# Individual Lab Report 3

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**Team B: Space Jockey**
**with Brian Boyle, Ardya Dipta Nandaviri, Songjie Zhong**
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## 1 Introduction

This week my team made very good headway on our stated goals from our last ISR. All of the parts we ordered were delivered and I was able to assemble and test the Servo Driver board with the High voltage servos. I worked with Songjie to flesh out the concept of our new robot design, and he has begun some rough cad drawings, and Dipta and I were able to finish up the draft for our power distribution board. Brian was able to fully restructure the operatior interface and clarified our expectations and plans for our continuing control software implementation.

## 2 Individual Progress

On Monday, all of our parts were delivered. So I spent the bulk of the day assembling and testing the Adafruit servo controller board to work with our 7.4 volt servos. As expected, the Adafruit board required several modifications to support the higher voltage servos using the Arduino Due. The on board voltage regulator had to be removed and bridged with solder to support raw 7.4V power to the servos, the Vdd input had to be severed and solder bridged to take 3.3V supply from the Due, and the legacy Duemilanove SDA/SCL traces had to be cut on the Adafruit board to restore access to the A4/A5 pins. Once the board was fully assembled, the servos fired up first try when driven by the included demo sketch. A few quick modifications to the source code allowed me to increase the control frequency to 300 Hz, allowing us to take advantage of the full speed response of the digital servos. My next effort in this area will be to abstract away some of the PWM implementation code, and add an interface to allow direct and simple servo position control from ROS using the rosserial package.

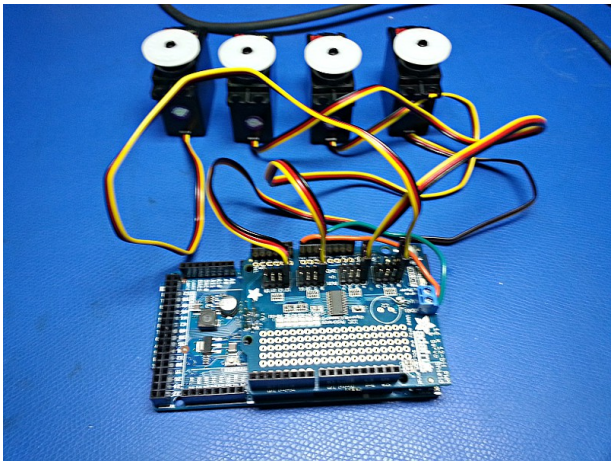

*Figure 1: Assembled Arduino and servo shield, with servos attached for testing.*

For the power distribution board, implementing the driver schematic was fairly simple. Dipta adapted the first draft from our Task 5 submission. And then handed it over to me

for verification. After some initial cleanup and some simplification based on feedback we received from the TAs, the final schematic is now complete (See *Appendix A*). I am currently in the process of developing a full bill of materials and parts list on Digikey, and selecting packages for all the components, so that Dipta can begin the draft board layout.

Songjie and I worked together to flesh out the new inchworm concept for the Chassis. Once he and I validated that the 7 DoF design that was sketched last week should meet our mobility requirements, We decided on a rough scale for the robot. Using a stroke length of 6” for the two prismatic joints as our guide, we estimate that the final design will come in at a roughly 1.5-2' long contracted, and a 2.5-3' at full extension, with a step length of about 6”. Songjie took this information and has assembled a rough solidworks design, which we will iterate on in the coming weeks. Due to the number and size of the parts we are designing for the robot, we have decided to use Laser cutting as our prototyping method, as it will be much faster and cheaper than 3D printing for large components. I have ordered several 1/4” MDF project panels so that we can begin cutting prototypes soon.

An additional challenge to tackle in the new design is the issue of the linear actuators on our prismatic joints. We decided that we need to minimize the number of flexible joints used, as every metal-on-metal joint presents a risk of cold-welding when in the vacuum of space. Thus we have decided not to implement a scissor-lift design for our prismatic joints. Instead, we are looking at an ACME screw (with graphite bearings for the space ready version) driven by a modified servo, or a commercial linear actuator that we can use to implement these joints. This will add cost to our design, but I think the simplified overall design will allow us to implement these links using money that would otherwise have purchased many more servos for the old legged design.

## 3 Challenges / Issues

This week, the majority of the challenges presented were small technical ones. As already stated, the Adafruit servo driver required several modifications to get working with our high-voltage servos. I also had some difficulty tracking down the hobbyist XT-60 connectors used on the 7.4V LiPo battery packs we have retrieved from the MRSD Inventory, but I managed to find some and order them, so we should be able to charge and test our battery pack sometime in the middle of next week.

There was still some miscommunication among our teammates this week about the manufacturing method for our “Gecko” material. I was under the impression that we still needed to retrieve a mold from Professor Sitti, and cast dry-adhesive micro-structures into the V-10 material. However, I learned that the V-10 itself provides the adhesion for us, so we just need to decide on our foot shape, and create a mold profile of the foot structure to begin casting parts, so we should easily start in the next two weeks.

The issue of our linear actuator design is the biggest design challenge we've encountered this week, and has yet to be solved, but it is first on our priority list for the next two weeks, so we should figure it out shortly.

## 4 Efforts By Team Members

As mentioned before, Songjie and I worked together on the Inchworm design, and Dipta and I worked together on the Power distribution board.

In addition to this, Dipta and Songjie cast a test puck out of the V-10 material, and tested it briefly by sticking it to all sorts of objects found around the lab.

This week, Brian was the most autonomous member of our team, and worked hard to redesign the GUI for the new design. This has also helped to inform our understanding about what logging and software modules will be needed long term and helps our design. In addition, Brian did a some good research into the current issues and development status of ROS, and has decided that we will use the older, more stable “Groovy Galapagos” distribution, so we should be able to start implementing the communication and control protocols for the Arduino and Servo controller boards in the next two weeks.

## 5 Future Plans

In the next two weeks, Brian and I hope to get ROS fully up and running, and our drivers for the servos and linear actuators all buttoned up with rosserial and ready to actuate the chassis. Brian will also start implementing an Rviz mockup of robot for the GUI, to help provide visual feedback about the system pose to the operator at all times.

Songjie and I plan to have the majority of the chassis designed, and we shall have begun laser-cutting and assembling components of the body segments. We also plan to have ordered/designed our linear actuators and have them ready to integrate with the Arduino and ROS controller.

Dipta and Songjie will be working to get the molds for the foot built, and begin casting adhesive foot prototypes for load testing.

Dipta and I are working to finish the PDB design, and we hope to have it all completed and submitted to a fabrication house, so that we can begin integrating the full control electronics package with the body in the first half of November.

## Appendix A -
## Final PDB Schematic