

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

The screenshot displays the Edge Impulse web interface. On the left is a sidebar with navigation options: Dashboard, Devices, Data acquisition, Experiments, EON Tuner, Impulse design (with sub-options: Create impulse, Retrain model, Live classification, Model testing, Deployment), and an Upgrade Plan. The main header shows the user 'Gaurav Gadekar' and the project 'Transfer Learning' (PERSONAL). A target specification 'Target: Cortex-M4F 80MHz' is visible in the top right. The 'Dataset' tab is active, showing 'DATA COLLECTED 64 items' and a 'TRAIN / TEST SPLIT' section. Below this is a table of dataset items:

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

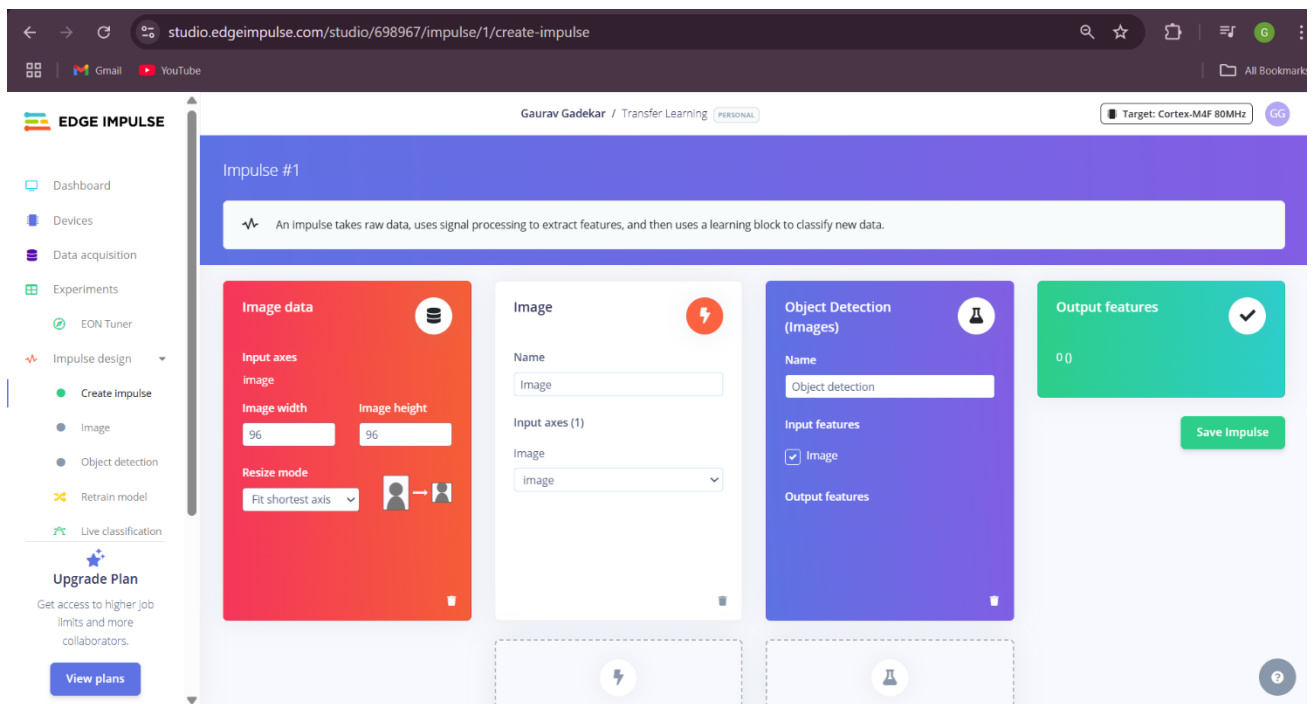
The item 'Headphone.5rehc1df' is highlighted. To the right of the table is a 'Collect data' section with a button to 'Connect a device'. Below this is a 'RAW DATA' section for 'Headphone.5rehc1df' showing an image of a pair of orange and black headphones.

This screenshot shows the Edge Impulse web interface with a different dataset. The sidebar and header are identical to the first screenshot. The 'Dataset' tab is active, showing 'DATA COLLECTED 64 items'. The table of dataset items is as follows:

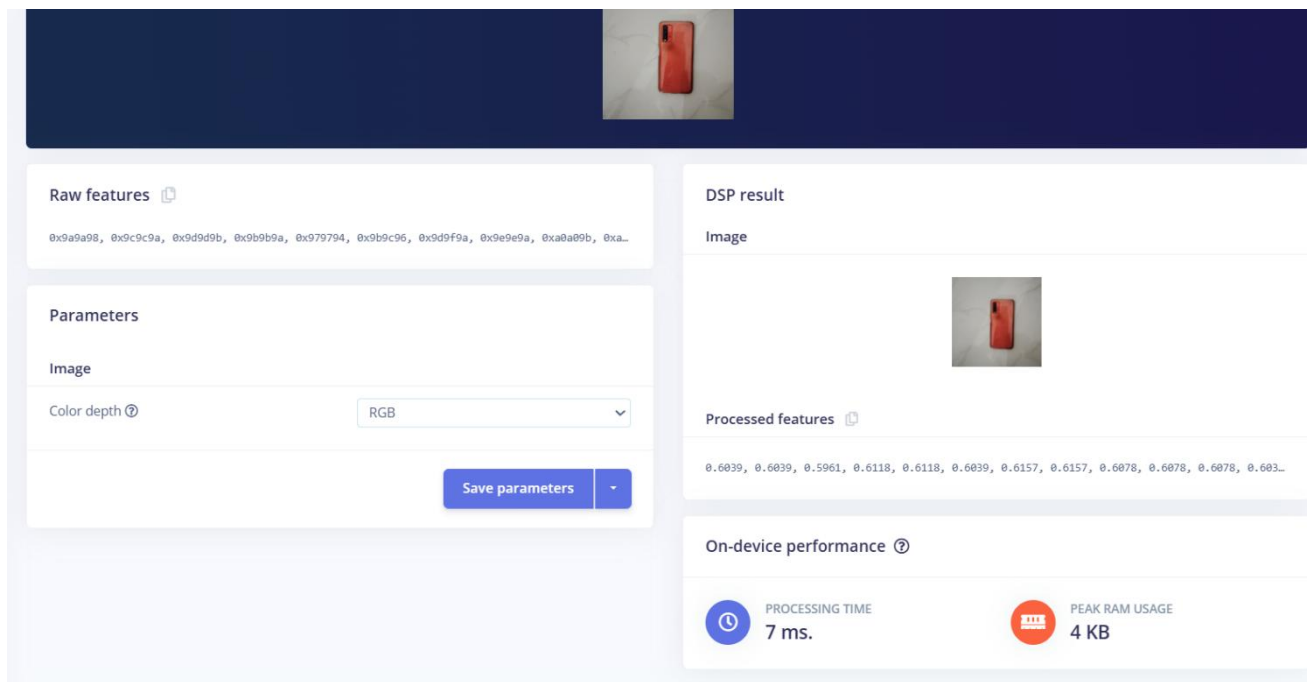
SAMPLE NAME	LABELS	ADDED
Mobile.5reimsae	-	Today, 20:21:47
Mobile.5reimq18	-	Today, 20:21:45
Mobile.5reimo9l	-	Today, 20:21:43
Mobile.5reimggr	-	Today, 20:21:35
Mobile.5reimdii	-	Today, 20:21:32
Mobile.5reimbq7	-	Today, 20:21:30
Mobile.5reim9bb	-	Today, 20:21:28
Mobile.5reim749	-	Today, 20:21:25

The item 'Mobile.5reimggr' is highlighted. The 'Collect data' and 'RAW DATA' sections are also present, with the raw data image showing a red smartphone.

Feature extraction - Image



Accuracy / Loss image



7) Validation Result – Image

Neural Network settings

Training settings

Number of training cycles ①

Use learned optimizer ② ☐

Learning rate ③

Training processor ④

Data augmentation ⑤ ☒

Advanced training settings

Validation set size ⑥ %

Split train/validation set on metadata key ⑦

Batch size ⑧

Profile int8 model ⑨ ☒

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: ⑩

Last training performance (validation set)

F1 SCORE ⑪ **94.7%**

Confusion matrix (validation set)

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