Wire Claw

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I hold my breath as the inspector examines our robot, turning it every which way to look. She looks up at my team, and the look on her face is all I need. Really? I resist the urge to laugh as I scan the robot. Wires everywhere. Wrapped around c-channels, stretched tightly from the motor to the brain, one is even sandwiched in between two gears. It's a mess—a mess that every robotics team knows too well. Wires are the last thing on my team's mind when building our robot, and when it's time to go to a competition, we hastily take a few zip ties and clump all the wires into a bundle. Not only does the robot look messy, but wires come loose, get damaged, and stop working at competitions, costing us games.

This is a problem that my team has run into year after year, but hasn't found an easy solution for until now. This year, I put my CAD skills to use and designed a part that helps manage wires on a robot efficiently. Introducing the Wire Claw. The Wire Claw easily screws into VEX standard holes on any piece of metal and can be secured with two to four screws. Using this part, the wire management of our robot is extremely efficient and clean. Whether it is changing the port of a wire, moving a wire, or re-designing the hardware, we simply remove the wire from the Wire Claw and put it back once the change is complete. The Wire Claw also keeps the wires on the robot housed neatly, rather than being wrapped around a c-channel in the hurry to test. It also allows for wire management to be part of the robot from day one, rather than being an afterthought.

This part went through three main design iterations. The first iteration was a simple, 2-pin design on a rectangular base that could hold 4-5 wires at a time, and be easily screwed into metal. I 3D-printed this version and mounted it on our robot. Although this design worked well for two or more wires, we found that when we wanted to secure only one wire, the wire would not sit snugly inside the part, defeating the purpose of having this part. We went back to the drawing board, and considered creating a separate part to hold a single wire. With two parts, we would either have to put them in pairs or know ahead of time where to use the single-wire part and where to use the multi-wire part. Neither of these options seemed ideal. In the second iteration, we added two pairs of shorter pins on either side of the main ones to push down a single wire and hold it in place securely. This new part could now hold from one to five wires, so we began testing our robot with it. Anytime we had to change our wiring, we could easily take

the wires out of the part and re-wire them. We ran into one more problem, however. When my teammates took the part off the robot, I realized that one of the pins on one of the parts was wiggling. Sure enough, when I wiggled it just a bit more, it snapped off. If the part breaks during a match, the wiring will all come undone. In the final iteration, I made the pins 1 mm thicker—the previous pins were 1.65 mm thick, and the new ones are 2.65 mm thick—providing a more stable and durable connection to the base of the part.

The final version of the Wire Claw has two large pins with a lip at the top. This gap between the lip is large enough to let a wire pass through on its thinner side. Once inside, turn the wire 90 degrees to lay flat. The wire is now securely in the inside cavity of the part, and will not come out when the robot moves. To take the wire out, you simply turn it onto its thinner side, and easily remove it from the lip at the top. In the end, we were able to design a part that is reusable, cost effective at 12 cents per part, and makes wire management easy, efficient, and neat on our robot.

I have used Tinkercad for a few years now, but decided to use Fusion 360 v2.0.9313 for this project to challenge myself. Through various design iterations, I learned about many different controls in Fusion, including rectangular patterning to create screw holes, and midpoints, lines and construction geometry to make sure that the part was symmetrical. Now that I have knowledge of Fusion 360, I plan to CAD my team's robot to ensure we have a solid design before we build it. Additionally, I had only heard about 3D printers before doing this project, but had no idea how they worked or how to operate one. This project allowed me to learn how to 3D-print a CAD design and experiment with different filaments, including ABS and PLA plastic.

Wire management is a specific problem in robotics that we have designed a solution for, but I've learned that CAD can be used in many places, from creating personalized prosthetics to 3D printing tools in space. Regardless of the career I pursue, my experience with problem solving and the knowledge of CAD that I gained throughout this project will help me understand and improve the world around me.