LAB 3: Object Detection

## THE CONVOLUTED

Course Number: ECE-597

**November 15th, 2024**

# Objective

The objective of this lab is to build an object detection system on an edge device utilizing the 640x480 pixel camera module, OV7675, compatible with the class-provided microcontroller, Arduino Nano BLE 33, that will be used in conjunction with it. Training and test images of pens/pencils and scissors, each comprising the two classes, will be collected and classified using the same camera module before the image data is used to create an impulse, generate features, and train a machine learning model. This is done in the hope of achieving the best accuracy when performing live classification utilizing the same microcontroller and camera module after deploying that model to the device from Edge Impulse using the Arduino IDE.

# Method/Model/Architecture

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| A screenshot of a training settings  Description automatically generated |

# Results

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| A screenshot of a computer  Description automatically generatedA screenshot of a computer  Description automatically generated |

# Takeaway

This lab required the most effort of the three labs to date but was still straightforward to perform following the established protocol. The sheer ease of use that Edge Impulse offers cannot be overstated. It turns what would normally be difficult and tedious tasks into simple ones by eliminating the dependency issues experienced with the first assignment. The most difficult part of this lab was capturing the image data needed using the provided camera module connected to the embedded device. The camera module was surprisingly difficult to work with because of its lack of stabilization and slow resolution and update speed. Even a slight movement would result in a warped or distorted image that would require time to stabilize, or if the movement occurred while the image was being captured, the image was utterly unusable. The best protocol was to hold the camera very still for 2-3 seconds every time an image was captured to make sure it was of decent, usable quality. However, once this procedure was established through trial and error, the remainder of the lab proceeded smoothly.

Once data collection was completed, the Edge Impulse platform simplified the process to perform the transfer learning procedure and achieve impressively, surprisingly high accuracy in both test and live metrics. The best model achieved 93.3% accuracy on detecting pens/pencils and scissors as the two classes being classified and maintained 88% precision, 100% recall, and a 93% F1 score. This is a clear indication of the strength of transfer learning in achieving high performance while maintaining small model size and reducing training times by only retraining a portion of the model. Transfer learning proved to be a flexible solution with many applications for downstream tasks.