Optical Shaft Encoder Mount

"Make It Real" CAD Engineering Challenge

Team 6105C – Blackout Robotics

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BLACKOUT robotics

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Introduction

Context

The optical shaft encoder is one of the most important sensors to include on a vex robot. The sensor measures speed and distance of the shaft by using coding. Many Vex teams use the sensor on their drive train to incorporate rotation and distance into their PID code.

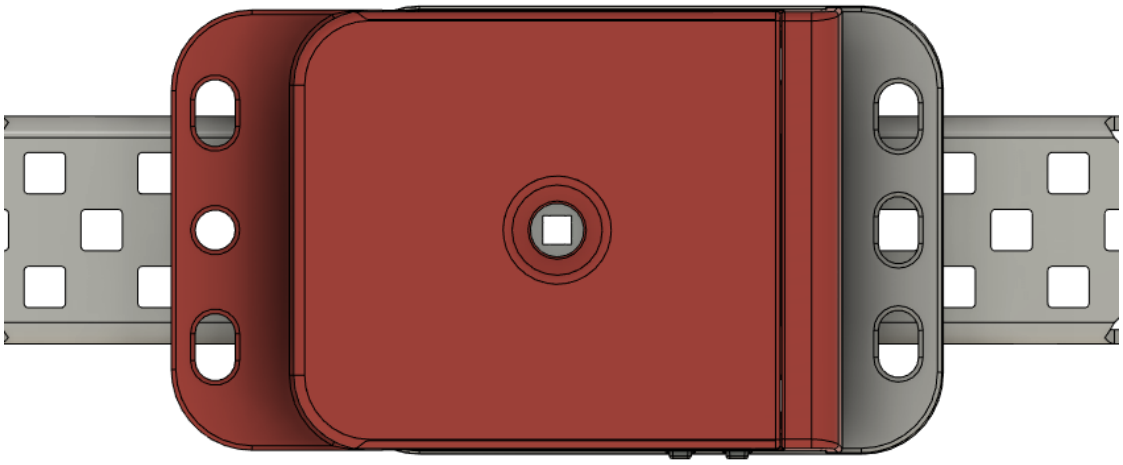
Issues

The functionality of the sensor itself is phenomenal, but the casing for the hardware has a complicating design that only includes screw mounts for one side of the encoder. This can cause inconsistencies like friction or uneven elevation of the axel to give inaccurate readings on the encoder. The encoder includes a cap to access the sensor inside, so I designed the part to fit in like the cap.

Uses for the Design

Drive Train:

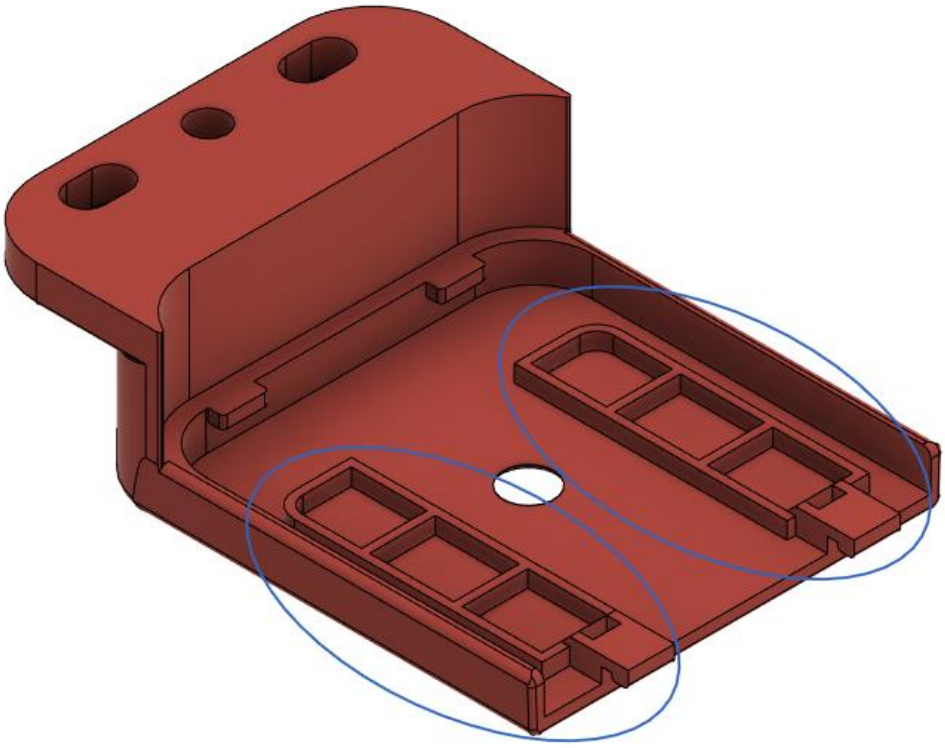
Prior to Vex V5, the newest version of vex hardware, the encoder was mostly used on the base on the robot. A lot of teams use the encoder on the center hole because their wheels usually lie on the center row on the c – channel. The original encoder designs only has one hole available on the case to attach the encoder on the row, so the encoder mount would allow teams to attach their encoder to the center row of the c-channel without worrying about the inconsistencies of attaching it at one point. After the introduction of V5, many teams started using the encoder for tracking wheels. Like the drive train, teams encounter similar issues mounting the encoder on the c-channel because they can only mount it on a single row of holes.



CAD Design Process

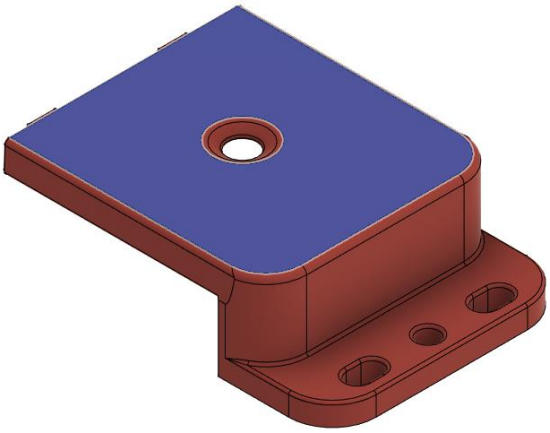
Reference

Before starting the model on Fusion 360 Version 2.0.9439, I needed a reference to use to make the mount of the encoder. Vex provides a CAD model of the original encoder design, so I used that with a combination of handmade measurements of the encoder to start modeling. One issue with the model provided by Vex is that the encoder model is different than the current model in that there are prongs at the end of the encoder cap that needed to be included for the encoder to be secure. Using calipers, I measured the encoder prongs I had in hand and incorporated it into the original model.

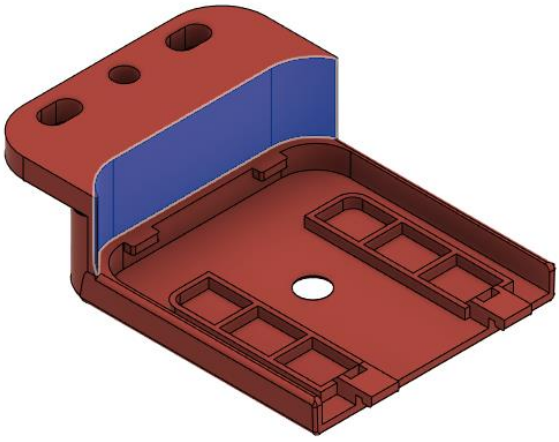


Extending

After figuring out the reference, I started to extend the piece and modify the lid to account for the mounting holes. The length of the lid was extended 5.346mm forwards to account for the extra mounting space. The rounded shape on the front of the encoder (the one without the original mounting holes) was also accounted for when making the CAD to maintain an aspect of its original design.

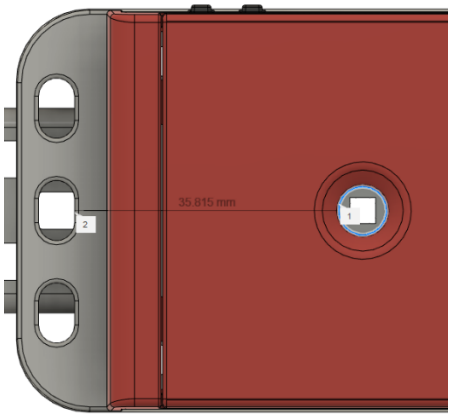


After the cap was extended forward, the portion of the encoder lid that would be attached to the original mounting holes would be extruded downwards to the base of the encoder (about 13.6mm).

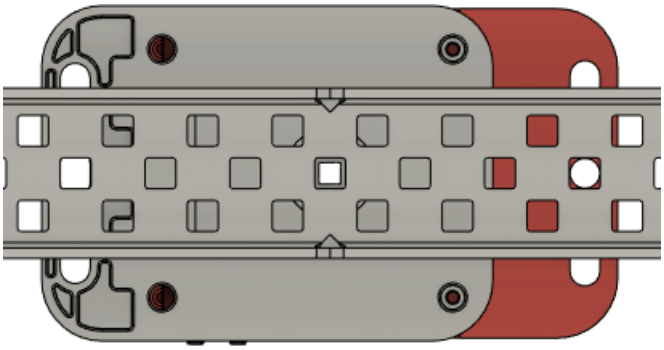


Creating the Mounting Holes

When creating the mounting holes, I wanted to hold on to the original design of the encoder to maintain the smooth aesthetic while also keeping consistent with the measurements and getting the mounting holes to align with the c - channel. Using the inspect tool, I determined that the measure from the end of the slot to the edge of the hole at the center of the lid was 35.815mm. This measurement was used to replicate the distance of the holes to the center where the axel would go.

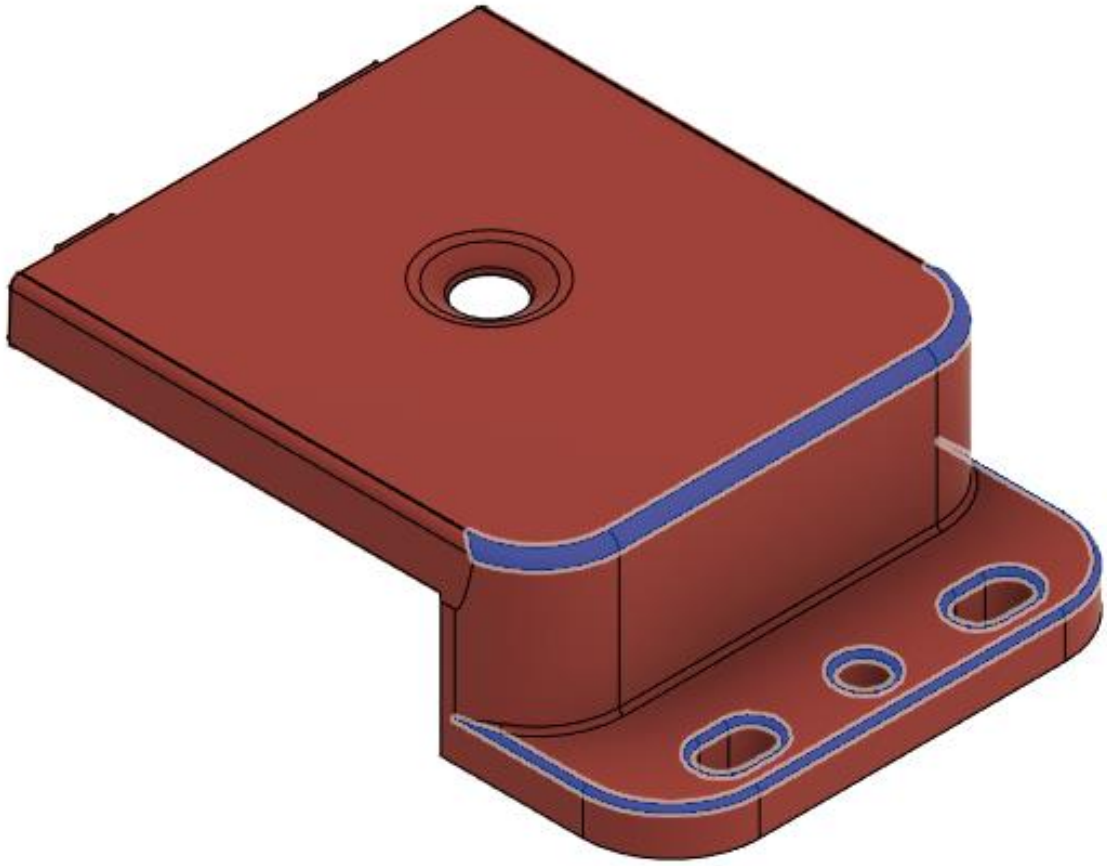


Afterwards, I measured the size of the slots to replicate it to the new mounting hole of the model. Using a c-channel CAD model, I made sure the holes were the correct distance from the center hole. In the end, the holes aligned perfectly to the center, holding symmetry.



Finishing Touches

After most of the measurements were finished, finishing touches to round out the design. Using the inspect tool, I measured the fillets on the original design to stay consistent throughout the CAD. Most fillets on the original model were 0.5mm in radius, so I added fillets to match the design on the original mounts.

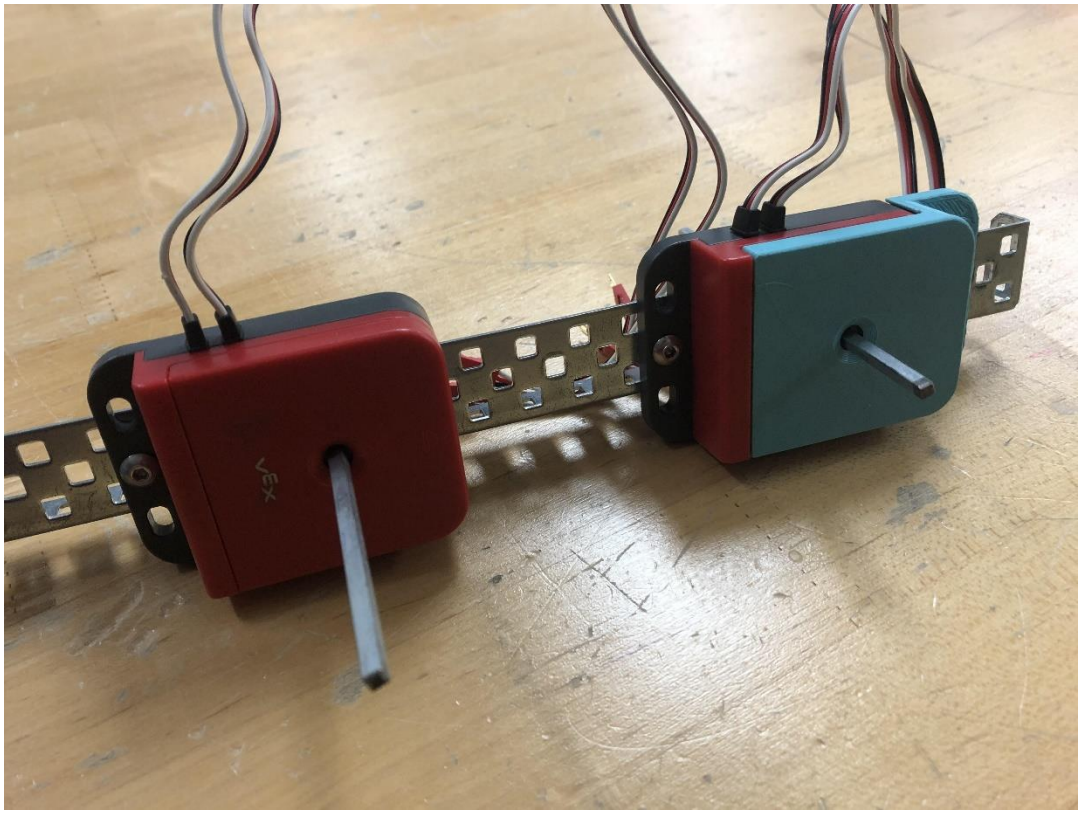


Once the CAD was double checked for measurements and design, the next step was 3D printing the piece and testing it out on an actual c – channel.

Testing

3D Print

To get a feel of the design, I took the time to 3D print the model to test the design on a c-channel. We used the CR-10S printer, which had a finer nozzle which would add more detail into the print. The print came out well on the first try and was able to fit into the slot of the previous cover of the encoder. I attached the encoder to a c-channel and compared the rigidity of the original encoder and the encoder with the custom cover. The encoder without the extra mounting holes pivoted on the single screw attached. The extra mounting holes on the other encoder helped it stay in place without relying on over-tightening the crew.



Conclusion

In summary, the additional encoder mount project has proven to be a helpful learning experience in designing and creating additional ideas for the vex community. Having the ability to model an idea and making it a reality has inspired me in taking the next step in the STEM field and learn the complex steps in designing and redesigning. It has opened my mind of the possibility's CAD software can open. The software would be of use in our robotics team when designing future builds or redesigns on our robot.