Christopher Gasper
EE 454 – Robotics and Profession Practice
Project Closeout – Intelligent Prosthetic Arm
5/11/17

I.) Project:

a. Initial and Final Project Description:

Initial:

The overall goal of this project is to use a person's EEG and EMG signals to control a prosthetic arm and hand. This will allow for amputees to complete basic tasks. In order to accomplish this goal, a database of sampled EEG and EMG signals will be complied. This database will hold the raw data relating to arm and hand movements/gestures. A microcontroller will receive a signal from electrodes placed on the user's body. Once the EEG/EMG signals are received, the microcontroller will process the movement using the defined database. The microcontroller will then allow for the prosthetic to move in the desired motion of the user as smooth as possible. The prosthetic is powered by servo motors so every joint is movable just like a real arm and hand. The client goal of this product is to be as user friendly as possible, this means attach and go.

Final:

Karissa Barbarevech and myself, decided to design and create an intelligent prosthetic arm for our EE 454 senior capstone project. The idea of this device is to help those who have lost an arm and needs a prosthetic. We want to make the learning curve to be as minimal as possible and the performance per user to be extremely well. So in order for the user to use the arm as intended it would need to be calibrated to the specific user. Therefore, the calibration would come about within the user's insurance policy prior to needing a prosthetic. This calibration will use a Microsoft Kinect to detect and record arm movements and gestures. This program will also be used with PowerLab software to capture the user's EEG/EMG signals for moving their arm. This insurance policy will allow for the user to attach the prosthetic and be able to use it immediately if they shall ever need a prosthetic in the future. Therefore, the prosthetic is tailored to each individual and will have no learning curve. In order to complete this project, the Kinect is needed to act as a bridge to obtain a user's brain signals to move the prosthetic using the RaspberryPi. This step is needed to create a database for arm movement based on brain signals. Once the bridge is made between the user's brain signals and the Pi, to move the prosthetic, the Kinect can be eliminated.

b. Initial and Final Expected Project Deliverables:

Initial:

1.) Obtain smooth movement of the prosthetic arm and hand.
2.) Read EEG/EMG signals and find patterns that pertain to movement.

3.) Recognize EEG/EMG signals with a microcontroller.
4.) Use recognized signals to move the prosthetic arm and hand.

Final:
Christopher Gasper:
1.) Get right arm movement detection software running on Kinect.
2.) EMG and EEG signals with PowerLab.
a.) Detect and save signals using fit-PC simultaneously from Kinect and PowerLab.

Karissa Barbarevech:
1.) Get right arm device moving smoothly and coordinates determined for Chris.
2.) Communication between Pi and fit-PC.

c. Project Deliverables Completed:

Mostly all of the deliverables have been achieved. The Kinect detection application is up and running on the fit-PC and outputs the coordinates of the user's right arm position in space. The EEG and EMG signals have been captured with PowerLab. Lastly, the prosthetic arm is moving in a smooth motion for basic gestures.

d. Project Timeline/Reasons for Deviation:

We faced one major deviation which was not achieving communication between the fit-PC and the Pi. This was due to not properly having Visual Studio IDE installed on the lab computers. Therefore we weren't able to achieve this deliverable. Along with this, we didn't receive the in class C# lectures we were supposed to have. Other than this, we followed a very tight and thorough timeline to get where we are.

II.) What was accomplished:

a. Documentation, Notebooks, Presentations and Papers:

All documentations and presentations relating to the project can be found on the web portfolio. Along with this, other papers such as discussions and the professional practice paper can be found on the web portfolio under their designated tabs. The notebook will be collected by Dr. Spalletta at the end of the semester.

b. Project Continuation, why or why not?

Karissa and I both agree that this is an excellent project to continue. This is due to the interfacing of several programming languages such as Python and

C#. The progress we had made has set everything up for completion of the project by the next student(s). The only knowledge they need is the C# programming language.

c. What needs to be done for Completion:

The next steps to complete the project start with obtaining communication between the fit-PC and the Pi. This is done through the SPI serial port on the fit-PC connecting to the SPI port on the Pi. The signal sent from the fit-PC needs to be inverted using a transistor circuit before the Pi receives the signal. This communication is needed so the Kinect application can send the arm position data to the Pi. The Pi can then interpret this data and move the designated servo motors to reach a matching arm position. Once the communication is complete, a database of EEG/EMG signals could be created using PowerLab. This is needed to relate arm position from the Kinect application to the brain signal of the desired movement. Once this is complete, an amplifier circuit is needed to capture the EEG/EMG signals on the Pi. The Pi can then process the signals and relate them to the created database. Lastly, an arm movement library can be made. This library can drive the servos based on the desired arm movement from the brain signal database. This will complete the project.

d. What can be Demonstrated:

Karissa and I can demonstrate the Kinect application detecting arm movement on the fit-PC. Along with this, the PowerLab software can be used to capture EEG/EMG signals. Lastly, smooth movement of the prosthetic can be displayed by using the PWM/Servo shield for the Pi.