Predicting Hand Gestures Using EMG Data

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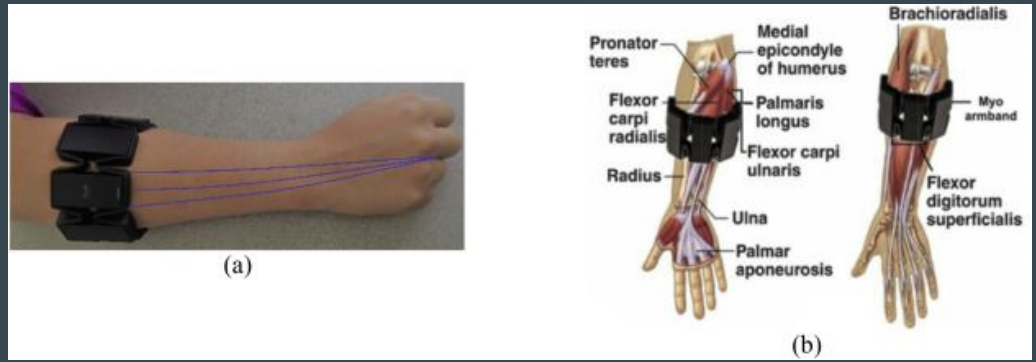
Background & Objectives

EMG: raw voltage reading of muscle activation

- Gesture Control
- Prosthetic Control systems



Objectives:

1. Predict hand gesture with 95% accuracy within one second
2. Determine which model optimally predicts EMG data

Dataset

4 Gestures:

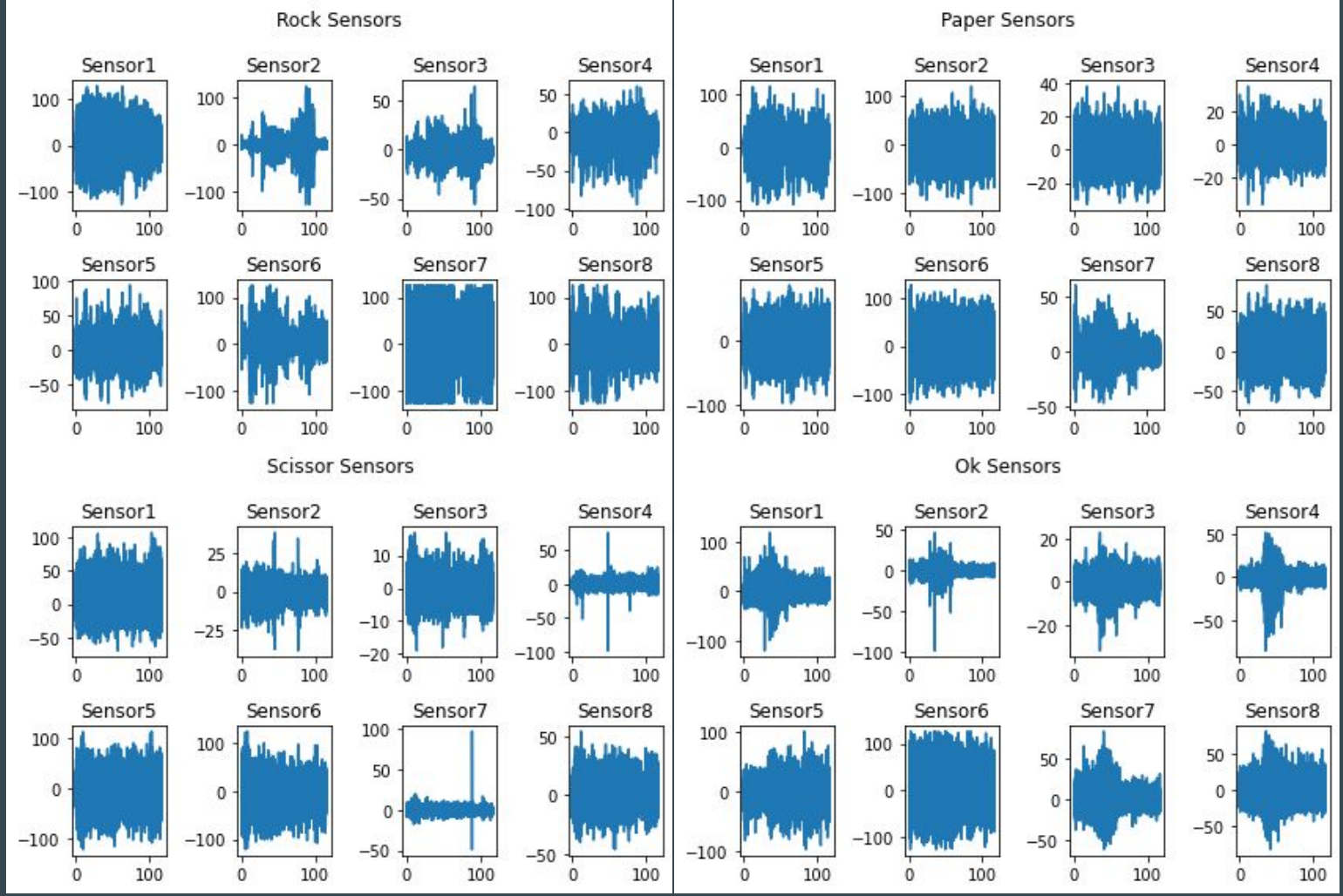
- Rock
- Paper
- Scissors
- OK

8 Sensors

200Hz

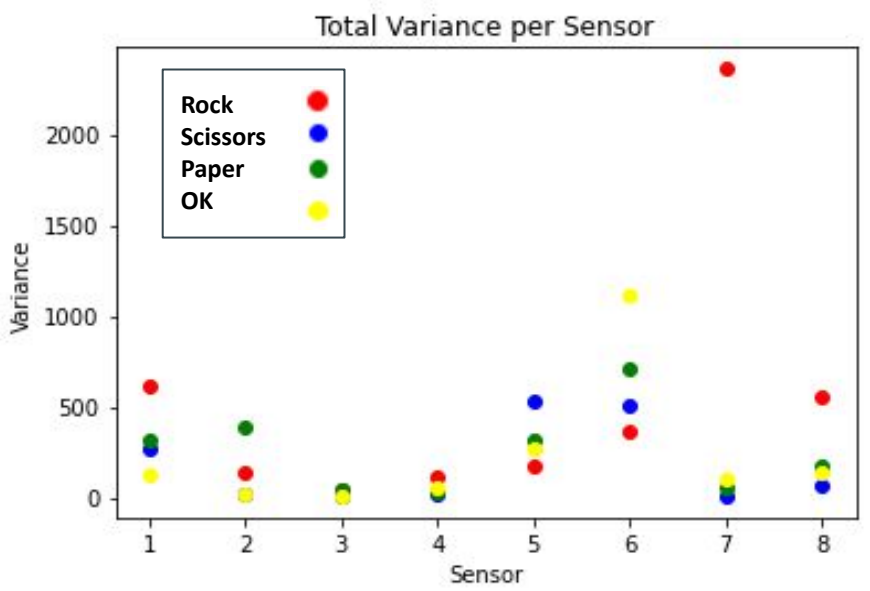
117 seconds per gesture

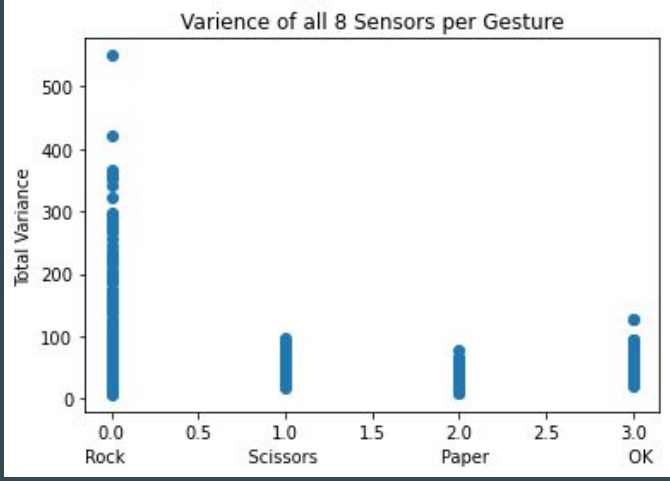
No Electrode location

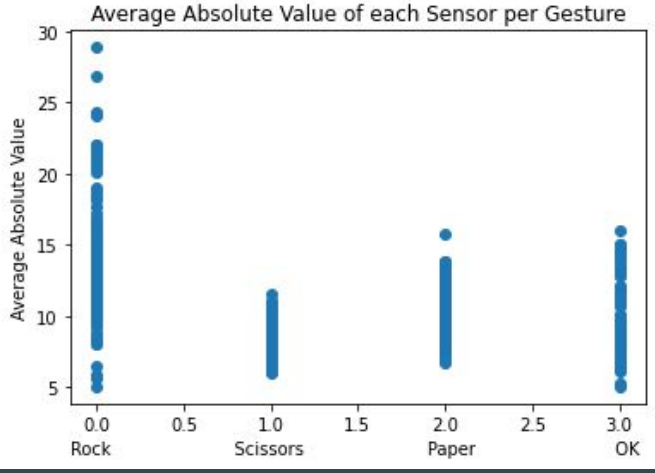


Methods & Key Data Characteristics

1. Reset Data Structure
2. Finding Key Characteristics of the Data
   a. Variance per sensor?
   b. Variance between each sensor?
   c. Average value of each sensor (absolute value)?
   d. Summed average value of each sensor?
3. Window data using the key characteristic
   a. 1.00 second window
   b. 0.50 second window
   c. 0.25 second window
   d. 0.05 second window
   e. 0.005 second window
4. Z-Scale Data
5. Apply Models
   a. MLP
   b. Linear
   c. Naive Bayes Gaussian
   d. Optimized KNN
   e. PCA
6. Confusion Matrix



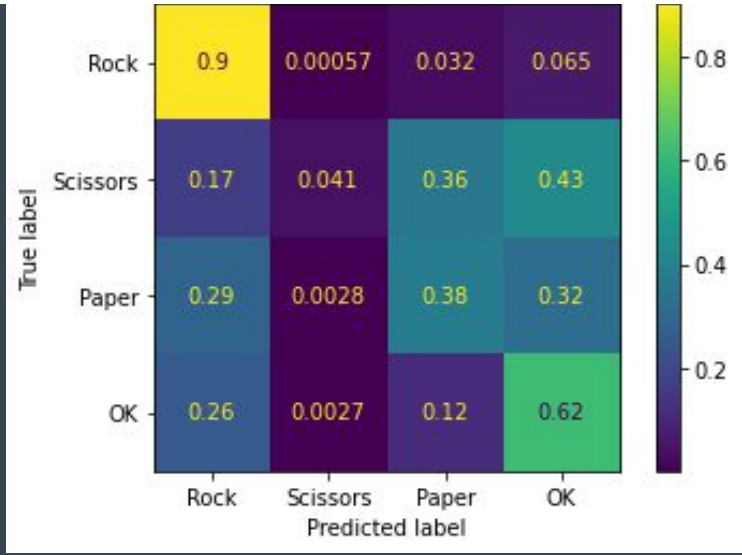




Results

- MLP, Linear, and KNN models showed accuracies above 95% with only 1/20th of a second of data.
- Decreasing to 1 datapoint per key characteristic (0.005 seconds) reduced accuracy by over 20% per model
- MLP consistently slightly better

MLP Model Confusion Matrix with 0.005 seconds



	1.00 Seconds		0.50 Seconds		0.25 Seconds		0.05 Seconds		0.005 Seconds	
Model	Train	Test	Train	Test	Train	Test	Train	Test	Train	Test
MLP	100.0%	99.7%	100.0%	99.8%	99.8%	99.6%	97.9%	98.4%	75.1%	76.2%
Linear	100.0%	100.0%	99.8%	100.0%	99.2%	99.8%	96.9%	97.1%	31.9%	31.7%
Naïve Bayes Gaussian	97.3%	99.3%	97.7%	98.6%	96.9%	97.7%	91.0%	91.5%	-	-
Optimized KNN	100.0%	99.1%	99.6%	99.5%	99.1%	99.5%	96.5%	97.5%	67.7%	73.6%
PCA	97.9%	99.3%	98.5%	98.6%	96.6%	97.3%	91.0%	91.5%	-	-

Discussion

Implications/ Conclusion

- Absolute value of mean per each sensor
- Fast gesture prediction
- Inconclusive potential model
  - MLP marginally better

Future Work

- Identify electrode placement and attempt referencing non-used muscles for active filtering
- Add more gestures
- Conform code for streaming constant data

Opinions

- Data structures can be incredibly difficult
- Work was completed on High-end EMG
- Completed project objectives and more!

Thank you!