Jorge Anton Garcia
Team D – CuBi
*Team mates: Laavanye Bahl, Paulo Camasmie, Changsheng Shen (Bobby), Nithin Subbiah Meganathan*

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## Individual progress

For CuBi, the two biggest things I focused on was controlling the dynamixel motors and updating the process by which we track and create new tasks. I worked with Nithin in the dynamixel portion of the assignment.

### CuBi Technical

Nithin and I spent a lot of time getting familiar with the interface to dynamixels and figuring out how to connect and control several of them in series. We got two AX-12, two MX 64, and an MX-106 from the inventory. We worked with Paulo to determine how we wanted to coordinate the movement between each of the motors. To avoid having objects fall once they have been picked up, we have initially decided to keep the tray always horizontal to the ground. This is also extremely important when picking objects on flat grounds (our initial test scenario) as our gripper mechanism does not work unless we are flat on the ground. For this to occur the bottom joint angle needs to be $\pi/2$ plus the top joint angle. Finally, we decided to have each of the two finger-like grippers move independently.

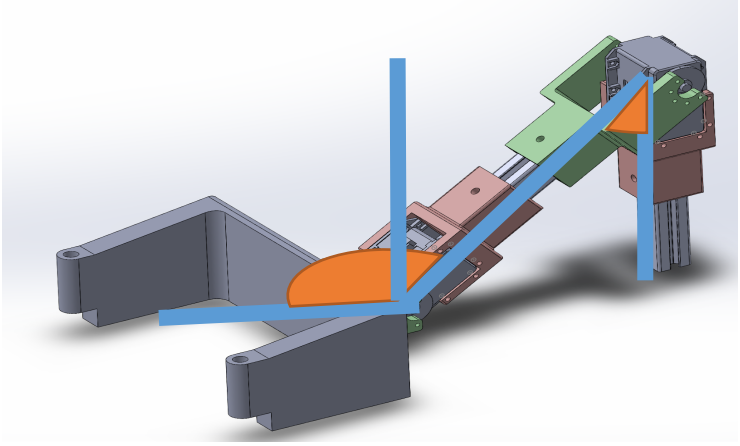

*Diagram 1. Shows how the joint angles need to be related to maintain the tray horizontal to the ground.*

We then talked to Paulo about how all the motors needed to be wired. Based on this, he corrected the mechanical design to ensure that the necessary connection was possible. We had not purchased the default chip to power the motors, so we ended up using the ArbotiX-M Robocontroller controller to do so. We put in 12V to the board and supplied 5V to the motors. We connected several as follows:

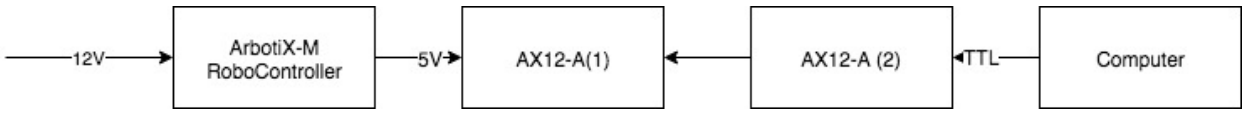


*Diagram 2. Shows how all the actuators were connected to the computer*

### CuBi Project Management

Trello has not been working efficiently for us. We are using the Gant Chart to get a sense, on a high-level, whether or not we are on track. Trello was used to see what everyone was working on for the week. Too much granularity results in a convoluted task visibility, but not enough does not add much value. Because of this, we have decided to use excel to keep track of all the tasks that need to be completed for each subsystem. We have included tasks that involve decision-making between team members to ensure that we are constantly thinking about validation throughout the whole process.

## Challenges

### Project

We initially tried to use the default library to control the actuators, but we were getting an error regarding incorrect packets being received. After testing a lot of different options, we realized that the firmware was probably outdated, so we installed a program to re-flash the all-in-one smart actuator system. After doing so, we were able to control the motors with a GUI. One of the motors had an error flag which led it to work for one second and then it would stop. The error was related to the amount of torque passing through the motor. After several hours trying to fix the error, we realized that most likely there is an internal connection problem in the motor and that it is not working properly. We were lucky that there are extra AX12-A actuators in the inventory, but next time we need to ensure that all motors are working beforehand. Otherwise, waiting to order more motors could result in a week delay in our schedule.

## Team Work

Nithin: Has worked directly with me to control the Dynamixel actuators. We began performing initial experiments in different scenarios to determine the ability of our gripper system to pick up objects in different scenarios.
Paulo: Manipulator was re-designed and the motors were integrated to actuate the grippers. He 3D printed all the parts and assembled them. He worked with Nithin and I to ensure that electronic assembly was also made possible.
Laavanye: Improved the segmentation algorithm. He performed statistical outlier removal and voxel filter down sampling.
Bobby: He worked on integrating the hardware and software. He replaced theReplace raspberry pi with Intel NUC, designed a splitter cable for power distribution, configured NUC to boot automatically when connected to power (set in BIOS), set up NUC to bring up as AP mode (WiFi access point) for remote access via SSH. We can now control the turtlebot via joystick driver, cmd_vel publisher and velocity smoothing mechanism.

## Plans

In 2-weeks, the robot will be completely assembled. We should be able to detect objects which fit on the tray based on size, actuate the grippers to grasp the objects, and ensure that the objects are carried in a horizontal position.

I will work with Nithin control all the 4 Dynamixels with ROS. As always I will also keep track of progress status and make sure we are on track and moving as a team. I will then start working with Laavanye on the vision system.