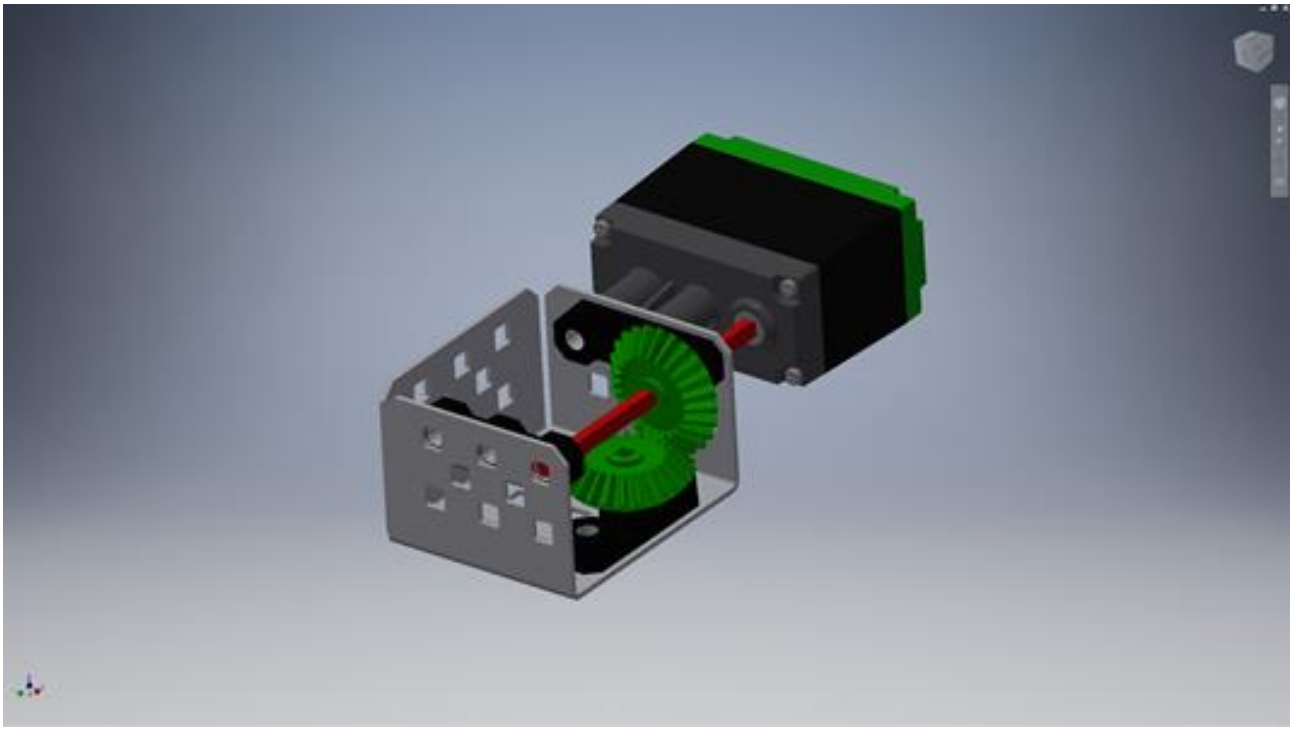

Figure 4- Orthographic view of the VEX bracket.

Design Process

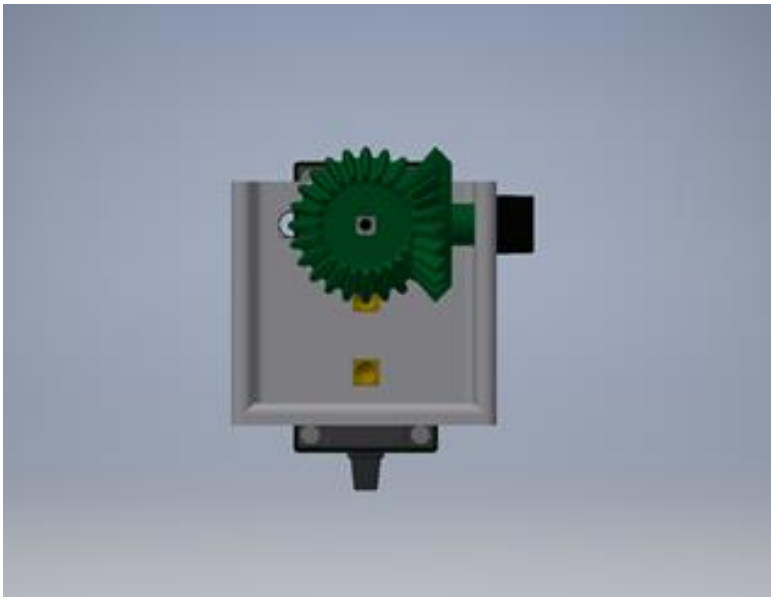

Figure 5- Front view of the new bracket to show how the motors are oriented

The best way to design the Bevel Gear Bracket 2.0 was via 3D design software with the goal of 3D printing. Our design is used in conjunction with VEX parts, so it can be used for any design that needs bevel gears. Our design could even a VEX Robotics manufactured part because of the simple, easy-to-use design and because it is strong and lightweight.

To design this bracket, the engineering design process was utilized. After building our robot, we noticed that the current VEX Bracket was not conducive to a well-functioning robot because it took up too much space. To solve this problem, we needed to design a custom piece. The following details design approach and the steps taken in order to create the bracket in Inventor:

1. Based on real-life utilization of 45-degree bevel gears, we determined possible methods to modify the design of the bracket to make it more compact.
2. Designing using Autodesk Inventor 2016 Professional (Student Version):
    a. The Design Process (discoveries regarding the Pneumatic Tank Support)
        i. Needs to be structurally supported and stable
        ii. Needs to have clearance from wheels and gears
        iii. Various ideas were visualized graphically before the final selection

b. The Engineering Process
    i. Measured space equivalent which is 3 hole; this reference was used as the main dimension
    ii. Bevel gear and motor assembly file was modified to ensure it fit nice and snug
    iii. A single Inventor file part was created for all VEX components
    iv. Measurements, in inches, were taken for the distance between the mounting holes, and distances for the bottom support
    v. Using a series of 2D Sketches made completely from geometric shapes, the outline of the part was created
    vi. Extrusions, 3D representations of the 2D Sketches, were used with slight alterations
    vii. Filets were used to improve the integrity of the part by rounding out the edges
    viii. 3D Parts were then added to the assembly file to ensure the correct measurements as well as to assess future potential modifications

3. The Manufacturing and Distribution Process
    a. Upon completion, part files were converted to STL files
    b. STL Files were imported into software and sliced for 3D printers
    c. Files were printed and used for the robot

Conclusion

This project has taught us how to minimize the space needed for a certain part. It has also taught us how to keep things as simple as possible. As a current VEX U team, we will continue to use Inventor CAD in order to make things such as brackets, couplers, and other aesthetic, but functional 3D parts. 3D design software such as Autodesk Inventor opens up a world of possibilities for structural designs and is especially useful for members of a competitive robotics team because the ability to incorporation of 3D parts nurtures functional creativity and imagination. We will continue to use Inventor not only for robotics competitions, but also for our individual and group design projects that we work on during the academic year and at home. As our team is composed of mainly electrical and mechanical engineers, it is necessary for us to understand how to use CAD software for schematics and 3D design software for prototyping. Having a working knowledge of both strengthen our skillset and make us more well-rounded engineers.

About Team NYIT

NYIT has been competing in the VEX U college division since 2010. Each year we learn more and are able to grow more as a team, with our accomplishments being largely aided by advancements in technology. Amongst these major developments include improvements in computer-aided design technologies. Using CAD software, particularly Autodesk Inventor has been a critical part of our growth and our team has designed many parts for our VEX competitions. NYIT's career being a part of VEX has been a great experience for all of our students, our school, and our community.