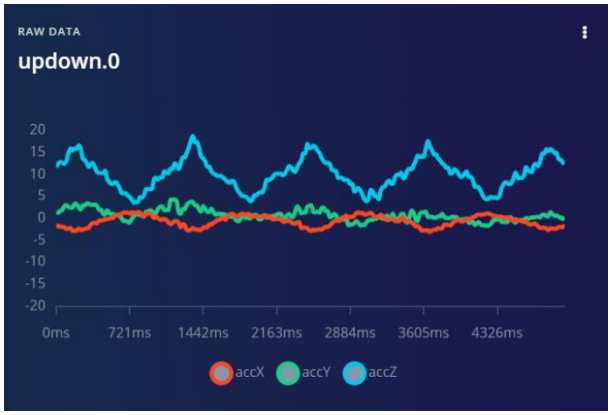
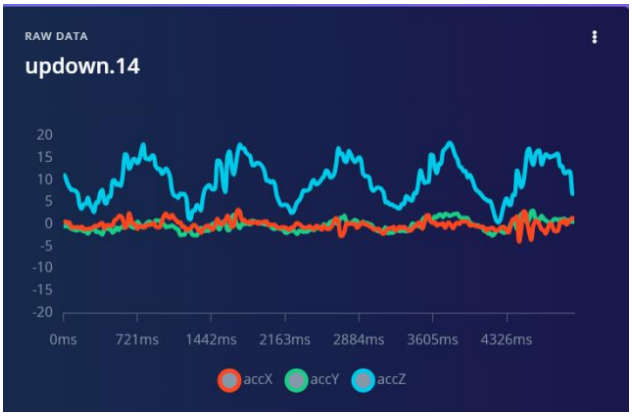
Index No: **SKF2400091**

Assignment 3: Motion detection using Edge Impulse

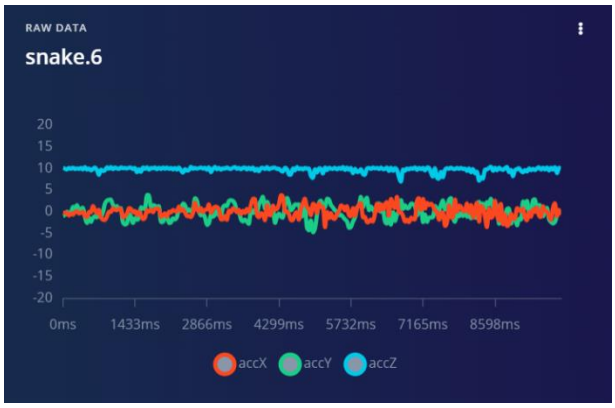
Task 1: Dataset

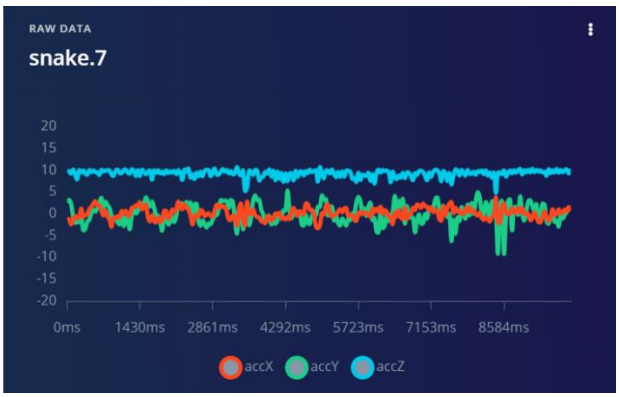
Briefly explain the reason for the shape of the waveforms of the 2 movements updown and snake





Updown movement typically involves moving the device vertically, either upwards and downwards. As a result, the accelerometer primarily detects significant changes in the Z-axis (which is aligned with the vertical direction). The waveform for the Z-axis (accZ) will show a periodic pattern corresponding to the upward and downward motion. The X and Y axes might show minor variations depending on the stability of the hand or slight tilts during the movement. The most significant changes will be observed in the accZ data, as this axis aligns with the vertical motion.

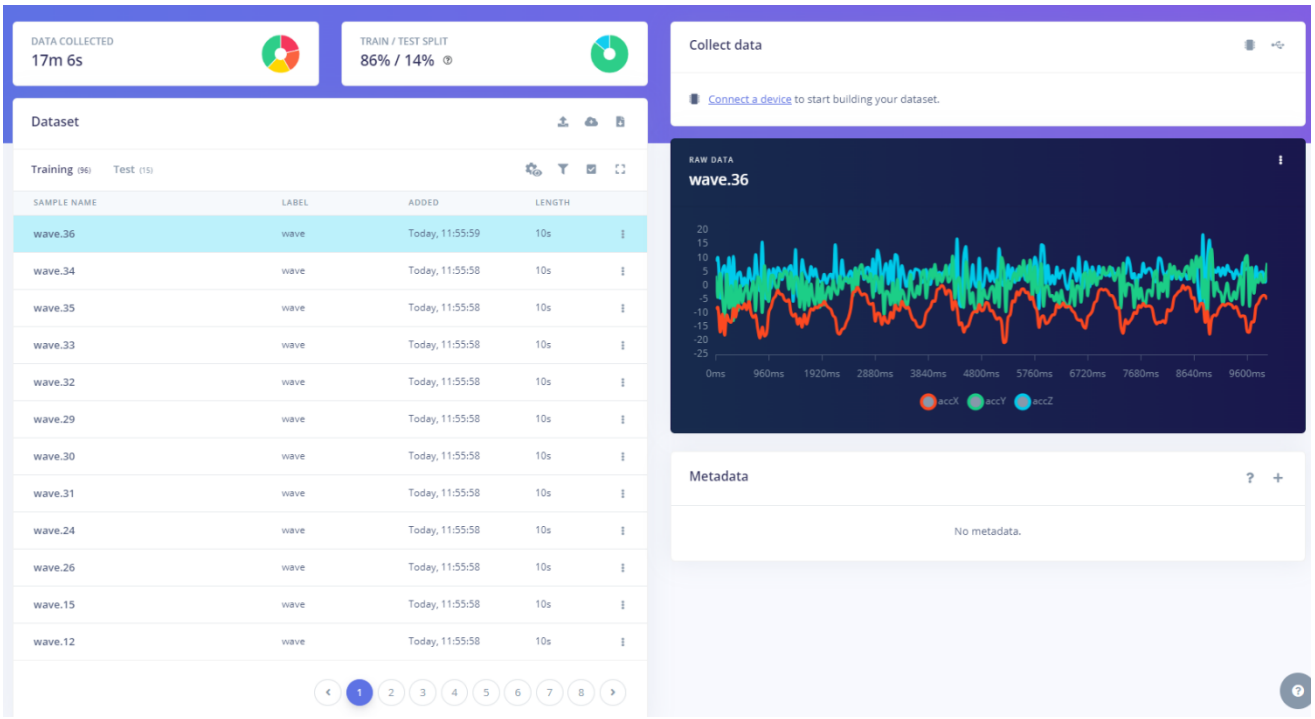




The "snake" movement involves moving the device in a serpentine or side-to-side manner on a flat surface. This movement primarily affects the X and Y axes as the device is dragged across the surface. The Z-axis (accZ) remains relatively constant as there is no significant

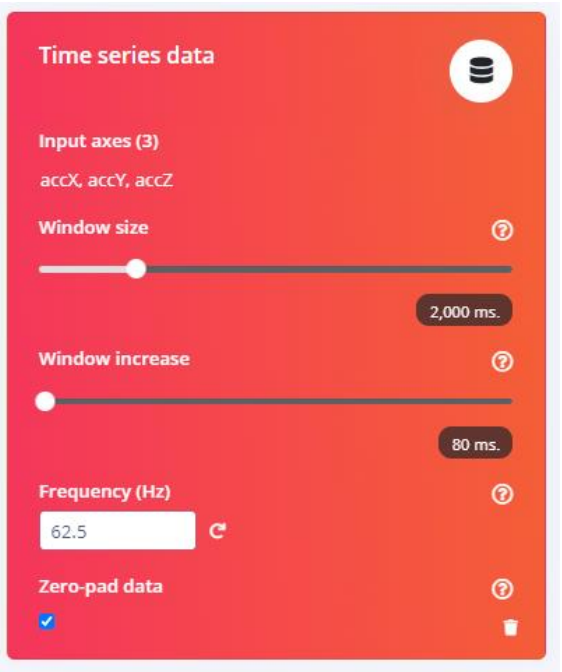
vertical motion involved. The most significant variations will be in the accX and accY data, representing the horizontal motions, while the Z-axis shows minimal variation.

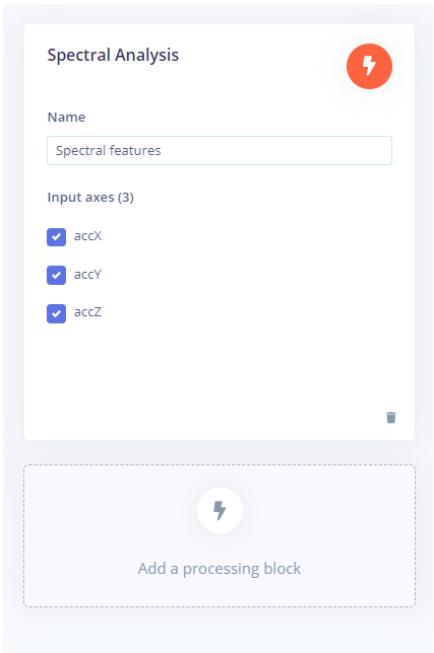
Include a screenshot to show that the dataset is properly loaded to the project.

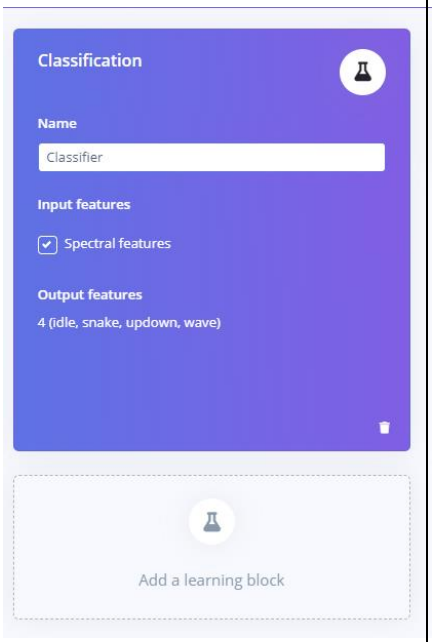


Have Uploaded the provided training and testing data separately with appropriate labeles.

Task 2: Creating an Impulse

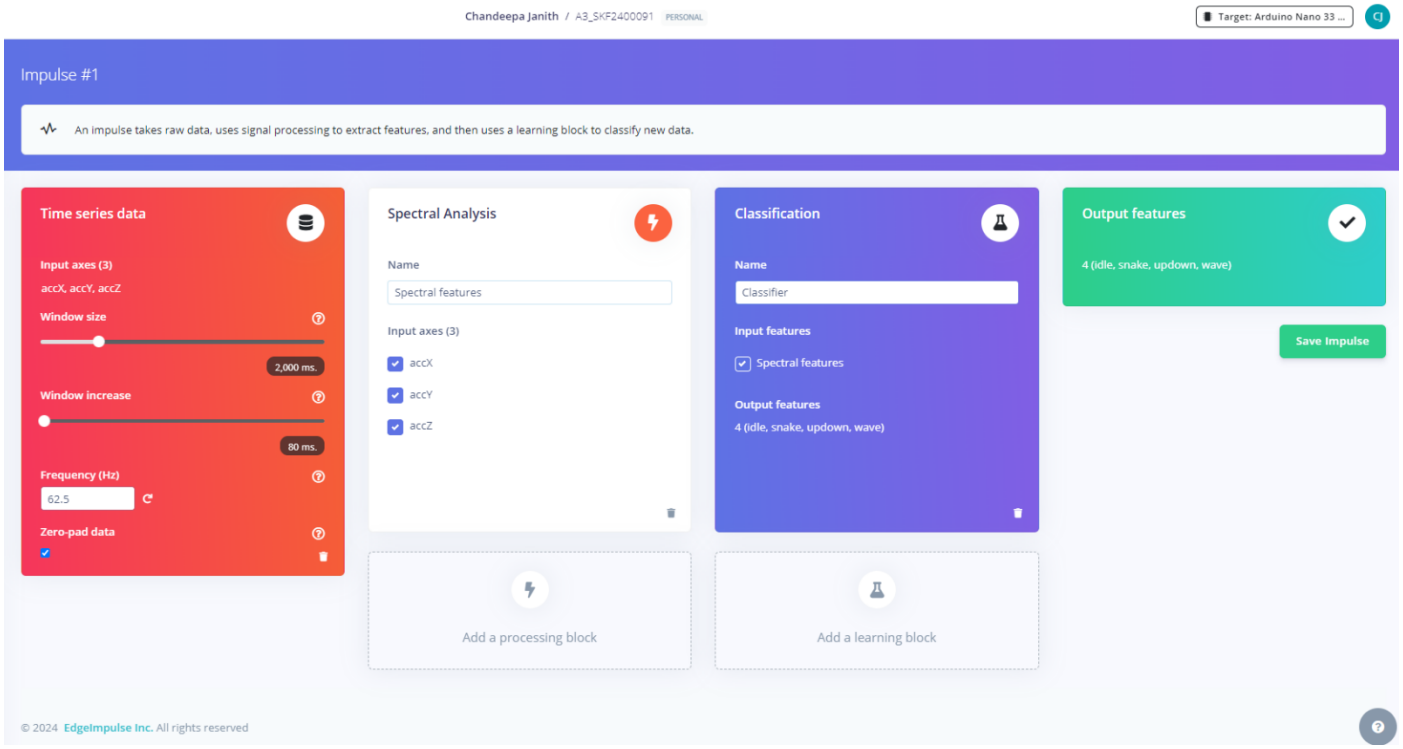






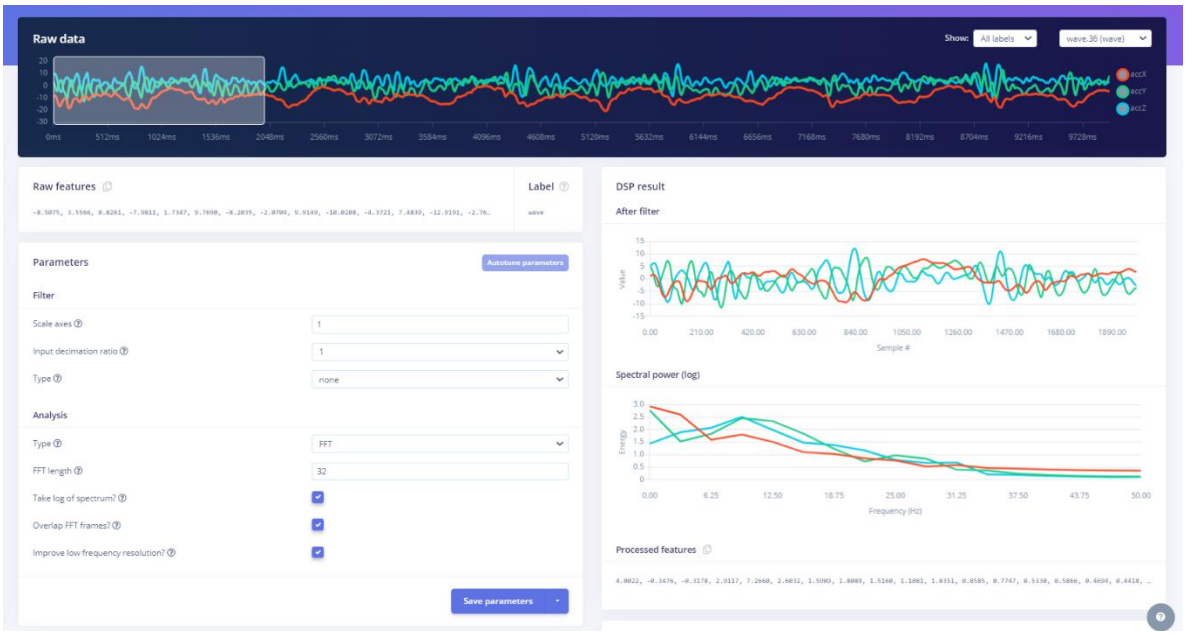
Have created an Impulse with given parameters for Time Series data. Also added Spectral Analysis block as processing block and classification block as learning block. Impulse Outputs 4 features.

Include a screenshot that clearly shows the impulse you have created.



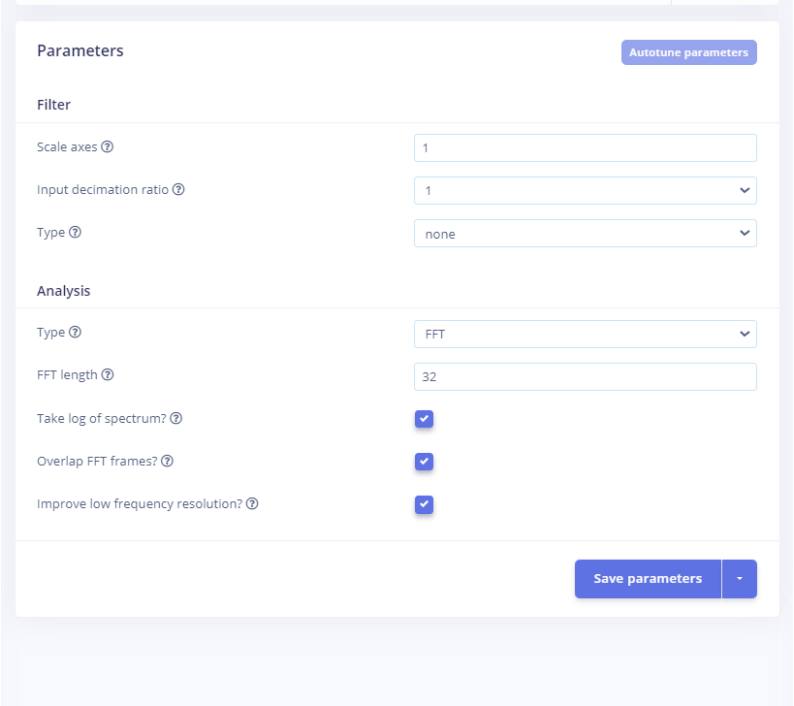
Task 3: Feature Extraction

Include screenshots to clearly show the selected parameters and the feature explorer

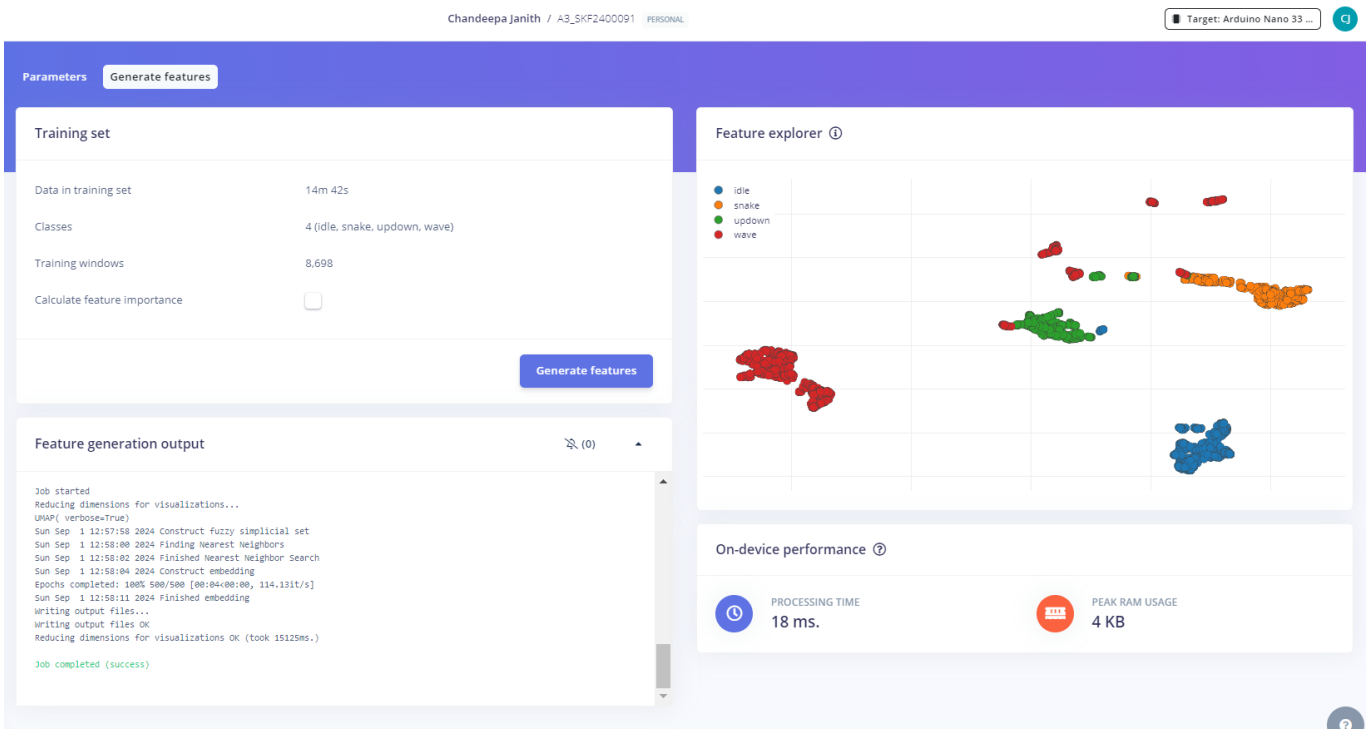


How parameters were selected:

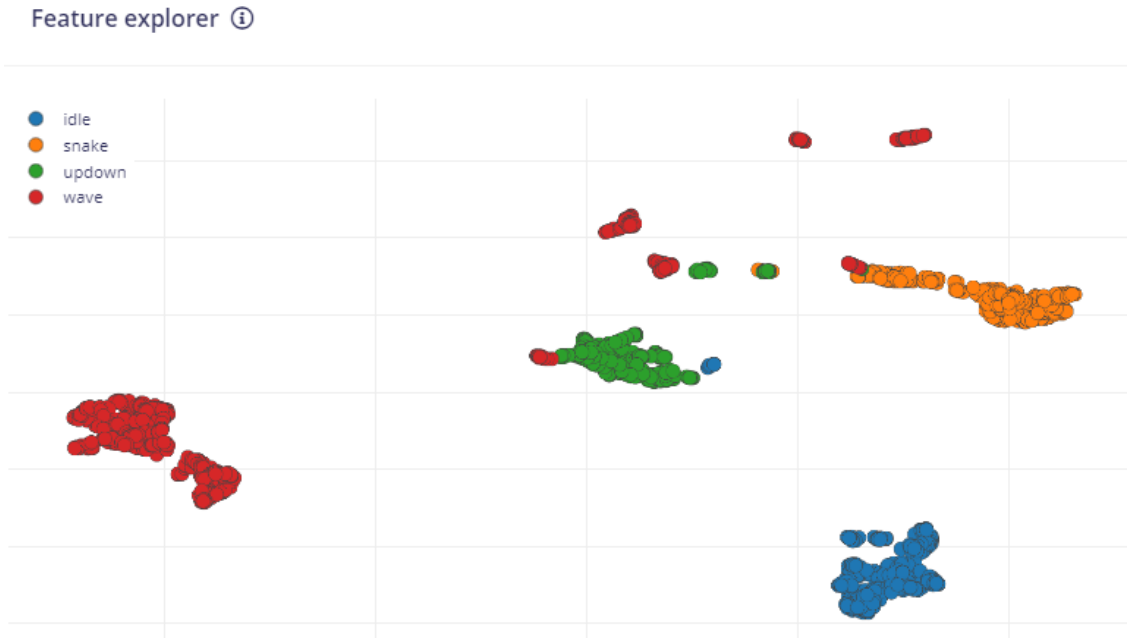
The parameters for the spectral feature extraction were selected to optimize motion data analysis. Scale Axes was set to 1 for consistent data normalization, and Input Decimation Ratio was kept at 1 to retain full data resolution. No filter was applied initially to avoid altering the raw signal. The FFT Length was increased to 32 for better frequency resolution, which is essential for detailed spectral analysis of complex motions. The Log of Spectrum was enabled to help the model manage large variations in spectral energy, and Overlap FFT Frames was activated to ensure continuous feature capture. Improve Low-Frequency Resolution was enabled to provide detailed analysis of low-frequency components, which are important for distinguishing subtle motion patterns like the "snake" movement. These settings were chosen to extract useful information from the data while keeping the signal accurate and clear.



Feature extraction

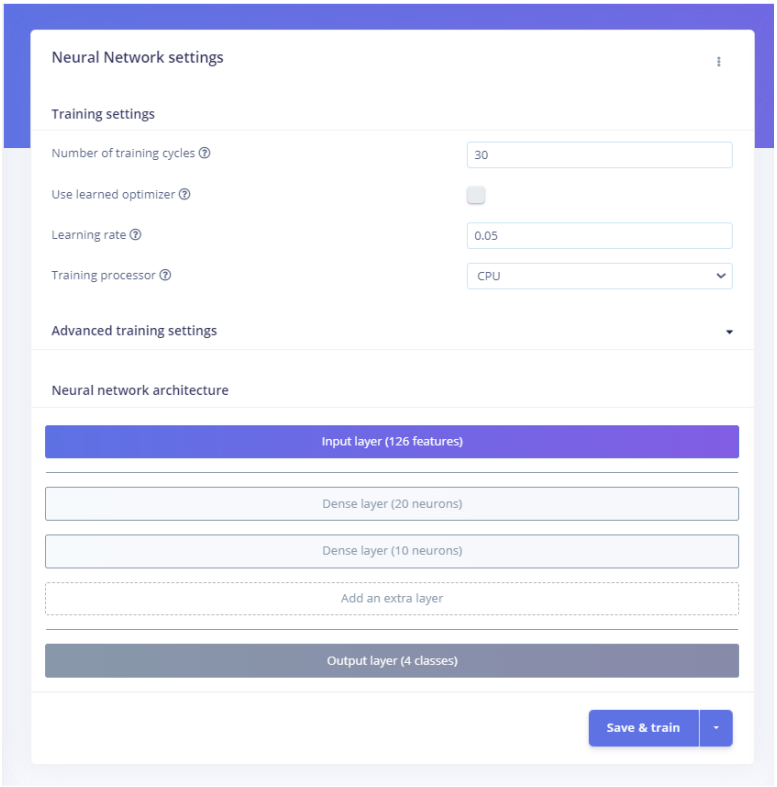


The feature explorer shows that the features in your dataset are well-extracted. The clear, separate groups for the four classes—idle, snake, updown, and wave—mean that the features are doing a good job of capturing what makes each class different.



Task 4: Model training and testing

Neural network settings and network architecture



Training performance. (Confusion matrix, metrics for the validation set and data explorer)

Confusion Matrix

Model

Model version: Quantized (int8)

Last training performance (validation set)

ACCURACY
97.9%

LOSS
0.09

Confusion matrix (validation set)

	IDLE	SNAKE	UPDOWN	WAVE
IDLE	**100%**	0%	0%	0%
SNAKE	0%	**100%**	0%	0%
UPDOWN	0.6%	5.4%	**94.0%**	0%
WAVE	0%	0.5%	1.8%	**97.7%**
F1 SCORE	1.00	0.97	0.95	0.99

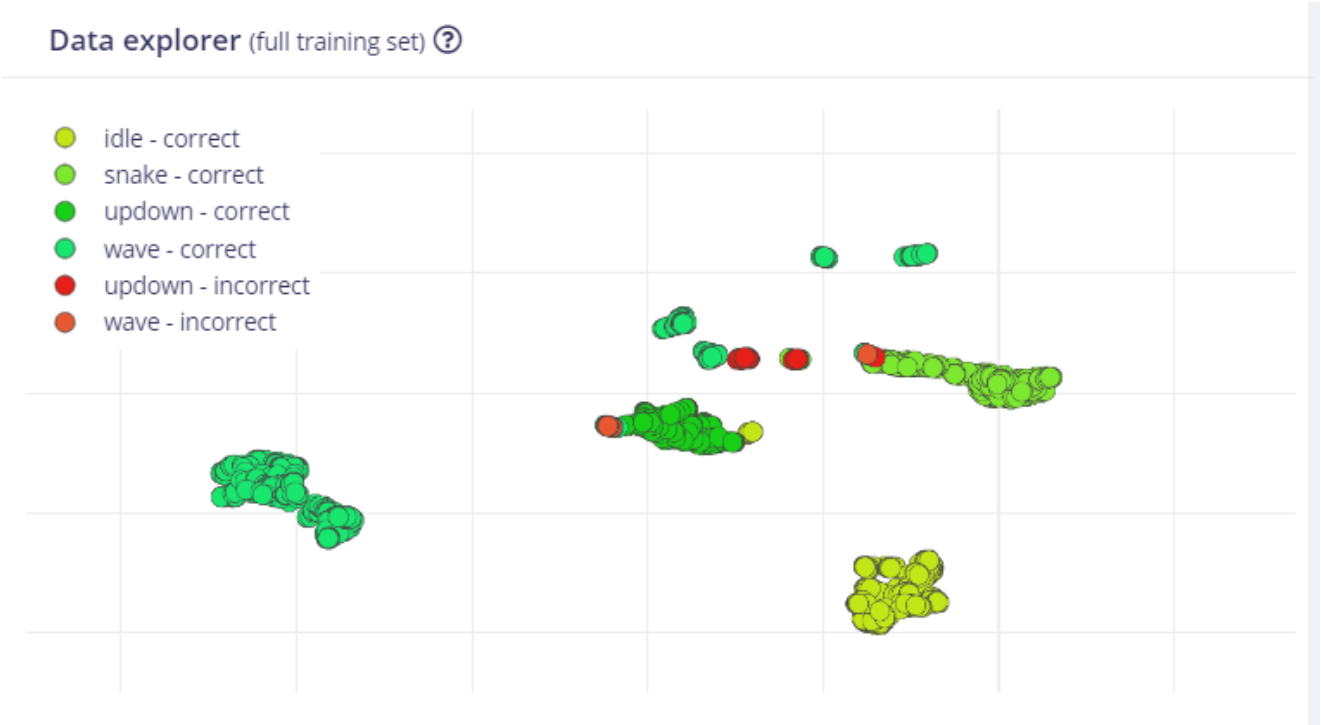
Achieved 97.9% accuracy for testing data without overfitting.

Metrics

Metrics (validation set)

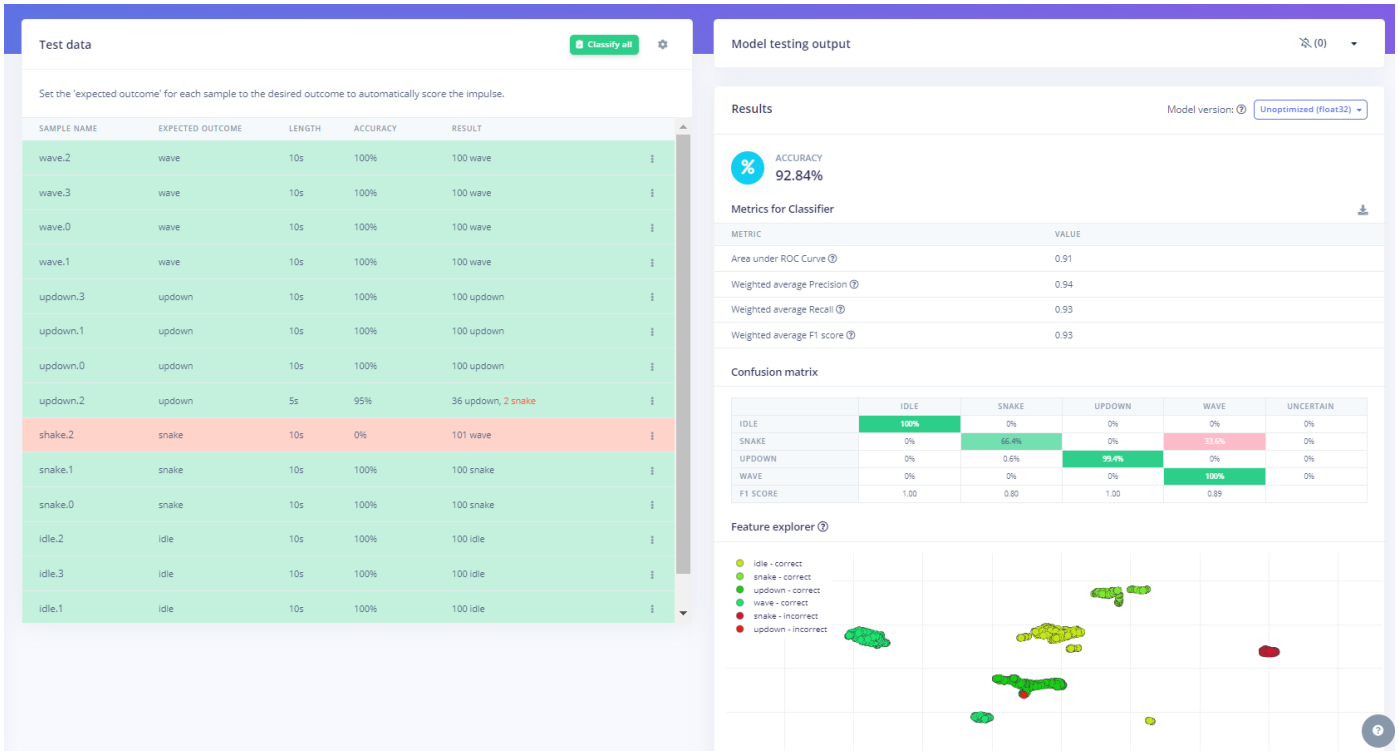
METRIC	VALUE
Area under ROC Curve	1.00
Weighted average Precision	0.98
Weighted average Recall	0.98
Weighted average F1 score	0.98

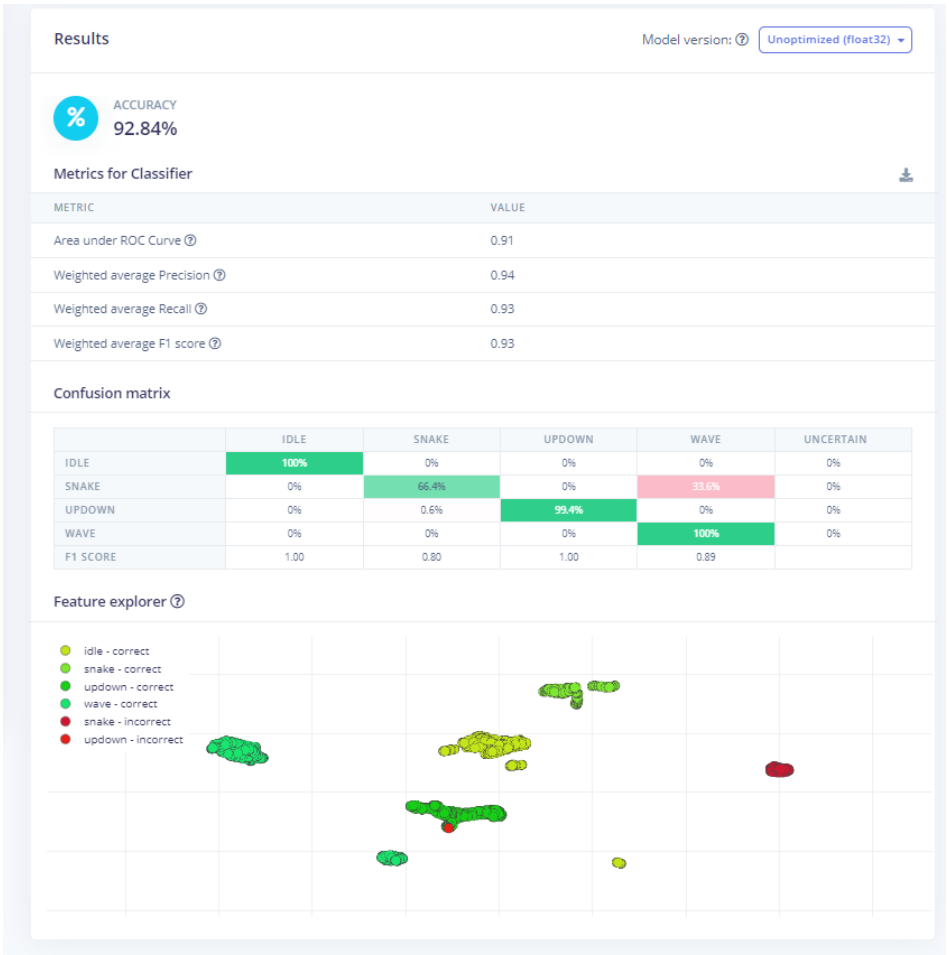
Data Explorer



Results obtained for the testing dataset

Achieved 92.84% accuracy for testing data

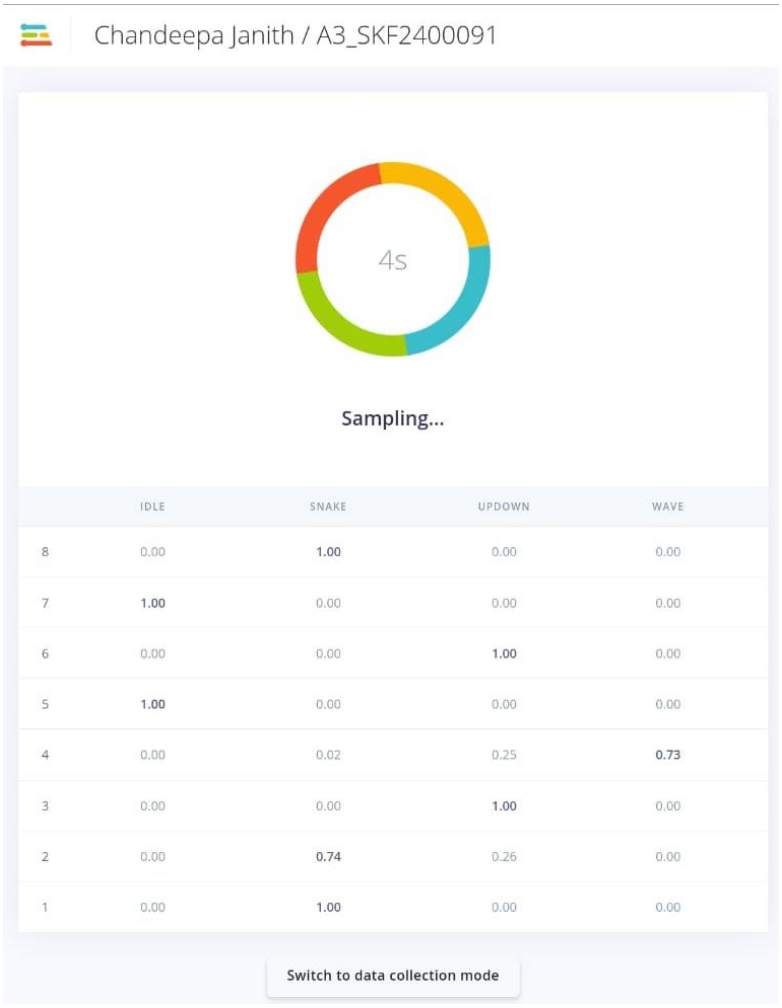




Simple reasoning of the parameters you have chosen.

Have selected 30 training cycles with a learning rate of 0.05 to avoid overfitting the data. The neural network architecture includes an input layer followed by two dense layers—one with 20 neurons and the other with 10 neurons. Finally, the output layer is designed to classify the data into 4 distinct classes. This setup allow the network to learn effectively while minimizing the risk of overfitting, ensuring that the model generalizes well to new data

Task 5: Deployment



Have done 3 snake movements, 2 idle instances, 2 up down movements and 1 wave movement using my phone from this deployed model. I got the correct results as expected.