Lab 2: Gesture Detection

## THE CONVOLUTED

Course Number: ECE-597

**November 8th, 2024**

# Objective

The objective of this lab is to implement a gesture recognition system utilizing TinyML on a microcontroller to demonstrate another application of a machine learning algorithm on an edge device using data collected from on-board sensors. In this case, the accelerometer will be used to sense movement frequencies and signal processing will be performed before a neural network is used to classify gesture types. Custom gesture data will be collected and labeled to train the model to recognize “UpDown”, “LeftRight”, and “PushPull” gestures made by an Arduino Nano BLE 33. Impulse creation, feature extraction and generation, and model design and training in Edge Impulse will be major emphases of this lab. Further, the resultant model will be loaded onto the Arduino using the Arduino IDE and results will be collected to test the overall accuracy of the model.

# Method/Model/Architecture

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# Results

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| **Model Training** |
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| **Live Classification** |
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# Takeaway

In the end, this lab’s resultant model was highly performant, having achieved perfect accuracy during online training and testing while maintaining minimal loss and high on-device performance. Additionally, when testing was performed in the Arduino IDE, 100% accuracy was achieved for both “PushPull” and “UpDown” while “LeftRight” only had one missed result for a resultant accuracy of 95% for that class and an overall accuracy of 98.33% between all classes. Edge Impulse made collecting and categorizing the data easy. Creating an impulse, generating features and calculating feature importance, and building, training, testing, and deploying the model for use in the Arduino IDE was simple on the platform. Two labs in and Edge Impulse has proven a reliable and incredibly simplified platform for implementing machine learning algorithms on edge devices.

Ultimately, this lab emphasized the use of different capabilities of an edge device, in this case the Arduino Nano BLE 33, in implementing machine learning algorithms. Specifically, it provided experience in the use of the accelerometer sensor that provides data to make sense of movement of the device itself. Utilizing neural network models for this purpose simplifies the classification of edge device sensory input (specifically movement, in this case) and enables helpful real-world and industrial use cases. Practicing these sorts of applications will prove increasingly useful as machine learning computation moves from servers to devices.