Edge Computing Laboratory
Lab Assignment 10

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Title

Study of Transfer Learning (Images) on Edge Computing Devices

Objective: Build a project to apply Transfer Learning of MobileNetV1 & V2 architectures trained on an ImageNet dataset

Tasks:

- Understand Transfer learning
- Understanding of MobileNetV1 & V2 Architectures
- Configure Edge Impulse for Object Detection
- Apply a pre-trained network for you to fine-tune your specific application
- Building and Training a Model
- Deploy on Edge Computing Devices

Introduction

Edge Impulse is a development platform for machine learning on edge devices, targeted at developers who want to create intelligent device solutions. The " Camera "sensor reading equivalent in Edge Impulse would typically involve creating a simple machine learning model that can run on an edge device, like classifying sensor data or recognizing a basic pattern.

Materials Required

- Nano BLE Sense Board

Theory

GPIO (General Purpose Input/Output) pins on the Raspberry Pi are used for interfacing with other electronic components. BCM numbering refers to the pin numbers in the Broadcom SOC channel, which is a more consistent way to refer to the GPIO pins across different versions of the

Here's a high-level overview of steps you'd follow to create a "Hello World" project on Edge Impulse:

Steps to Configure the Edge Impulse:

40. Create an Account and New Project:

    - Sign up for an Edge Impulse account.
    - Create a new project from the dashboard.

41. Connect a Device:

- You can use a supported development board or your smartphone as a sensor device.
- Follow the instructions to connect your device to your Edge Impulse project.

42. Collect Data:

    Use the Edge Impulse mobile app or the Web interface to collect data from the onboard sensors.

    - For a "Hello World" project, you could collect accelerometer data, for instance.

43. Create an Impulse:

    - Go to the 'Create impulse' page.
    - Add a processing block (e.g., time-series data) and a learning block (e.g., classification).
    - Save the impulse, which defines the machine learning pipeline.

44. Design a Neural Network:

    - Navigate to the 'NN Classifier' under the 'Learning blocks'.
    - Design a simple neural network. Edge Impulse provides a default architecture that works well for most basic tasks.

45. Train the Model:

    - Click on the 'Start training' button to train your machine learning model with the collected data.

46. Test the Model:

    - Once the model is trained, you can test its performance with new data in the 'Model Testing' tab.

47. Deploy the Model:

    - Go to the 'Deployment' tab.
    - Select the deployment method that suits your edge device (e.g., Arduino library, WebAssembly, container, etc.).
    - Follow the instructions to deploy the model to your device.

48. Run Inference:

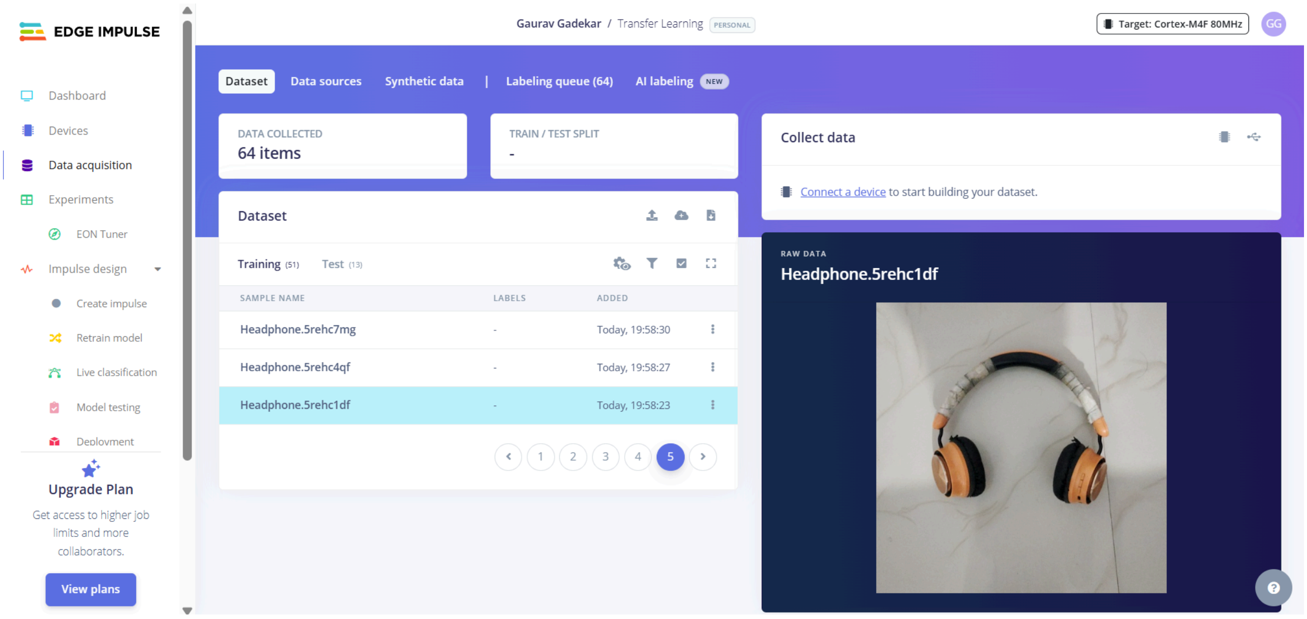
    - With the model deployed, run inference on the edge device to see it classifying data in real-time.

49. Monitor:

    - You can monitor the performance of your device through the Edge Impulse studio.

Screenshots:

Dataset image



DATA COLLECTED
64 items

TRAIN / TEST SPLIT
-

Collect data

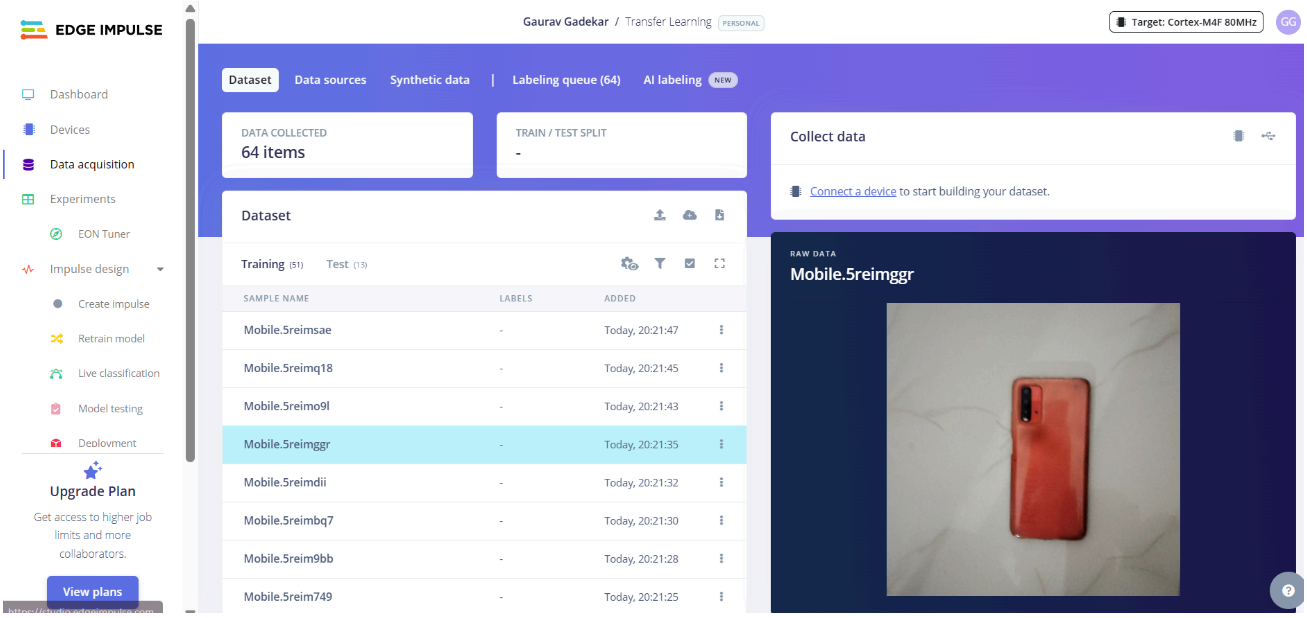
Connect a device to start building your dataset.

Dataset

SAMPLE NAME	LABELS	ADDED
Headphone.5rehc7mg	-	Today, 19:58:30
Headphone.5rehc4qf	-	Today, 19:58:27
Headphone.5rehc1df	-	Today, 19:58:23

RAW DATA

Headphone.5rehc1df



DATA COLLECTED
64 items

TRAIN / TEST SPLIT
-

Collect data

Connect a device to start building your dataset.

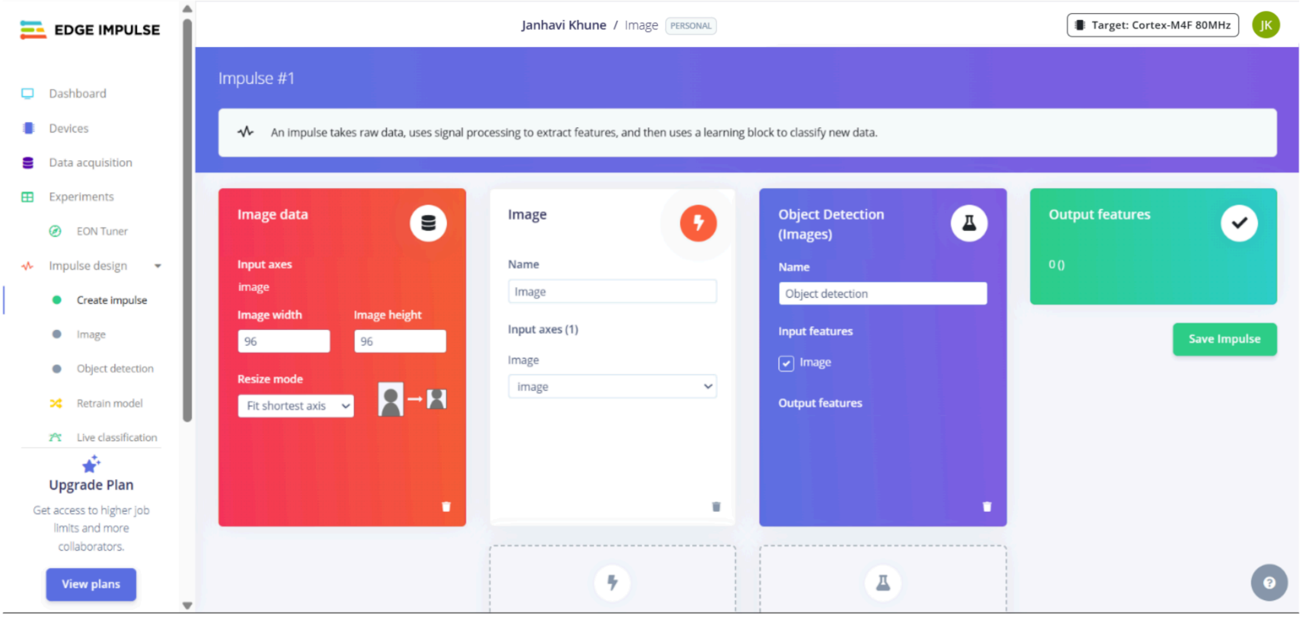
Dataset

SAMPLE NAME	LABELS	ADDED
Mobile.5reimsae	-	Today, 20:21:47
Mobile.5reimq18	-	Today, 20:21:45
Mobile.5reimo9l	-	Today, 20:21:43
Mobile.5reimggr	-	Today, 20:21:35
Mobile.5reimdii	-	Today, 20:21:32
Mobile.5reimbq7	-	Today, 20:21:30
Mobile.5reim9bb	-	Today, 20:21:28
Mobile.5reim749	-	Today, 20:21:25

RAW DATA

Mobile.5reimggr

Feature extraction - Image



Janhavi Khune / Image PERSONAL

Target: Cortex-M4F 80MHz

Impulse #1

An impulse takes raw data, uses signal processing to extract features, and then uses a learning block to classify new data.

Image data

Input axes
image

Image width: 96

Image height: 96

Resize mode: Fit shortest axis

Image

Name: Image

Input axes (1)

Image: image

Object Detection (Images)

Name: Object detection

Input features

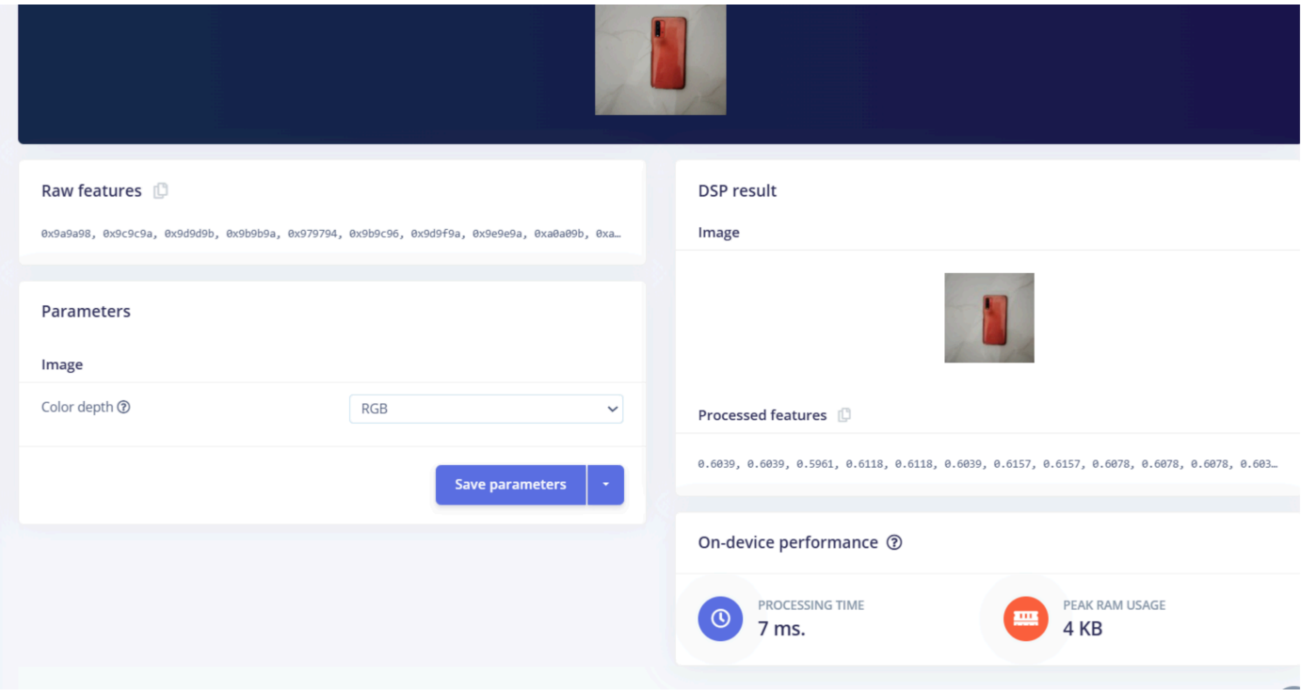
☑ Image

Output features

Output features

0 ()

Accuracy / Loss image



Raw features

```
0x9a9a98, 0x9c9c9a, 0x9d9d9b, 0x9b9b9a, 0x979794, 0x9b9c96, 0x9d9f9a, 0x9e9e9a, 0xa0a09b, 0xa…
```

Parameters

Image

Color depth: RGB

DSP result

Image

Processed features

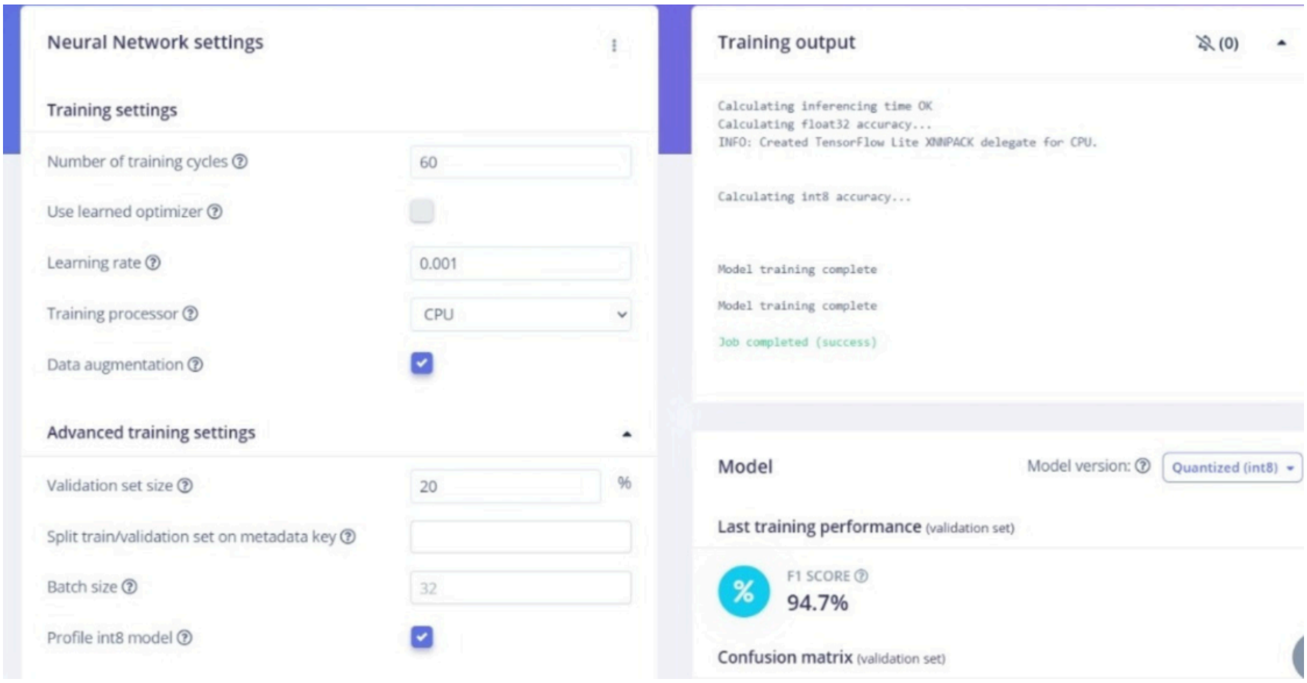
```
0.6039, 0.6039, 0.5961, 0.6118, 0.6118, 0.6039, 0.6157, 0.6157, 0.6078, 0.6078, 0.6078, 0.603…
```

On-device performance

PROCESSING TIME
7 ms.

PEAK RAM USAGE
4 KB

Validation Result – Image



Neural Network settings

Training settings

Number of training cycles: 60

Use learned optimizer: □

Learning rate: 0.001

Training processor: CPU

Data augmentation: ☑

Advanced training settings

Validation set size: 20 %

Split train/validation set on metadata key:

Batch size: 32

Profile int8 model: ☑

Training output

```
Calculating inferencing time OK
Calculating float32 accuracy...
INFO: Created TensorFlow Lite XNNPACK delegate for CPU.

Calculating int8 accuracy...


Model training complete

Model training complete

Job completed (success)
```

Model

Model version: Quantized (int8)

Last training performance (validation set)

F1 SCORE: 94.7%

Confusion matrix (validation set)

- **Conclusion:** Understood of MobileNetV1 & V2 Architectures and custom training on new dataset for edge devices.