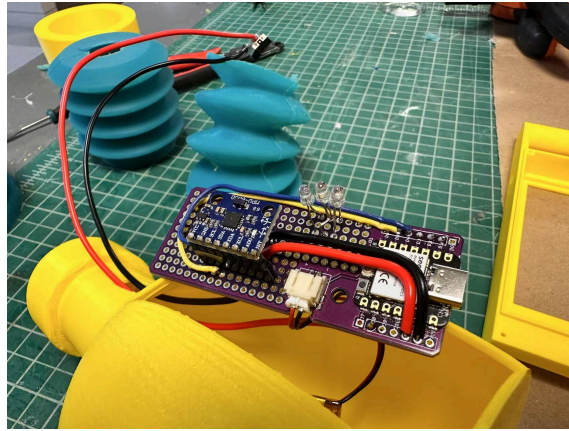
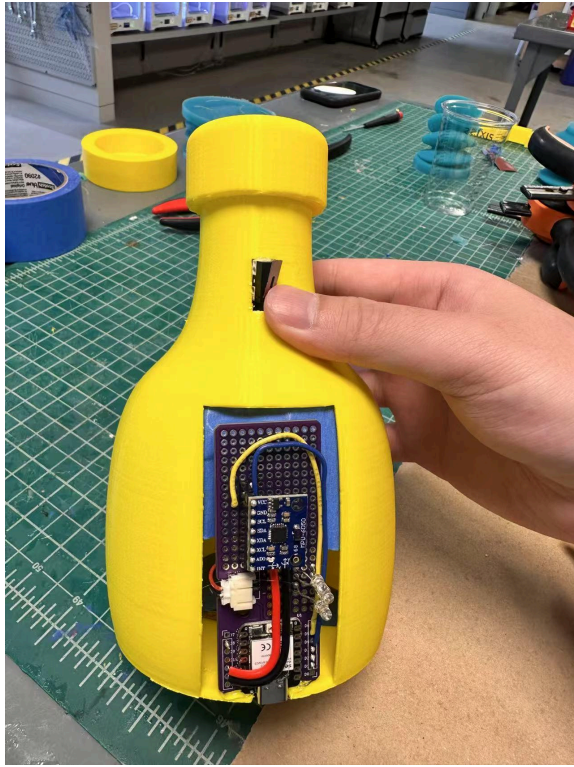


Pictures of hardware setup and connections:



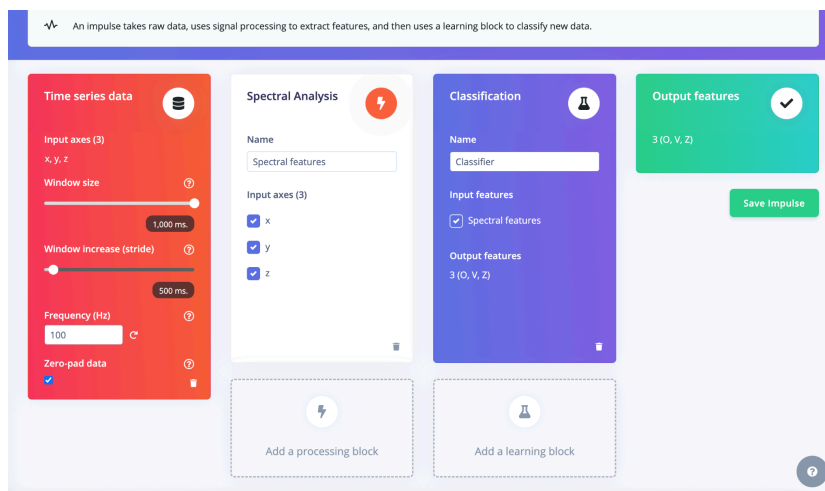
Data collection process and results:

I collect 25 pose each, Labeled them for edge impulse

```
1 timestamp,x,y,z
2 0,-3.11,3.55,7.31
3 10,-3.67,3.6,7.0
4 20,-4.59,3.11,6.5
5 30,-4.95,2.53,5.75
6 40,-5.58,1.87,5.74
7 50,-7.86,1.62,6.19
8 60,-9.41,1.94,5.02
9 70,-13.21,2.04,5.86
10 80,-14.05,2.86,5.87
11 90,-13.66,2.66,8.01
12 100,-13.31,2.55,9.6
13 110,-12.6,2.5,11.16
14 120,-10.29,3.13,13.43
15 130,-7.57,4.22,16.88
16 140,-3.96,5.36,20.17
17 150,1.34,6.42,22.67
18 160,8.01,8.83,23.02
19 170,14.03,9.98,20.75
20 180,17.54,11.15,16.83
21 190,17.4,11.05,13.6
22 200,15.46,9.55,12.85
23 210,13.26,7.55,12.57
24 220,12.61,6.19,11.71
25 230,12.69,4.89,10.12
26 240,12.99,3.72,7.37
27 250,13.19,2.62,4.86
28 260,12.52,1.02,3.75
29 270,11.03,-0.4,2.04
30 280,10.28,-0.86,-1.12
```

Edge Impulse:

Performance analysis and metrics:

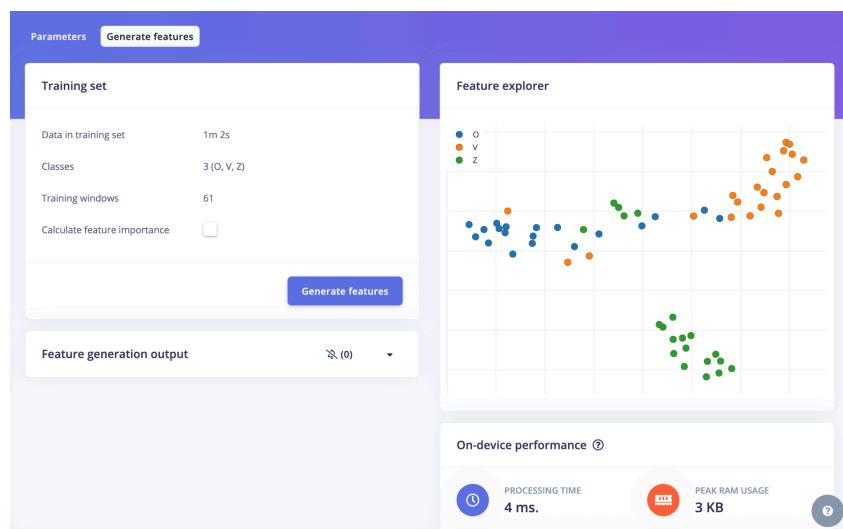
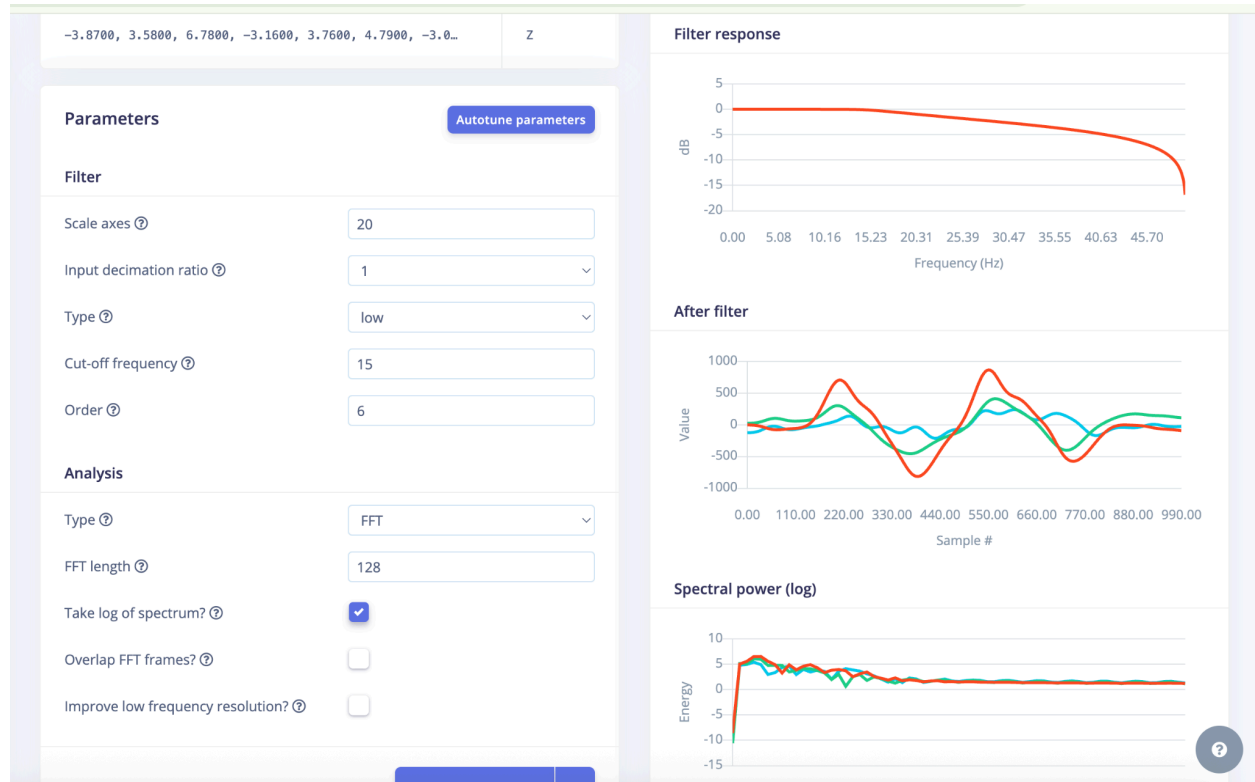


The blocks I choose is Spectral Analysis and classification

The reason to choose spectral analysis is because it's good for motion as mentioned:

Great for analyzing repetitive motion, such as data from accelerometers. Extracts the frequency and power characteristics of a signal over time.

The reason to choose classification is because we are trying to define more than 2 motions not trying to answer a yes and no question which uses regression.



For the DSP Block I made some adjustments for parameters:

1. Scale Axes: since we want to distinguish the different poses, therefore we want to enlarge that difference and I choose 20 than 1 for default

2. For the fft, i choose 128 because the speed of movement is high.
3. For cutoff frequency I choose 15 because the rest of motions are lazy
4. For final training I choose 30 as training cycle and try 15 as well, 30 is a sweet spot

### Neural Network settings

#### Training settings

Number of training cycles ②

Use learned optimizer ② ☐

Learning rate ②

Training processor ②

#### Advanced training settings

#### Neural network architecture

Input layer (72 features)

Dense layer (20 neurons)

Dense layer (10 neurons)

Add an extra layer

Output layer (3 classes)

### Training output

Model version: ②

#### Last training performance (validation set)

ACCURACY  
69.2%

LOSS  
2.98

#### Confusion matrix (validation set)

	O	V	Z
O	66.7%	33.3%	0%
V	16.7%	83.3%	0%
Z	25%	25%	50%
F1 SCORE	0.57	0.77	0.67

#### Metrics (validation set)

METRIC	VALUE
Area under ROC Curve ②	0.89
Weighted average Precision ②	0.75
Weighted average Recall ②	0.69
Weighted average F1 score ②	0.69

#### Data explorer (full training set) ②

### EDGE IMPULSE

- Dashboard
- Devices
- Data acquisition
- Experiments
- EON Tuner
- Impulse design
  - Create impulse
  - Spectral features
  - Classifier
- Retrain model
- Live classification

#### Upgrade Plan

Get access to higher job limits and more collaborators.

[View plans](#)

☑ This lists all test data. You can manage this data through [Data acquisition](#).

### Test data

Set the 'expected outcome' for each sample to the desired outcome to automatically score the impulse.

SAMPLE NAME	EXPECTED OUT...	LENG...	ACCURACY	RESULT
output_Z_T...	Z	1s	100%	1 Z
output_Z_T...	Z	1s	100%	1 Z
output_Z_T...	Z	1s	100%	1 Z
output_Z_T...	Z	1s	100%	1 Z
output_V_T...	V	1s	100%	1 V
output_V_T...	V	1s	100%	1 V
output_V_T...	V	1s	100%	1 V
output_V_T...	V	1s	100%	1 V

### Model testing output

Model version: ②

#### Results

ACCURACY  
92.86%


#### Metrics for Classifier

METRIC	VALUE
Area under ROC Curve ②	1.00
Weighted average Precision ②	0.94
Weighted average Recall ②	0.93
Weighted average F1 score ②	0.93

#### Confusion matrix

	O	V	Z	UNCERTAIN
O	75%	25%	0%	0%
V	0%	100%	0%	0%
Z	0%	0%	100%	0%
F1 SCORE	0.86	0.92	1.00	

Link Video Link:

 Magic Wand

Challenges faced and solutions:

1. Soldering: Since the board provided does not function like a breadboard, therefore we have to figure out how to use one wire to power multiple subjects such as ground and vcc. The solution is to get the GND into an open place and then solder different wires on that open space.
2. Model Training parameter adjustment, at first I'm not sure about how each parameter represent in edge impulse, after research and try, i figure out the relationship, increase the accuracy from 30% to 90%
3. Enclosure: it's hard to consider everything beforehand and I have different iterations on enclosure.

Performance analysis and metrics:

Questions:

1. Discussion: 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.

Because you need variety of motions and increase the robustness

2. Discussion: Discuss the effect of window size. Consider

- the number of samples generated
- the number of neurons in your input layer of neural network
- effectiveness when capturing slow-changing patterns

We need larger window size since the motion changes very fast

3. Discussion: Give at least two potential strategies to further enhance your model performance.

1. Train more data, right now there's 25 each
2. Try distinguishing between motions and also use different models to train large differences motion and small movements