Andrew Heath

Student Research

18 August 2025

The Watering Robot Project

Over the course of this summer between the last Spring 2025 school semester and upcoming Fall 2025 school semester I was lucky enough to take part in a MTSU sponsored research project. Over the last two months I have learned new skills and have been able to integrate my classroom learning into an actual project, something I hadn't done at the start of this summer. Guided by Dr. Hongbo Zhang and with the help of my fellow researchers, I was able to desgin several key parts to the watering robot, also known as the 106 robot.

Coming into the project I was given several expectations which included contacting my peers and consistently communicating with them, and an expectation of full transparency of my work to Dr. Hongbo. I let the professor know my plans for the week and for parts and submitted all of my designs and finished mechanisms to Dr. Hongbo. This communication allowed the work to progress smoothly eliminating most hiccups that would come with a lack of it.

With my certification with SolidWorks and my expressed interest, Dr. Hongbo hired me as a mechanical designer to work on the robot's mechanical features and to come up with designs for any parts which were needed. My first job was to create an adapter to hold an internal case in

place which protects parts from potential damage from water or other external sources.

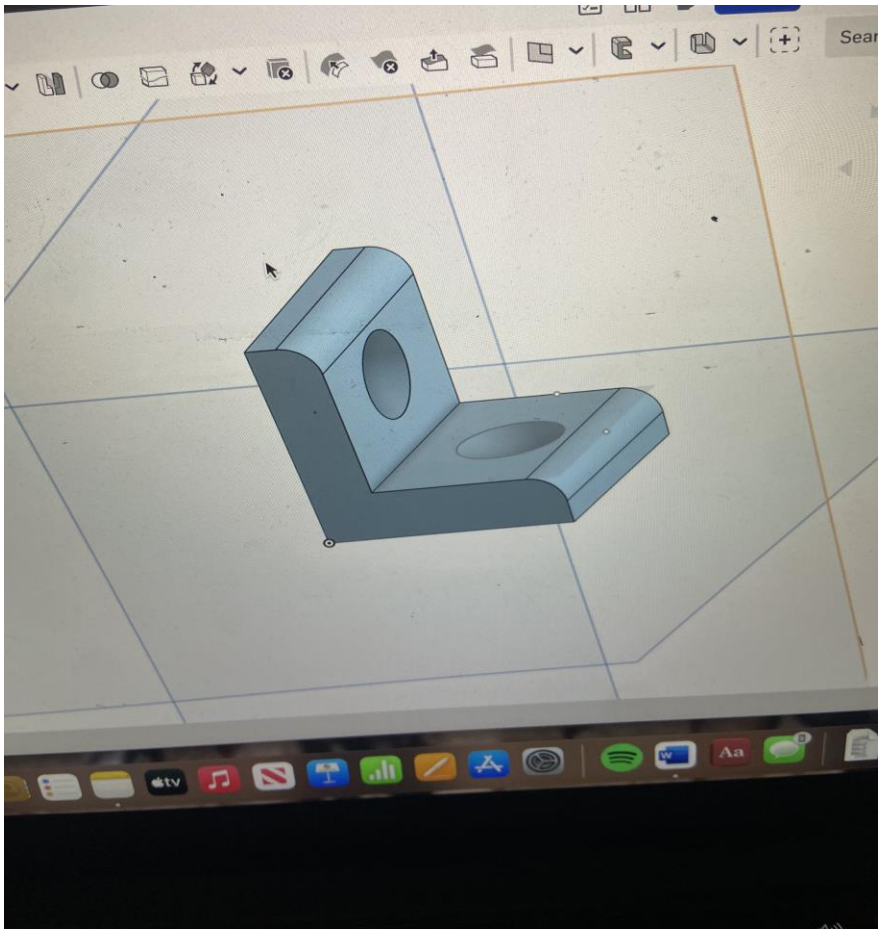

Figure 1.

The image in Fig 1. depicts the original design I created in SolidWorks to be 3D printed for the internal case. With the construction of the Applied Engineering Building, the equipment being used in the VET was being transported to the new building, so machinery was becoming more and more hard to come by as the weeks progressed. 3D printers were some of the first to go so unfortunately, I could not get this part 3D printed. However, with this misforturne came a learning experience because I was then tasked with using an angle bar to cut this part and design it 100% by hand. After talking to Dr. Hongbo and Mr. Rick

Taylor, I learned how to use the machinery that was needed and I was able to successfully create six adapters.

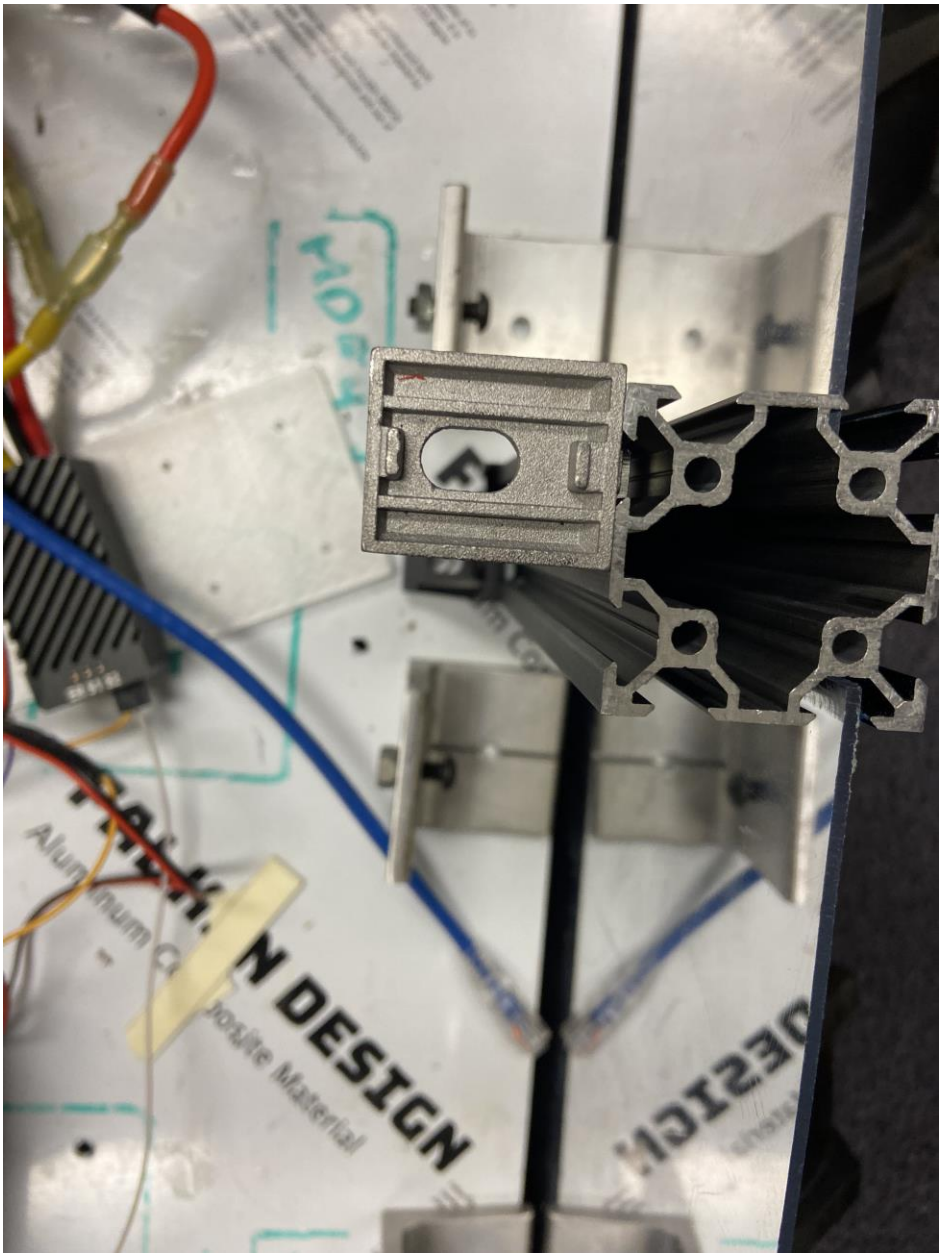

Figure 2.

As seen in at the bottom of the case in Fig 2., the adapters were designed to be spaced apart and screwed into the case and into the inner case as seen. Figure 3 can be seen to show a better representation of the adapters connected to the case and inner box. Following the creation of the adapters, it was clear that the inner case needed to be changed to allow for cables to pass through it and to allow for better waterproofing.

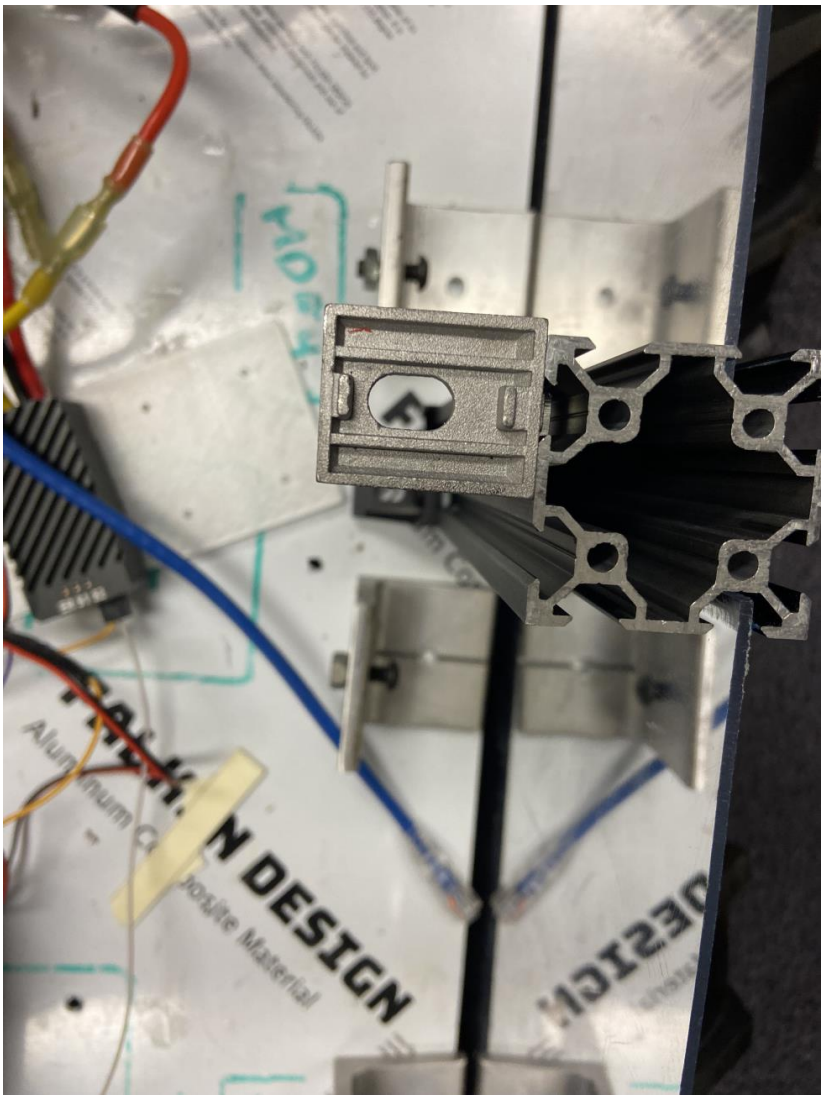

Figure 3.

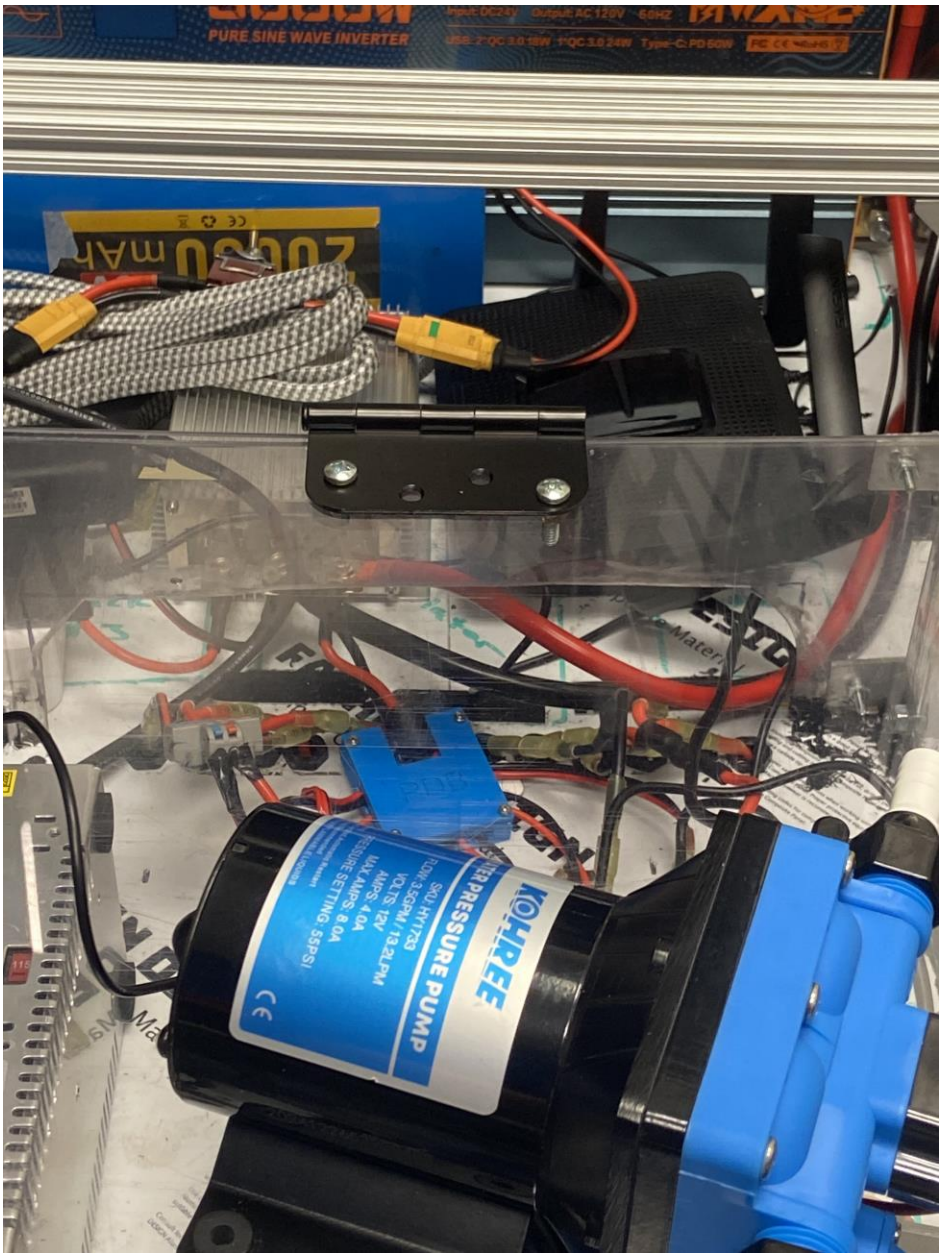

Figure 4.

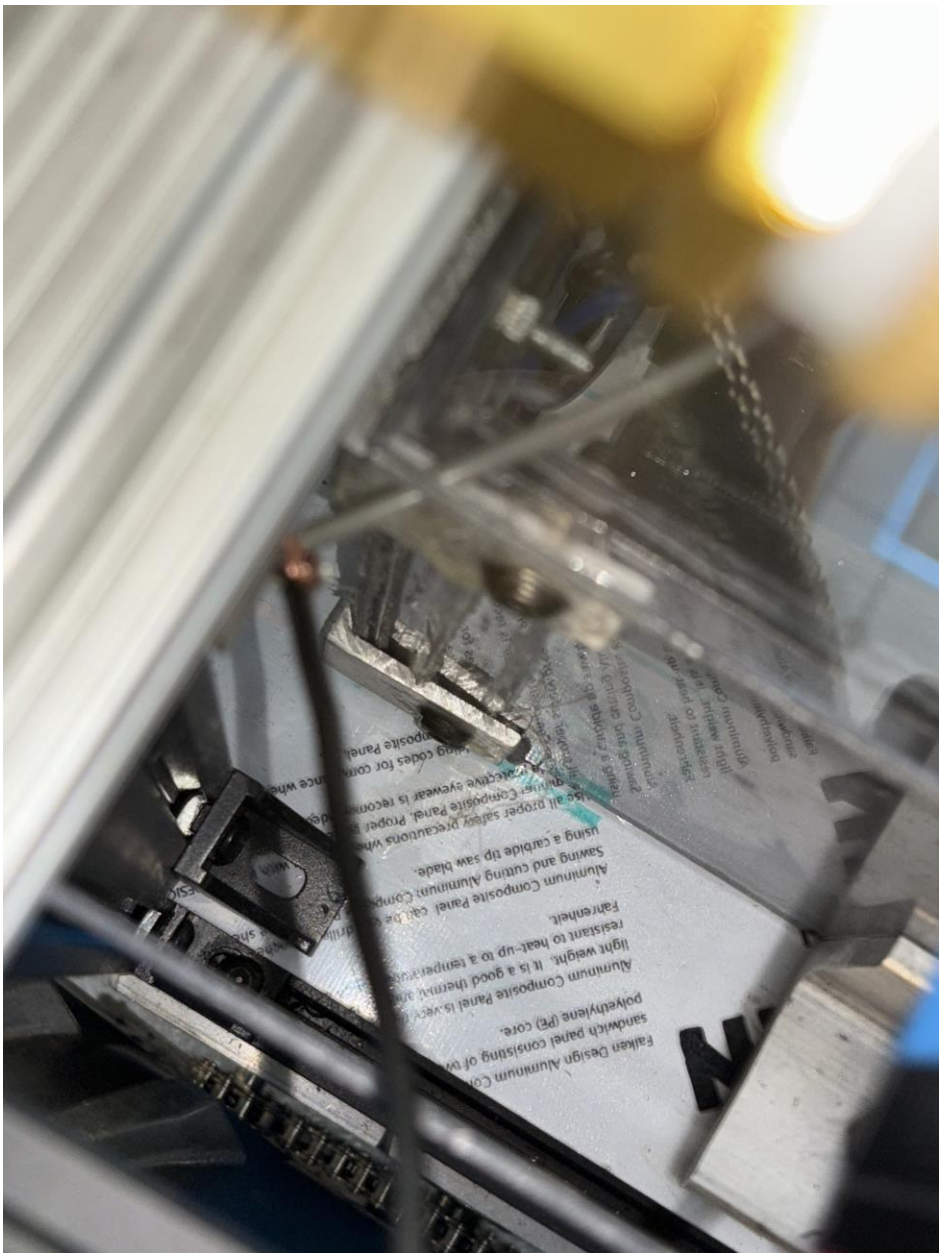

Figure 5.

Figure 4 depicts the part of the inner box which was cut in order for the cables to pass through, while figure 5 shows the part that was used to fasten the corners together to add structure and prevent leakage. In the next step of the inner box, the box was secured down, and caulk was applied to both the inner and outer edges of the bottom of the inner case to

fully prevent any leakage. Following the case being secured down, it was clear that the case still needed to be accessed and needed a mechanism which could be easily removed if needed. In order to accomplish this with the limited supplies, I drilled holes in the existing case and added a hinge to the roof (Fig. 6) to allow for access to the inner box.

At this point in the project, most of the equipment needed to continue the project was moved to the new building so machinery was very limited to a band saw and hand drills. Despite this, we continued the project to the best of our ability and were still successful in delivering the final product.

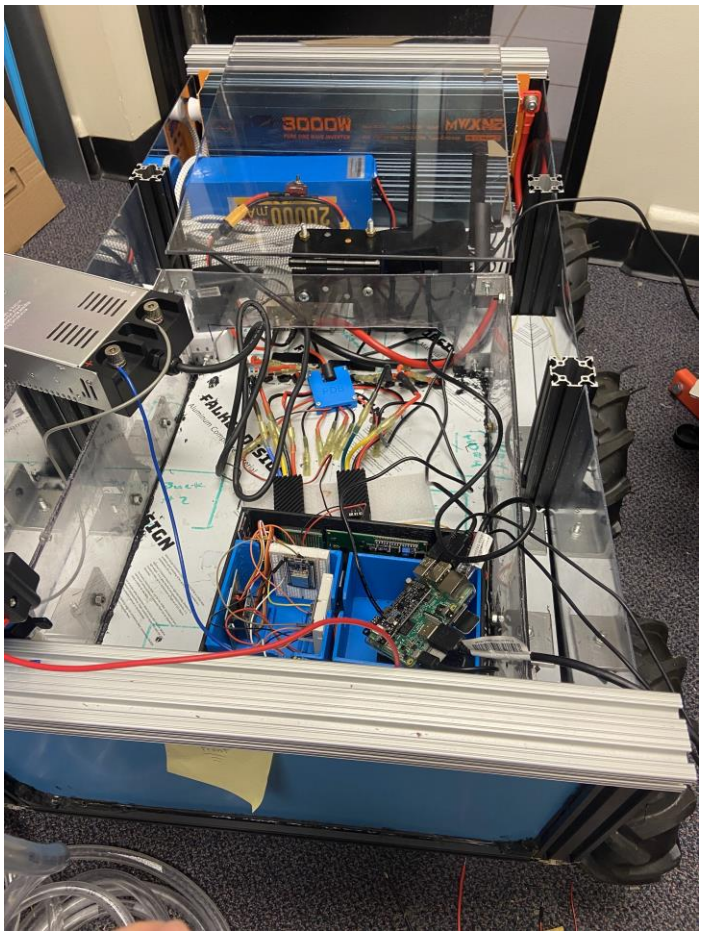

Figure 6.

My next task for the robot was to seal the tank we were using and to mount the tank onto the robot. Initially, the tank was mounted using a ratchet strap and some well secured 8020 bars; which worked well to secure the tank (Fig. 7). However, after many failed attempts to seal the tank, it appeared to be warped – so a new tank had to be used. While waiting for the new tank to arrive, I designed and tested the mount for the pump. I found that securing two 2020 bars together allowed the pump's bracket to be perfectly aligned with the 2020 bar's nut path (Fig. 8). This made mounting the pump very simple and by the time this was completed the new tank had arrived.

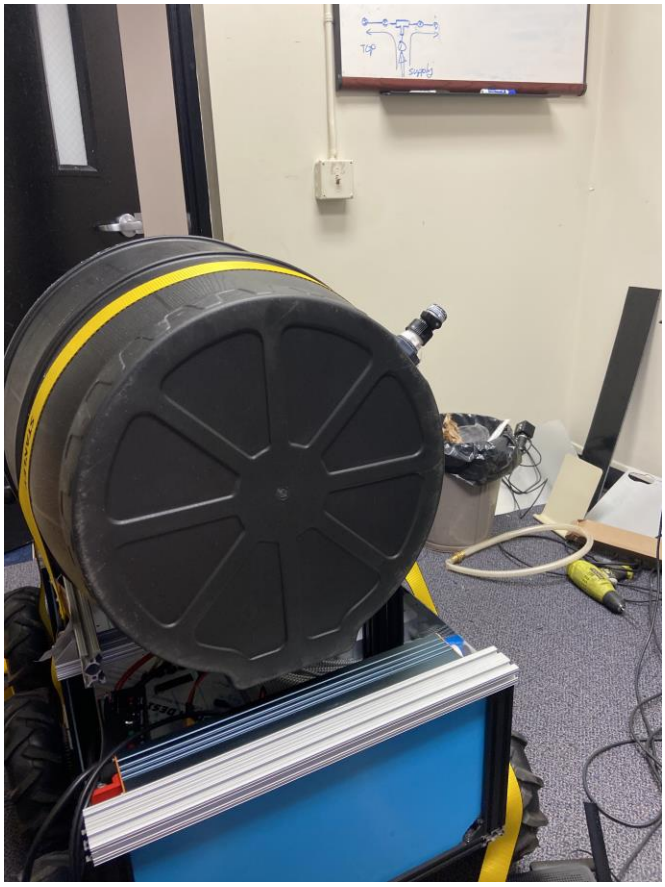

Figure 7.

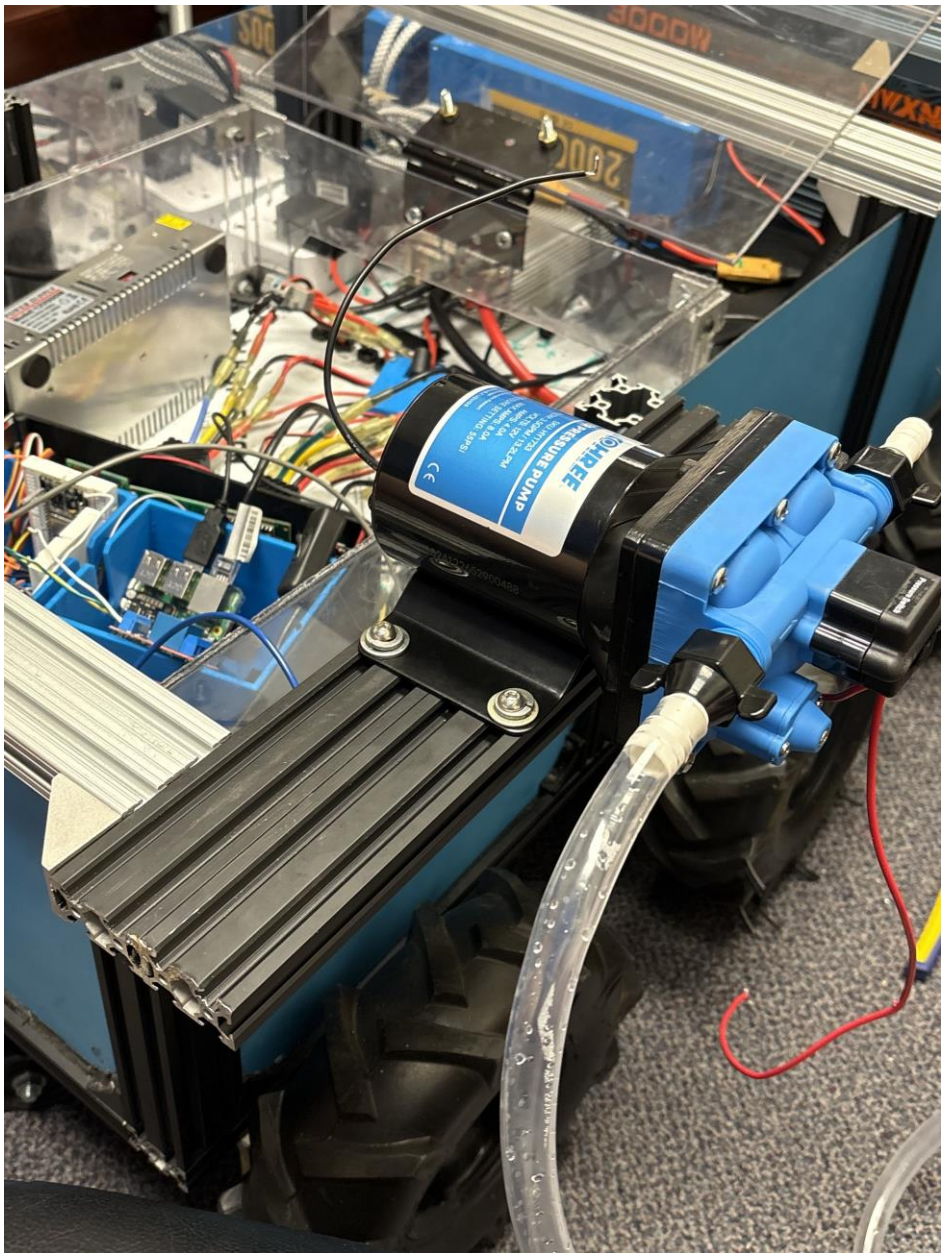

Figure 8.

Figure 9.

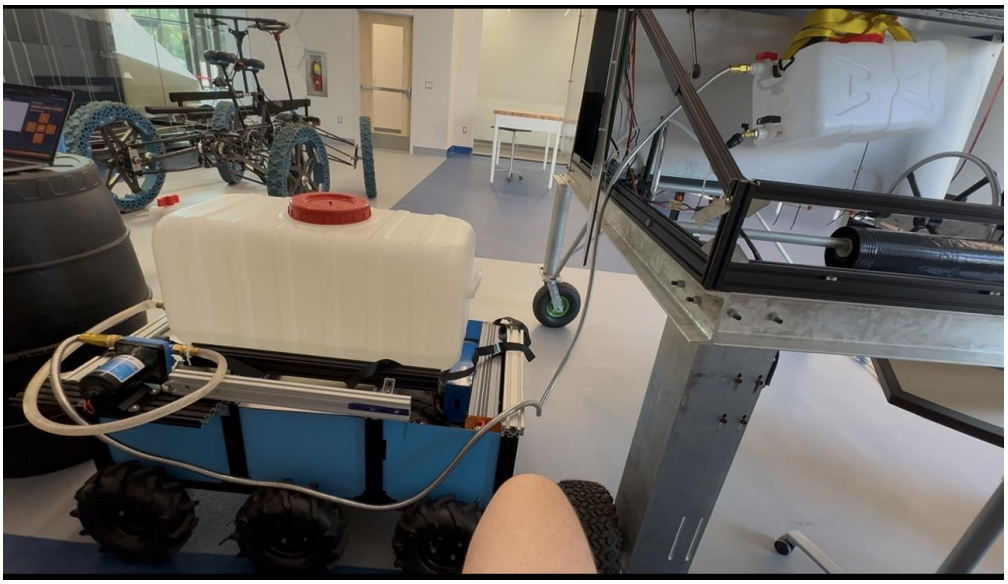

Figure 10.

In order to mount the tank I used a similar method that was used for the previous tank with small changes. For this new tank I used two large 2020 bars to secure the tank in place then added two straps to ensure the tank was properly secured (Fig. 9). At this point the project was nearly complete, the final step was to connect the tanks of the irrigation robot and the watering robot together on route with the pump. After gathering the correct fittings, gaskets, and hoses, the loop was assembled and tested (Fig. 10). The connection and testing was successful and the project was completed successfully.