Progress Report to the Team

EE 454: Robotics and Professional Practice

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For my senior project in the EE 454 Robotics and Professional Practice course, Christopher Gasper and I are designing an intelligent prosthetic arm. The plan for the design is to have the user come in and calibrate the device using the Fit PC and Kinect in conjunction with the Powerlab. This calibration would act as an insurance policy. If the person were to ever lose a limb, the intelligent prosthetic would be programmed using this calibration and would be immediately ready for use.

Thus far, we have replaced the shoulder and elbow with DC motors in conjunction with drivers, which allow them to be controlled like a servo motor, while also supplying the high torque necessary. We have also set up the Raspberry Pi with a High Precision AD/DA Board and an Adafruit 16-Channel PWM/Servo Hat. The AD/DA board will be used to obtain brain waves from the user. Using FFTs, these waves will be converted to movement intent and the Servo Hat will be used to control the multiple servos and DC motors of the prosthetic. Finally, the Fit PC has been used in conjunction with the Kinect to obtain 3-D locations of the user in space.

Currently, I am working on communications between the Raspberry Pi and the servos and DC motors through the Servo Hat. I have encountered a small problem, which I hope to soon overcome. I was looking for the literature on communication between the Raspberry Pi and the servos and DC motors via the servo hat on Adafruit's website. On their website, they provide a link to the literature, located on GitHub. Unfortunately, GitHub a rearranged their website, so the provided link no longer leads to the literature. I am currently having difficulty finding the new location of the literature, but if I am unable, I will look elsewhere for assistance with the device.

Looking forward, my partner and I have created Tall Pole Analyses of our individual tasks to be completed. For my tasks, once I am able to set up communication between the Raspberry Pi and the motors, I will begin working on smooth motion of the arm. I have labeled

this task red and in order to overcome this I will be reading *Introduction to Robotics* by Saeed B. Niku. My next task will be to communicate between the Raspberry Pi and the Fit PC. I have labeled this task as yellow because although I do not know exactly how I plan on setting up this communication, the steps my partner and I will complete before should provide the necessary knowledge.

While I am working on these tasks, my partner will be working with the Powerlab to obtain EMG and EEG signals with the Powerlab, which he has labeled as a yellow task. This is because he is not familiar with the signals or equipment currently and knows there is research to be done, so the task will take longer to complete. He has already begun this research and is preparing to test the equipment. Once that is done, he will begin simultaneously obtaining data with the Powerlab and the Kinect, saving this data, and analyzing it. He has labeled this task as red because in the analysis of the data, he will have to recognize patterns between the EEG and EMG signals and body movement. These patterns will likely be subtle and difficult to find.

These are the tasks we have done tall pole analysis on thus far, once they are done, we plan to cut the Kinect out so that the arm is being directly controlled by the EEG and EMG signals. Finally, the Raspberry Pi will be programmed to obtain EEG and EMG signals directly. This will be done by using a cascade of operational amplifiers to amplify the EEG and EMG signals. The Raspberry Pi will then perform a series of algorithms to convert the EEG and EMG to motion intent. Using this information, the Raspberry Pi will then send signals to the servos and DC motor drivers on the prosthetic arm, causing it to move in that manner. If you have any further questions on this project or our progress so far, please feel free to contact me at Karissa.barbarevech@scranton.edu or my partner Christopher Gasper at Christopher.gasper@scranton.edu.