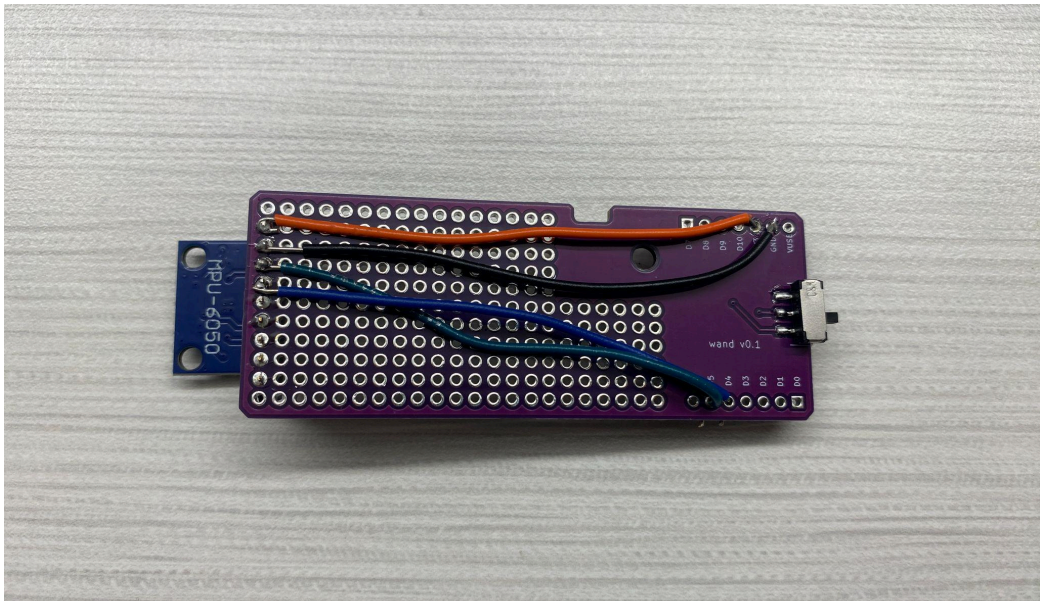
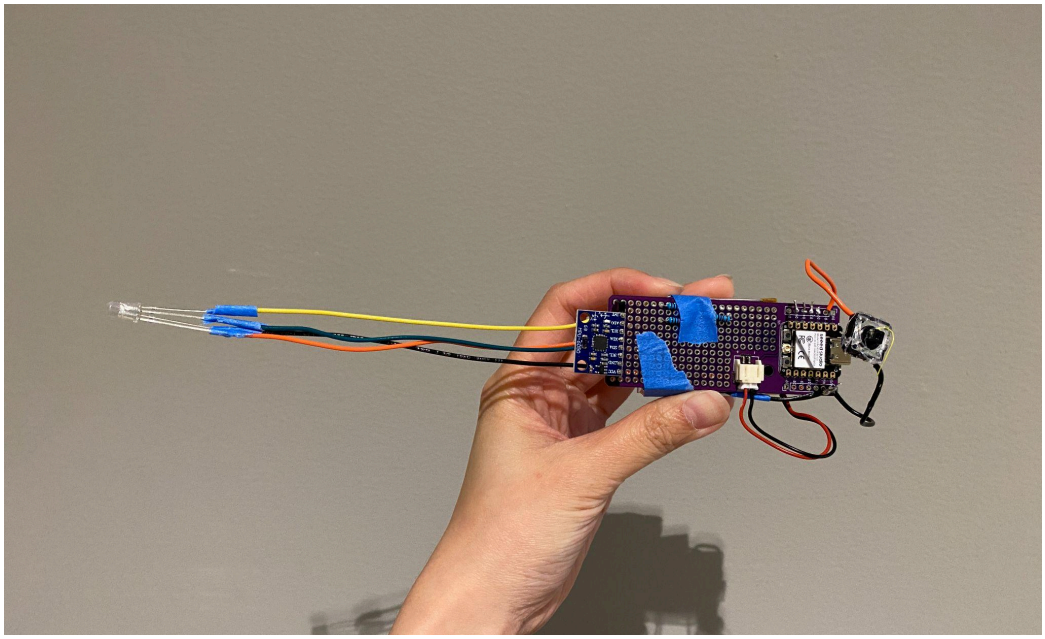
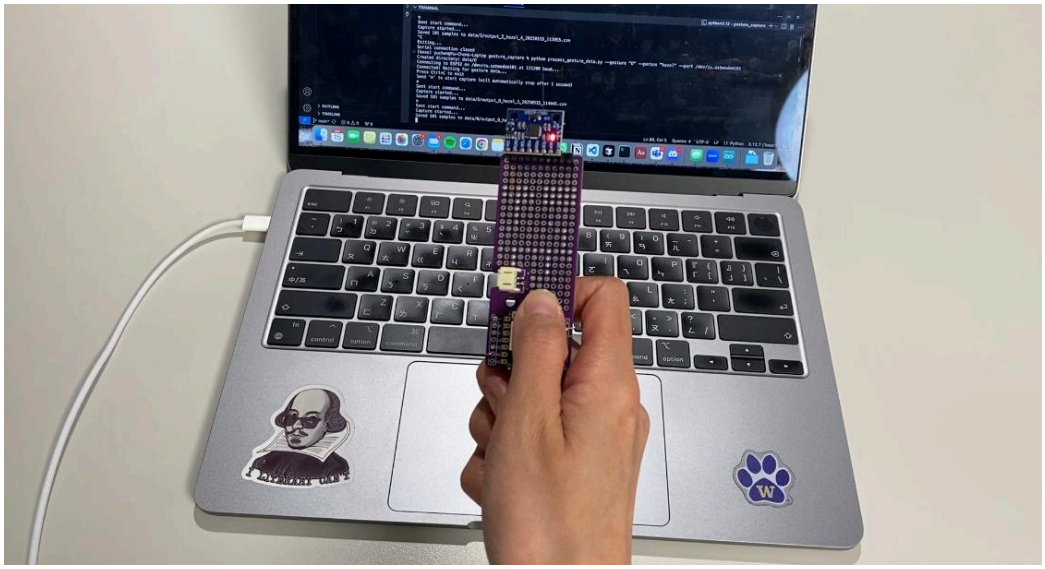
TECHIN515 Lab 4: Magic Wand

Pictures of hardware setup and connections





Data collection process



Edge Impulse model architecture and optimization

- Time Series Data
  - Window size
  - Window increase
- Processing Block
  - Spectral analysis
  - Flatten
- Learning Block
  - Classification model
- Classification
  - Neural network architecture
    - Input layer (60 features)
    - Dense layer (20 neurons)
    - Dense layer (10 neurons)
    - Output layer (3 classes)

Performance analysis and metrics

Window size	Window increase	Number of samples	Number of neurons	Accuracy	Precision	Recall
1000ms	1000ms	142	93	69%	74%	69%
500ms	400ms	284	93	84.2%	84%	84%
200ms	400ms	426	93	68.6%	73%	69%

Demo video link

See media/demo.mp4

Discussions

- Why should you use training data collected by multiple students rather than using your own collected data only? Think about the effectiveness and reliability of your wand.
    - Using training data from multiple students makes the model more reliable, effective, and inclusive. It better represents the real-world usage scenario, ensuring the wand can perform accurately across users.
- Add a processing block. Read through the available options and pick one for your impulse. Justify your option.
    - I chose “Spectral Analysis” because it’s good for analyzing repetitive motion, such as data from accelerometers. And I also added “Flatten” to get average data.
- Add a learning block. Read through the available options and pick one for your impulse. Justify your option.
    - I chose the “Classification” model because my goal is to distinguish between gesture types.
- Discuss the effect of window size.
    - Smaller windows allow more overlapping segments from the same dataset, increasing the total number of training samples, which can lead to better performance.
    - When window increase is less than window size, some data will be missed, resulting in worse performance.

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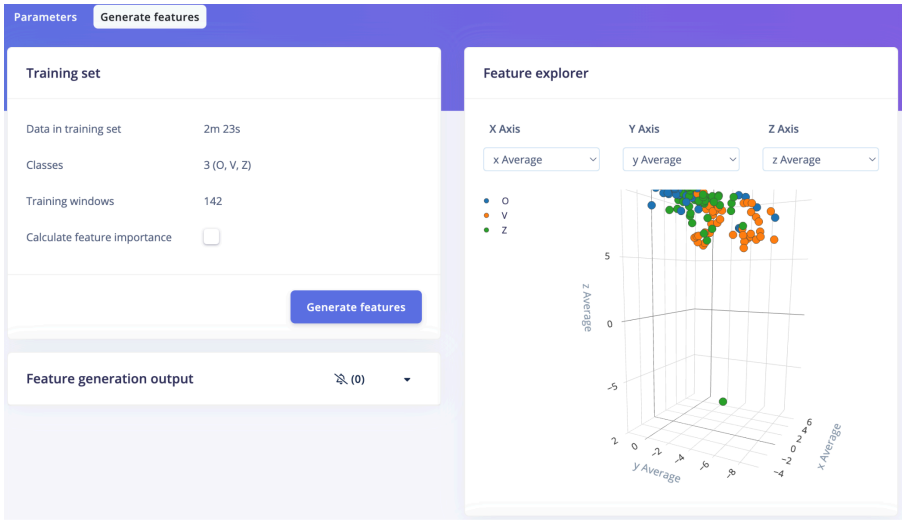
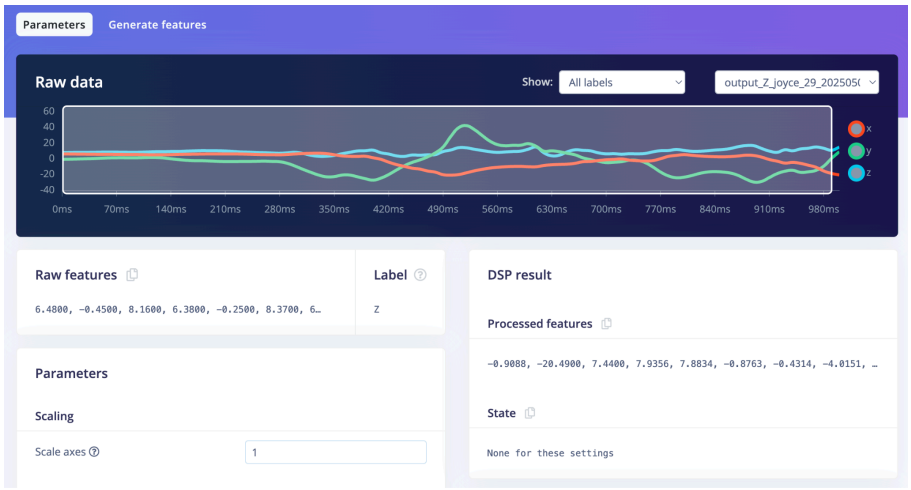
200ms	400ms	426	93	68.6%	73%	69%

- Take a screenshot of your generated features, and sketch a rough decision boundary between classes. Explain why you believe the generated features are good enough.
    - While there is minor overlap between two of the classes, the majority of data points are well-separated. This suggests that the features extracted by the processing block are informative enough for classification.





- Report the learning performance, your choices of hyper-parameters, and architecture. Use "Live classification" and "Model testing" in the sidebar to test your model performance. Please clearly document all metrics being used, e.g., accuracy, TP, FP, F1, etc.

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200ms	400ms	426	93	68.6%	73%	69%

    - Number of training cycles: 30
    - Learning rate: 0.0005
    - Neural network architecture
        - Input layer (60 features)

        - Dense layer (20 neurons)
        - Dense layer (10 neurons)
        - Output layer (3 classes)

- Discussion: Give at least two potential strategies to further enhance your model performance.
    - Tune parameters within the processing block to better capture relevant signal characteristics.
    - Add more training data and collect data under slightly varied conditions to increase robustness.