Natural Robot Control Interfaces Using Wearable Bio- Sensors

By Maximilian Salceda

Jet Propulsion Laboratory, California Institute of Technology, 4800 Oak Grove Drive, Pasadena, CA 91109

Methods

The goal of this project is to integrate the JPL BioSleeve into a virtual reality (VR) environment. The BioSleeve is a gesture control interface worn on the forearm, which contains an array of sensors and processing algorithms for pattern recognition. Compression clothing lined with electromyography (EMG) sensors will measure the electrical activity caused by muscle contractions and convert the activity into controls for a desired object. Controls using bioelectric activity will be more intuitive and natural as well as allow the wearer to keep their hands free for other task. Testing was done after alteration to the code were made and a new sleeve prototype was constructed.

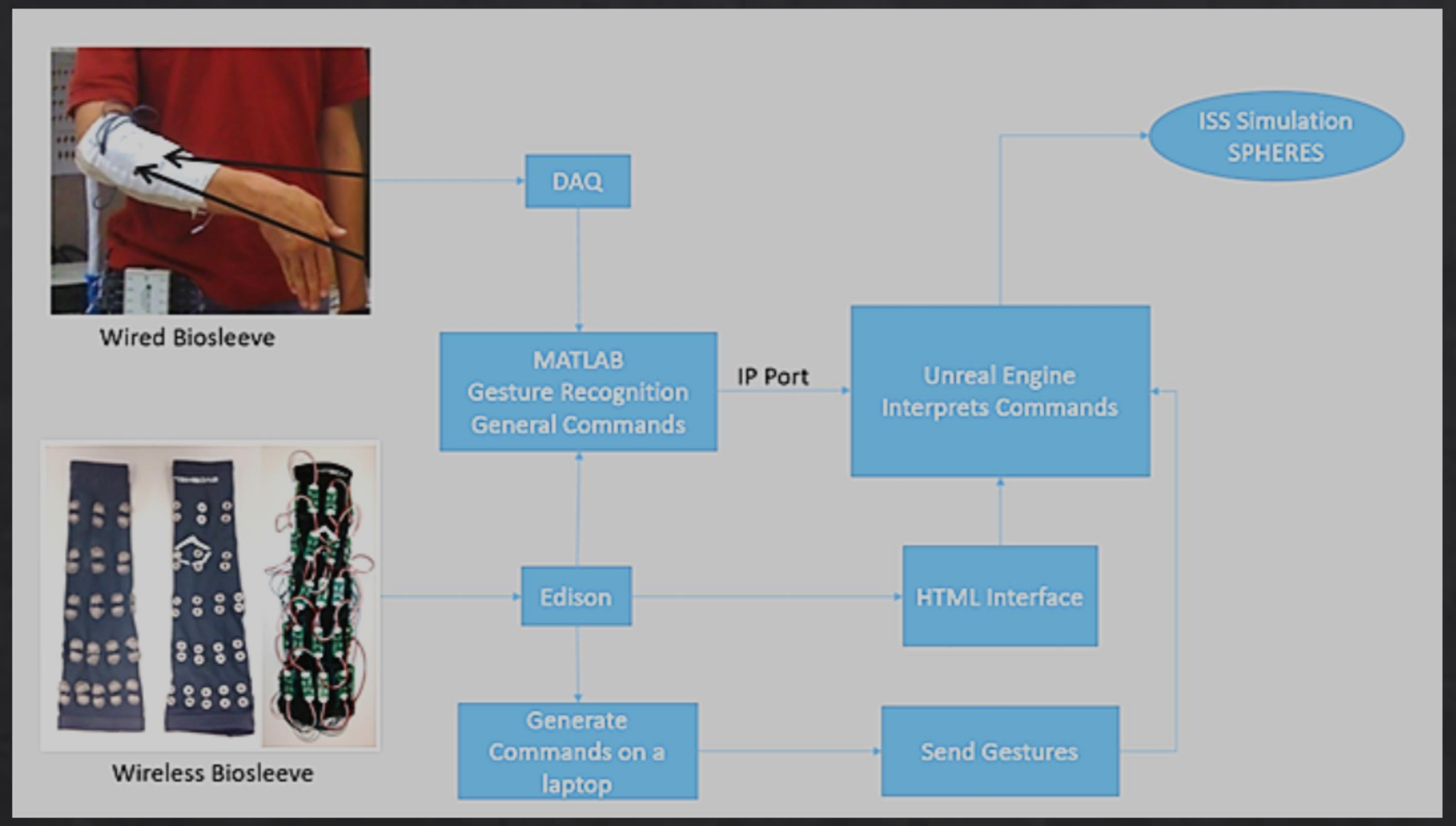

Figure 1. Current communication process

Applications

An area of particular interest is the possibilities for prosthesis enhancement. Placing a BioSleeve on a person forearm could effectively give many hand amputees use of a mechanical hand. Many of the muscles and nerves that are essential to movement in the hand are actually located in the forearms. The muscles that would need to be targeted would be the flexor and extensor digitorum. The sleeve could also perform similar movements for people with different orthopedic needs. The BioSleeve has wide range of capabilities that if pursued could improve how people work or interact with objects around them.

- Astronauts
- Military
- Industrial
- Medical
- Orthopedics

Objective

There were several objectives including
- Reconstructing Biosleeve
- Recreating the International Space Station in the unreal engine
- Altering segments of code to make it compatible with current versions of Matlab
- Combing the components to work in virtual reality

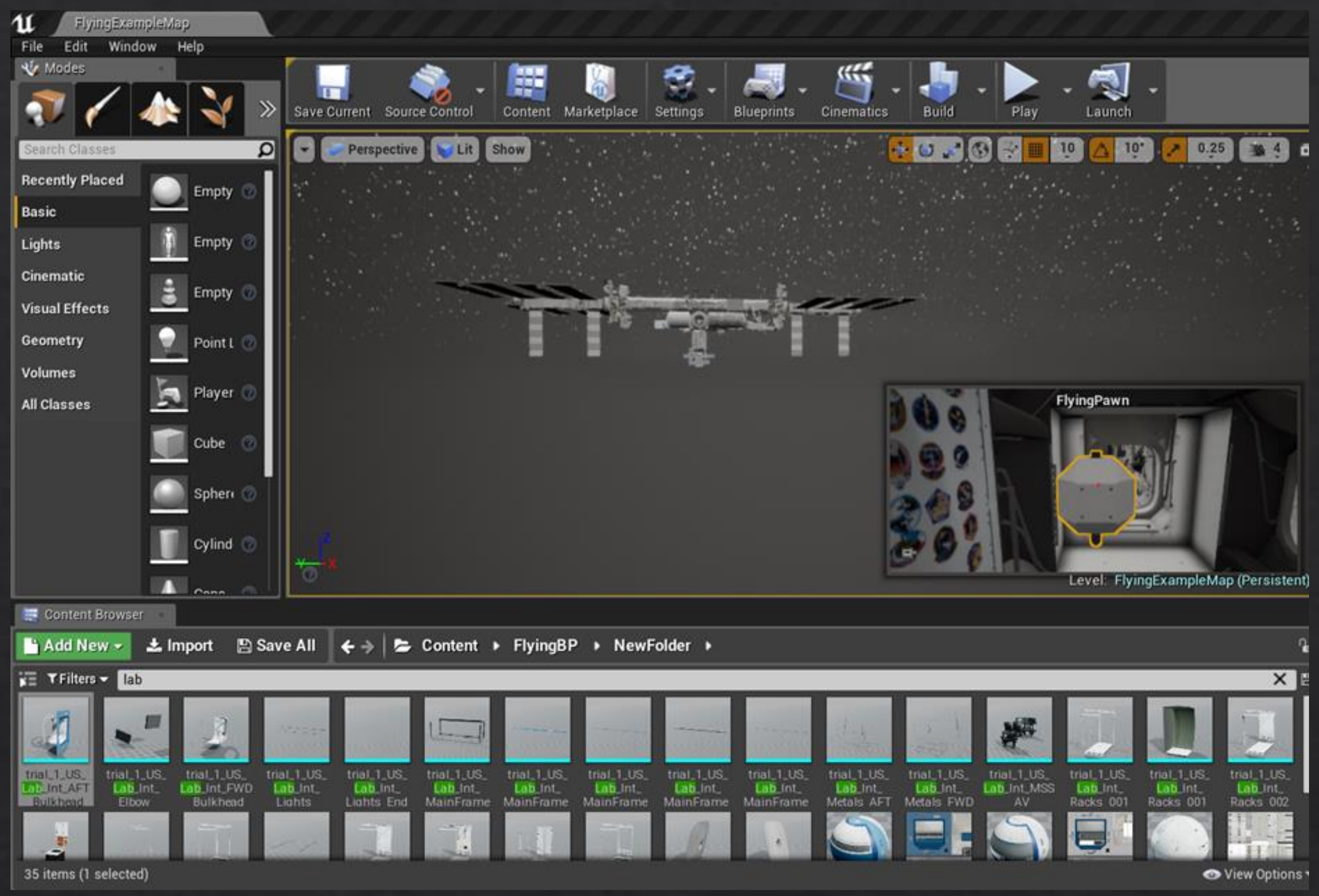

Figure 2. Replica of the International Space Station

Procedure

1. The Biosleeve is placed on the forearm with a concentration of sensors on the anterior and posterior of the arm on top of the flexor and extensor muscles.
2. The Biosleeve is then zipped up and the emg machine is turned on.
3. Each sensors is then checked on the machine to make sure it is making contact with muscle.
4. Sensors placement will be adjusted to improve readings
5. The program will then be started and the subject will perform a series of gestures for a predetermined amount of time
6. The training will be saved
7. The program will then be set to run live allowing the machine learning algorithm to predict the gesture the subject is making
8. The user can then connect to a robot and link commands with movements.
9. This process can be repeated as needed.

Results

The testing of the Biosleeve in the Unreal Engine showed mixed results. The sleeve was able to send appropriate keystroke simulations with the trained gestures. However, the two programs Unreal Engine and Matlab were only able to communicate for a brief period before the commands would no longer register. Parts of the Matlab code were altered to send fewer inputs to the game engine and it did seem to allow the user more control, but the problem with unregistered inputs persisted. Due to the inconsistency in registering keystrokes, it would still be worthwhile to pursue other means of control in the Unreal Engine like a plugin to allow communication between the sleeve and the level directly.

Conclusion

The data from the training classes and testing in the unreal engine representation of the International Space Station show the viability and effectiveness of the technology as well as the need for further development. In the current state it is susceptible to input errors but once the program has been refined to minimize noise on the electromyogram machine it will allow for people to use it in various applications that will make task easier.

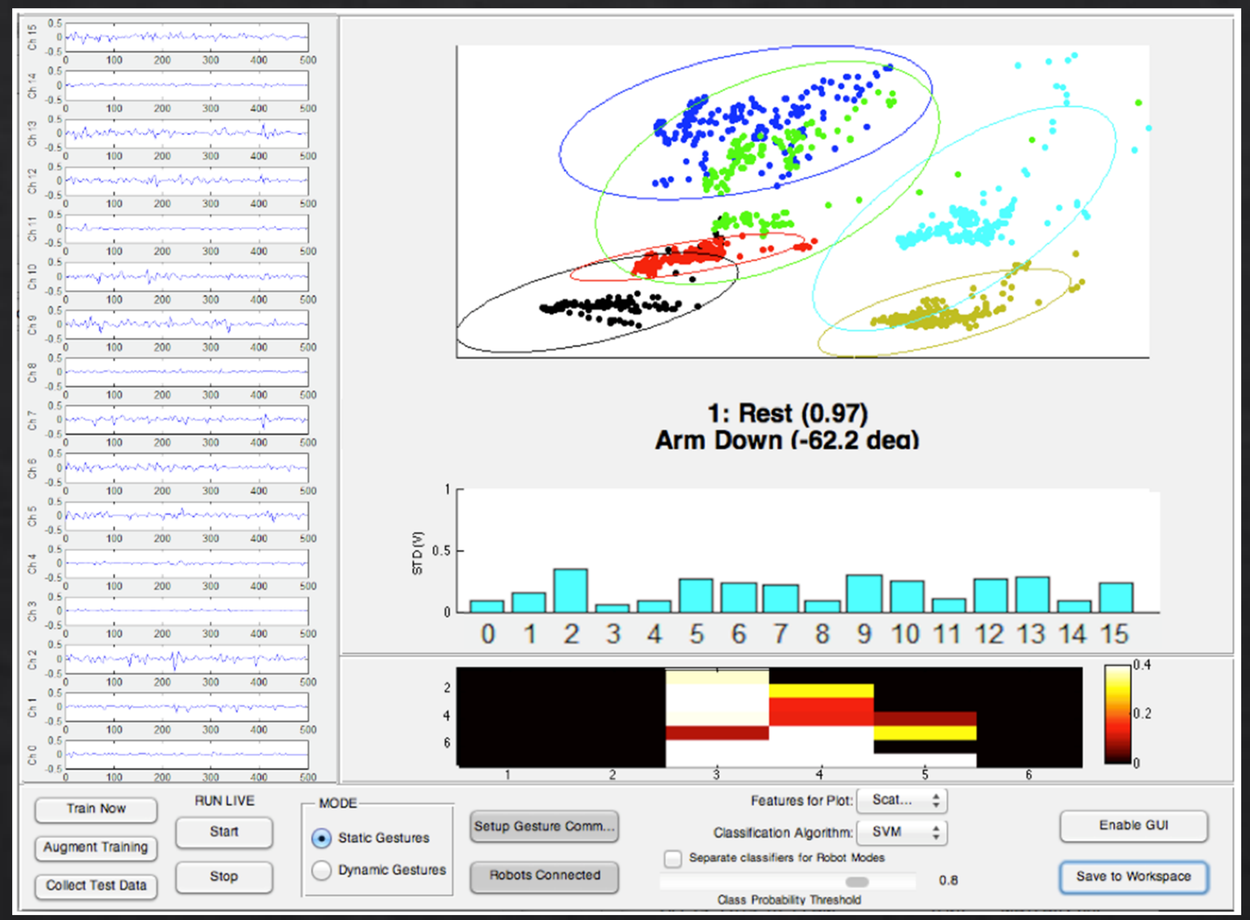

Figure 3. Training Classes.

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