Individual Lab Report

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Team E

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Individual Progress

After the previous PR Leo and I spent Sunday working to complete what was initially promised for Wednesday the 15th. For my portion of that task I determined why the linear actuator was having trouble going to the correct location. I believed that there was nothing fundamentally wrong with the software or hardware I had made, so I had probably made a mistake about how the Festo controller works. I used an oscilloscope to determine if I was getting the correct feedback. Figure 1 shows the feedback that I was receiving. I was apparently getting two feedback signals per move, but only when I was queuing commands of the same type.

Figure 1. The output of the feedback pin from the Festo motor controller.

Essentially, the motor controller was confusing new commands of the same type with the previous command. The gap between the edges in the double feedback event was about 200 ms, which means for consistency there much be at least a 200 ms gap between each command of the same type. In the actuator manual this time is listed as "> a few milliseconds", so technically the manual was correct, but I did not expect 200 ms. It is not unrealistic that ten or so commands could be executed per move from bin to tote, which will occur at least 24 times per full SVE run. This adds up to about 48 seconds, which is a fairly large amount of time to waste in a 15 minute run, especially since it limits our ability to execute trajectories with the slider and arm simultaneously, which would eat perhaps another minute (that value is much harder to make a concrete estimate for).

The solution to this is to switch to a new and more complex control type that is also supported by Festo. This method can store 32 moves. The idea is to store 25 absolute positions at 4 cm increments with 6 relative movements to traverse in between those absolute positions for a total resolution of 1 cm. This should eliminate or greatly reduce the likelihood of a double feedback event. I have started constructing a new level shifting board will work for the new configuration, which has about ten new I/O's. This board is shown in Figure 2.

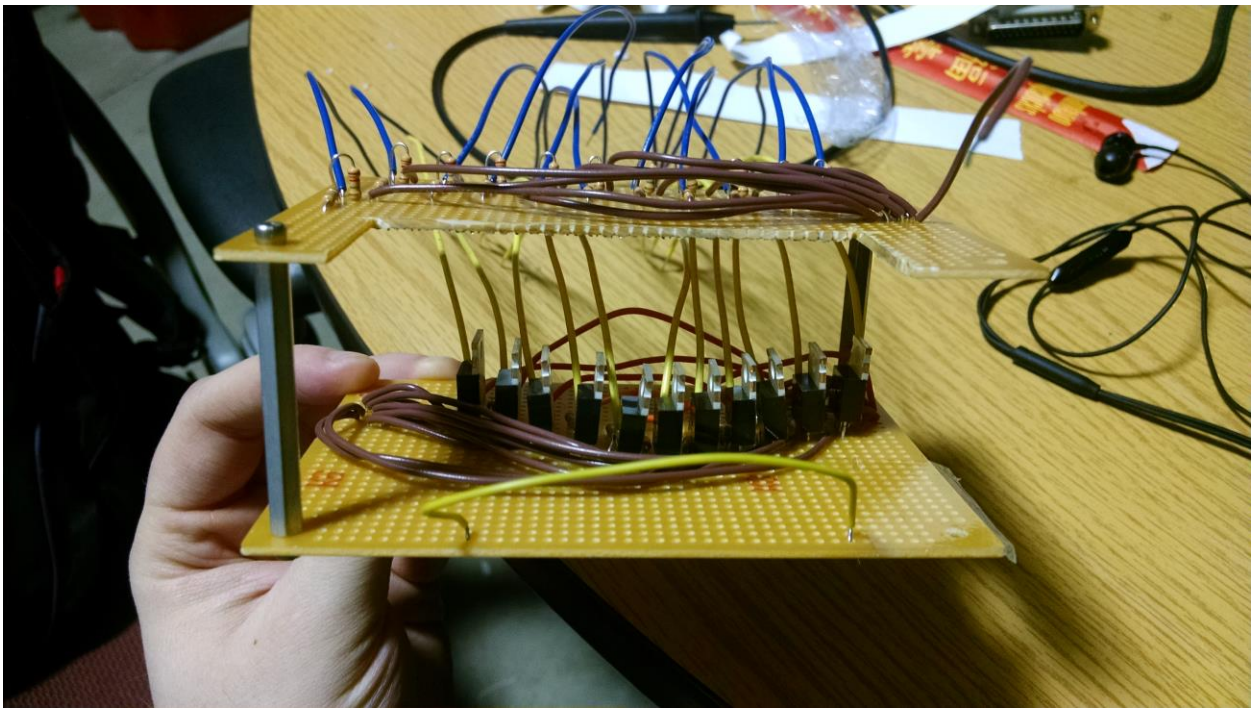

Figure 2. The new level shifting board, missing the final connector.

After that I spent time with Akshay and Leo to integrate their changes into the full system. With Leo, I helped determine the position of our new arm mounted camera in the planning scene. I moved the arm to a known pose where the camera could see an april tag at the base of the arm. Once the camera offset was determined Leo was able to project segmented point clouds into the planning scene.

After that my work with Akshay involved integrating the new grasping code into the older grasping code. Akshay's function accepted point clouds and returned suggested grasp poses. I modified the old graspsing code to use this function, but the poses returned were inconsistent and frequently impossible to reach. Akshay was able to adjust his code based on my feedback, but due to some other small issues and the late hour we were only able to verify runs in simulation.

I also integrated some changes from Alex, that will become very important soon. These changes will allow the arm to execute trajectories that use the linear slider and actuated suction head in a robust way.

Challenges

There were no large challenges the past two weeks. I had some issues with the new universal robot driver, but Alex was able to help me solve the problem quickly. The problems that prevented me from completing my part for the demonstration weren't technical issues, they were scheduling issues. Mike and I anticipated these issues, but frankly there is nothing I can do about it.

Teamwork

Akshay worked on generating grasps points for deformable objects.

Leo worked with the new ASUS camera and was able to use this camera and past vision work to measure the position of objects and project them into the planning scene.

Mike finished the first iteration of the new end effector, which includes an actuated suction head and the new ASUS camera. Mike also performed a brief case study on which items will be most difficult for the current end effector.

Jin has been collecting date for the new item set. She is identifying the most difficult objects for vision.

Future Work

My future work mostly involves testing the arm with 7 and 8 DOF planning. Primarily this means getting robust control over the new DOFs. Alex has made modifications to the trajectory execution code, which need to be integrated with the new DOFs.

The parts for the new arm base have come in, so I will also start finding preposition poses and camera angles for each of the bins in order to reach the entirety of the shelf. This should be possible with the new base.