Alignment Bearing

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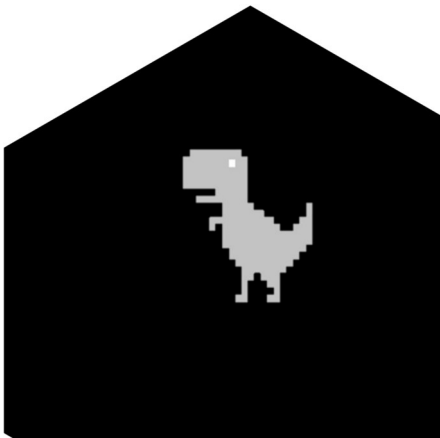
2019 Autodesk CAD Challenge



Alignment Bearing

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Introduction
We noticed that the square holes in the VEX EDR pieces allow clearance between it and the screws, allowing the part to move relative to the part it is fixed to. This flaw causes inconsistency. To fix this problem, we designed an alignment bearing (Fig. 1 & 2) to keep the screw in one place.

How it Works
To align two holes, the structural pieces are lined up, and the bearing is snapped in between the aligned holes. When the bearing is snapped into place, the screw can fit through the hole but the bearing fills the rest of the space to prevent relative movement of the screw. In our robot, the alignment bearing would be used to stop our conveyor from sagging, but it could be used to help align any two structural VEX EDR pieces.

Software
To design the alignment bearing I used Autodesk Tinkercad 4.3.1. First, I got the measurements of a structural piece so that I knew what dimensions the part should be. In Tinkercad, I started by manipulating a cube to make the pad that the screw head touches. Then, I used another cube to make the spacer that fills the gap in the hole and put a hole in both parts. After that, I used a very small rectangular prism to create the clip. To finish it off, I added radii and chamfers.

Additional Functionality
Along with centering the screw, the alignment bearing includes some other benefits. Because of the clip on the alignment bearing, the structural pieces are held together so that you don't have to hold them while someone else gets nuts and screws. The structural pieces can be left, supported by the bearing, while you get the nuts and screws. Also, when designing and visualizing, screwing and unscrewing takes up a lot of precious time. With the alignment bearing, you can just snap pieces together until you are satisfied with the design, and then screw the pieces together. The part is symmetrical too, so it can be installed with ease. Chamfers on the edges make it smooth to insert the piece.

Isometric Views of the Alignment Bearing

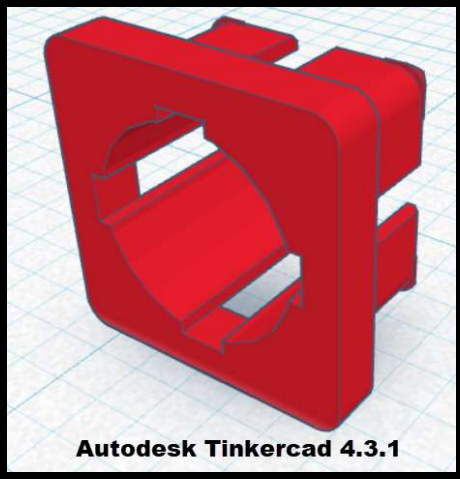

Fig.1: Part Design Front

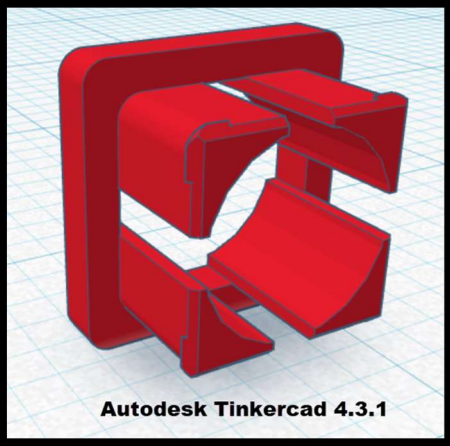

Fig. 2: Part Design Back

3D Printed

I 3D printed the part (Fig. 3 & 4) to test its functionality. I assembled two structural pieces without the bearing (Fig. 6 & 7) and one piece could move 16 degrees relative to the other part. When I added the alignment bearing (Fig. 8 & 9), it could only move 2 degrees. This is a big improvement, especially when doing an autonomous program where everything must be precise. Over a 6-inch length, 16 degrees can change the position by 1.65 inches, while 2 degrees only changes the position by 0.25 inches. This could make the difference between an effective conveyor and an ineffective one.

Conclusion

The alignment bearing fixes the critical flaw of pieces shifting, causing inconsistency, by filling the gap that causes the ability for a piece to shift relative to another piece (Fig. 5). It can do this while being able to hold pieces together when designing or building. The alignment bearing is also symmetrical so that lining it up to be inserted is easy. This is a part that would be useful for any robot.

In the future, my team plans on using Autodesk Fusion 360 to design our robot and robot assemblies. Using Fusion 360, we can attempt changes to our robot that may prove disastrous. This way we will not make the same mistakes in the real world causing us to waste valuable parts and lose precious time. We started learning to use Fusion 360 this year and plan on furthering our utilization of Fusion 360 next year.

3D Printed Part

Fig. 3: Printed Part Front

Fig. 5: Printed Part in a Structural Piece

Fig. 4: Printed Part Back

Appendix

Measured Angles:

Without Alignment Bearing:

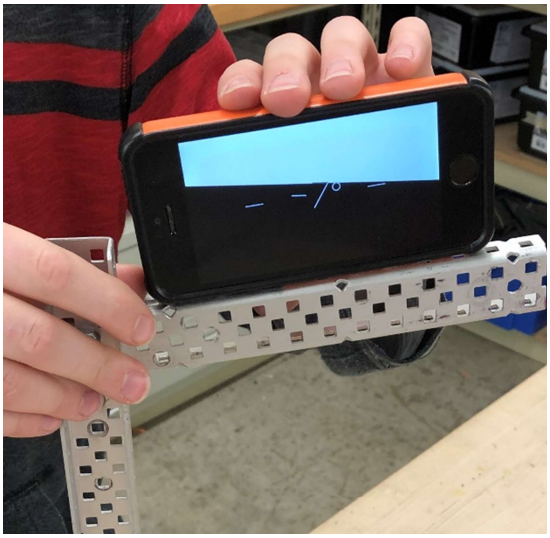

Fig. 6: Upper Limit

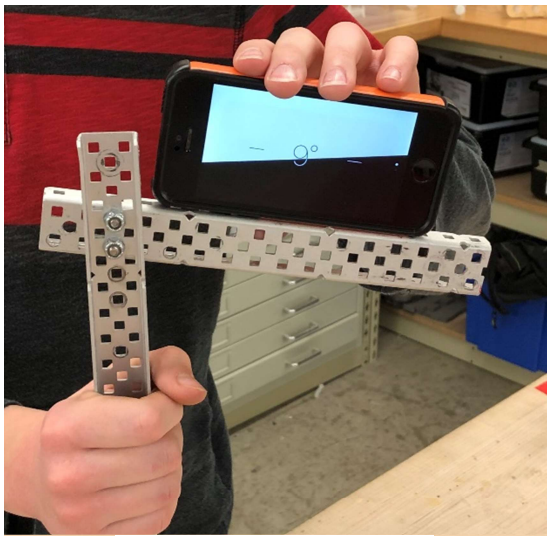

Fig. 7: Lower Limit

With Alignment Bearing:

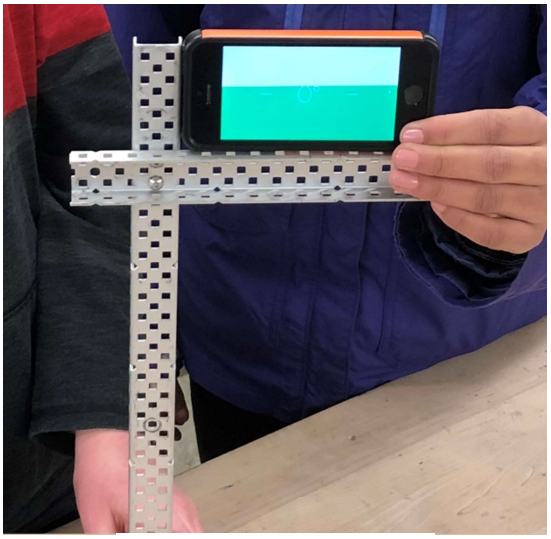

Fig. 8: Upper Limit

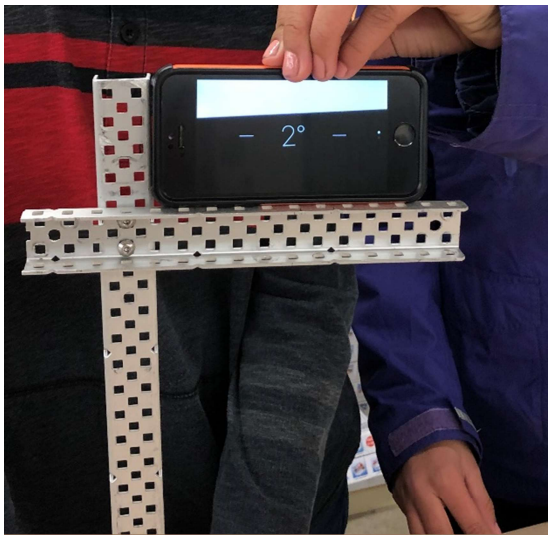

Fig. 9: Lower Limit

CAD Assembly in Fusion 360:

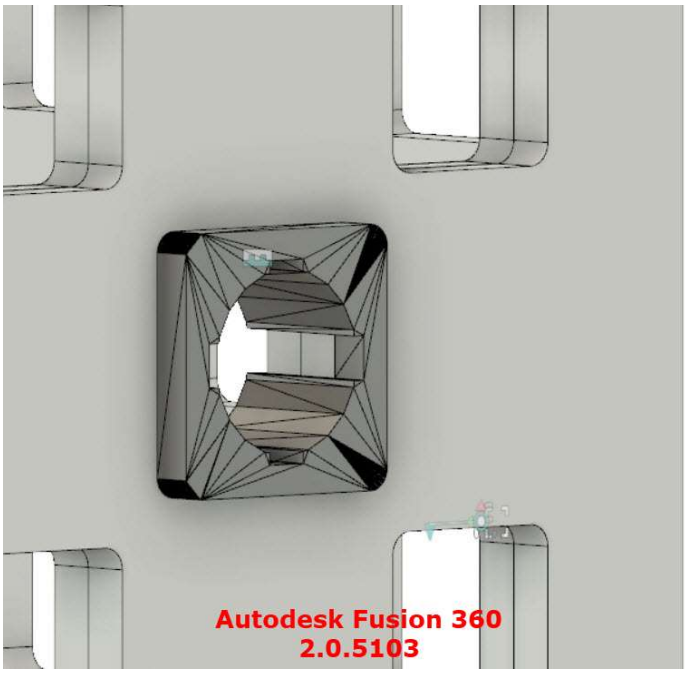

Fig. 10: Alignment Bearing Assembly Front

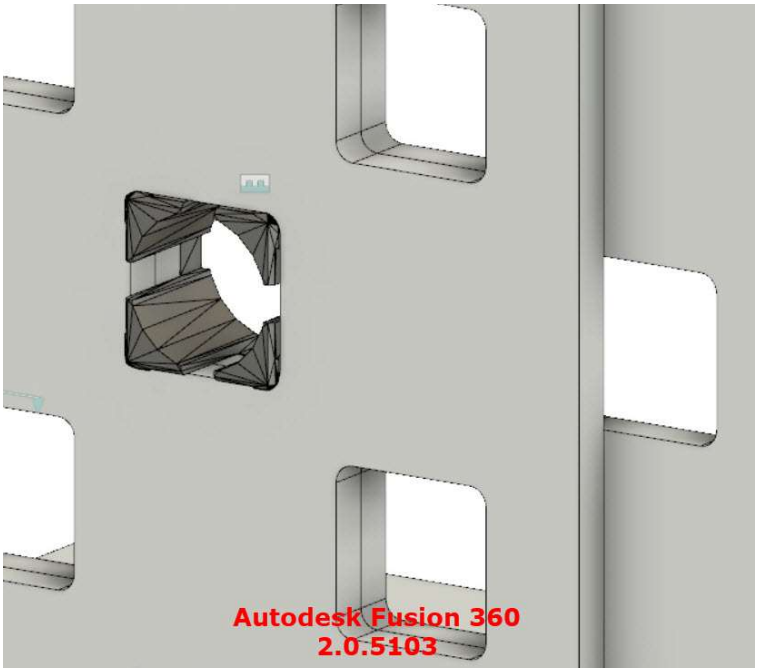

Fig. 11: Alignment Bearing Assembly Back