CE 6302.001 – Microprocessor and Embedded Systems – F22

Dhavalashri Prasad Net-ID : dxp210085	Sanmati Marabad Net-ID : sxm210368

TinyML - Audio Classification

The main aim of this project is to train TICC1352P Launchpad connected to BoostExcel-sensors board for different kinds of motion recognition.

Softwares Used

- Edge Impulse CLI
- NodeJS
- Texas Instruments Uniflash

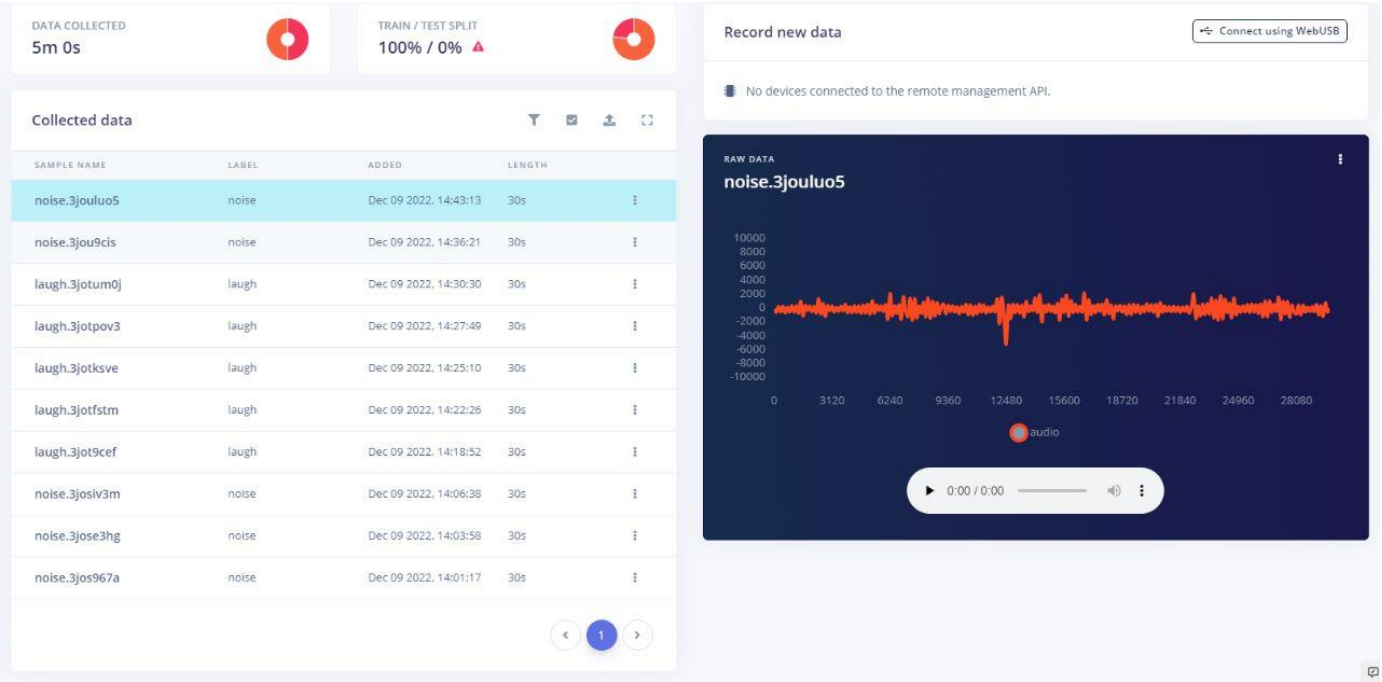
Steps to connect development board to Edge Impulse

- Flash the board using Texas Instruments Flash Batch 5.
- Create an account on Edge Impulse which is used to collect the data and train the system.
- Connect to the board using Edge Impulse daemon command.
- Now we can access the device on the Edge Impulse website
- After the connection is succeeded, we start training the system for different kind of movements.

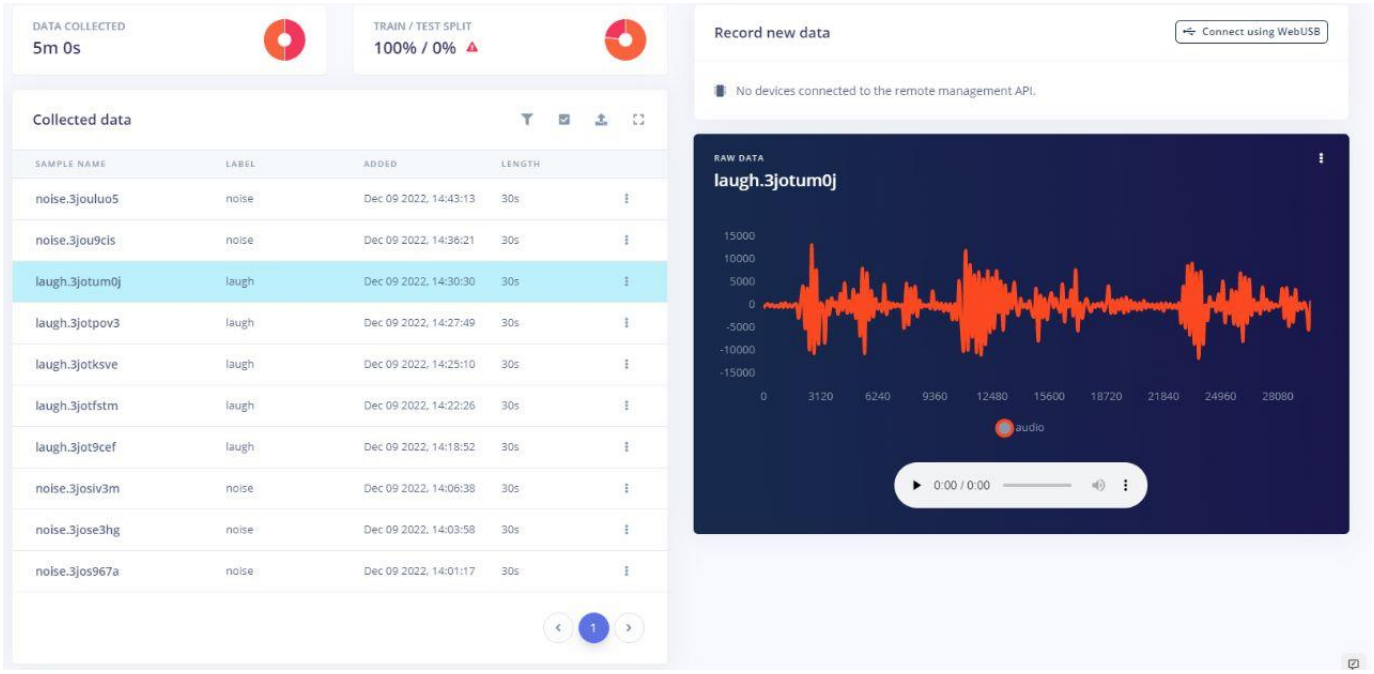
Data acquisition

This is the process of collecting different data sets in order to train the system.

- For each kind of audio, we create a different label like noise and laugh where noise is the background noise in a room and laugh is the audio of a child's laugh.
- The sample length is set to 10,000 and frequency is set to 62.5Hz
- We use the built-in microphone in the booster sensor pack for audio inputs.
- Each sample data was 30 seconds long. Similarly, for each audio sample, data was collected 5 times (5 samples).



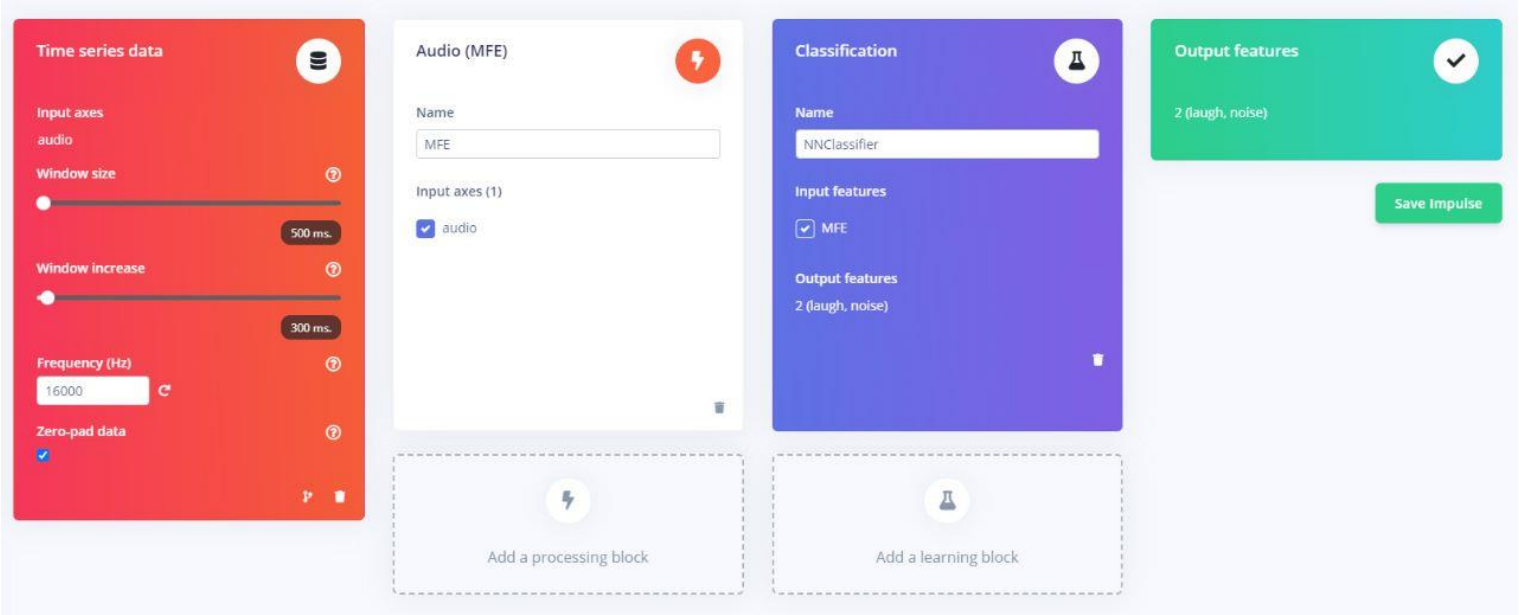
Data Acquisition for noise



Data acquisition for laugh

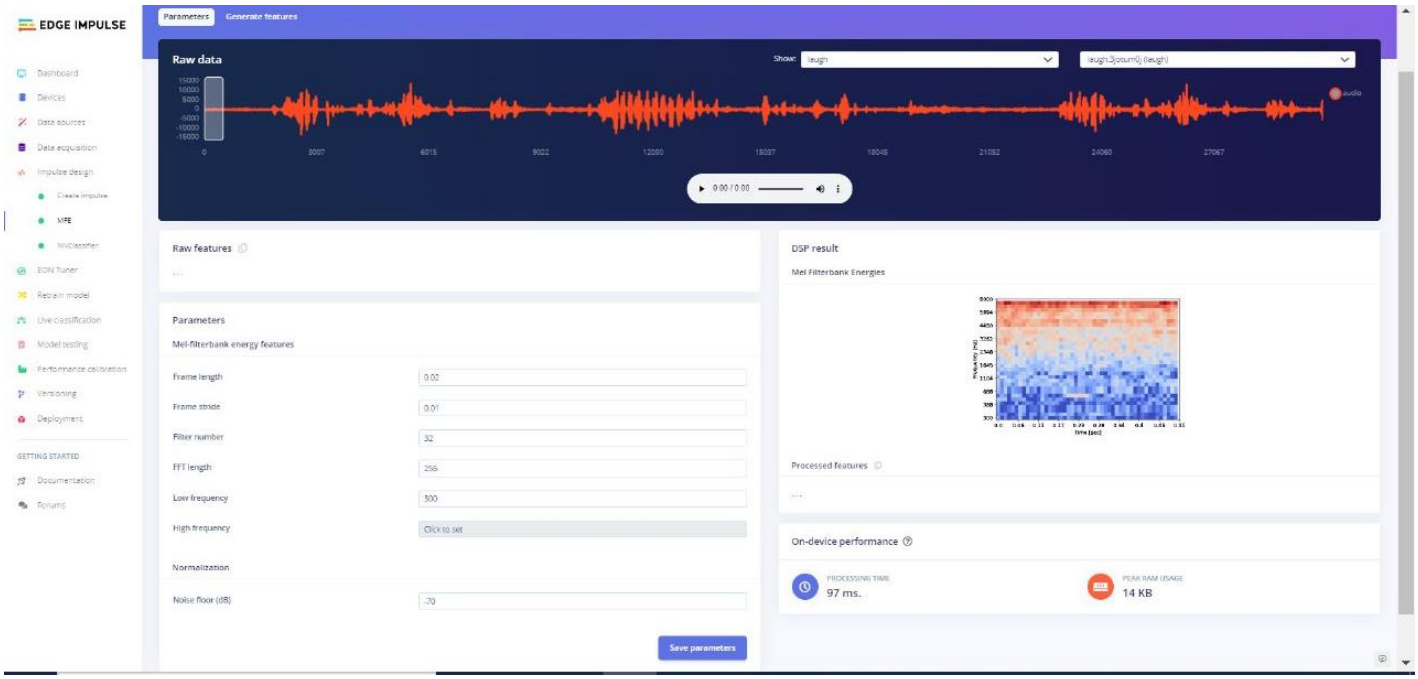
Impulse Design

Your Impulse may now be made when you have gathered the necessary facts for your project. Three primary building components will make up a full Impulse: an input block, a processing block, and a learning block.

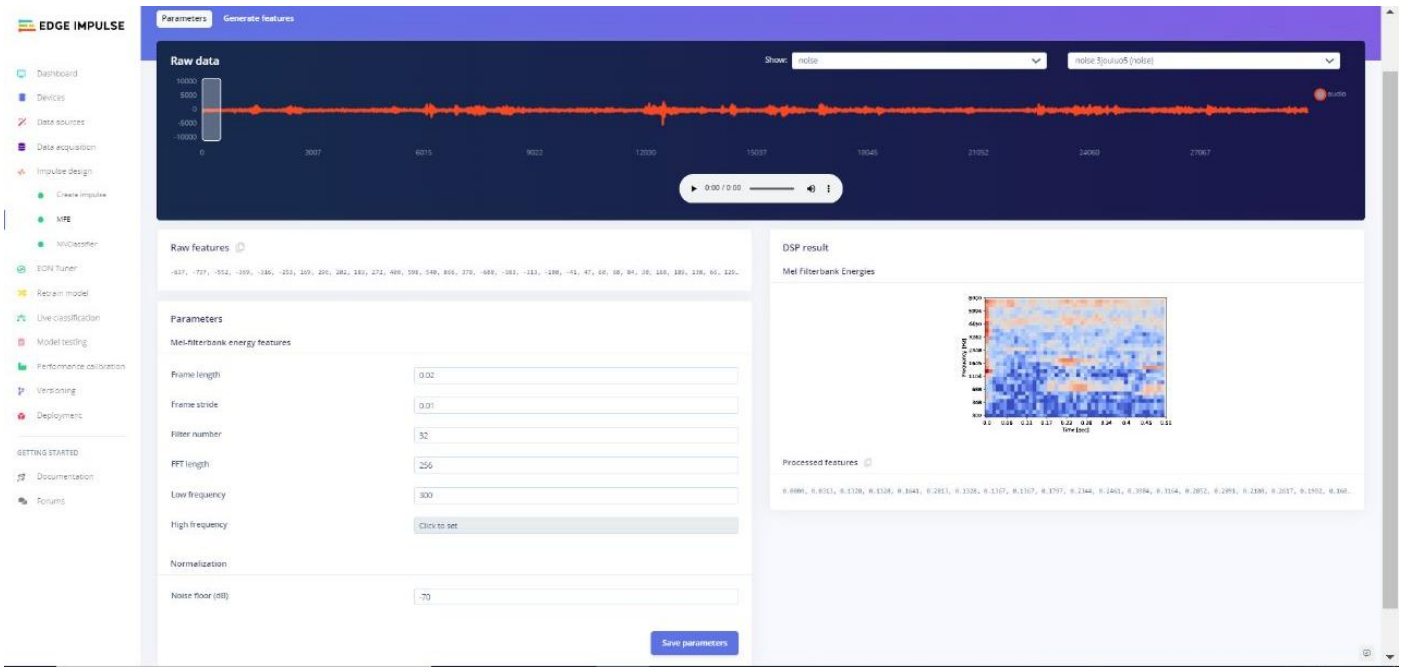


- ❖ **Input Block**
  - The input block indicates the type of input data that the system is getting trained. This can be audio, motion or images.
  - The inputs to input block is audio axis and a window size of 500ms and window increase of 300ms.
  - The frequency is set to 16,000Hz.
- ❖ **Processing Block**
  - A processing block is a feature extractor which processes the input data and extracts the features from it so that the machine learning model can be trained using the extracted features.
  - For audio recognition, we use the MFE block as a processing block.
  - The input to MFE block is audio axis.
- ❖ **Learning Block**
  - A learning block is a neural network that is trained to learn the input data.
  - In the current project, we use classification(NN Classifier) as the learning block where it classifies and outputs two features: Noise and laugh

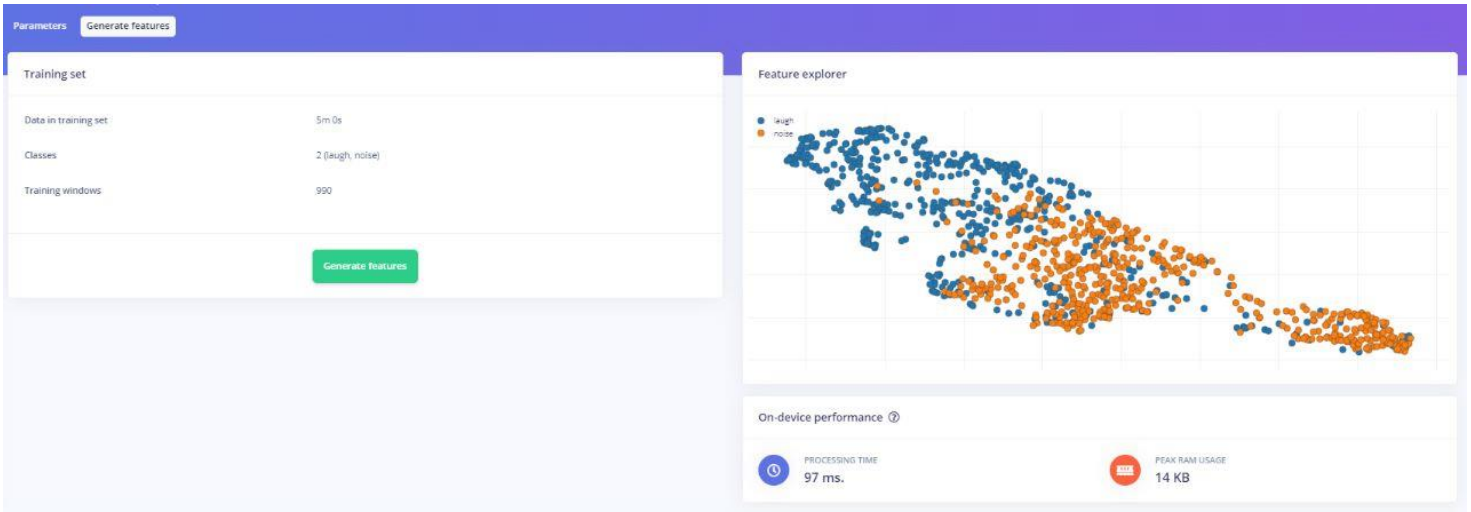
After selecting the impulse blocks, we need to save the impulse and next step is to generate the features using spectral features. This step extracts and generates features from the raw input data.



Parameters for Noise feature



Parameters for Laugh feature



Features generated for different types of inputs

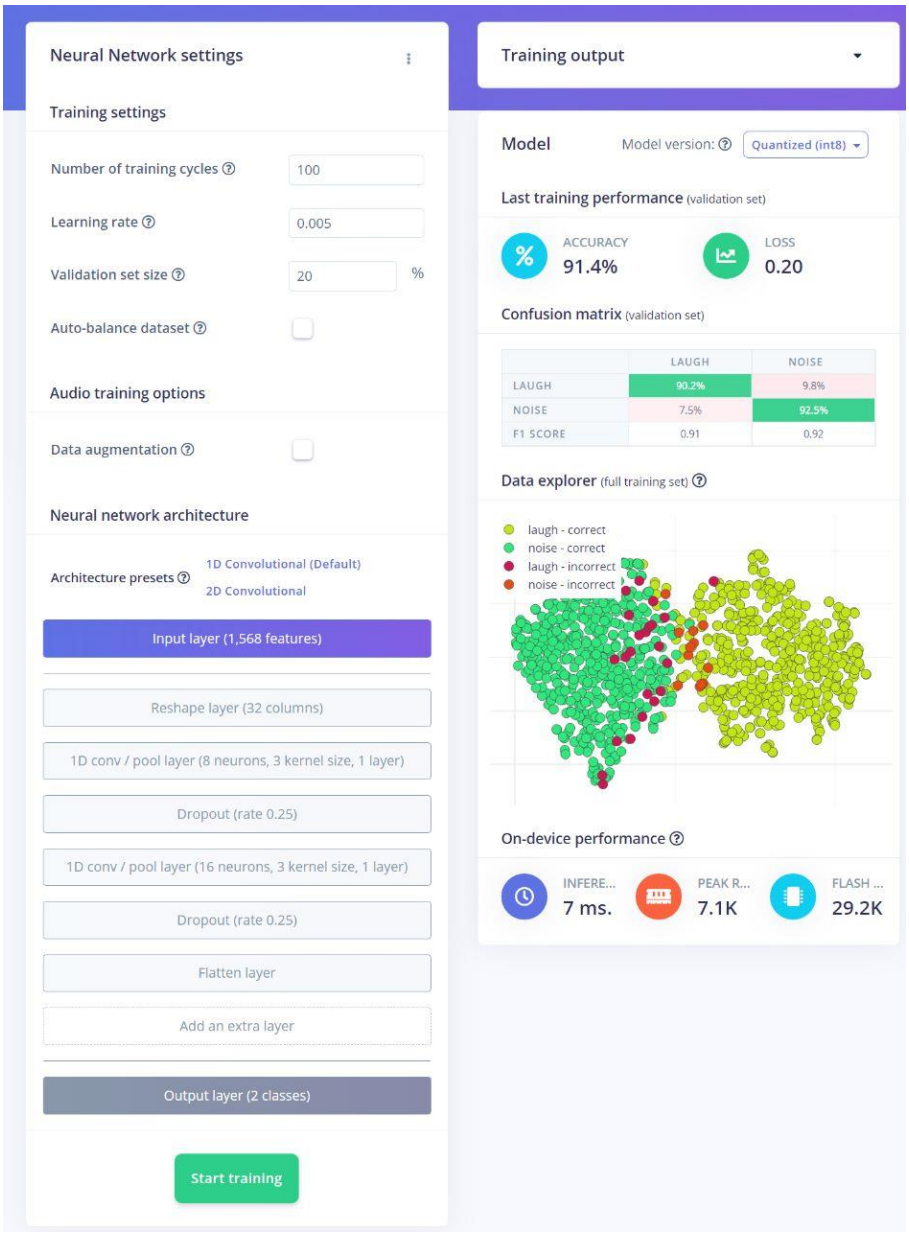
Training Result

Classifier

In order for the system to learn the features extracted from the input data, we need to train it using classifier.

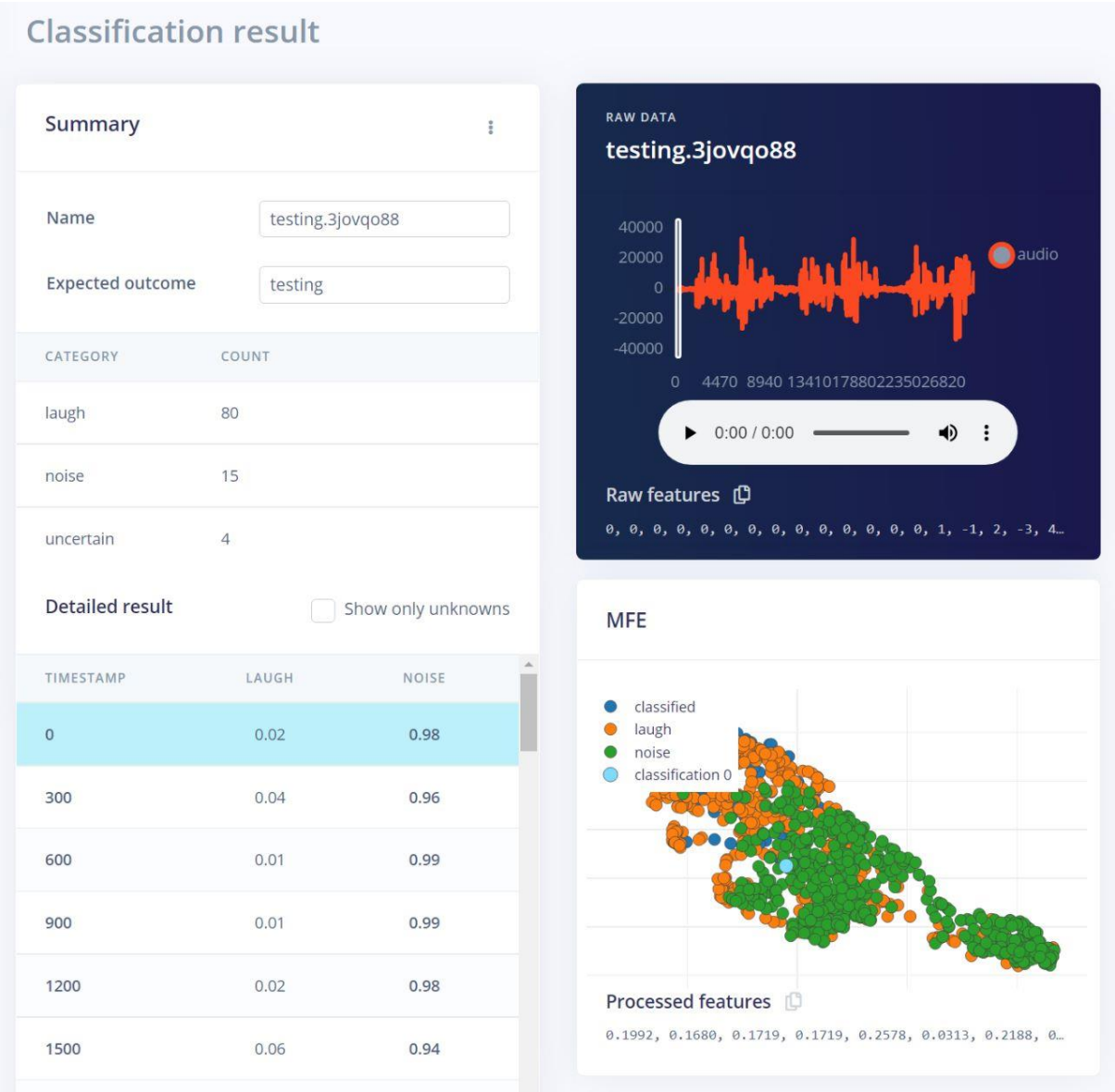
Results of training

The accuracy for each class is found to be 91.4% and there was loss of data of 0.2% observed since the during sample collection of laugh, there was background noise involved.

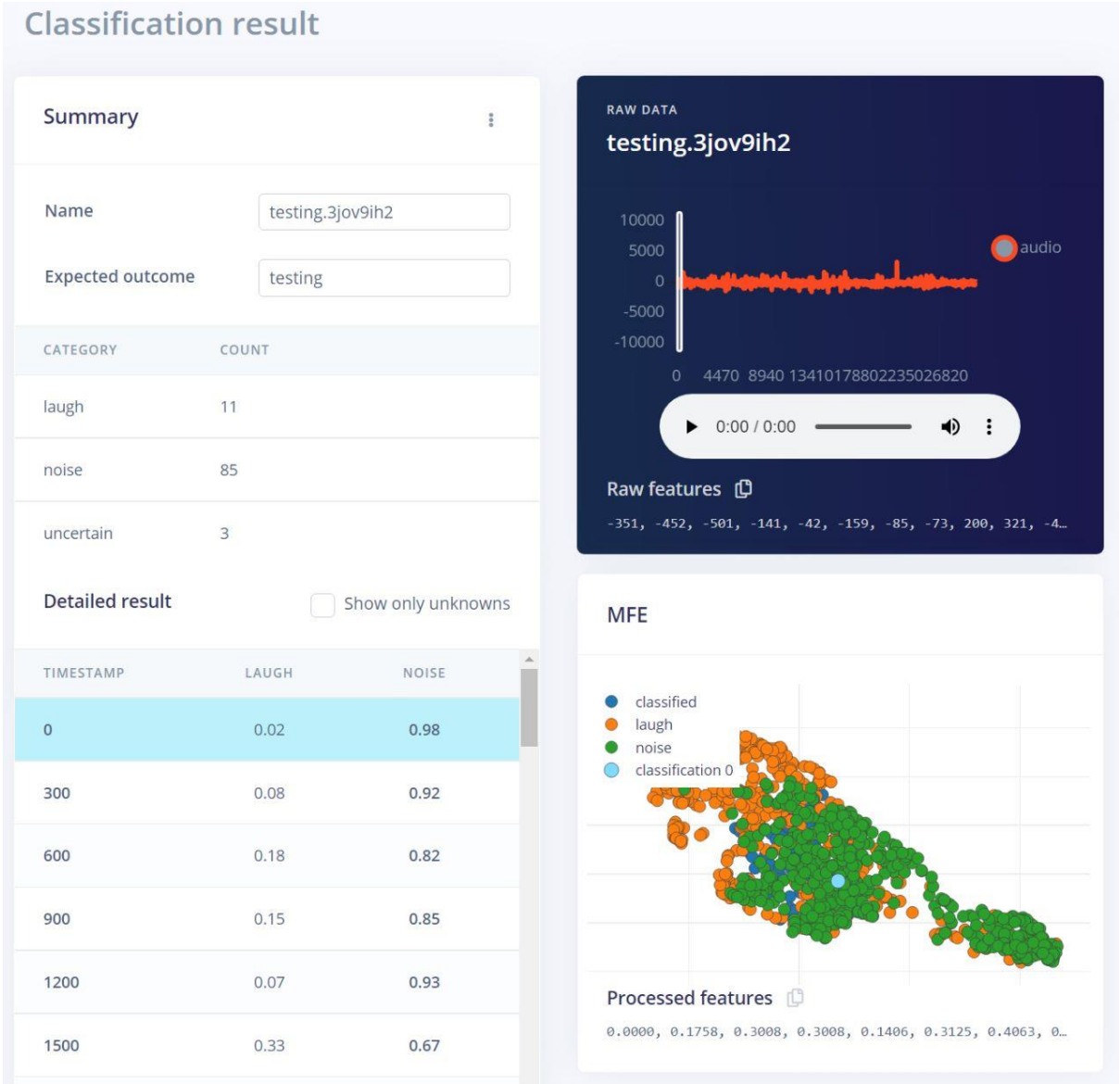


Testing using Live Classification

Before dumping the trained model into the board, testing it using Live Classification is necessary. The classification results were observed to be 80-85% accurate for all the different inputs that were given.



Classification Result of Laugh



Classification Result of Noise

After live classification is tested, the code is dumped to the board and now we can use the board as a trained model to classify the input data.