



**LIVERPOOL
HOPE
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School Of Mathematics Computer Science and Engineering

**Internet of Things
(CSCM035AZ2021/2)**

**Infant Sound Detection with TinyML
on Sseed Wio Terminal**

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INTRODUCTION

This project aims to build a system that detects infant sounds for the seed wio terminal using TinyML and Edge Impulse. Edge Impulse is an online machine learning development platform for edge devices which enabled me to collect data using the wio terminals' built-in microphone or upload data from my host machine, filters and visualize the data using a processing block (Audio MFE) and a learning block (Keras Neural Network Classifier) to perform live classifications. A free account can be created [here](#).

The Wio (Wireless Input and Output) Terminal is a SAMD51-based microcontroller with Wireless Connectivity which is compatible with Arduino and MicroPython and powered by Realtek RTL8720DN. It runs at 120MHz (Boost up to 200MHz), 4MB External Flash and 192KB RAM.

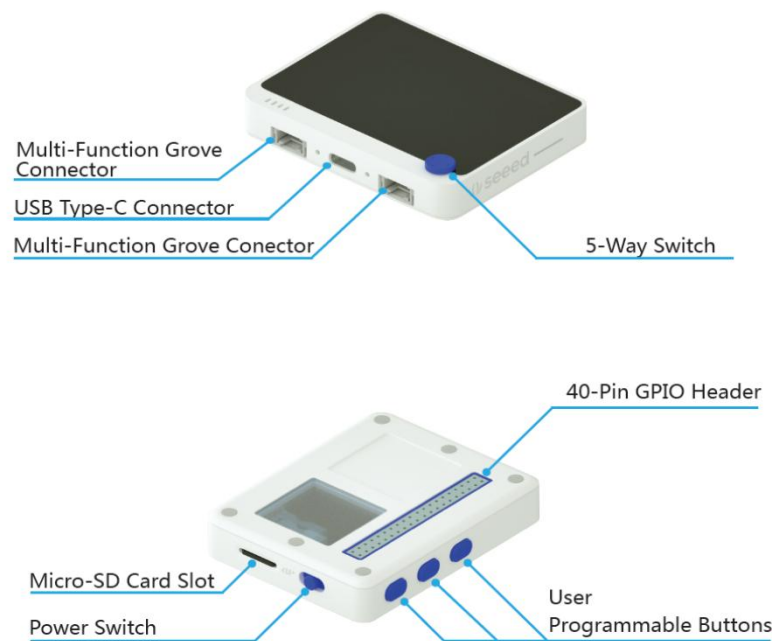


Figure 1: Seed Wio Terminal



Figure 2: USB Type C Cable

GETTING STARTED

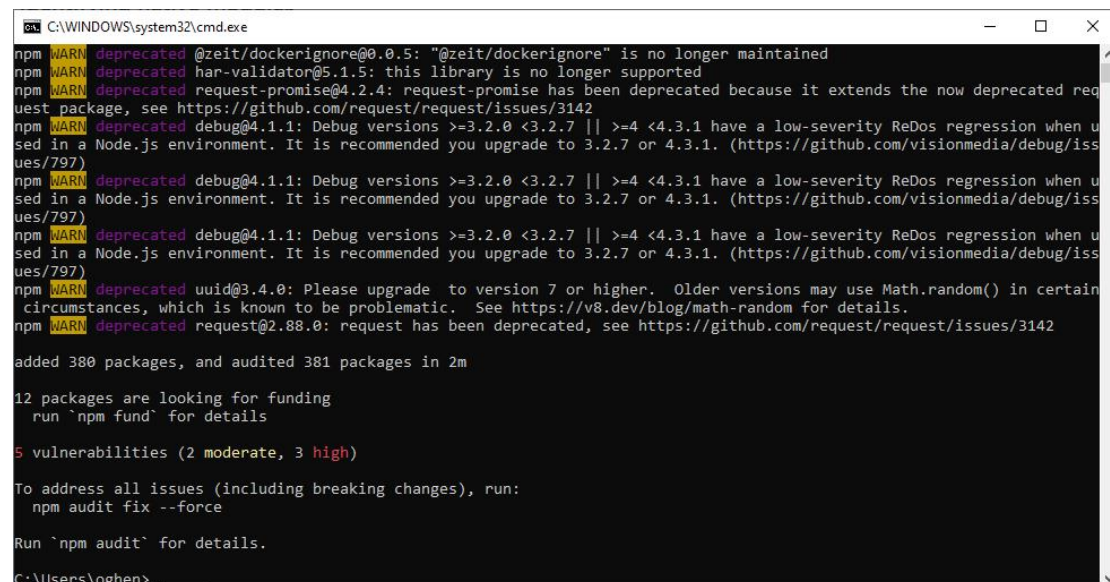
First, I installed [Node.js](#) for windows then I tried installing Edge Impulse CLI but encountered node-gyp build errors on the command line so I manually installed [Python 2.7](#) (I had Python 3 but apparently it is not supported yet) and Installed Visual C++ Build Environment: [Visual Studio Build Tools](#) (using "Visual C++ build tools" workload) or [Visual Studio Community](#) (using the "Desktop development with C++" workload). After installation, I launched cmd and typed in

```
npm config set msvs_version 2017 then set the path to executable
```

```
Python npm config set python /usr/bin/python2.7
```

After that I was able to install Edge Impulse CLI

```
npm install -g edge-impulse-cli
```



```
C:\WINDOWS\system32\cmd.exe
npm WARN deprecated @zeit/dockerignore@0.0.5: "@zeit/dockerignore" is no longer maintained
npm WARN deprecated har-validator@5.1.5: this library is no longer supported
npm WARN deprecated request-promise@4.2.4: request-promise has been deprecated because it extends the now deprecated request package, see https://github.com/request/request/issues/3142
npm WARN deprecated debug@4.1.1: Debug versions >=3.2.0 <3.2.7 || >=4 <4.3.1 have a low-severity ReDos regression when used in a Node.js environment. It is recommended you upgrade to 3.2.7 or 4.3.1. (https://github.com/visionmedia/debug/issues/797)
npm WARN deprecated debug@4.1.1: Debug versions >=3.2.0 <3.2.7 || >=4 <4.3.1 have a low-severity ReDos regression when used in a Node.js environment. It is recommended you upgrade to 3.2.7 or 4.3.1. (https://github.com/visionmedia/debug/issues/797)
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npm WARN deprecated uuid@3.4.0: Please upgrade to version 7 or higher. Older versions may use Math.random() in certain circumstances, which is known to be problematic. See https://v8.dev/blog/math-random for details.
npm WARN deprecated request@2.88.0: request has been deprecated, see https://github.com/request/request/issues/3142

added 380 packages, and audited 381 packages in 2m

12 packages are looking for funding
  run `npm fund` for details

5 vulnerabilities (2 moderate, 3 high)

To address all issues (including breaking changes), run:
  npm audit fix --force

Run `npm audit` for details.

C:\Users\oghen>
```

Figure 3: Edge Impulse CLI Installed

Then, I created an account on [Edge Impulse](#), verified the account through my email and logged in. To connect the Wio terminal, I plugged it in and entered boot mode by sliding the power switch quickly twice then dragged the already downloaded Edge Impulse uf2 firmware file (wio-terminal-ei-mic.uf2) to Arduino drive.

I then launched Edge Impulse Daemon on cmd by going to a given location where the downloaded stand alone node.js is and executing edge-impulse-daemon.

```
C:\WINDOWS\system32\cmd.exe - "node" "C:\Users\oghen\AppData\Roaming\npm\node_modules\edge-impulse-cli\build\cli\daemon.js"
Microsoft Windows [Version 10.0.19044.1706]
(c) Microsoft Corporation. All rights reserved.

C:\Users\oghen>cd OneDrive
C:\Users\oghen\OneDrive>cd Documents
C:\Users\oghen\OneDrive\Documents>cd nodejs-ei
C:\Users\oghen\OneDrive\Documents\nodejs-ei>edge-impulse-daemon
Edge Impulse serial daemon v1.14.13
Endpoints:
  Websocket: wss://remote-mgmt.edgeimpulse.com
  API:       https://studio.edgeimpulse.com/v1
  Ingestion: https://ingestion.edgeimpulse.com

[SER] Connecting to COM3
[SER] Serial is connected, trying to read config...
[SER] Retrieved configuration
[SER] Device is running AT command version 1.3.0

[SER] Device is not connected to remote management API, will use daemon
[WS ] Connecting to wss://remote-mgmt.edgeimpulse.com
[WS ] Connected to wss://remote-mgmt.edgeimpulse.com
[WS ] Device "wio" is now connected to project "Oghenetejiri-project-1"
[WS ] Go to https://studio.edgeimpulse.com/studio/105965/acquisition/training to build your machine learning model!
```

Figure 4: Launching Edge Impulse

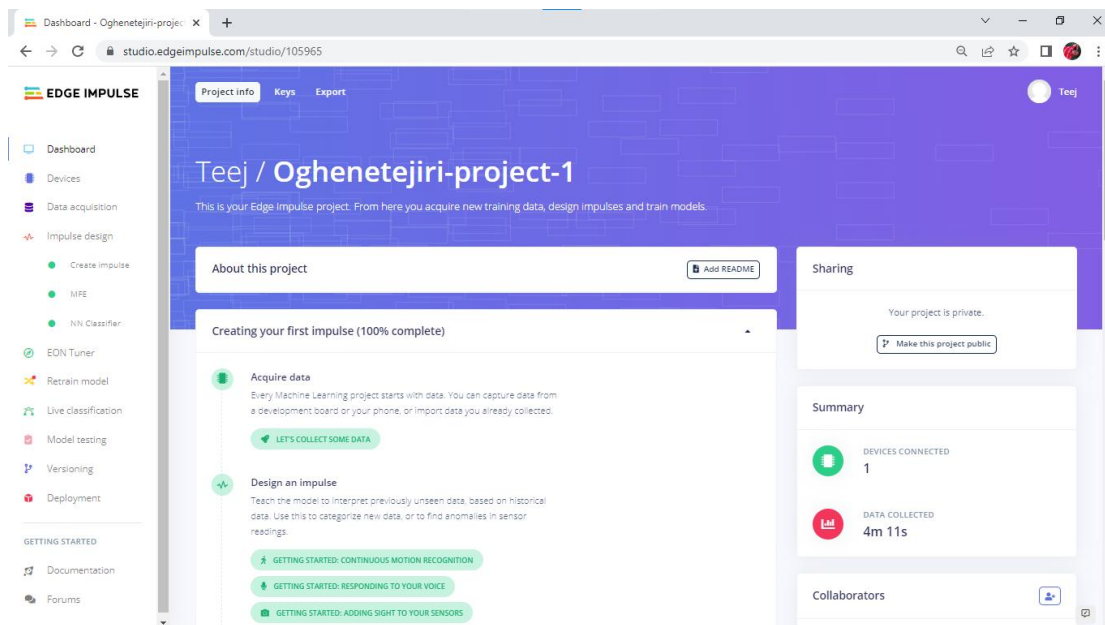


Figure 5: Dashboard

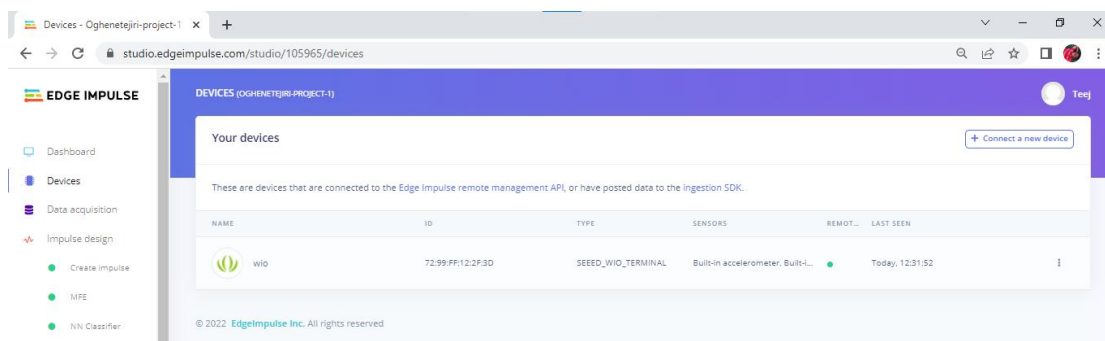


Figure 6: Wio Connected

DATA ACQUISITION

I download infant sounds from <https://freesound.org/> and uploaded them. I also recorded silence dataset using the build-in microphone. I also ensured that all three datasets (baby cry, baby laugh, silence) were equal.

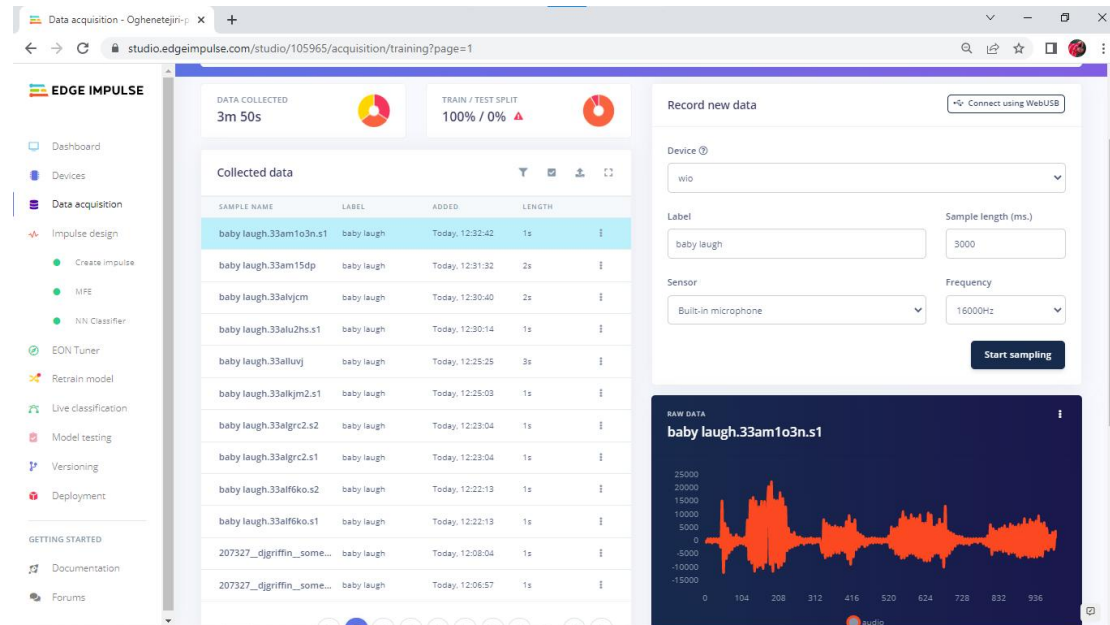


Figure 7: Data Acquisition

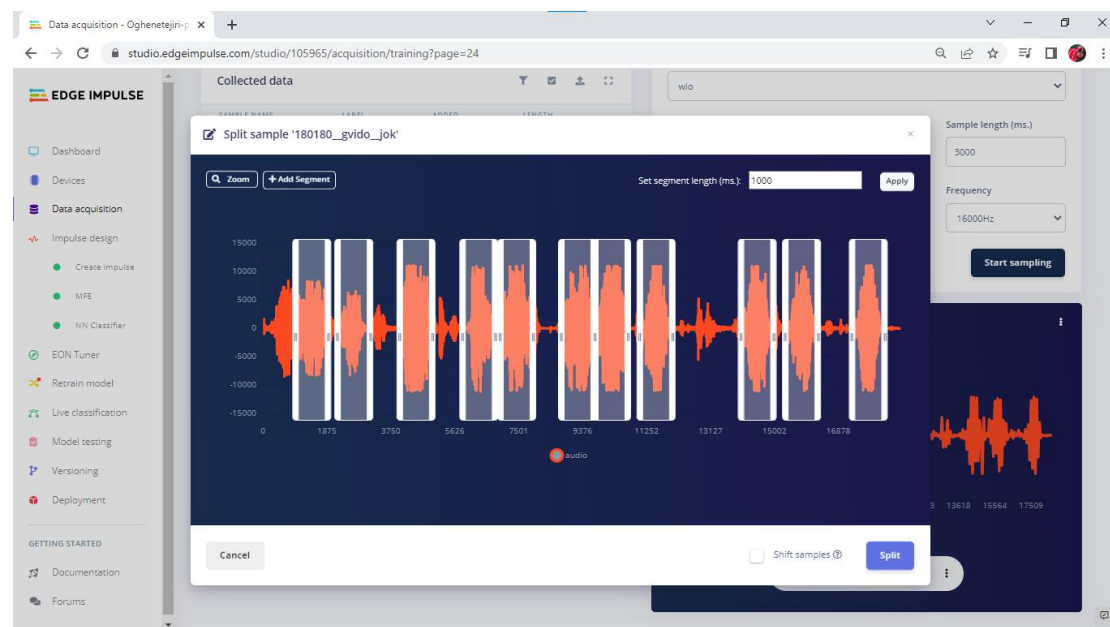


Figure 8: Spilt Samples

I then created the impulse with Audio MFE and Keras Neural Network Classifier,

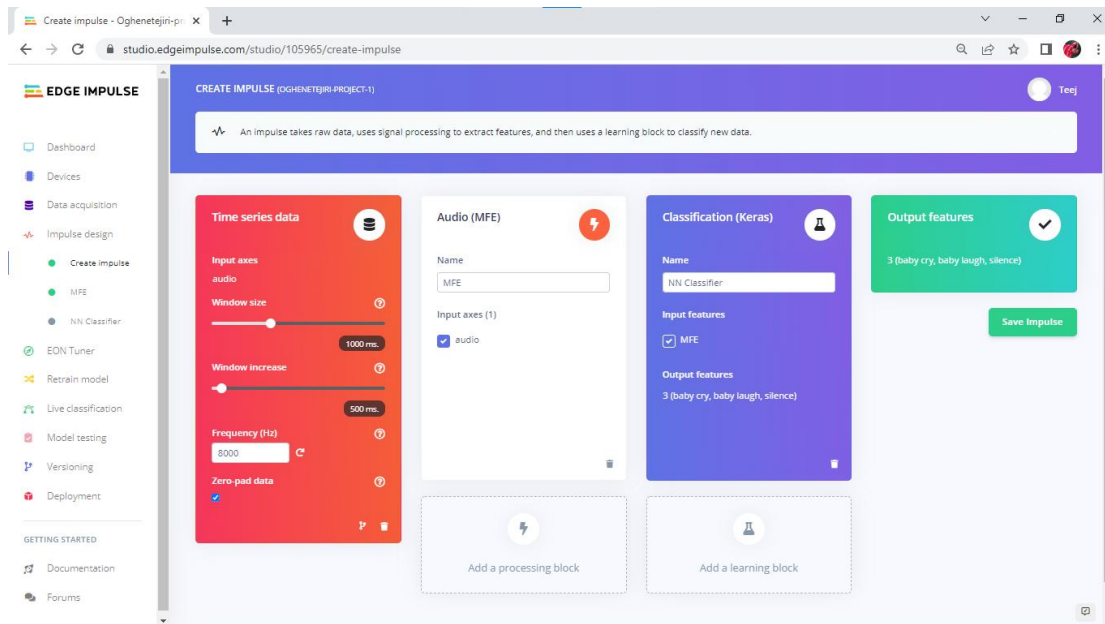


Figure 9: Create Impulse

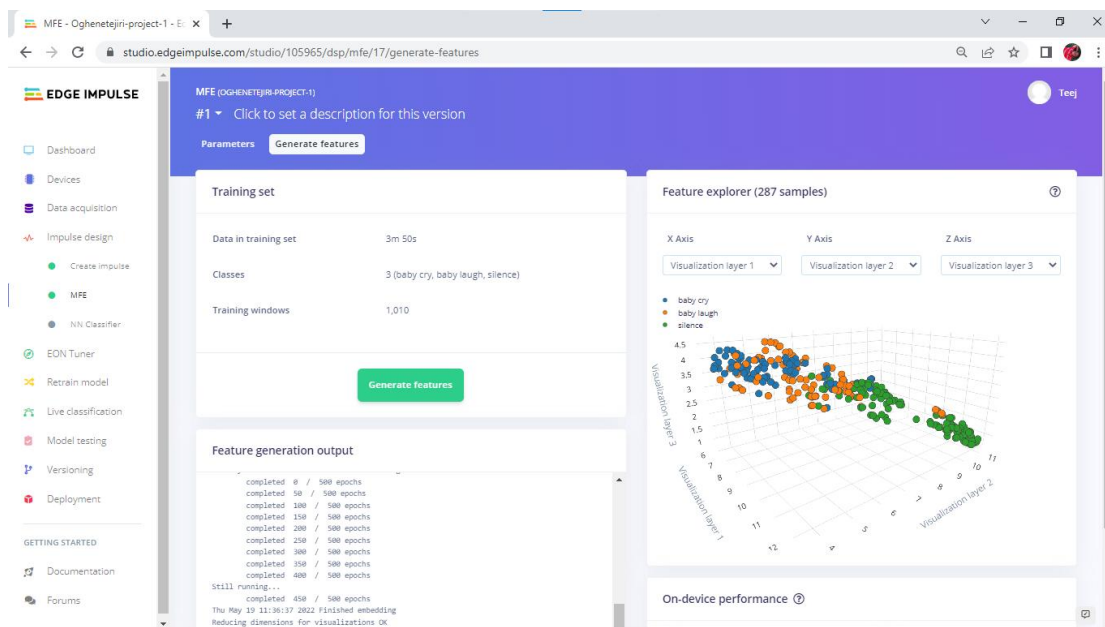


Figure 10: Mel Frequency Energy (MFE)

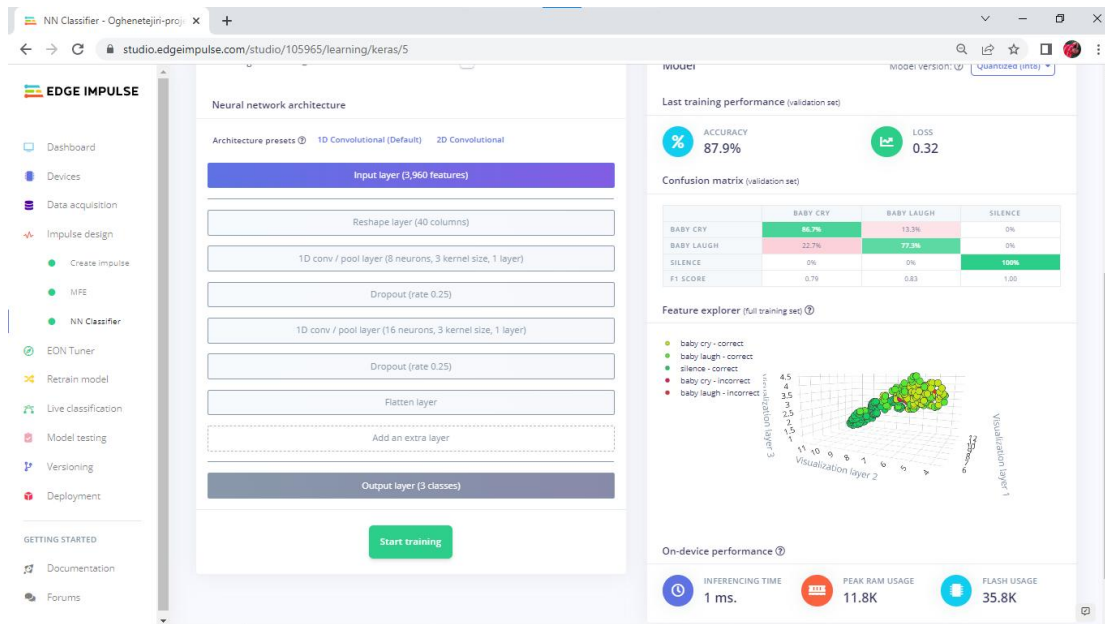


Figure 11: Neural Network Classifier

After creating the impulse I did a live classification to test it.

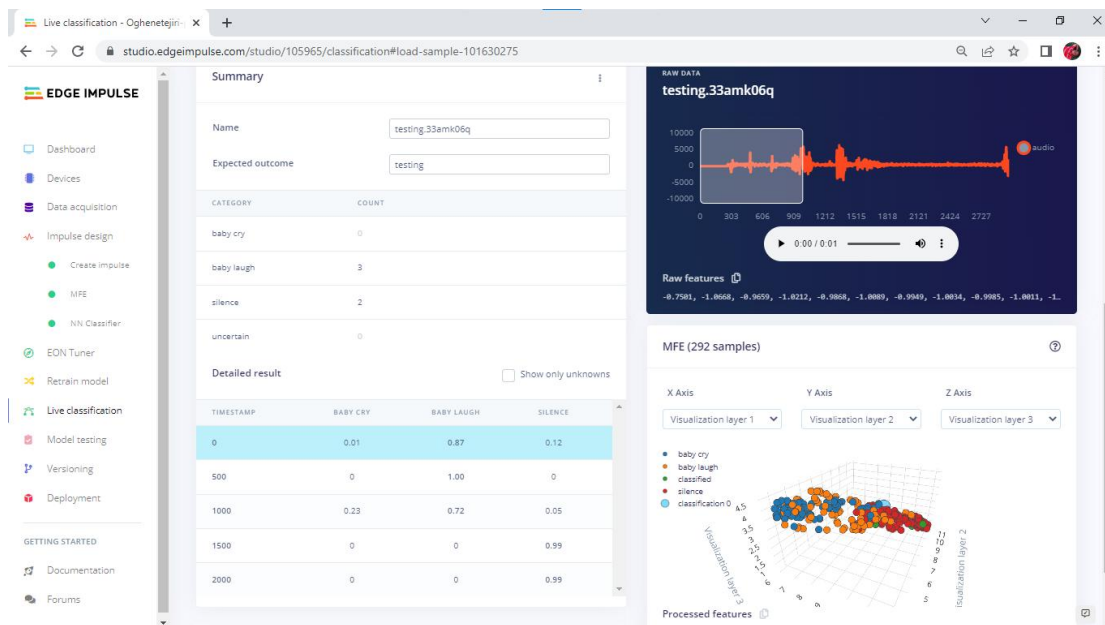


Figure 12: Live Classification

It worked!

I deploy the impulse and downloaded it as a zip file, including it as a library on the the Arduino IDE, rewrote the code giving on Moodle, restarted the Wio terminal and uploaded the code.

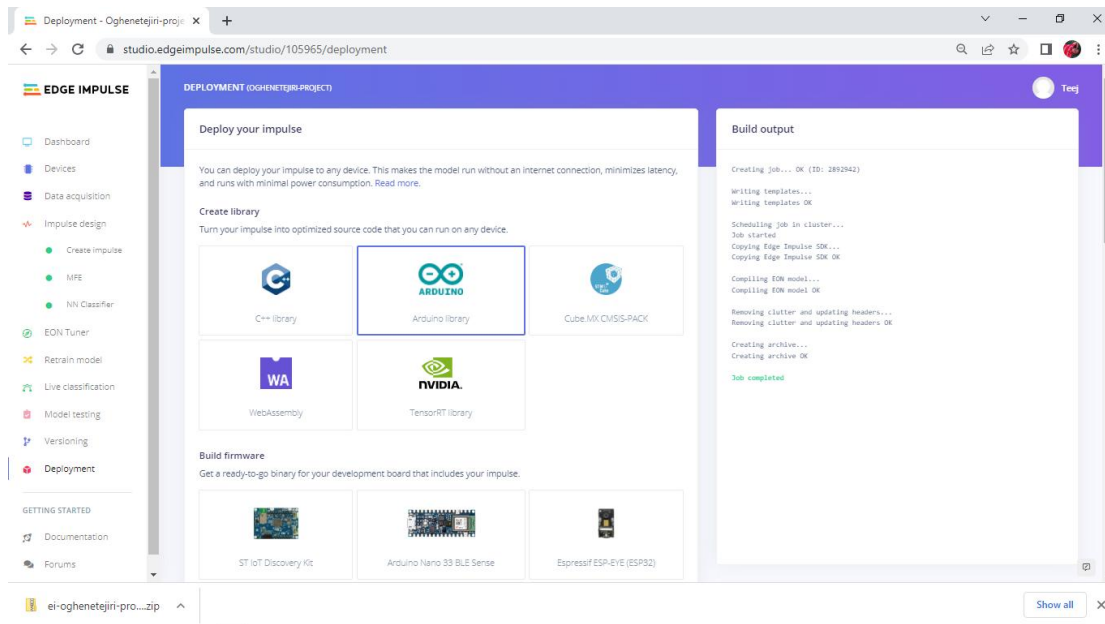


Figure 13: Deployment

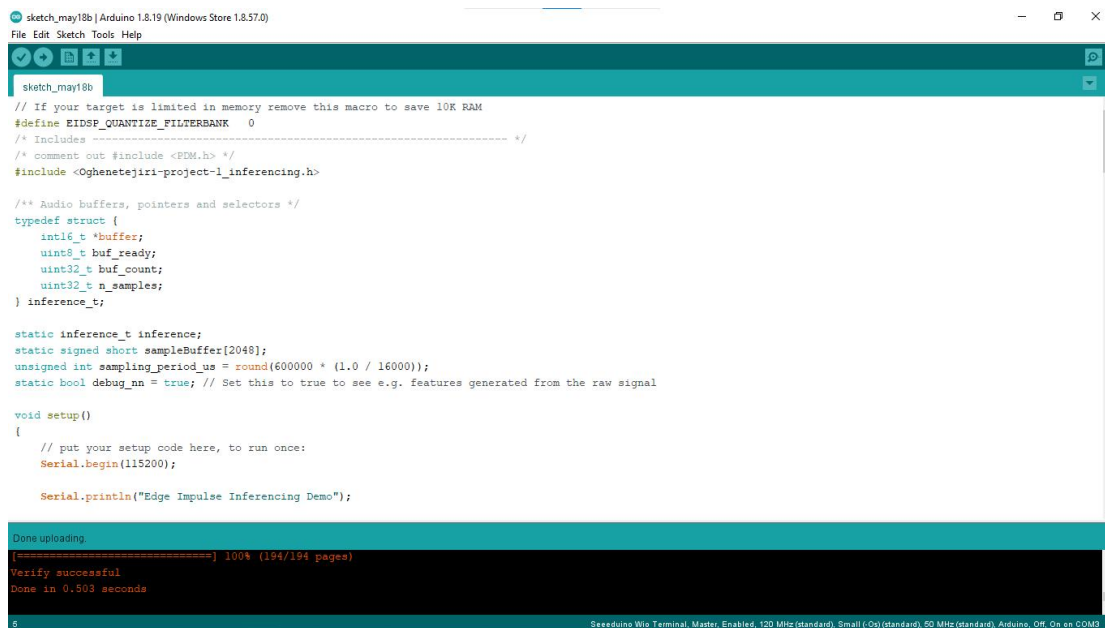


Figure 14: Code

