Don’t we all have those pesky spots on our robots where parts keep popping off and there is nothing you can do that would give a solid solution?

I am Mattias Peroni, part of team 1550C Da Swedish Fish and our robot Albert was having this problem. The connection at the claw and lift kept coming loose and sometimes popped off as we were picking up and dropping of rings. The claw and the lift were attached with L-connectors, in the direction of the pull, facing forward. (see photo 1) I have tried a few different options, like rubber bands and additional pieces to make a solid connection but nothing was working well.

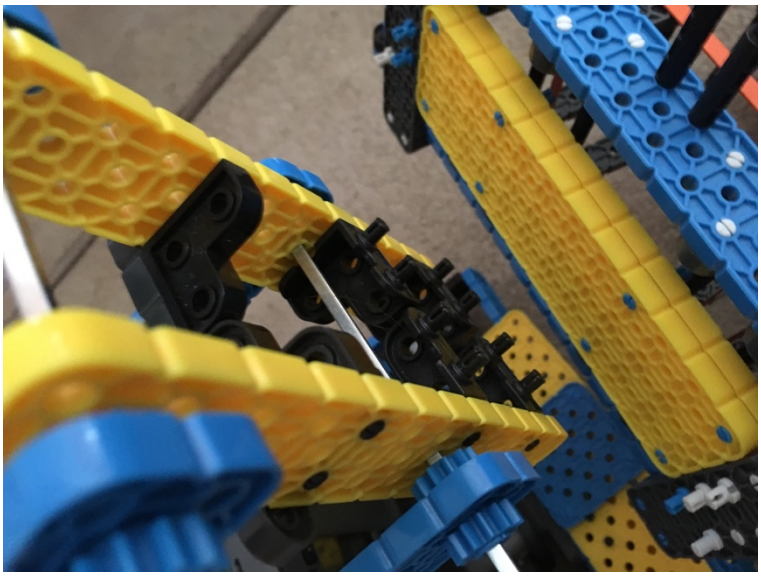

Photo 1. The claw falling off the lifting mechanism. Note the only connectors being the black L–connectors.

I decided to design a piece that would let me connect and secure the claw with pins in two different ninety-degree directions perpendicular to the direction that the claw fell off in. (see photo 2)
This would give the claw a solid and secure hold. This piece could also be used to attach a platform to a base or hold color sensors.

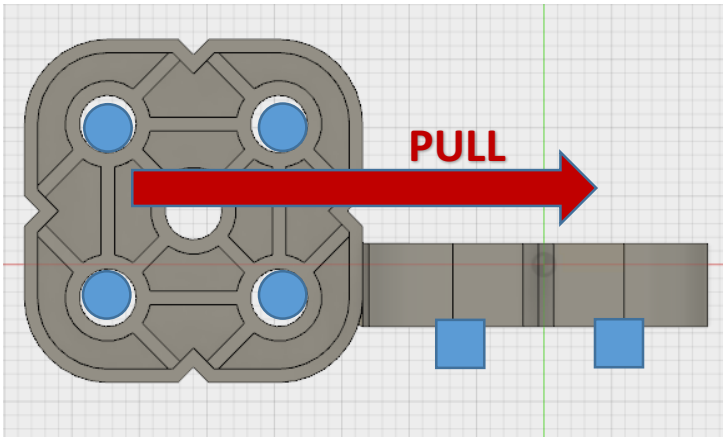

Photo 2 Diagram of the way the pegs would hold in 90 degree angle to the pull that the claw would experience

I began to design this piece from scratch in Autodesk Fusion 360 (version 2.0.3706). (see photo 3)

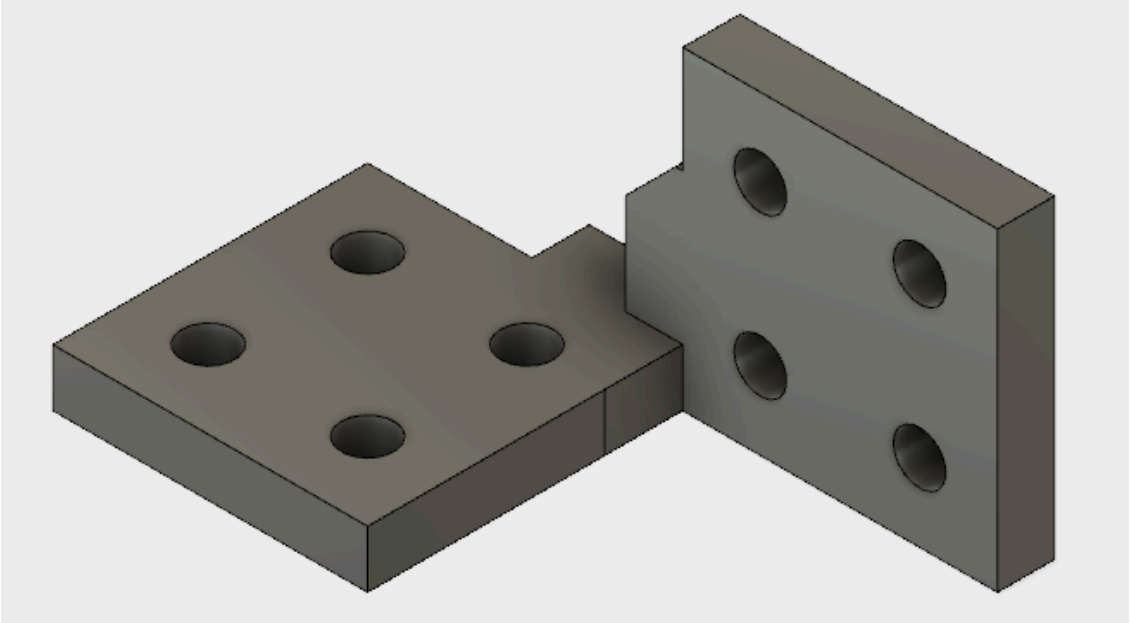

Photo 3 The initial design in Autodesk Fusion 360

My coach asked me if I could make it look more like a VEX piece, which would mean a lot of additional work. She told me about the downloadable CAD files of each VEX piece. This was a great idea as I could be certain that the measurements would be absolutely correct and the piece would also look like a VEX piece. I figured that “reinventing the wheel” was not a good use of my time.

I started over by downloading and importing a 2X2 Vex IQ piece and then another. I moved them so that they were next to each other, both standing on the x and y plane. I then flipped one 90 degrees so it was standing on the x and z plane. Now it looked like the piece I had imagined. The next step was to connect them.

I decided to take a closer look at my robot to make sure that the piece would fit. (see photo 4) I realized that the 2x2 pieces had to be offset just a little to align with the holes on the claw and lift. I moved one piece over the correct distance in Autodesk Fusion 360 and then made a sketch on the x and y plane that I extruded and moved to create a bond between the two pieces. This left a tiny space that was not filled. I made another sketch that I extruded and moved into that tiny space to fill it. I did this to make it look better, but also to make the union bigger and that area of the piece stronger. I now had a piece that looked almost like an official Vex IQ piece

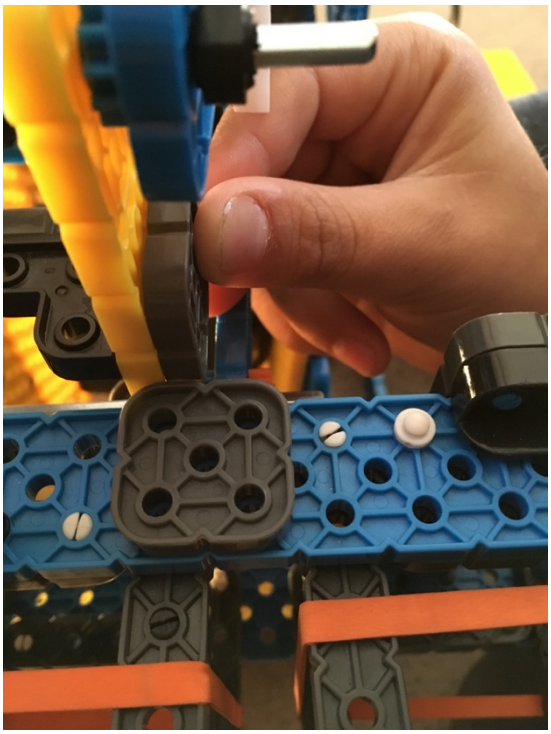

Photo 4 Placing the 2x2 pieces on the robot to align with the holes.

and that would do what I wanted it to do. The next step was to create one that was mirrored, so that I could use it on the other side of the claw (see photo 5), and to 3D print it.

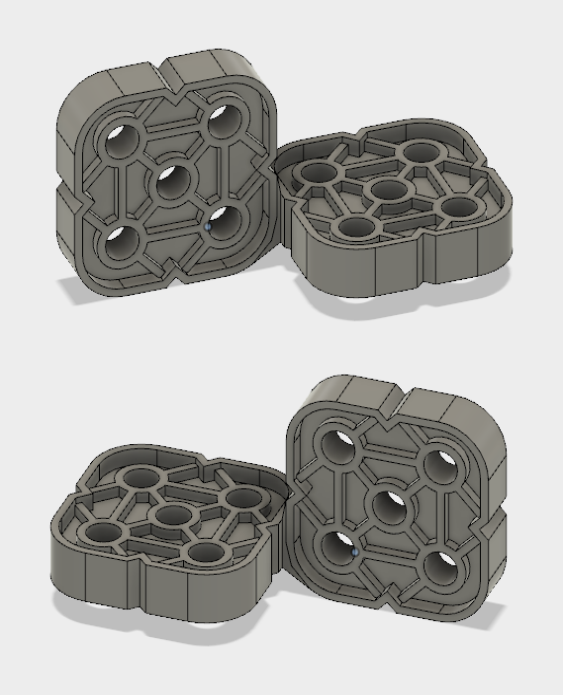

Photo 5 The two pieces created in Autodesk Fusion 360 (version 2.0.3706) that were sent to STAX3D for printing

I saved them as STL files and sent them to STAX3D for printing. They printed them in PLA which made the quality not as good as a real mold injected VEX piece (see photo 6).

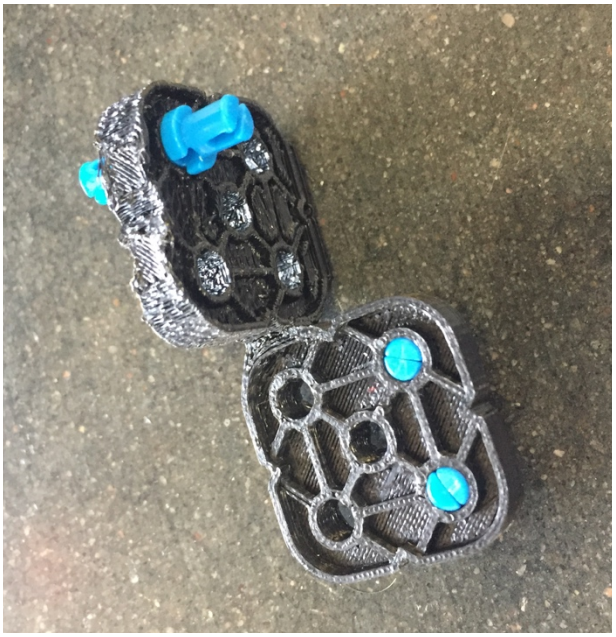

Photo 6 Printed 3D piece. We tested if the pins would fit and they did. Quality not perfect.

I was so excited to get the pieces though and they fit on Albert the Spineasaurus Rex almost like I had intended. (see photo 7 and 8)

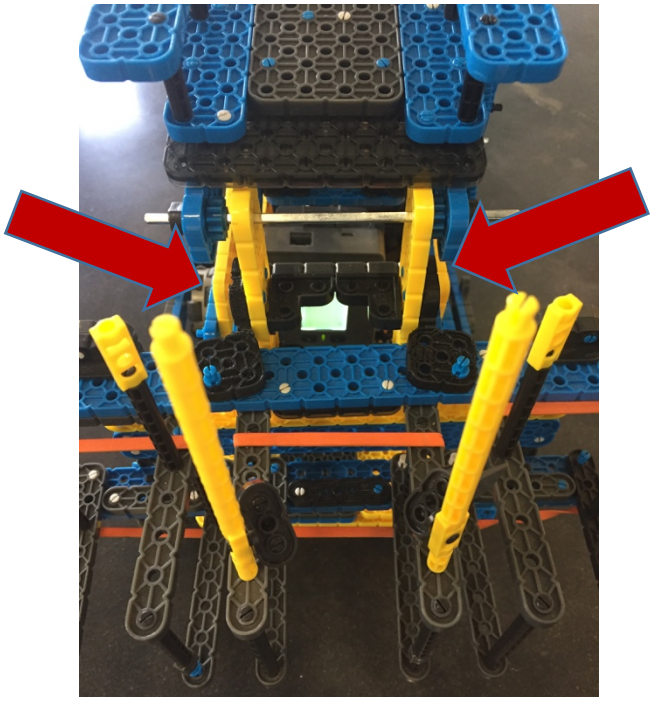

Photo 7 The 3D printed pieces on each side of the claw

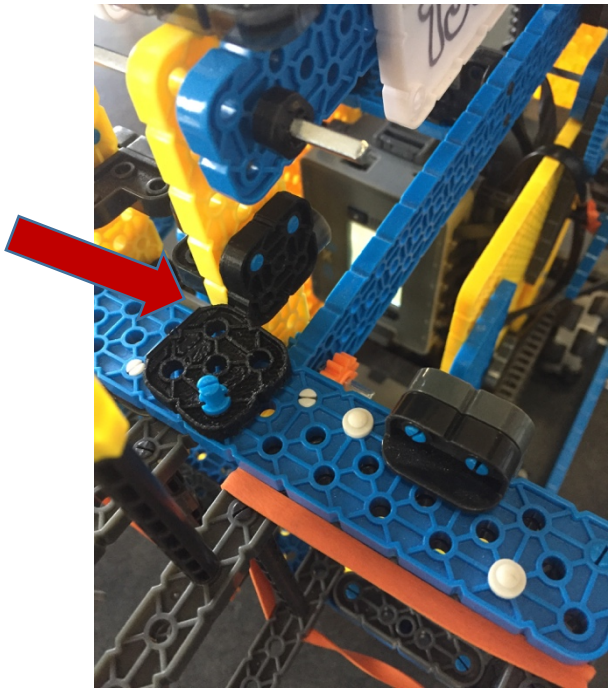

Photo 8 Close up of the 3D printed pieces on the one side of the claw. Only one pin fit.

The pieces were a little off in the hole alignment, which is something I could have fixed if I had a precise mm measuring tool (micrometer digital caliper) and my own printer so I could print multiple test.

The test also confirmed what I suspected, that the union was not strong enough as I broke one in the first 5 minutes. I fixed this by reinforcing the piece with a triangle covering the two holes on the one side to give more surface area to the union. (see photo 9) Unfortunately there were no more funds for printing this piece.

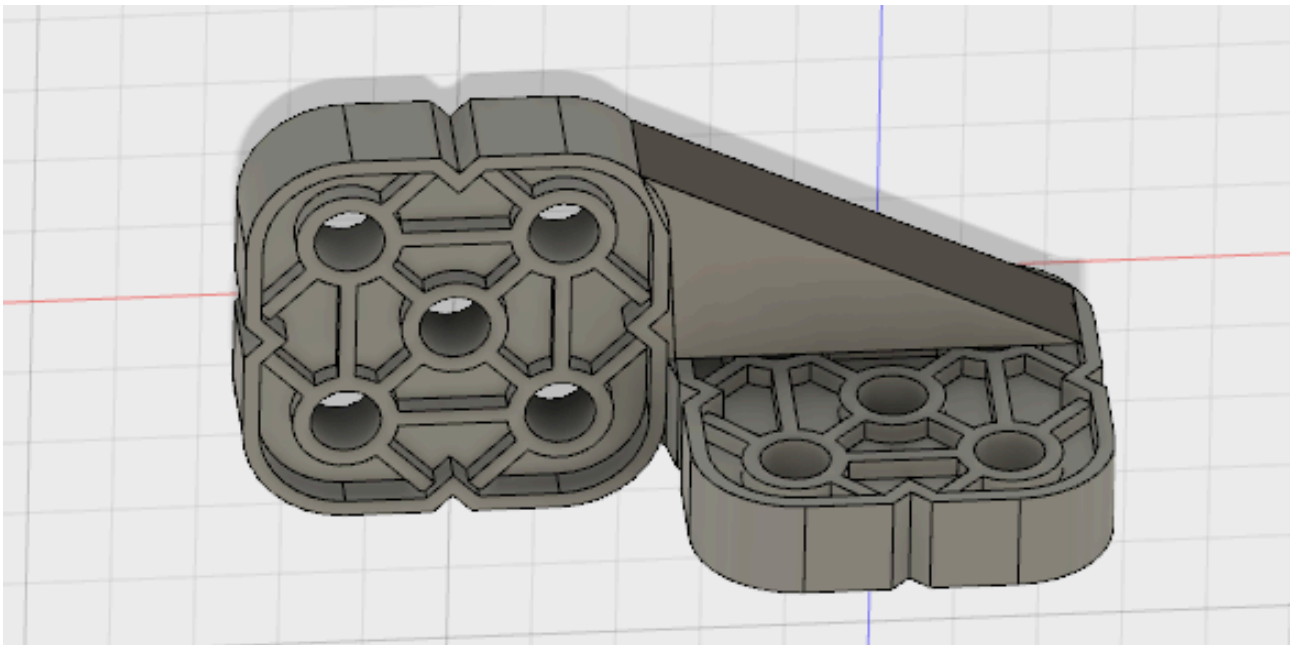

Photo 9 Picture of reinforced piece created in Autodesk Fusion 360 (Version 2.0.3706)

I have been 3D designing for 2 years. I initially taught myself Rhinoceros with the help of YouTube videos because they had a 90-day free software trial. I tried OpenSCAD where I had to actually code to create something. This took way too long. I used Tinkercad but it was basically dragging blocks, and didn't allow me to create with fine details. Watching the 3D Printing Nerd on YouTube, I was introduced to Autodesk Fusion 360 and I fell in love with it. The graphical interface is very easy to use and the different modes of sketch to modeling allows for more precise pieces.

This Online Challenge taught me how to create bodies separately, and then combine them into one piece. It also taught me to test and make sure that my measurements are exactly correct before I design the entire thing. I am excited to be able to use these skills in the future for other things I create.

This year my VEX IQ adventure benefited from 3D printing as I was able to have rings printed, before I ordered some official ones. (see photo 10) For my future robotics team career, a 3D printer would allow me to print and test a piece I'd like to use before I order a whole set of something. This would make my coach happy.

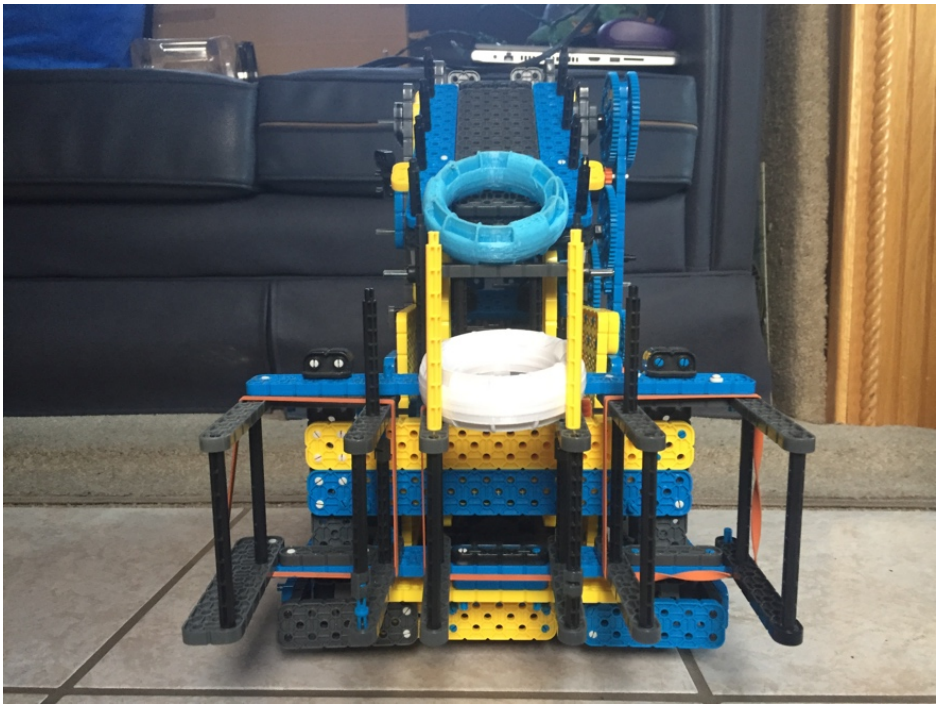

Photo 10 Albert the Spineasaurus Rex with the two rings we started with. One printed by my uncle and one by a kid on Vashon island.

In conclusion, I am sure I will enjoy 3D printing for the rest of my life. I am saving up to buy a good 3D printer, but in the meantime I have had friends and companies print what I design. I have already designed and sold some fidget spinners and I see myself doing custom work for others when I get my 3D printer. Since I was in 2nd grade I have wanted to be an inventor and a 3D printer will help because I can print what I create right away, test and modify my designs.