sEMG Hand Movement Classification System
# HANDS-EMG

Project Overview

The HANDS-EMG Team, in conjunction with the SDSU Smart Biomedical Systems Laboratory, has developed a portable surface electromyography (sEMG) system designed to classify hand movements using machine learning. The device captures muscle activity signals from the user's forearm and interprets them in real time through a trained TinyML model running on an STM32 microcontroller. The system uses custom signal processing in MATLAB and Python to train the model, which is then converted into TensorFlow Lite for embedded deployment. This tool is battery-powered, non-invasive, and intended to support applications in prosthetics and rehabilitation by enabling accurate and efficient hand movement recognition.

Block Diagram
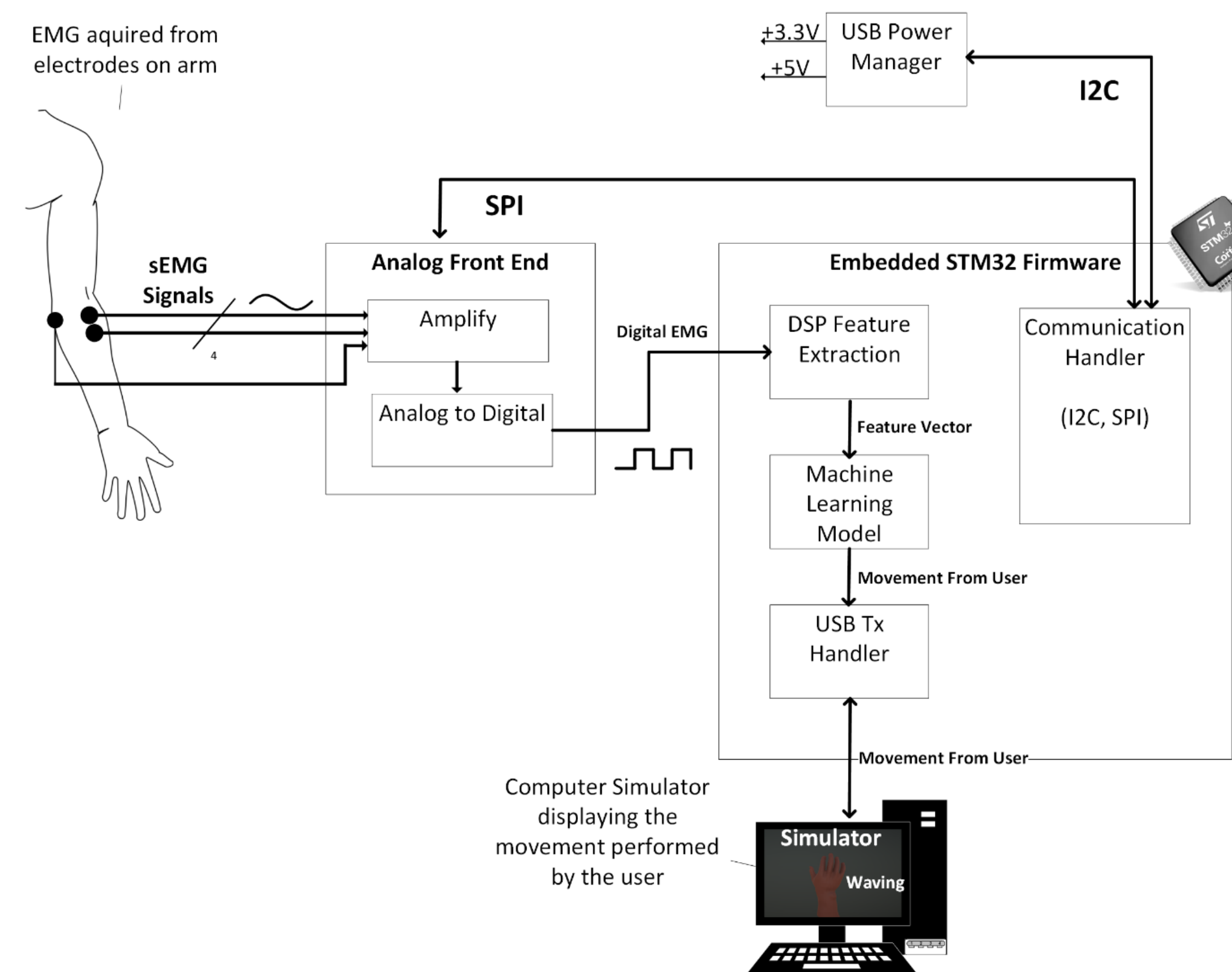
## PCB Design
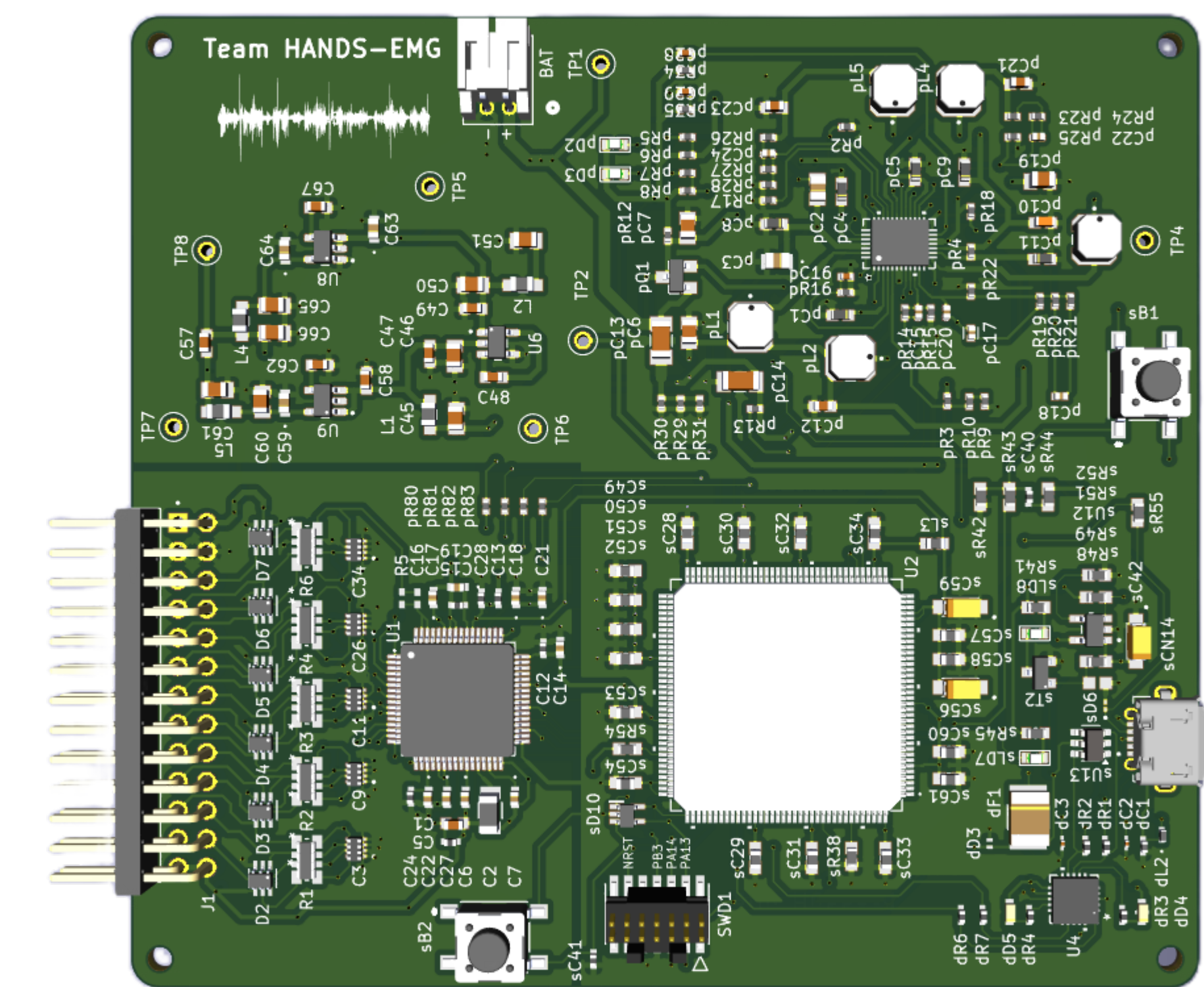
sEMG Biopotential Signals

Challenges:
In the human body, muscles are controlled by weak EMG signals. EMG signals are voltages generated by the muscle fiber electrical activity. Though surface measurements of these signals are less invasive for the patient, they present uniquely difficult issues for signal integrity and noise robustness in measurement. Additionally, human skin presents unique issues in shifting both signal strength, and impedance between signal source and electrode over time.
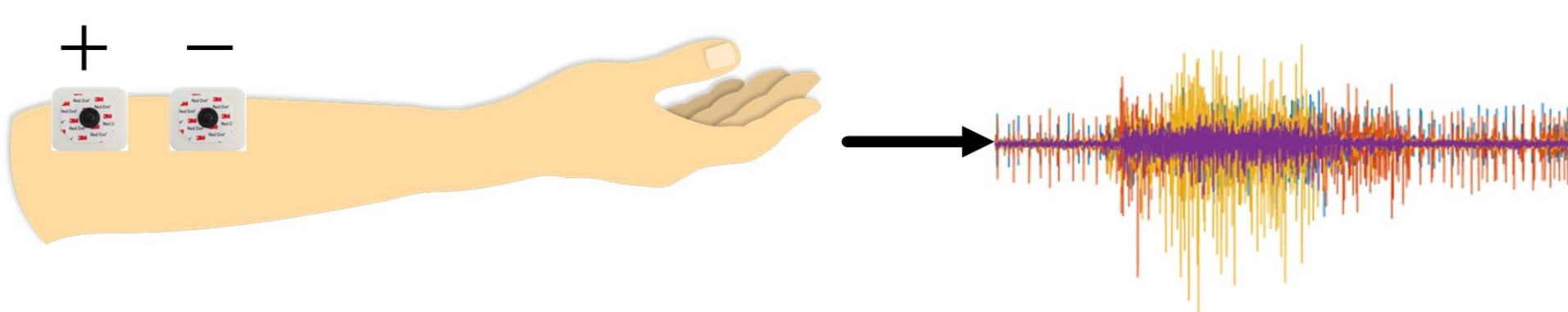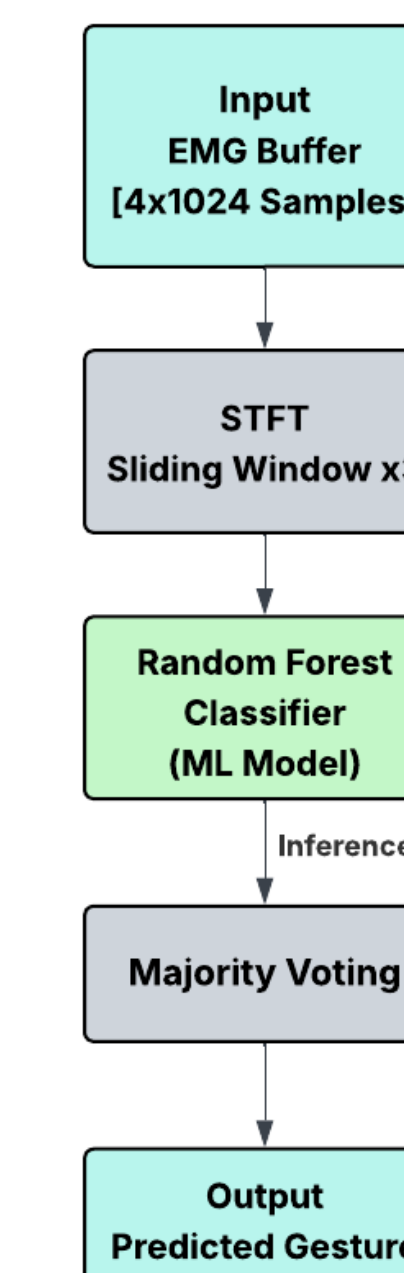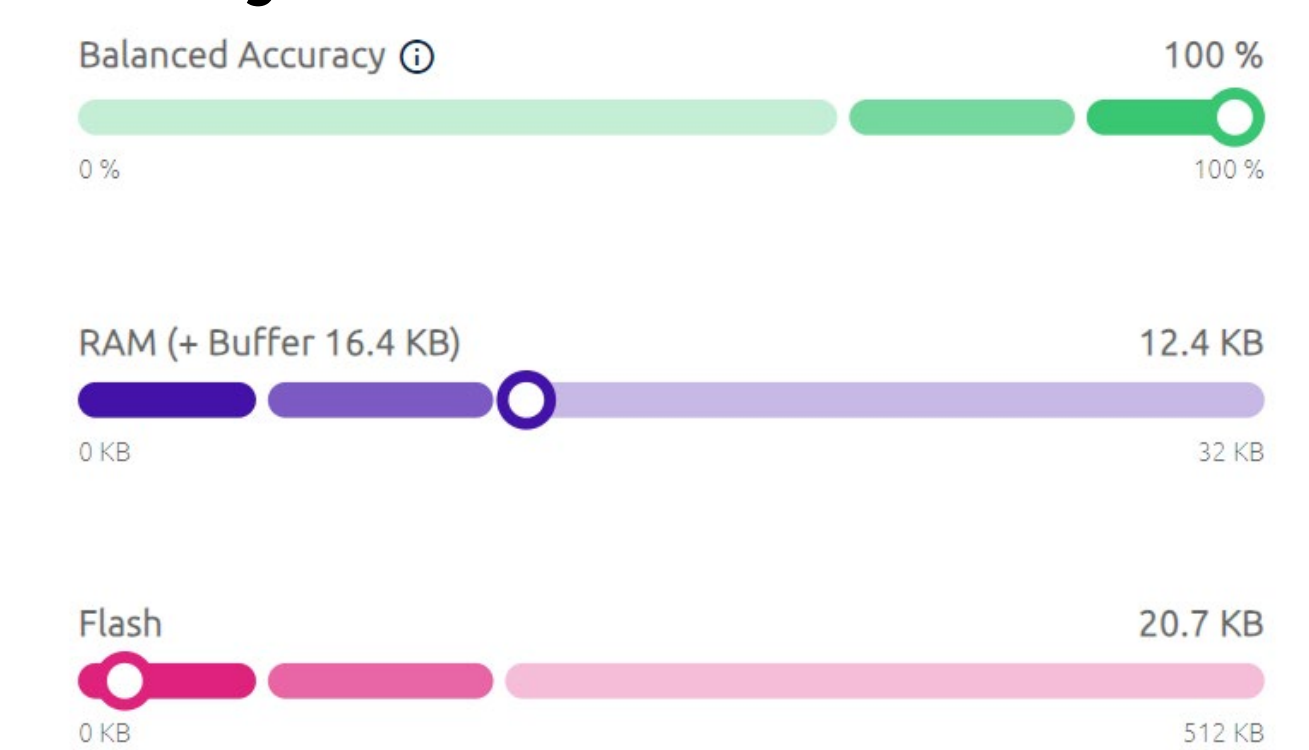

The System In Action
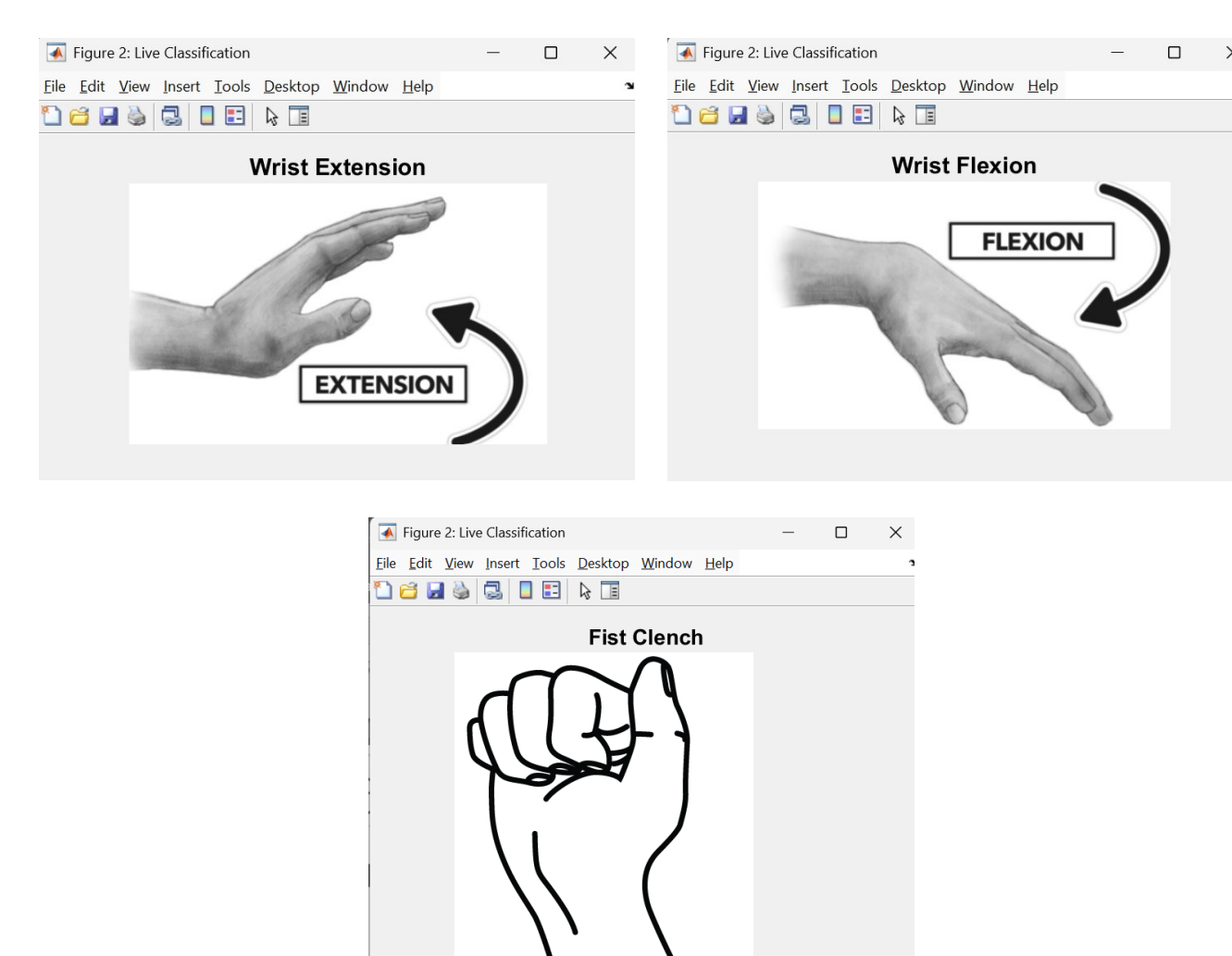
Movements Classified
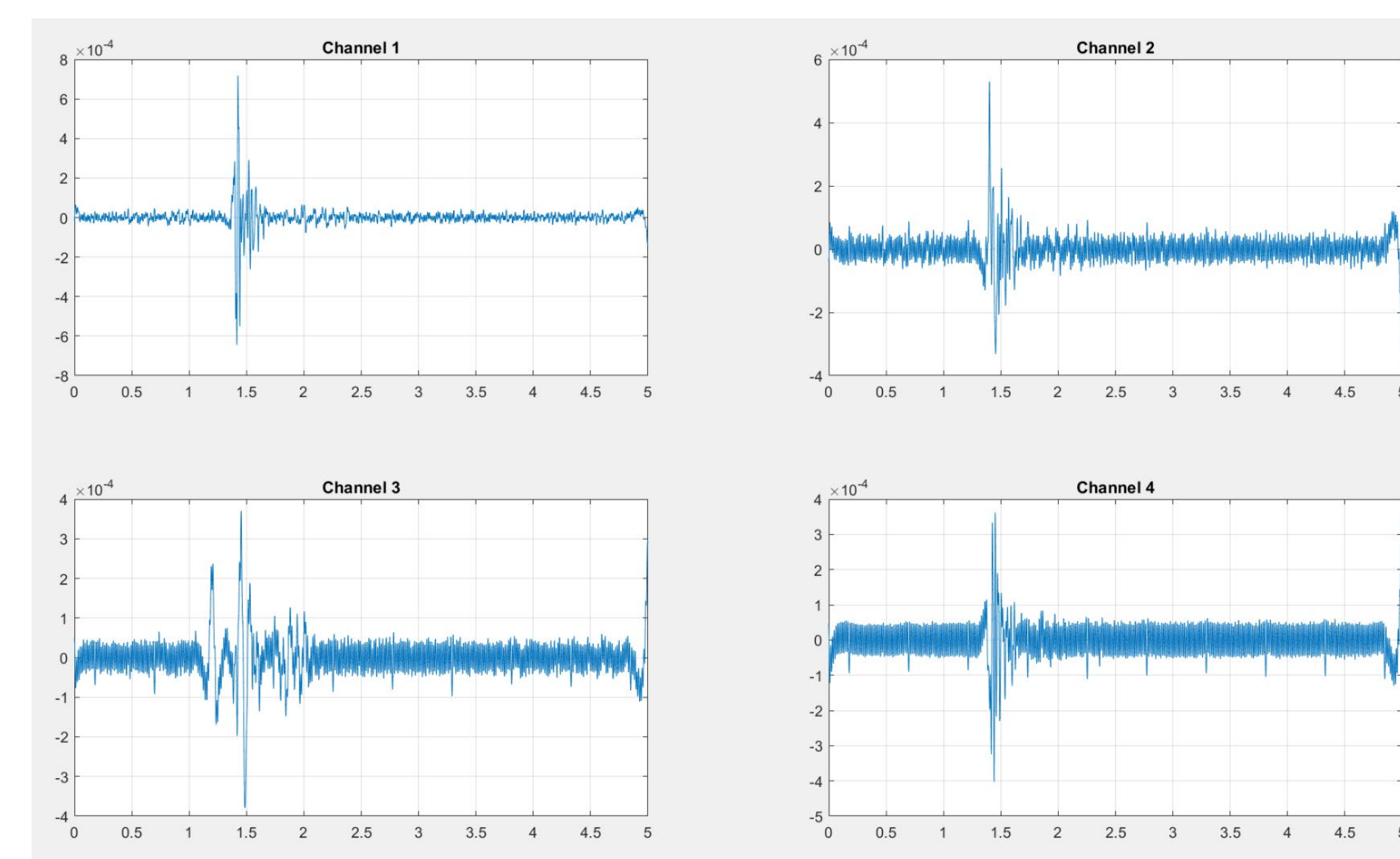
Live sEMG Data from the 4 Channels
(when performing wrist flexion)

Machine Learning Design

TinyML Embedded Statistics

Balanced Accuracy — 100 %

RAM (+ Buffer 16.4 KB) — 12.4 KB

Flash — 20.7 KB

For 3 Gesture Classification

Acknowledgements

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