VEX Online Challenges: Autodesk Engineering Challenge

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VRC Team 7110Y “Fired Up!”

The Wire Tube

Wiring. The perennial downfall of engineers. Small and yet intensely complicated, these connections- meant to bring life into an inanimate object – vex scientists at every turn. At the center of this intense struggle lies wire management, an ostensibly simple task which quickly escalates into a disastrous venture of entanglement. Countless methods have been created to combat this problem, however none have been successfully implemented at a large scale for VEX Robotics. Our team decided to tackle the ubiquitous problem with a simple solution: the Wire Tube.

The task of wiring a robot can seem very daunting to newer teams and having to cut several zip-ties in order to test new wiring pathways can be very irritating when the team is on a tight schedule to finish their robot. Being a rookie team ourselves this year, we faced this problem first hand where we wired our robot the day before a competition. We hadn’t expected the process to take as long as it did or be as tedious as it was – we were under the assumption that our limited time should be utilized to improve the overall design and functionality of our robot itself. We feel that newer teams often have to make the compromise between spending time improving and iterating designs for their robot, or wasting time trying to cut zip-ties and switch around mounting locations for wires while ending up with a tangled mess and having to restart the whole process. We designed the wire tube to make this tedious process easier on newer teams so they can spend more time brainstorming, creating quality robot designs, and studying existing designs in order to enhance their own robot.

The Wire Tube would be used to hold wires securely while offering easy wire insertion and removal. The tube itself has a hook at one end and a slot on the other end. This makes it so multiple Wire Tubes can be attached in a chain while retaining the feature of easy insertion and removal. Additionally, this system reduces the number of zip-ties used to two, and rubber bands used to zero. Regardless of the length of the wire, the zip-ties only need to be attached on the first and last Wire Tubes in a chain, while the hook and slot system takes care of keeping the rest of the tubes in a secure position. Minimal spacing is one of the key desires of teams in competition robotics, so naturally we made the Wire Tube incorporate a compact design in order to fulfill this need.

Our intention from the beginning of this challenge was to create a system of wire management that would be reliant on a scalable, cylindrical structure with a way to easily insert and remove wires while retaining the capability to connect to other cylinders to the same capacity. We decided to use Autodesk Inventor Professional 2018 to design this structure due to the collective experience we had in using the software. We began the design process by making a circle 15mm in diameter in a 2D sketch on the XY plane, using the Extrude tool to extend this into a 100mm long 3D cylinder after deciding that this was a compact size for a wire management tool. Our next task was to create a wire insertion slot and a resting position for inserted wires. To fulfill this task, we made a mushroom-shaped 2D sketch on one base of the cylinder using the rectangle and circle tool and used the Extrude tool to cut this shape through the entire cylinder. We then flipped the cylinder to the right side view and created a work plane on the surface of the cylinder in order to sketch the basis for the hook and slot which would be used in connecting multiple cylinders together. We made a sketch of two rectangles that protruded from each end of the cylinder width. Continuing to sketch on the same work plane, we drew a line through the middle of the cylinder and set it as our edge-wise axis and used the Mirror tool to replicate the double-rectangle sketch on the other end of the cylinder. This would allow the cylinder to securely connect to other cylinders with ease. We had planned on using the Extrude tool to cut away the rectangles from one end of the cylinder (to create the “hook”) while cutting away the area surrounding the rectangles from the other end (to create the “slot”) , but realized that the slot end of the cylinder would need to have a larger diameter so that it could hold on to the hook end of another cylinder. We then enlarged the circle sketch on the slot end from 15mm to 21mm and extruded it 20mm. After drawing a line and cutting away the excess portion of the new slot section, we extended the mushroom extrusion to accommodate for the larger slot section. Finally, we cut away the area surrounding the rectangles on the slot portion and completed our design, naming it the Wire Tube due to the intuitiveness of the name.

This challenge gave us the opportunity to refresh our experience with Autodesk Inventor and were reminded of how powerful the tool can be in creating designs and prototypes. We also learned that complex problems, like wiring, can be solved using fairly simple solutions like the Wire Tube. After this challenge, we plan on incorporating Autodesk Inventor and the VEX part libraries in prototyping and finalizing the rest of our robot design process. We think that this would greatly enhance our robot’s design, giving us the ability to prevent potential design errors when constructing the robot. Some of our team members are interested in an engineering related career path and Autodesk will surely be a very powerful tool to have experience with in the future.