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Make it Real CAD Engineering Challenge Entry:
Easy Removal Attachment Point for VRC License Plate Kit

Introduction

The Make It Real CAD Engineering Challenge shows off the ability of a participant to create and model a part compatible with the VEX EDR ecosystem, within Autodesk Inventor Professional or Autodesk Fusion 360.

As a High School (9th grade) Engineering-Design student, and a highly involved VEX Robotics Competition team member (Team 81Y – VEXMEN: Cypher), I felt I could take the challenge of creating the next VEX part.

Inspiration and Early work

My search for a problem was quite short after accepting the Challenge mentally on the 7th of January. I remember seeing the CAD Challenge at VEX Worlds in 2015, but never thought I would be able to compete with my horrible CAD skills at the time. Due to my time as a 9th-grade engineering-design student, I have easily mastered the basics of part design and pulled ahead of my classmates.

Last year, VEX decided to phase out the previously used Flags and ID plates, and replace them with the VRC License Plate Kit. Due to unknown constraints, VEX never created a standard mounting system for the plates. As they would be needed to be switched for each match, a permanent mounting system could not be used. I decided to fix this.

Design Constraints

- MUST work in all orientations.
- Must be low cost.
- MUST be easy to attach plate.
- MUST hold the plate(s) firmly.
- MUST be easy to detach plate.
- Can hold one OR two back-to-back plates.
- Other plate is less visible and not readable by the referee.

Design

My final design is inspired by the current mounting system on our robot. Starting with the official CAD model of the license plate, I combined the VEX IQ 0x2 Idler Pin [228-3201-084] with the plate in the assembly using Create Simplified Part. I chose the Idler Pin as I felt the square cross section of the pin would create an easier attachment/removal process for the end user when compared to the common round IQ pin (see Design Constraints). I then continued to fuse the parts together into a smooth solid. As I knew the holes on the Plate must be compatible with the VEX EDR system, I created an array of holes from one using the Rectangular setting in the Pattern tool. I finished off the design with a slit to make the plate easier to remove.

Fabrication

With the ability to print my part, I exported my *.step* to a *.stl* and printed it on a school owned uPrint SE. Being an industrial grade printer, I felt I would have a better result with the pins, as they were very small with highly weak connection points.

The print lasted a total of 2 hours. 75 percent through the print, I found the corners had warped up, and the bottom of the print was no longer flat. After conversing with my teacher, we decided to finish the print regardless, as the top of the print was still level.

The part was soaked in acid to remove the support material for an hour. We then found that the pins were incredibly fragile as I had feared. My theory is that the Fused Filament Fabrication (FFF) process just could not produce the parts fine features. I feel that if the part was printed on a Stereolithographic (SLA) Printer, or was Injection-Molded, the result would be much better.

Conclusion

This experience has been a great one. I learned how to combine two parts into one, and how to make smooth transitions between combined parts. I also learned that there are limitations to Fused Filament Fabrication, even with very advanced ones. Inventor Professional is an amazing program. The longer I use it, the more powerful I see it becomes. I love using Inventor to make the things that help me. In the future, I hope to enter a STEM field where I may use Inventor and other Autodesk products. (see photos and renderings below)

Photos and Renderings

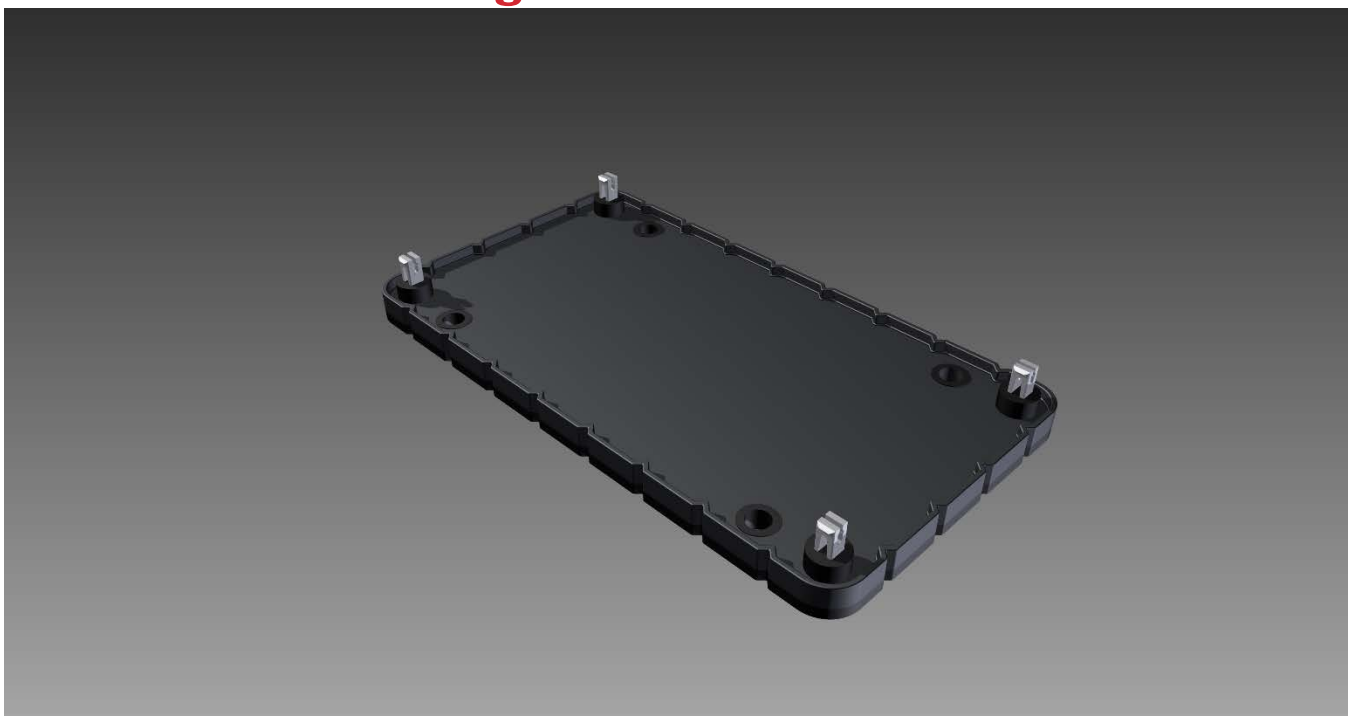

Figure 1- Initial parts (fused)

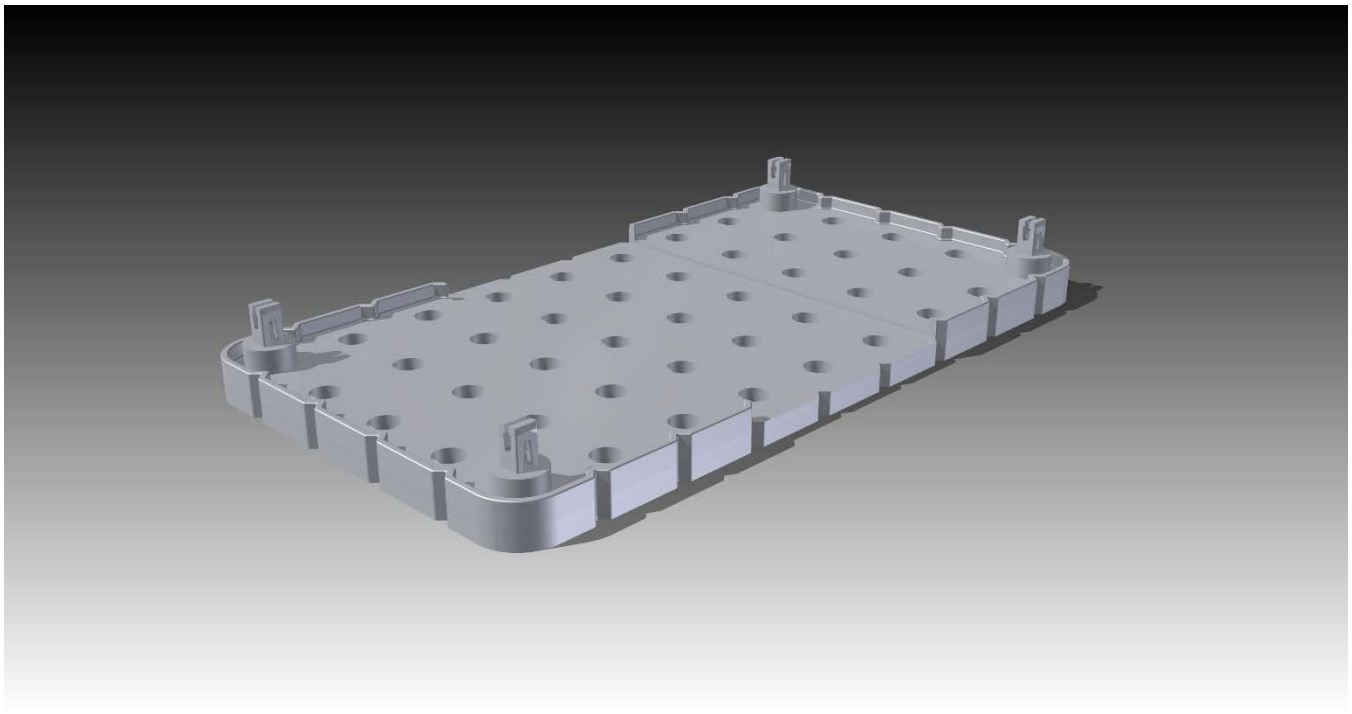

Figure 2- Final Rendering of finished license plate holder part

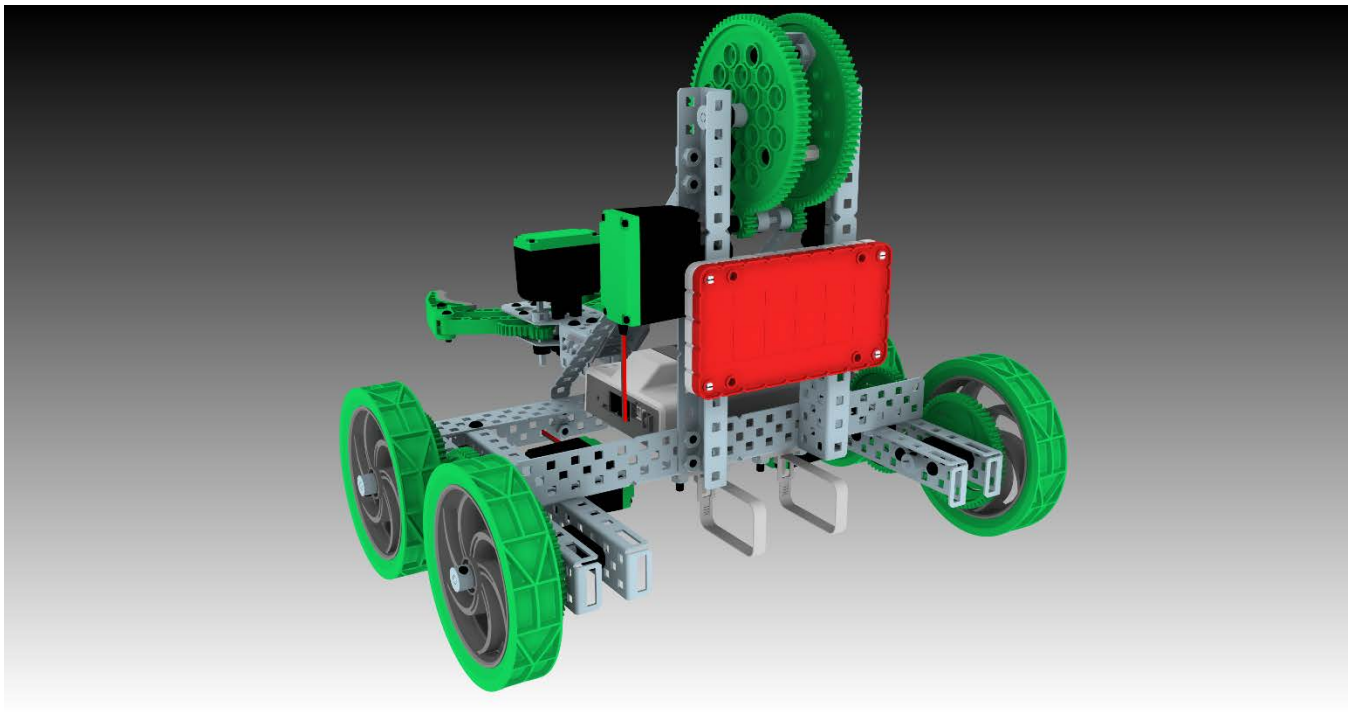

Figure 4- Plate holder installed on a completed robot

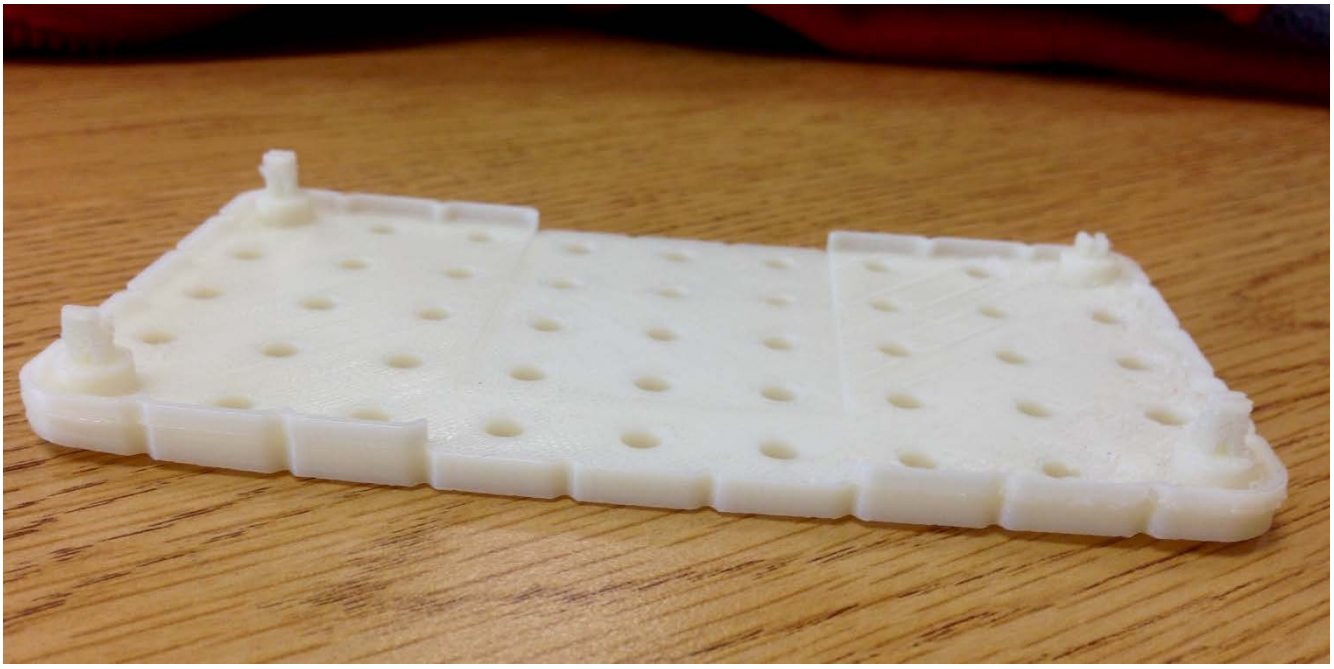

Figure 3- Final 3D printed part (first draft-one pin broke after printing)

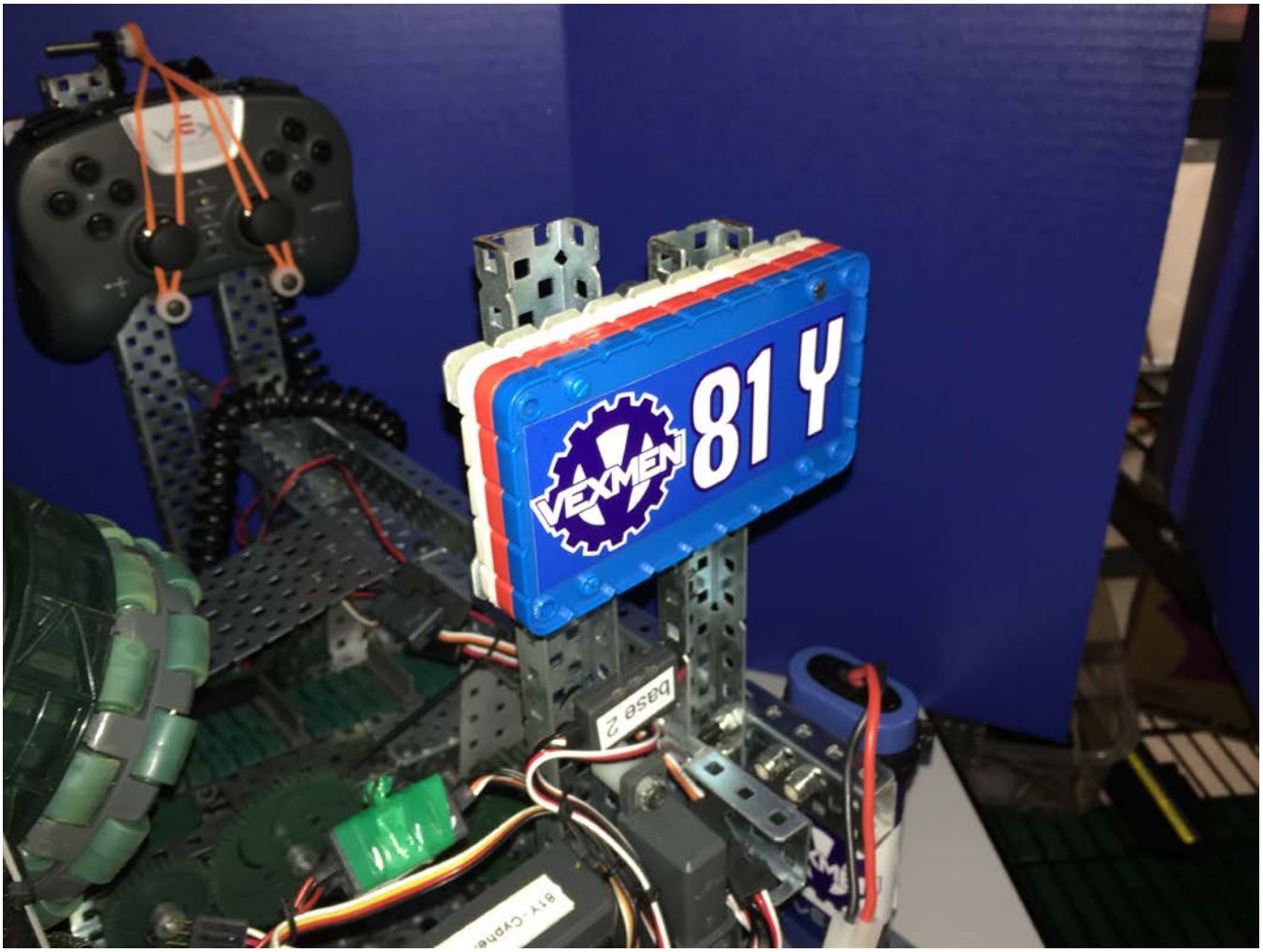

Figure 5- Final 3D printed part attached to our robot and holding double plates.