NEUROMUSCULAR CONTROL SYSTEMS

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https://myerauedu.sharepoint.com/teams/DB_College_of_Engineering/DB_Mech_Eng/Neuromuscular_Control_Systems/SitePages/Home.aspx

BACKGROUND

The use of electromyography (EMG) signals allows the MYO Armband to understand specific gestures based on muscle contractions such as a wave in and a fist, to name a few. The EMG signals detect the electric potential generated by muscle cells. Couple with IMU and accelerometer data, the sensors housed in the MYO armband work together to identify different gestures and orientations.

The MYO Armband can be used to control a wide variety of devices. For the purpose of this project, a drone will be the device of choice. The drone industry is growing rapidly. However, properly controlling a drone requires significant practice and skill. Many of the influential companies in the industry have been developing gesture control systems, focusing their efforts on image processing. The main issue with image processing is that it requires line of sight. Leveraging the gestural control offered by the MYO armband for unmanned applications can have a wide range of applications, especially military.

MYO AND SOFTWARE DEVELOPMENT

- Neuromuscular information is sent to the Edison, for processing and translation into commands
- The team created a software flowchart that will serve as the “road map” for controlling the drone.
- Programming used included, Command Line Interfacing, C++ and Python
- Information is sent through Wifi to the Solo’s on-board controller.
- These procedures have been successfully tested in trial flights, where the drone has responded correctly to commands output by the user and the Myo.


Figure 1: MYO Armband

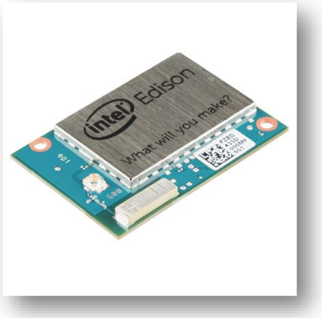

Figure 2: Intel Edison Board

Figure 3: 3DR Solo Drone With Camera Gimbal

DRONE DEVELOPMENT

- 3DR Solo was chosen as the project drone.
- Compatible with the Intel Edison
- Can be controlled by a remote controller, but has been modified to respond to neuromuscular commands from the MYO.

HEART RATE SAFETY MODULE

- For safety purposes, the team has implemented several fail safes to the decrease the chances of an incident.
- 2 pulse sensors will monitor the users heart rate, and will send information to the drone about the well-being of the user.
- If heart rate stops, the drone will revert to autonomous control and land near the user.
- GPS receiver will allow the drone to be within a safe distance of the user.
- All information will be sent as packages through Wi-Fi connection.
- All the sensors will be integrated into a vest that the user will be wearing during operation.

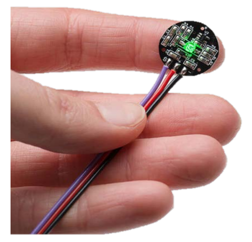
Figure 4: Pulse Sensor used in Safety Module


Figure 5: GPS Sensor for Safety Module


Figure 6: MOLLE vest used for mounting sensors

OBJECTIVE

- To develop a direct connection between the MYO armband and the 3DR Solo drone to accurately manipulate the drone, without the use of a third party application.
- Safety features such as a geo-fence and heart rate sensor will also be incorporated during development.

ABSTRACT

Currently, developers are continuing to discover new and interesting ways to leverage neuromuscular data provided by the Myo Gesture Control Armband. For example, developers have successfully controlled drones with the use of a third party application on a device such as a cell phone or a tablet. The technology for direct connection between the armband and devices such as UAVs has yet to be developed.

The focus of this project is to cut out the middle man (phone, tablet, etc.) and create a small, wearable control module that can be used for directly commanding a small unmanned aerial system. The team foresees possible uses in commercial, military and recreational applications.

This discovery will not be limited to drones, as this research can be employed for a world of electronic devices. This year, the team was successful in connecting and sending information directly from the Myo to the drone computer. The Myo team created the software logic flowchart that will be used for decision making during software development and the drone team researched, compared and finally ordered the drone that the team will use in testing and development.

SOFTWARE FLOWCHART

The flowchart is a visual representation of the decision making logic behind the control code.

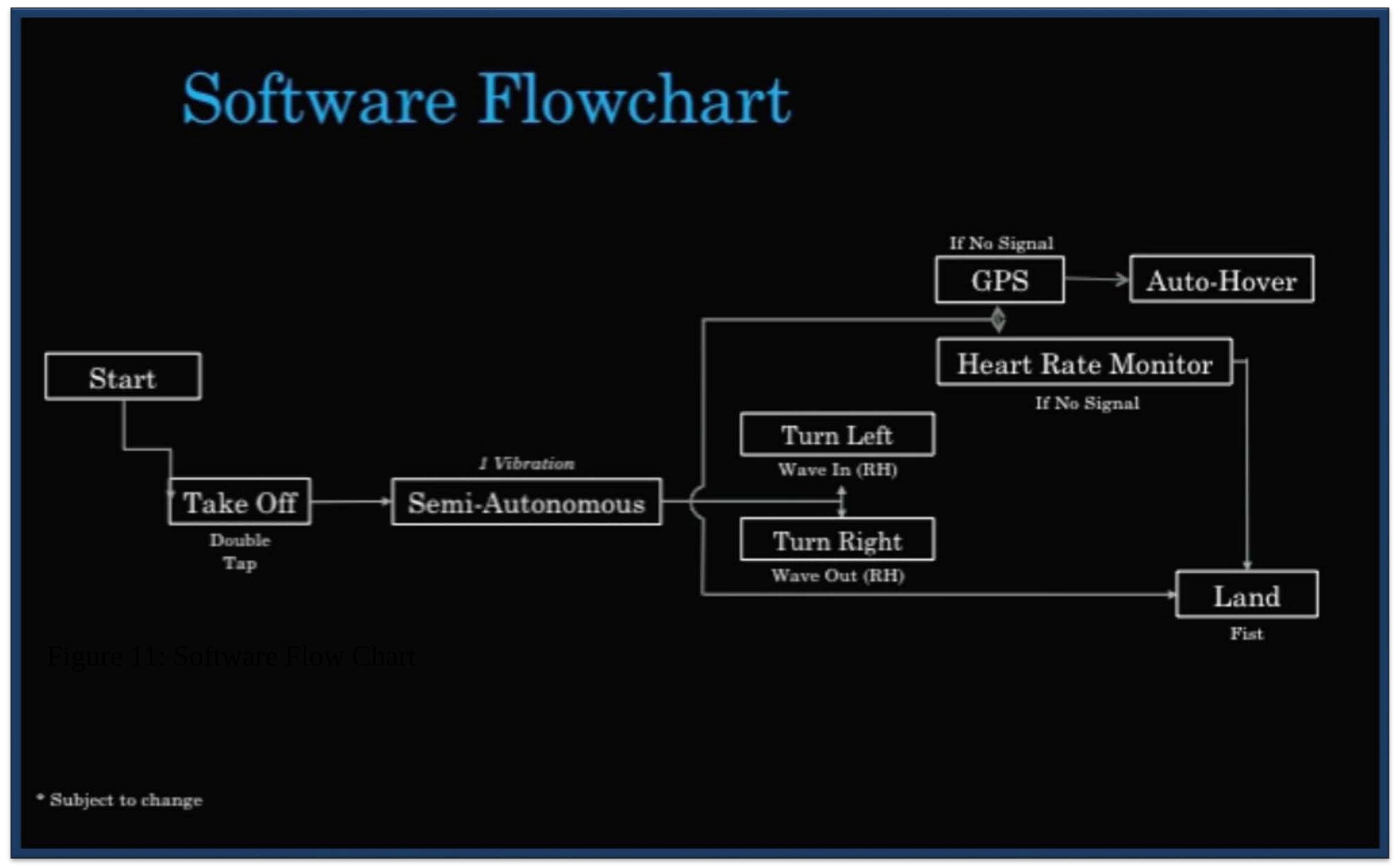

Figure 7: Code Logic

RESULTS

- A direct connection between the MYO and the Intel Edison board was achieved through the use of Python 2.7.
- connection between the drone and the Intel Edison was made to send commands.
- A test flight was conducted and the drone responded to the different gestures that were employed.
- Pulse sensors are able to read a persons beats per minute rate.
- GPS receiver is able to locate the sensor and give real time location data.
- The flowchart below shows the logic behind the code that will be implemented into the Edison.

GESTURE IDENTIFICATION FROM MYO EMG SIGNALS

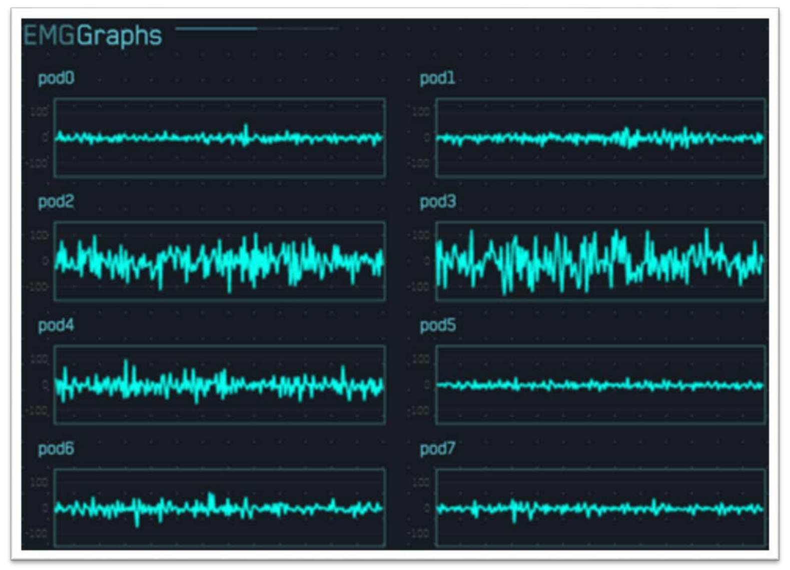

Figure 7: EMG Graphs for Wave Out

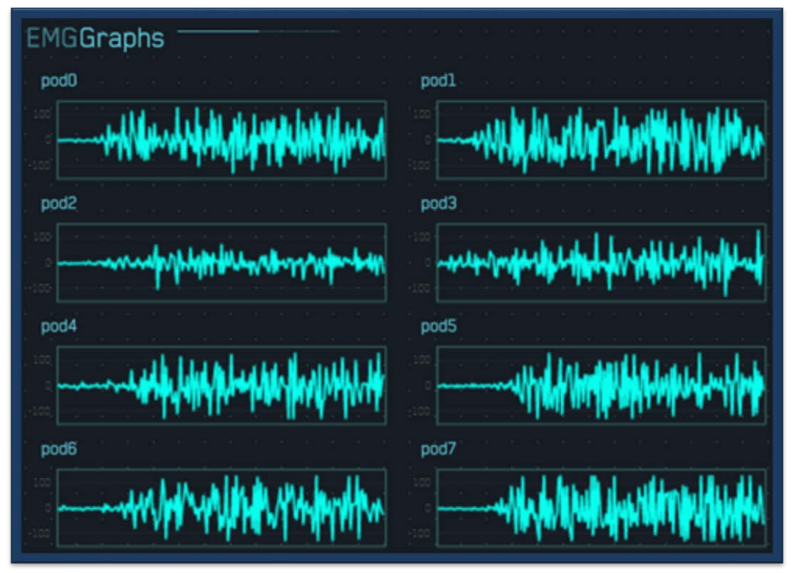

Figure 8: EMG Graphs for Fist

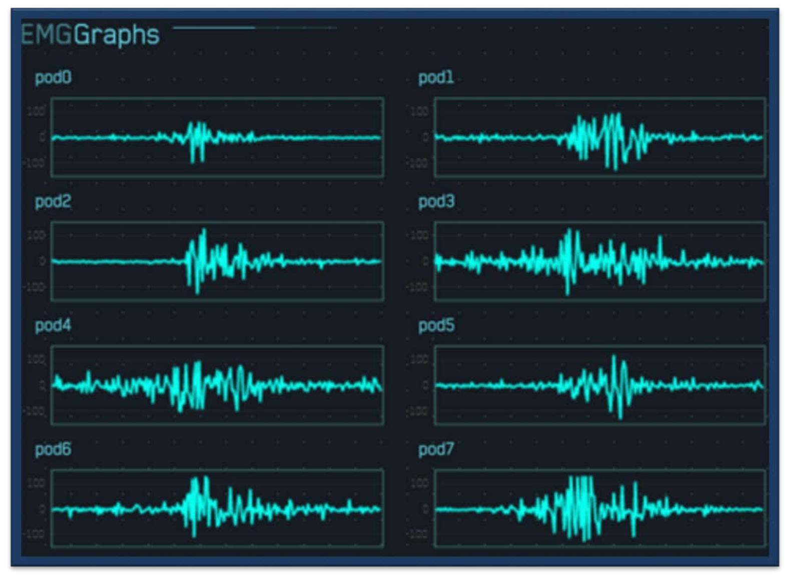

Figure 9: EMG Graphs for Snap

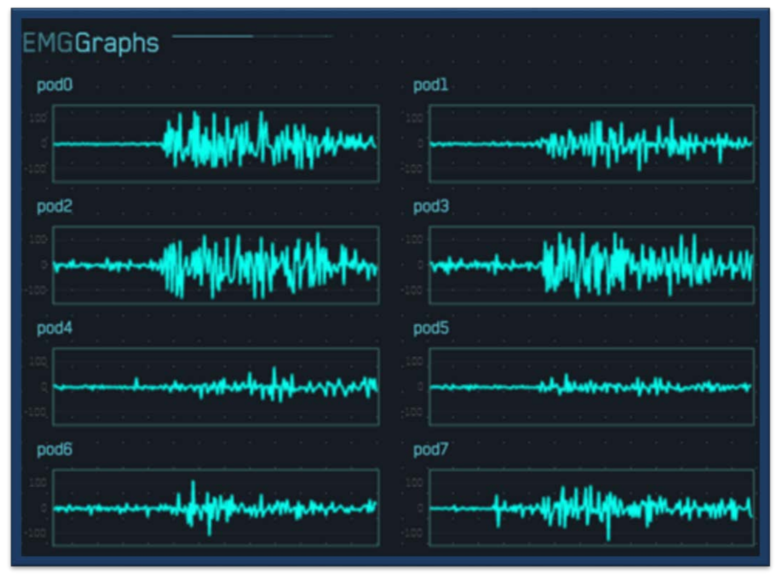

Figure 10: EMG Graphs for Spread Fingers

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