Ossur Gesture Recognition Update

Eodyne Sytems

Developments

Calibration Protocol

The calibration protocol is designed to visualize the signal from all sensors in real-time and consists of three stages. In the first stage. we ensure that the electromyography (EMG) signal has minimal noise and the displacement has approximately 3mm of resting displacement. In the second stage, the subject is asked to extend the wrist to ensure that the sensor on the extensor records high activation, while the sensor on the flexor shows no to little activation. The third stage involves the same process but with the flexor.

Data Collection

To date, we have collected data from seven subjects and developed a gesture classification model to interpret these signals.

Model Training

We have trained an XGBoost model for every subject. The following features are extracted from the EMG signal - MAV (mean absolute value), RMS (root mean square), waveform length, slope of sign change, variance, ZCR (zero crossing rate), and integrated absolute of second and third derivatives. (window size: 200, step size: 50)The FMG sensor values are used as a feature as is.

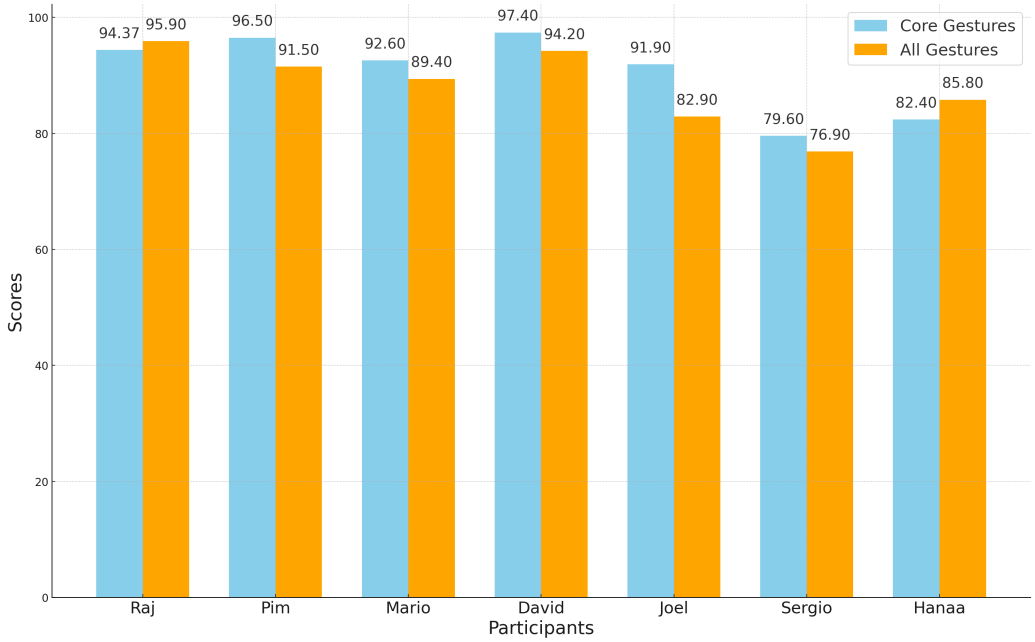


Figure 1: Gesture classification results.

Testing Protocol

We employ two different testing protocols: one that we've been using at Eodyne and another that we've been informed is being used at Ossur. The Eodyne protocol involves three takes, with five iterations per gesture for each, where the model is trained on two takes and tested on the third. The Ossur protocol consists of a single take with 15 seconds of gestures, with the model being trained on 80% of the data and testing on the rest. Both testing protocols follow a k-fold cross-validation approach. Our preliminary results indicate significant differences between the two protocols, with Ossur's protocol tending to inflate accuracy. This suggests that consistency in sensor placement is crucial for the performance of the models.

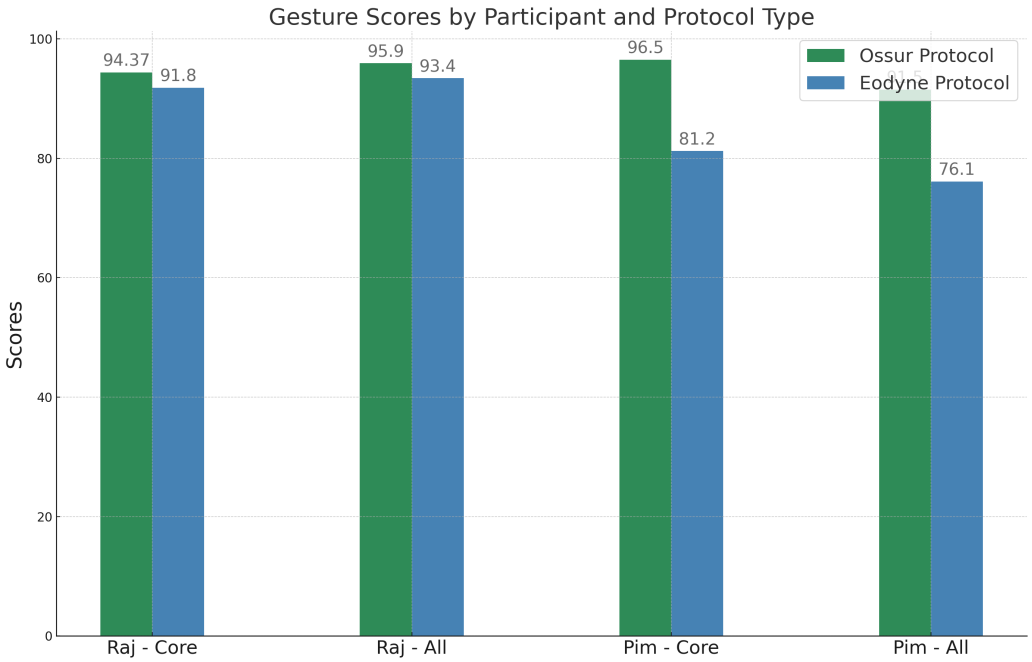


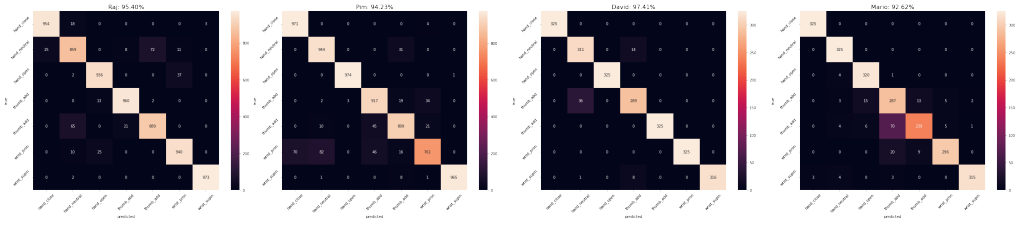
Figure 2: Differences between testing protocols.

Issues

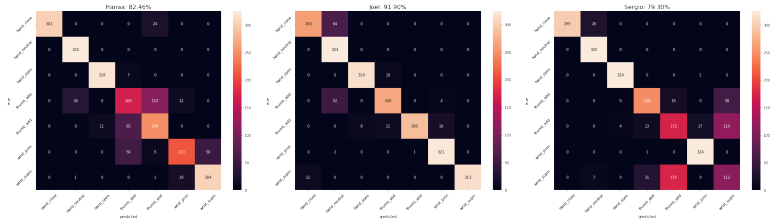
Several challenges have been identified during the initial phases of our study, including:

- Difficulty in detecting muscles for some subjects.
- Some subjects exhibit a noisy resting state.
- Unexpected muscle activations, such as activations in the flexor during wrist extension.

Appendix - Model Performance

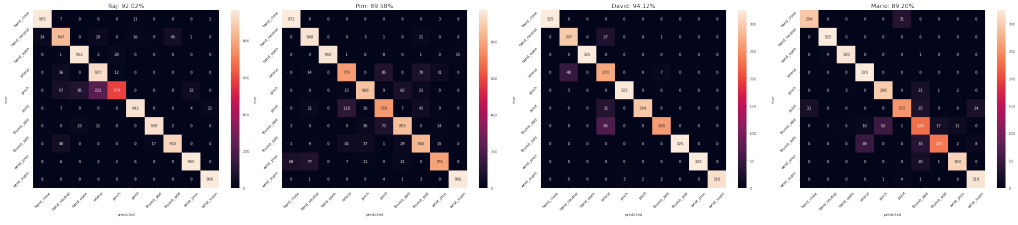


(a) (b) (c) (d)

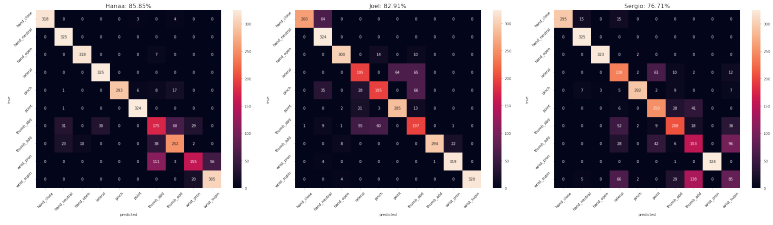


(e) (f) (g)

Figure 3: Model performance for core gestures.



(a) (b) (c) (d)



(e) (f) (g)

Figure 4: Model performance for all gestures.