Carnegie Mellon University

16-681

MRSD Project I

Task 12 Progress Review 3
Team C - COBORG

Jonathan Lord-Fonda
Teammates: Husam Wadi, Feng Xiang, Yuqing Qin, Gerry D’ascoli

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1. Individual Progress

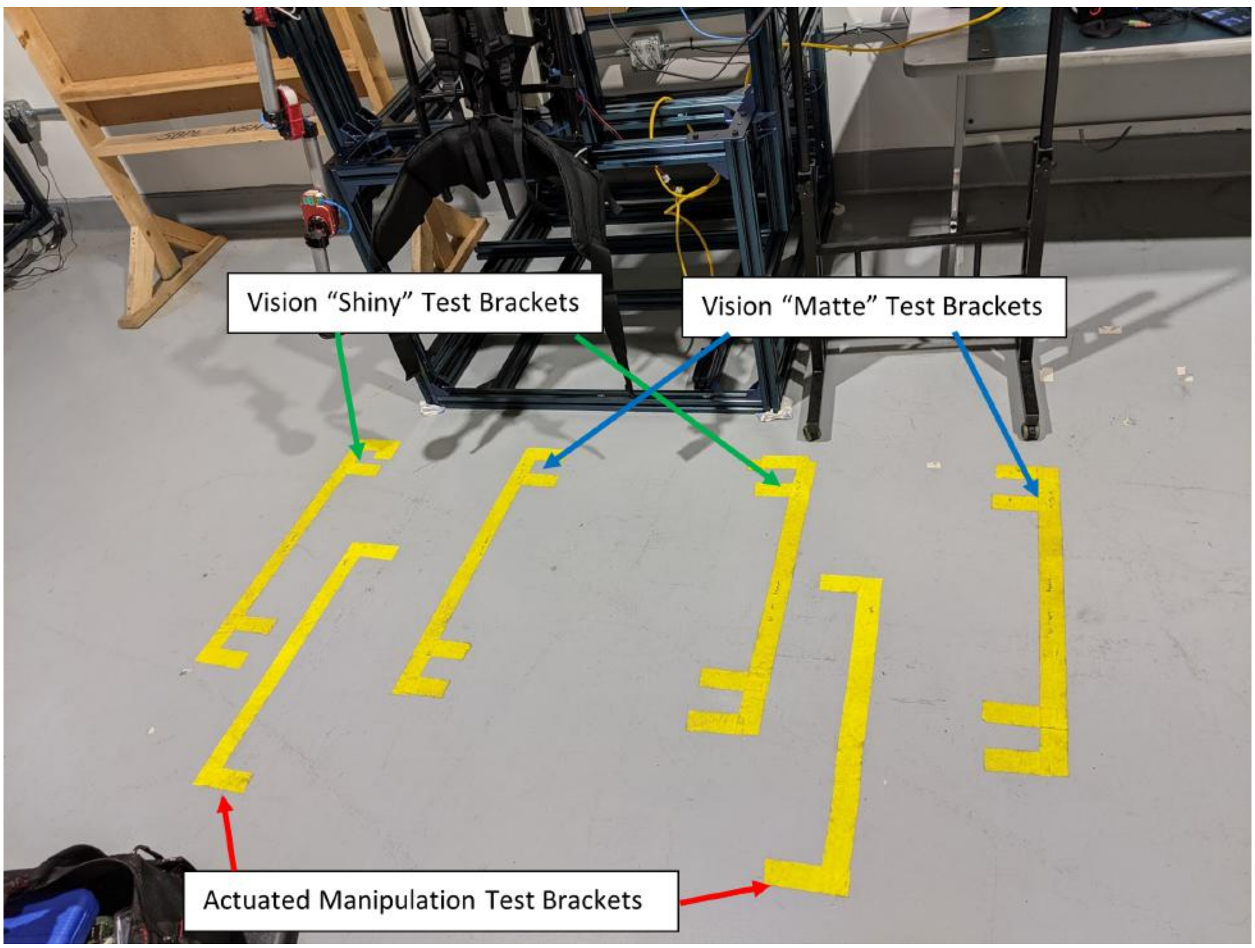
My primary tasks for this progress review were centered on the validation testing. I wrote the 1-pagers for the SVD and FVD. I also created two requirements for the speaker that was recently added to our system, one for the accuracy of the speaker and one for general effectiveness (i.e. Can it be heard?).

I went through each of the validation plans with the subsystem leads and together we made changes and corrections to the plans so that they were updated for our current system. Most of the changes we made were to narrow down exactly what positions would be tested and how many repetitions would be tested. Since the voice subsystem was the furthest along I was able to run through the entire voice subsystem validation test with Gerry. During the test we realized that "accuracy" did not have a trivial definition. The system itself regularly triggered incorrectly on words, thinking they were "Coborg," but didn't proceed to execute an action. This is analogous to how Alex often thinks someone spoke to it and signals its alertness, but then realizes it was a dud when no one issues it a command. For our validation test we decided that such an action would not be considered an inaccuracy because it wouldn't lead to any action from the Coborg, merely an indication to the user that it was listening. Therefore, our voice validation test measured accuracy as the number of successfully-interpreted voice commands (true positives) against the sum of successfully-interpreted voice commands (true positives), not identified or incorrectly-interpreted voice commands (false negatives), and voice commands published when no command was given (false positives). Under these conditions the Coborg scored roughly 85% accuracy.

We were also able to perform the "strength test" portion of our spring validation testing. This involved extending the arm to its full length at slightly below horizontal, applying a 2 lb. weight to the end, and bringing the arm up through horizontal, thereby testing the ability of the system to lift 2 lbs. at full extension. Unfortunately, the system was unable to lift the weight. More description of the problem and our solution will be provided in the "Challenges" section of the report.

The last task I completed for the validation testing was to begin making measurements and setting up for the validation test. In Figure 1 below, you can see the tape markings where we intend to place a board to perform both vision and actuated manipulation tests. Having these locations measured out will allow us to pick a point in space and measure how closely the Coborg comes to identifying or reaching that point.

Figure 1 - Validation Testing Measurements



This figure shows the locations measured out for validation testing of the vision and actuated manipulation subsystems. They're at fixed locations relative to the Coborg support's frame so that we can establish a "ground truth" measurement to test against.

In addition to my primary tasks described above, I also began writing an impedance controller to enable part stabilization. Unfortunately, due to time constraints I didn't finish that yet.

2. Challenges

The primary problem that we encountered in this cycle was that our Coborg system failed the strength test that we had set for it. For better or worse, this requirement was largely a guess from our group due to lack of information because our sponsor is in academia and not industry. As such it was written in such a way as to be easy to validate. After discussing the Coborg's failure with John Dolan he recommended rewriting both the requirement and validation test to be more applicable to our proposed use case. Considering that we didn't have much basis for our proposed requirement, this solution seemed acceptable. To that end we're rewriting the requirement so that the Coborg system will be able to hold, overhead, a piece of plywood or aluminum sheeting of a typical size to be used with this system. This will allow us to validate the strength of our system with a method more closely tied to our use case (higher weight, but overhead).

3. Teamwork

The progress and future plans of each team member are listed in the chart below:

Team Member	Teamwork Progress	Challenges	Future Work
Feng Xiang	-Created ROS Node to publish goal positions every second to MoveIt -Moved robot arm based on relative frame on URDF based on goal position rostopic	-Develop a functional and robust stabilization model so robot arm can maintain global position through time	-Move robot arm relative goal pose to D435 camera link frame -Implement OMPL+CHOMP motion planner for a more iterative updating motion planning model -Develop 3D goal pose to update stabilizer robot arm relative to global odom frame
Jonathan Lord-Fonda (Updated for PR3)	-Wrote SVD/FVD 1-pagers -Added the speaker to requirements and validation plans -Checked in with Gerry, Jason, and Yuqing to ensure validation plans still matched voice, actuated manipulation, and vision subsystems and updated validation plans -Began setting up validation testing -Ran through voice validation with Gerry -Ran through strength test -Started writing impedance controller for stabilization	-How to define accuracy for voice subsystem -Problems with strength validation	-Research the other Elastic Bands papers -Research and implement CHOMP (or Elastic Bands) -Run through validation testing -Update and finalize validation plans -Work with team to integrate ROS nodes
Gerry D'Ascoli	-Fixed problems with the voice subsystem triggering on false positives -Rand through the validation testing with Jonathan	-Voice subsystem triggering on random words	-Finalize voice subsystem and run through/time validation test
Yuqing Qin (PR3)	- Implemented the postprocessing node (goal_getter) - Implemented the surface normal - Set up the validation environment	- Make sure the accuracy of 3d position - Run time restriction on the Zotac	- Measure the accuracy of vision system - Further improve the accuracy of averaged 3d position
Husam Wadi	-Created launch files for main node and voice node -Assisted Gerry with removing false positives in voice subsystem -Assisted Gerry with PCB design and refinement	-Creating a timing service that keeps track of how long it takes for a voice input to translate into a command and how long the vision subsystem takes to recognize and publish the goal point	-Tie in the voice subsystem to the vision subsystem through the main node

4. Plans

Before the next progress review I will run through the validation test for each subsystem from top to bottom, ensuring that we can complete each test and (ideally) meet each listed requirement within our 20 minute time limit. I will also be working with my teammates to integrate their ROS nodes so that the system can begin to function as a single unit. In addition to those tasks I intend to finish the impedance controller and implement either CHOMP or Elastic Bands so that we can begin developing our stabilization system.