



Learn how to use Google Coral for your Edge ML projects with balena

DevFest UK + Ireland - 29th January 2022



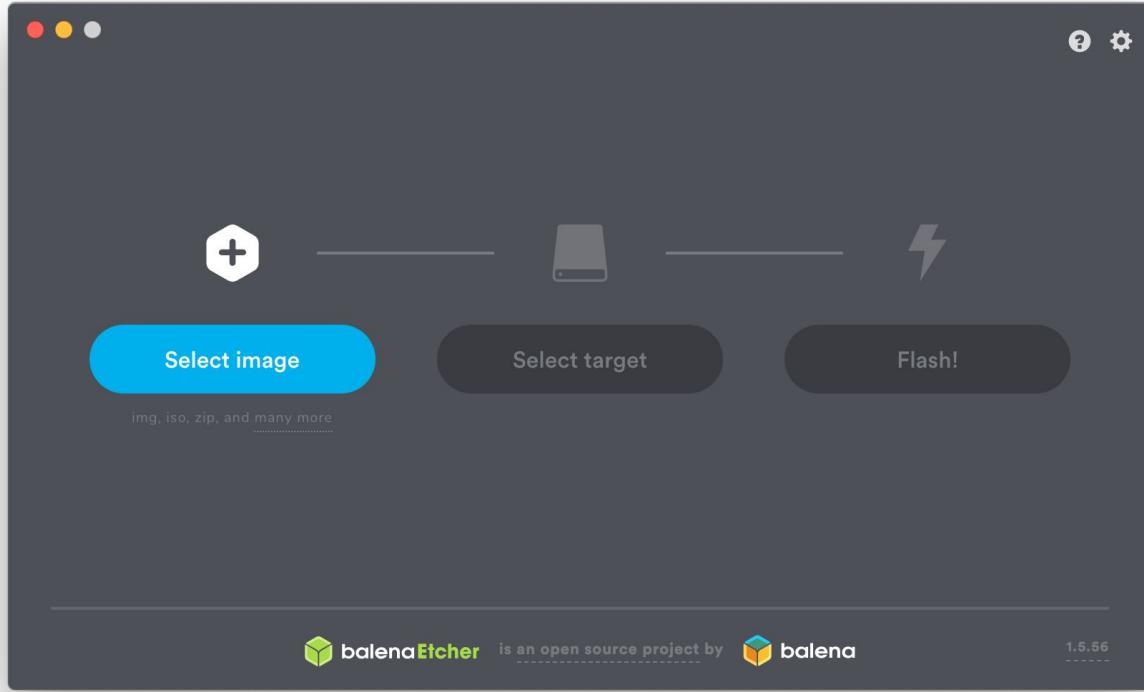


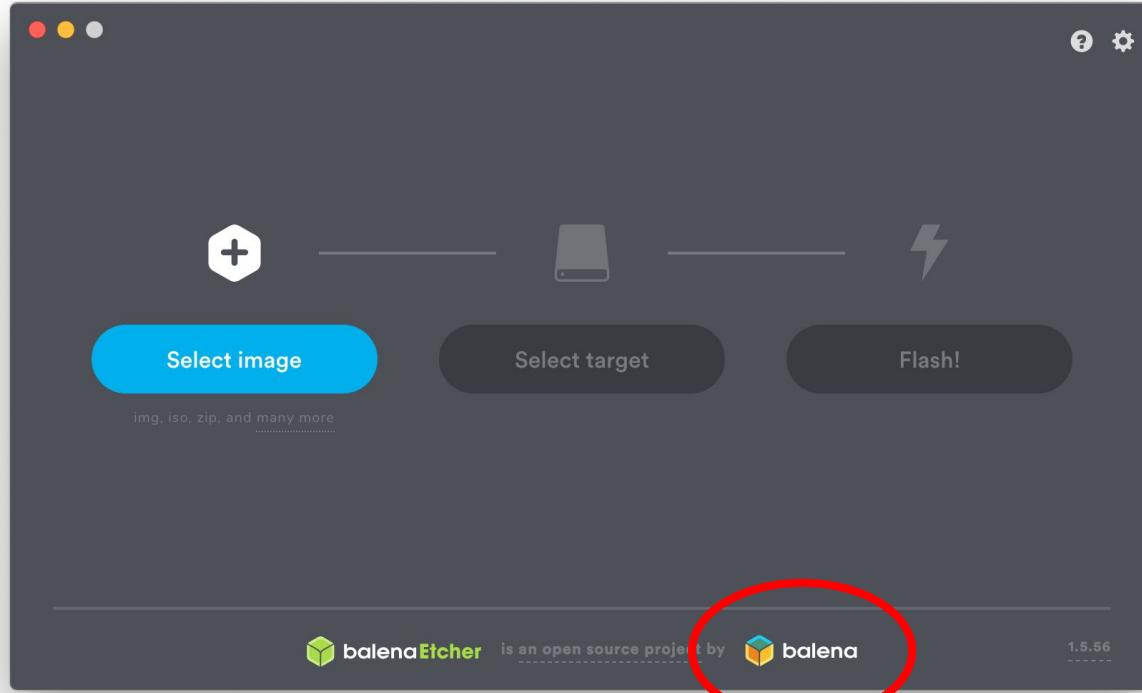
# Marc Pous

balena.io

Developer Advocate





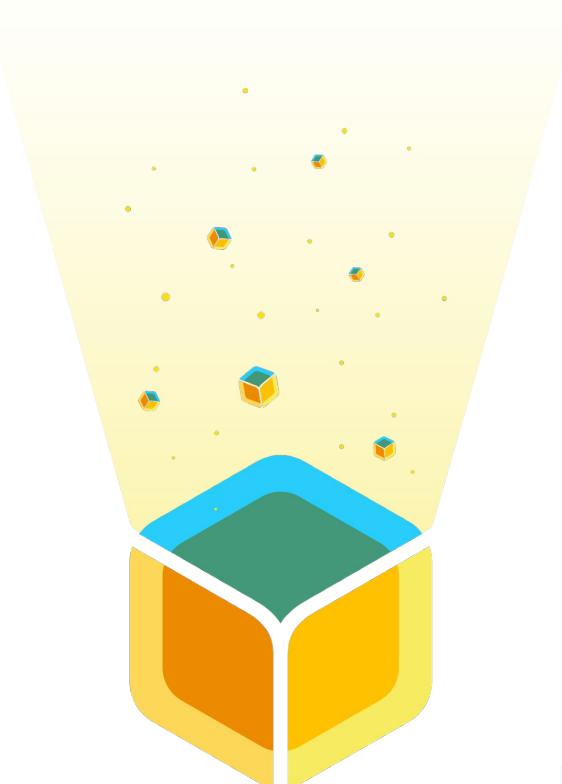


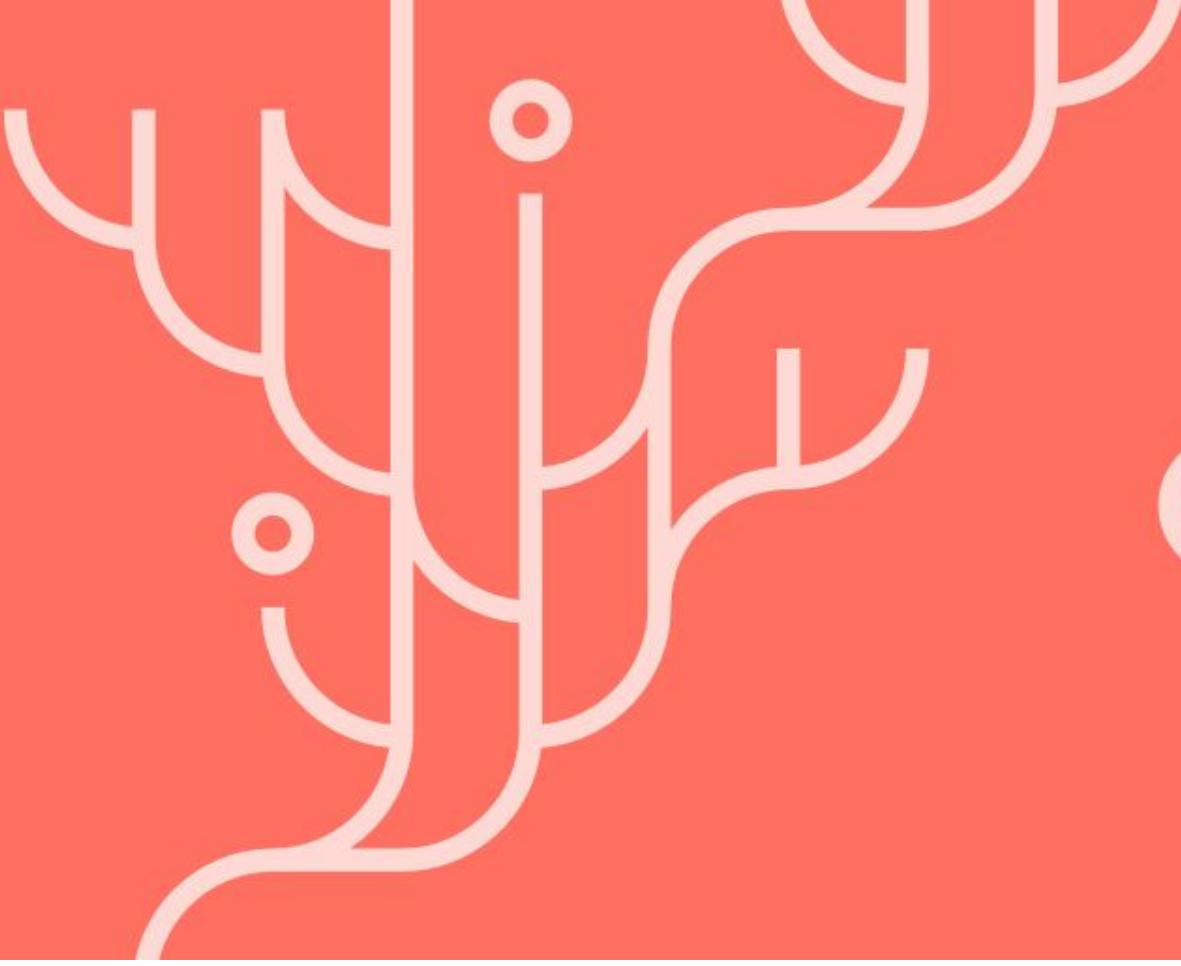
# Goals

Introduce IoT and AI using Coral.

Show how you can do it at home.

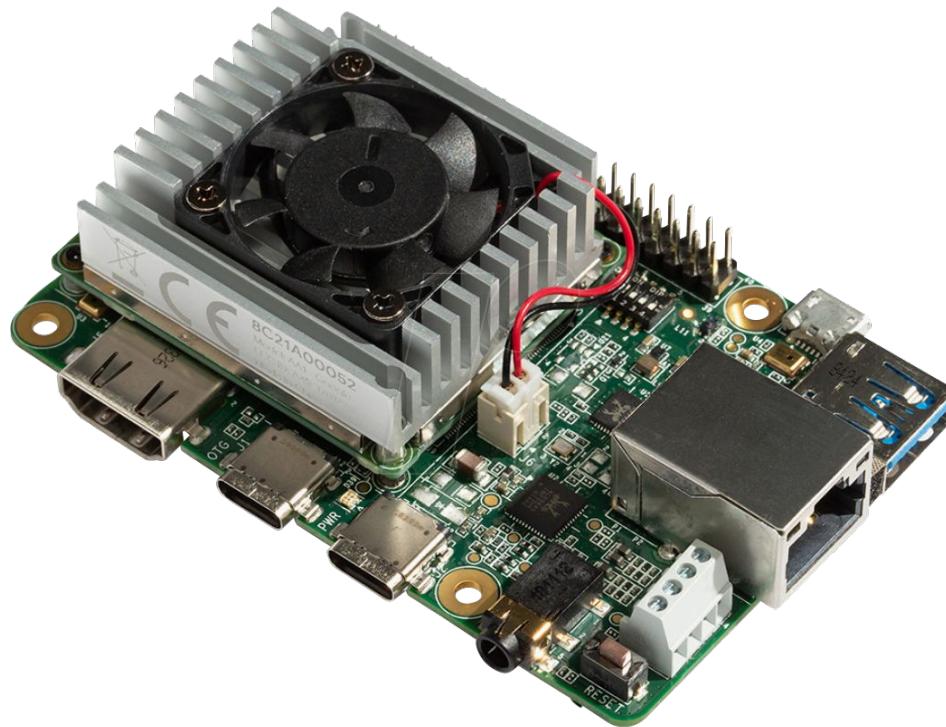
Involve the community in the project.





Coral







AI-equipped cameras will spot x +

https://www.theverge.com/2019/1/3/18166769/ai-cameras-conservation-africa-resolve-intel-elephants-serengeti

SCIENCE \ TECH \ ARTIFICIAL INTELLIGENCE

# AI-equipped cameras will help spot wildlife poachers before they can kill

A new camera developed by nonprofit Resolve uses Intel technology to keep watch in the Serengeti

By James Vincent | Jan 3, 2019, 11:44am EST

f t SHARE



Photo by Wolfgang Kaehler / LightRocket via Getty Images

2 ▾



Subscribe to get the best Verge-approved tech deals of the week.

Email (required)

By signing up, you agree to our [Privacy Notice](#) and European users agree to the data transfer policy.

SUBSCRIBE



Gunshot Detection - ShotSpotter +

https://www.shotspotter.com/law-enforcement/gunshot-detection/

English

Solutions Results Platform Resources About Us Contact Us

SHOTSPOTTER RESPOND™

# Reduce Gun Crime with Proven Gunshot Detection Technology

Identify and Accurately Locate Gunshots in Seconds

REQUEST A CONSULTATION



William Scott  
Chief of Police, San Francisco PD

The Impact of ShotSpotter on Police Agencies

## THE CHALLENGE FOR LAW ENFORCEMENT

**Gun Violence is an Epidemic. Many Communities Aren't Resourced to Combat It.**

Unreported gun fire leaves police unaware of majority of gunfire



Gun violence in America's cities is a devastating epidemic. It has killed more than 65,000 individuals and injured several hundred thousand in just the last five years. What's more devastating – **88%**



Noise Maps - ACTION Project

https://actionproject.eu/citizen-science-pilots/noise-maps/

HOME ABOUT CITIZEN SCIENCE PILOTS NEWS ACCELERATOR MASTERCLASSES TOOLKIT RESOURCES CONTACTS

# NOISE MAPS

**ALL PILOTS**

- AZOTEA
- CITICOMPLASTIC
- CITIZEN SCIENTISTS, DRAGONFLIES AND PESTICIDES
- IN MY BACKYARD
- LOSS OF THE NIGHT
- MAPPING MOBILITY
- NOISE MAPS
- OPEN SOIL ATLAS
- RESTART DATA WORKBENCH
- SONIC KAYAKS
- STREET SPECTRA

**LOCATION**  
Barcelona (Spain)

**TYPE/S OF POLLUTION**  
Noise pollution

**SUSTAINABLE DEVELOPMENT GOALS ADDRESSED?**

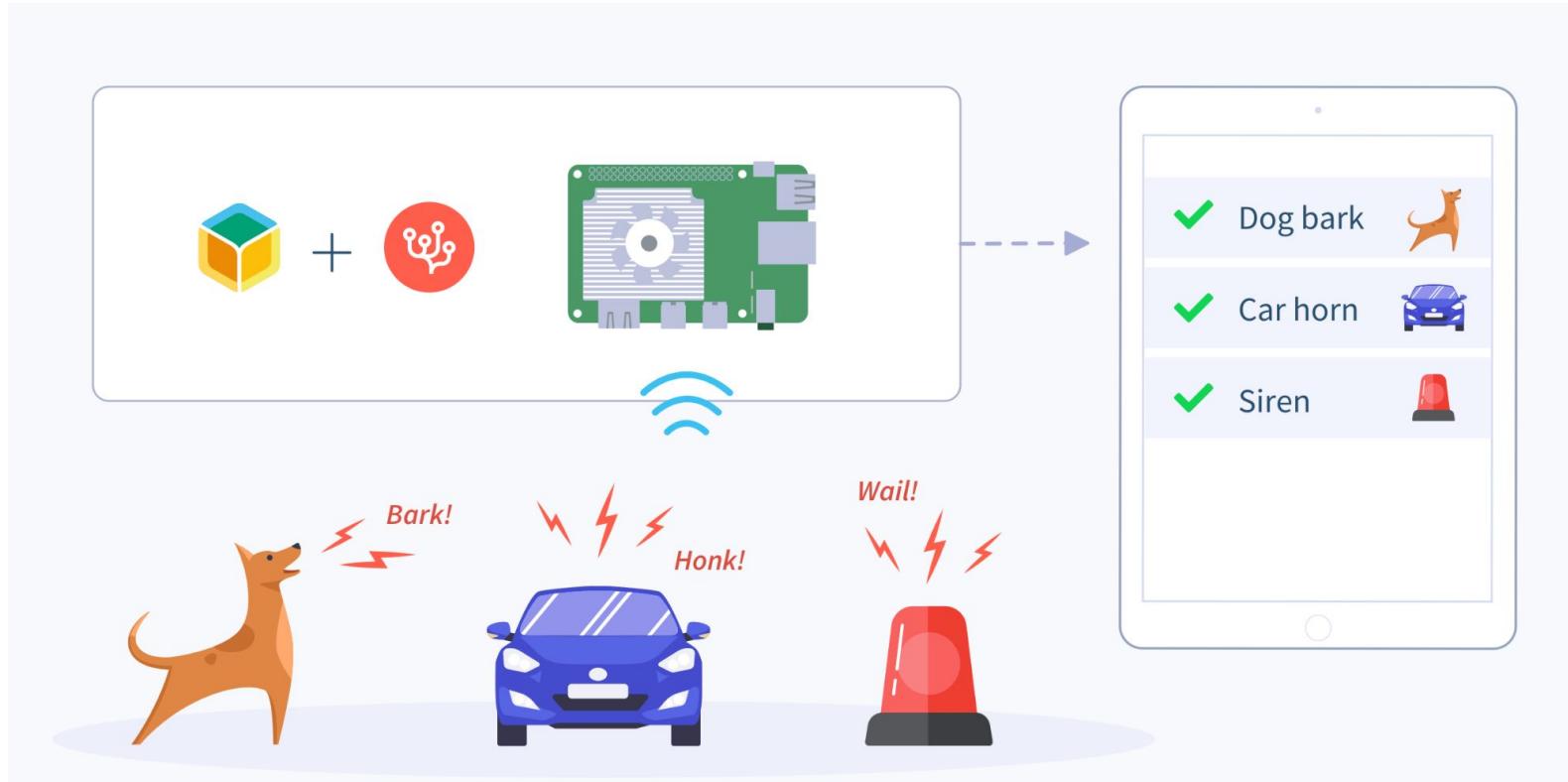
- 3 GOOD HEALTH AND WELL-BEING
- 4 QUALITY EDUCATION
- 11 SUSTAINABLE CITIES AND COMMUNITIES

**NUMBER OF CITIZENS SCIENTISTS INVOLVED**  
20

**IS THE PILOT LOOKING FOR PARTICIPANTS?**  
No. The pilot was concluded in October 2020.

Privacy & Cookies Policy





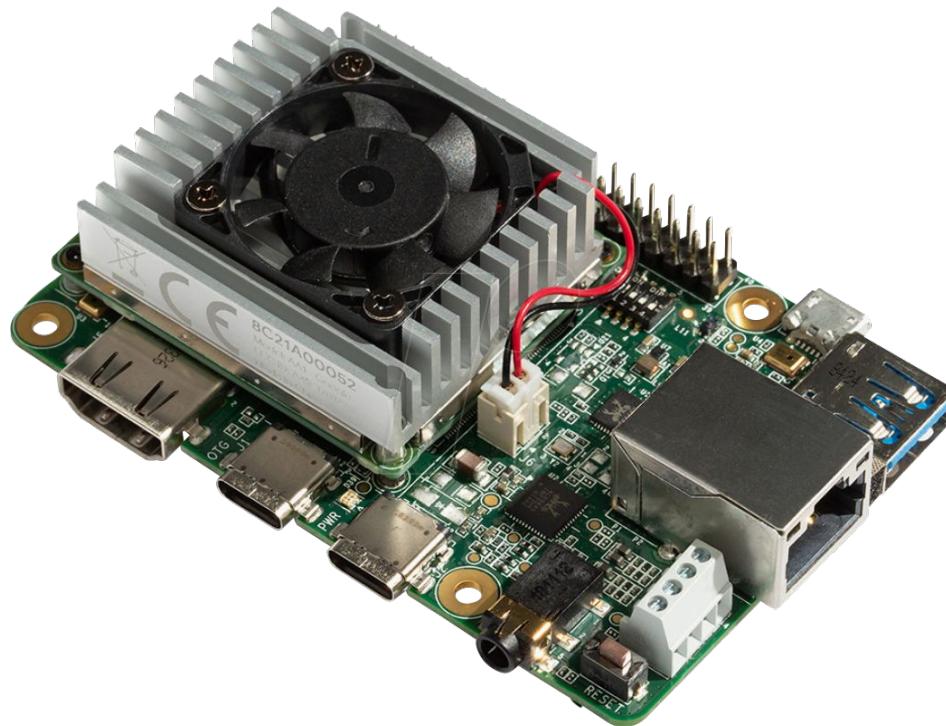
<https://www.balena.io/blog/analyze-sounds-using-ai-on-the-edge-and-fleet-intelligence-part-1/>





What is a fleet?

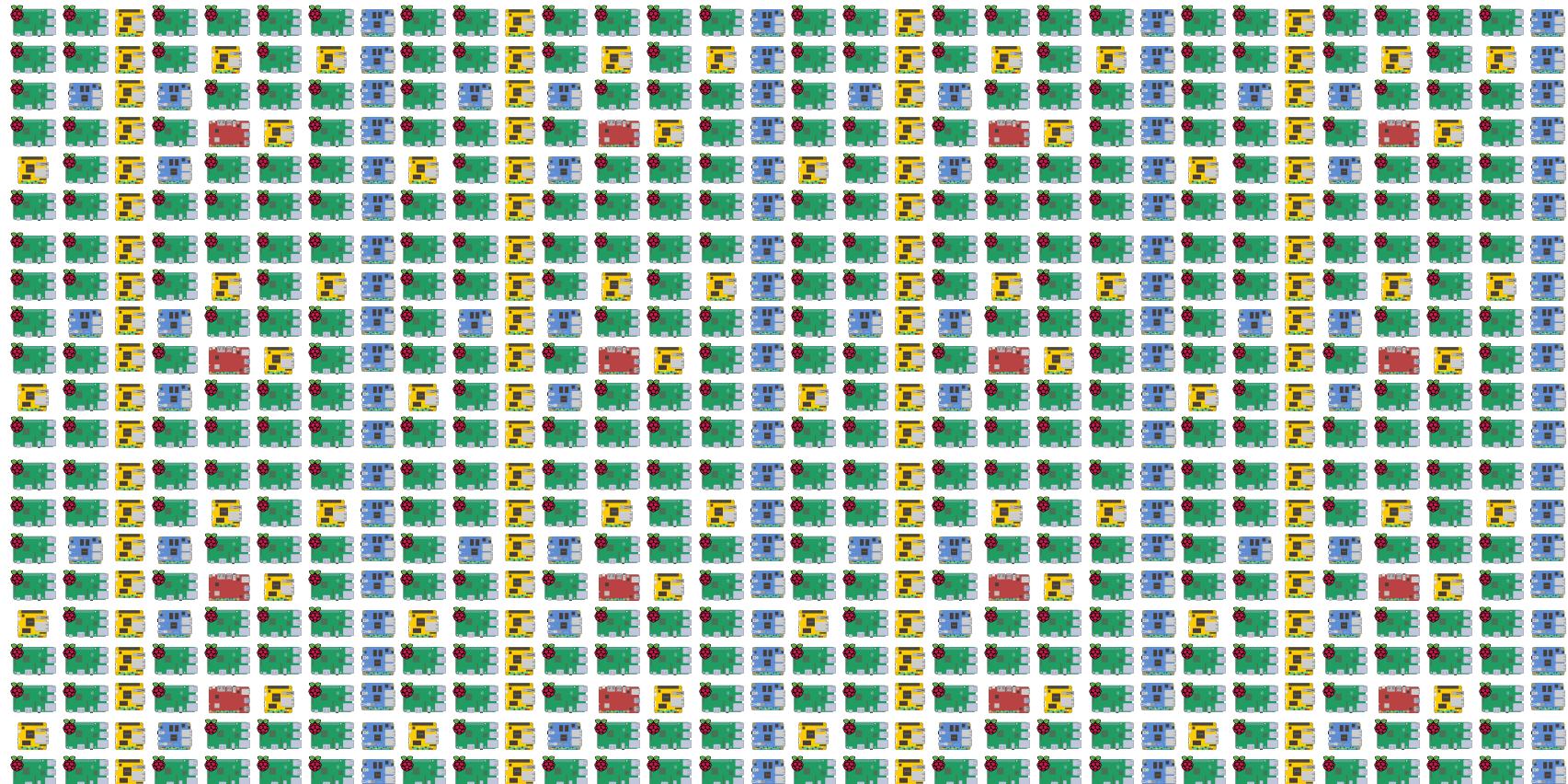




Prototypes are easy™

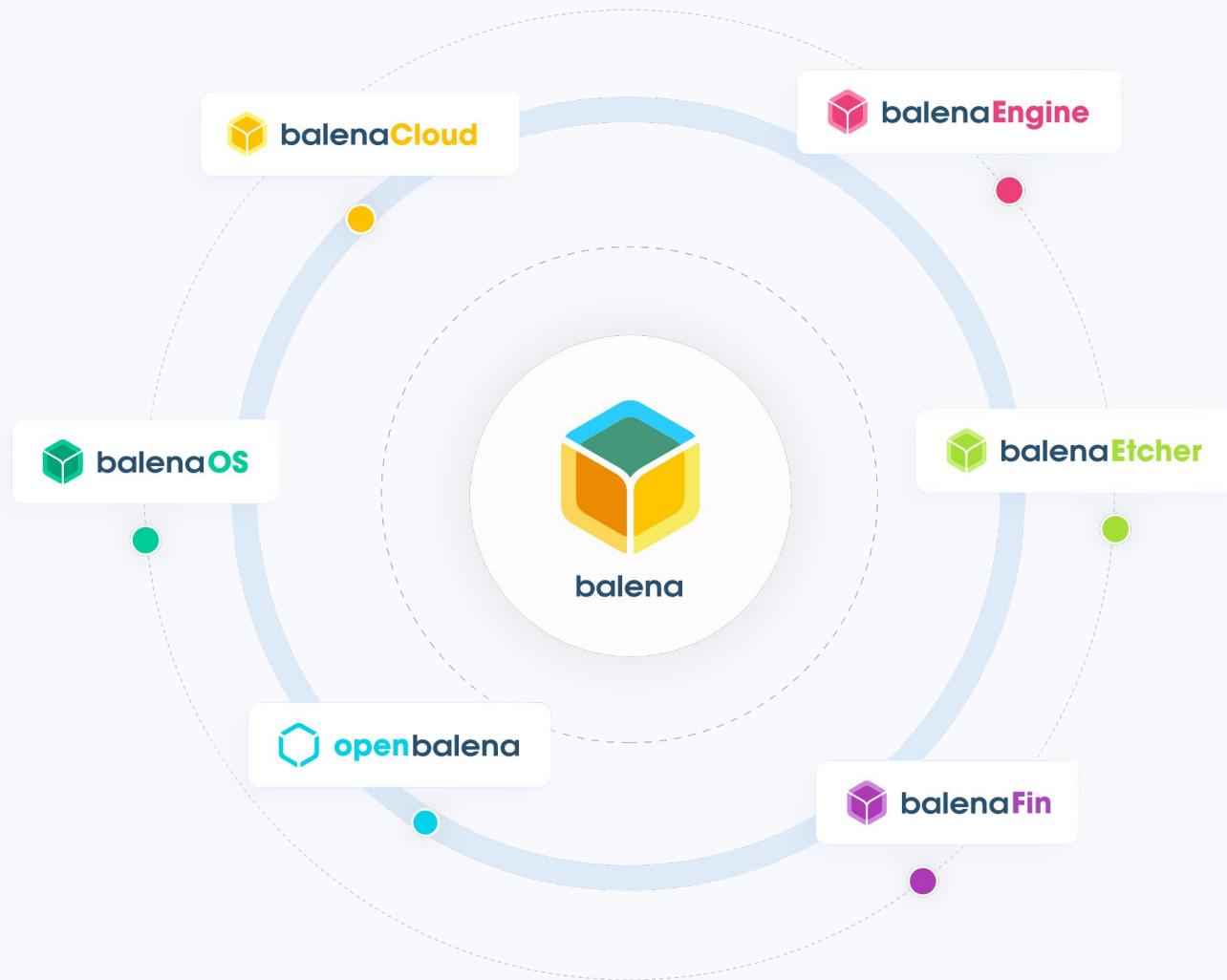


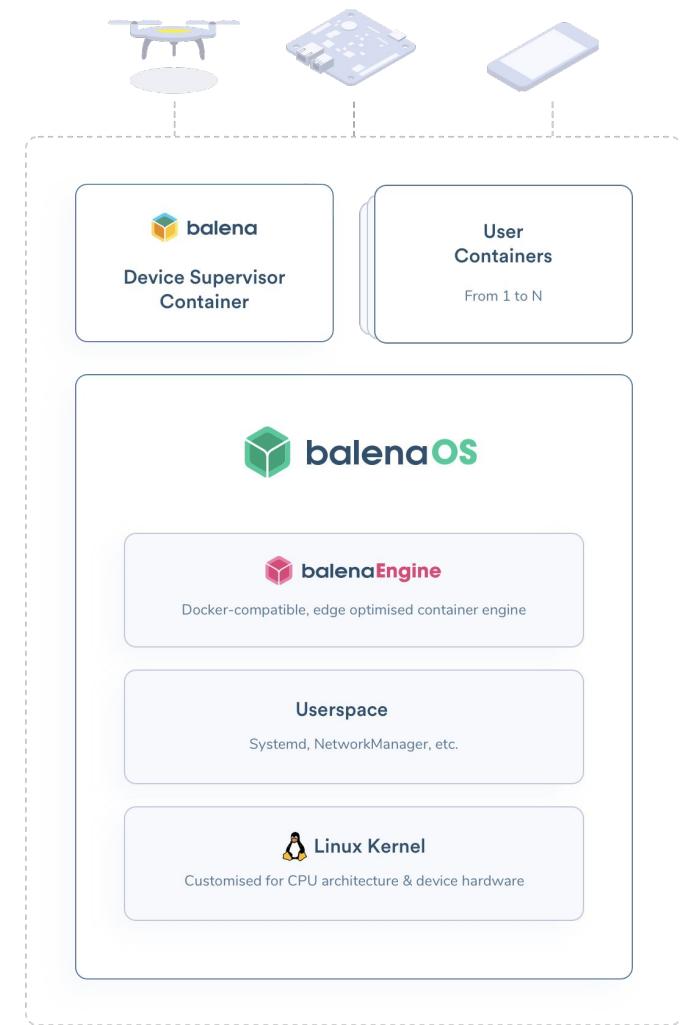




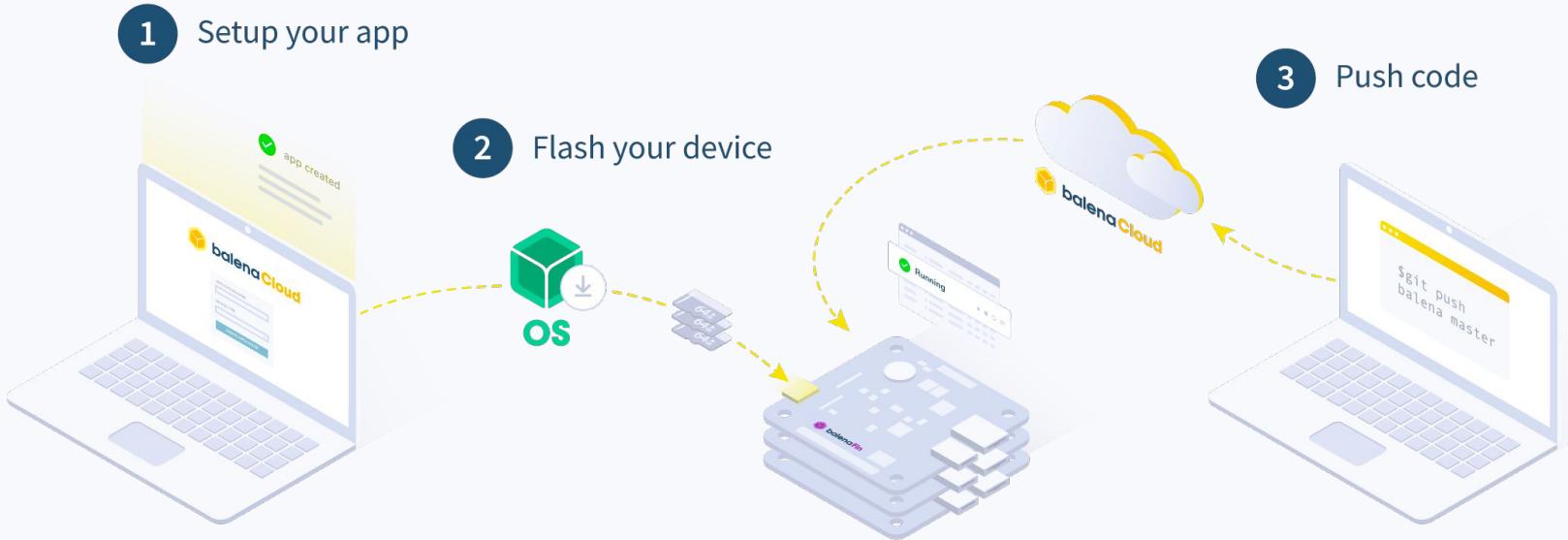


balena





# How it works



# How to build it?





The DIE HARD method



Deploy with balena

or KEEP CALM AND USE balena method



Build it with me :-)

- 1 Prepare Coral Dev Board or Raspberry Pi + Coral USB
- 2 Deploy the balena Fleet
- 3 Share it, contribute and inspire others.



1

# Prepare Coral board or Raspberry Pi with microphone



# Hardware

Coral Dev Board

or

Raspberry Pi 4 + Coral USB + Microphone

SD Card

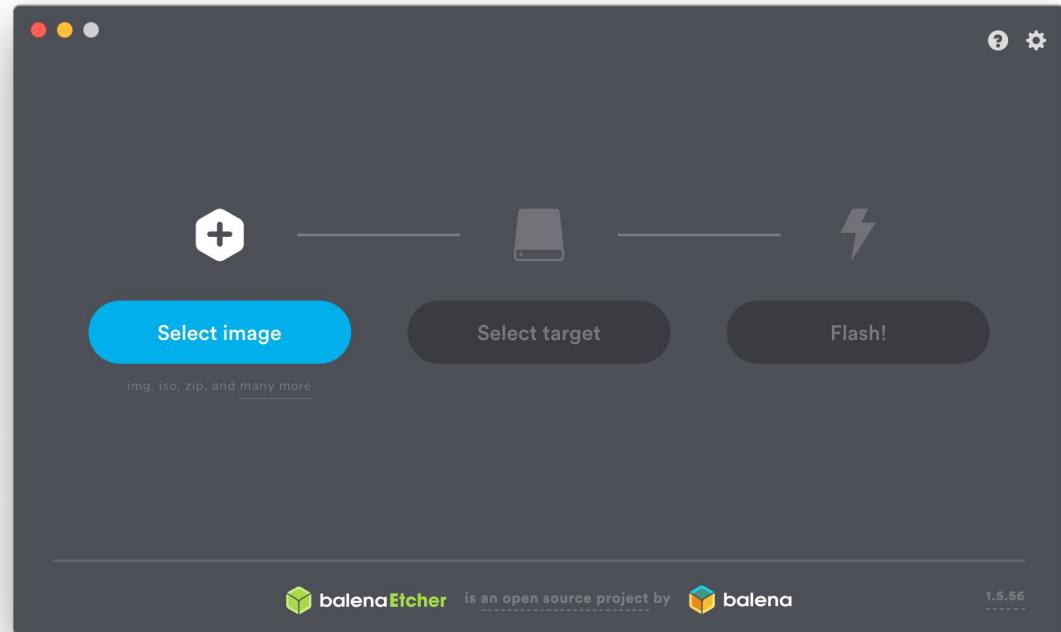
Power Adapter



# Software

[balenaCloud](#)

[balenaEtcher](#)



2

# Deploy the balena fleet in just one click



Analyze sounds using Coral AI

<https://www.balena.io/blog/analyze-sounds-using-ai-on-the-edge-and-fleet-intelligence-part-1/>

balena Blog

Content

Overview

What is an Edge TPU?

Our setup

Hardware required

Software required

Setting up an edge node

Add a device and download the balenaOS disk image

Flash the SD card and boot the device

Start analyzing noise

Using the noise analyzer

Using the web Interface

Uploading Files

How it works

What's next?

30 November 2020 / Last updated: 19 Feb 2021

## Analyze sounds using Coral AI on the edge and fleet intelligence, Part 1

Execution time: 1hr - 2hr | Difficulty: Medium | Cost: Medium

Can we use AI to help us identify and quantify noise pollution? In this project, we're using a Coral Dev Board or a Raspberry Pi 4 with an attached Edge TPU to listen to ambient sounds 24/7 and categorize them for us.

We'll also demonstrate how we could deploy a fleet of these devices (e.g. across an entire city) and feed new information back to all the devices to make them "smarter."



<https://www.balena.io/blog/analyze-sounds-using-ai-on-the-edge-and-fleet-intelligence-part-1/>

balenalabs-incubator/coral-audio-analysis

https://github.com/balenalabs-incubator/coral-audio-analysis

Code Issues Pull requests Actions Projects Wiki Security Insights

Code master 4 branches 0 tags Go to file Add file Code

alanb128 Add logo URL 2b23884 on 19 Feb 180 commits

classifier Fix SQL statement 13 months ago  
recorder Delete Dockerfile.base 12 months ago  
webserver Add Minio region 13 months ago  
README.md Update README.md 12 months ago  
balena.yml Add logo URL 10 months ago  
docker-compose.yml Added depends on 15 months ago  
logo.png Add files via upload 13 months ago

Readme 29 stars 5 watching 5 forks

About

Coral Edge TPU project for analyzing noise pollution

Releases

No releases published Create a new release

Packages

No packages published Publish your first package

Contributors 2

alanb128 Alan Boris  
saintaardvark Hugh Brown (Saint Aar...)

Languages

CSS 33.6% JavaScript 22.6%  
Python 22.2% EJS 17.3%  
Dockerfile 2.3% Shell 2.0%



<https://github.com/balenalabs-incubator/coral-audio-analysis>

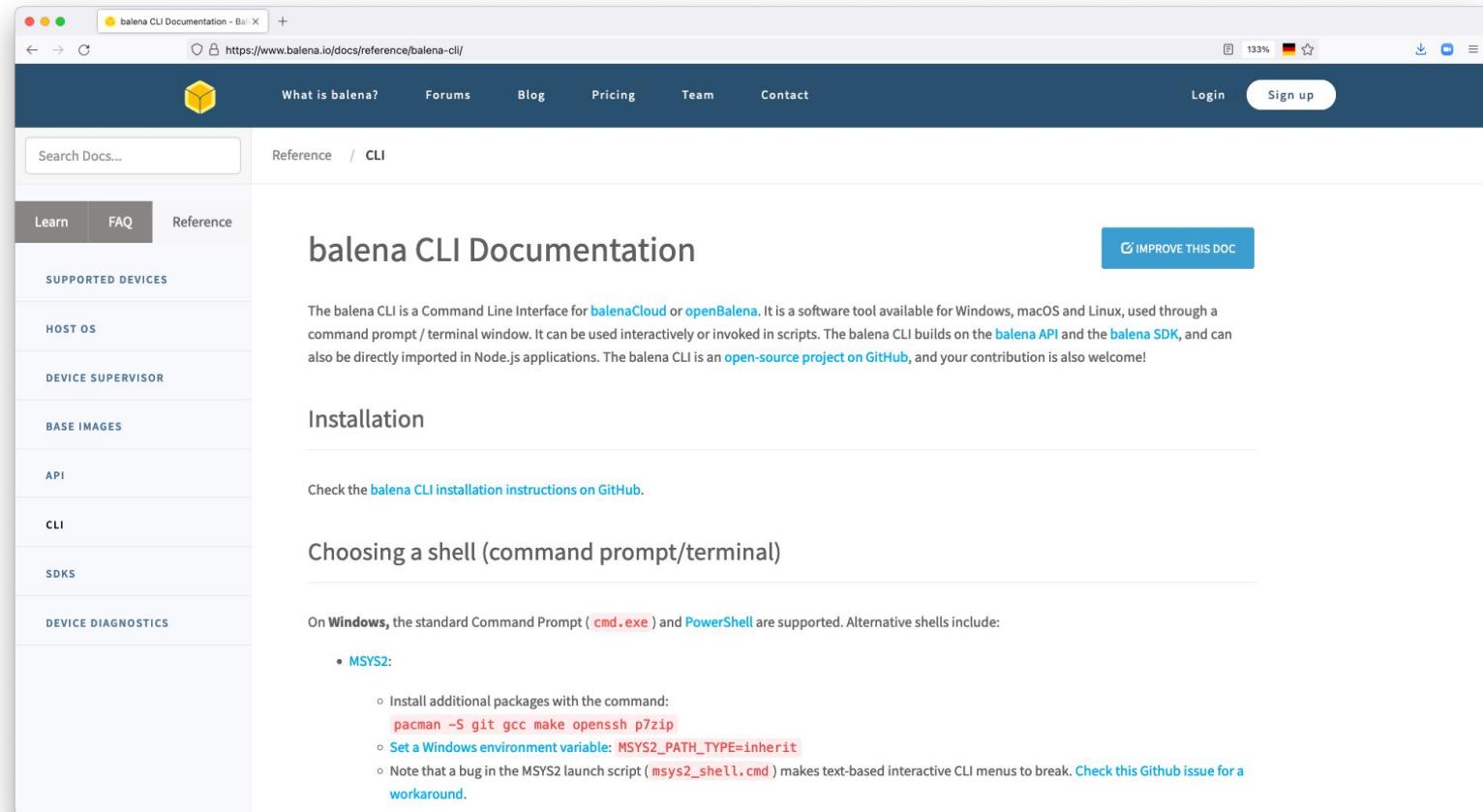


Deploy with balena



```
$ git clone https://github.com/balenalabs-incubator/coral-audio-analysis.git  
$ cd coral-audio-analysis  
$ balena login  
$ balena push coral-audio-analysis
```





The screenshot shows a web browser window displaying the [balena CLI Documentation](https://www.balena.io/docs/reference/balena-cli/). The page has a dark blue header with the balena logo, navigation links for 'What is balena?', 'Forums', 'Blog', 'Pricing', 'Team', 'Contact', and user options 'Login' and 'Sign up'. A search bar is at the top left. The main content area has a light background. On the left is a sidebar with a vertical navigation menu:

- Learn (selected)
- FAQ
- Reference

---

- SUPPORTED DEVICES
- HOST OS
- DEVICE SUPERVISOR
- BASE IMAGES
- API
- CLI (selected)
- SDKS
- DEVICE DIAGNOSTICS

The main content area has a title 'balena CLI Documentation' with a 'IMPROVE THIS DOC' button. Below it is a paragraph about the balena CLI. The 'Installation' section contains a link to GitHub installation instructions. The 'Choosing a shell (command prompt/terminal)' section discusses Windows support and provides MSYS2 setup steps.

The URL in the browser's address bar is <https://www.balena.io/docs/reference/balena-cli/>.

# balena CLI Documentation

The balena CLI is a Command Line Interface for [balenaCloud](#) or [openBalena](#). It is a software tool available for Windows, macOS and Linux, used through a command prompt / terminal window. It can be used interactively or invoked in scripts. The balena CLI builds on the [balena API](#) and the [balena SDK](#), and can also be directly imported in Node.js applications. The balena CLI is an [open-source project on GitHub](#), and your contribution is also welcome!

## Installation

Check the [balena CLI installation instructions on GitHub](#).

## Choosing a shell (command prompt/terminal)

On [Windows](#), the standard Command Prompt ([cmd.exe](#)) and [PowerShell](#) are supported. Alternative shells include:

- **MSYS2:**
  - Install additional packages with the command:  
`pacman -S git gcc make openssh p7zip`
  - Set a Windows environment variable: `MSYS2_PATH_TYPE=inherit`
  - Note that a bug in the MSYS2 launch script ([msys2\\_shell.cmd](#)) makes text-based interactive CLI menus to break. [Check this Github issue for a workaround](#).

<https://github.com/balena-io/balena-cli/blob/master/INSTALL.md>



balena dashboard | Fleets

https://dashboard.balena-cloud.com/fleets/1888715/summary

90% Getting Started Docs Forums Status Marc Pous MP

### coral-gdg

Architecture aarch64  
Slug marc6/coral-gdg  
Created Dec 8th 2021, 10:03 am  
Microservices

### Devices

2

Online Config Updating Offline Post proc Inactive

### Releases

1

Default Track latest

Coral Audio Analysis Learn more

Add device Tags Actions

Name	Status	Device type	Last seen	UUID	OS version	OS variant	Supervisor version	IP address	Public address	Current release	Target Release
Phoenix	✓ Online	Coral Dev Board	Online (for 19 hours)	e0fe52e	balenaOS 2.67.3+rev2	Development	12.3.0	192.168.0.64	2600:8800:7:d000:f322	c18a5e4	c18a5e4
Barcelona	✗ Offline	Raspberry Pi 4 (using 64bit OS)	18 hours ago	58f4c25	balenaOS 2.87.16+rev1	Development	12.11.0	192.168.1.44	88.0.18.2	c18a5e4	c18a5e4

Need help



balena dashboard | coral-gdg

https://dashboard.balena-cloud.com/fleets/1888715/summary

Getting Started Docs Forums Status Marc Pous Help

Organizations Marc Pous Fleets coral-gdg Summary Devices Releases Variables Configuration Actions Settings Members Teams Location

coral-gdg

C Devices 2 Releases 1

Add new device

Select device type ?

C Coral Dev Board (NEW)

Select version ?

v2.67.3+rev2 (recommended)

Show outdated versions

Select edition

Development ? Recommended for first time users  
Development images should be used when you are developing an application and want to use the fast local mode workflow. This variant should never be used in production.

Production  
Production images are ready for production deployments, but don't offer easy access for local development.

Network Connection

Ethernet only

Wifi + Ethernet

+ Advanced

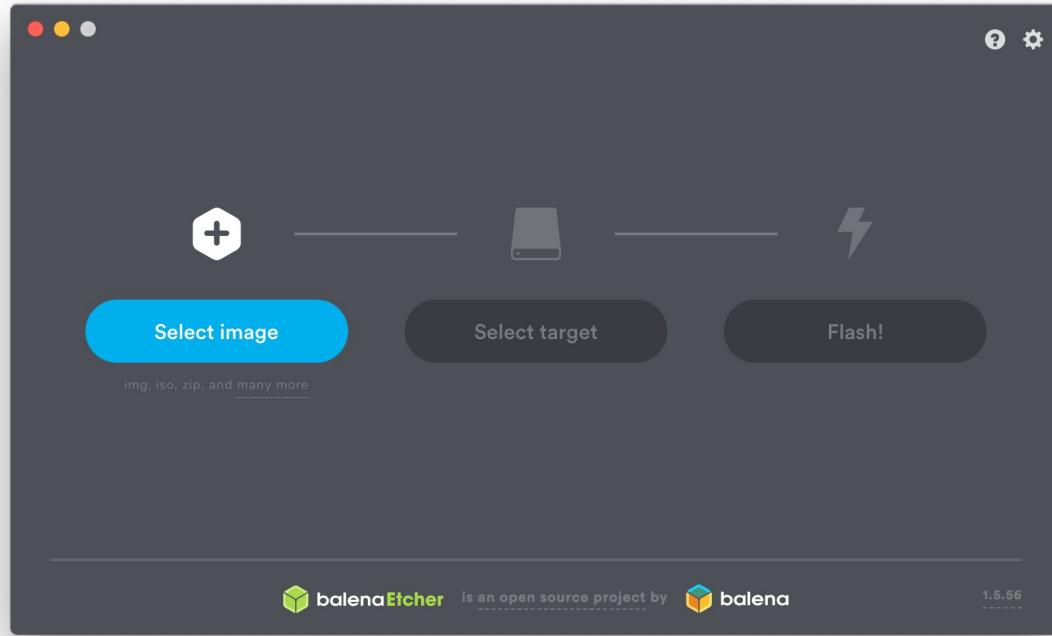
Download balenaOS

Instructions

- 1 Use the form on the left to configure and download balenaOS for your new device.
- 2 Set the BOOT\_SELECT switch to the SD-CARD position.
- 3 Write the OS file you downloaded to your SD card. We recommend using Etcher.
- 4 Insert the freshly burnt SD card into the Coral Dev Board.
- 5 Warning! This will also completely erase internal storage media, so please make a backup first.
- 6 The device is performing a shutdown. Please wait until all LEDs are off.
- 7 Remove the balenaOS installation media.
- 8 Set the BOOT\_SELECT switch to the eMMC position.
- 9 Remove and re-connect power to the board.
- 10 Your device should appear in your fleet in the dashboard within a few minutes. Have fun!

For more details please refer to our [Getting Started Guide](#).





balena dashboard | Phoenix

https://dashboard.balena-cloud.com/devices/e0fe52e49b9a5007c8b6bafe8b60c49/summary

90% 90% ⚡ Getting Started Docs Forums Status Marc Pous MP

### Phoenix

**STATUS** Online **UUID** e0fe52e49b9a5007c8b6bafe8b60c49 **TITLE** Coral Dev Board

**ONLINE FOR** 19 hours **HOST OS VERSION** balenaOS 2.67.3+rev2 **SUPERVISOR VERSION** 12.3.0

**CURRENT RELEASE** c18a5e4 **TARGET RELEASE** c18a5e4

**LOCAL IP ADDRESS** 192.168.0.64 **PUBLIC IP ADDRESS** 2600:8000:7:d000::f322 **MAC ADDRESS** 7C:D9:5C:B1:B1:1A 7C:D9:5C:B1:B1:1C 7C:D9:5C:B1:B1:1B

**TAGS** No tags configured yet **PUBLIC DEVICE URL**

**NOTES** Add device notes...

**SERVICES**

Service	Status	Release
classifier	Running	c18a5e4
recorder	Running	c18a5e4
webserver	Running	c18a5e4

**CPU** ~42% **Temperature** ~60C **Memory** 499 MB/985 MB **Storage** 4.8 GB/6.4 GB

**Logs** UTC Timestamps

Add filter Search entries... Views

```
09.12.21 21:27:19 (+0100) webserver 'dog_bark',  
09.12.21 21:27:19 (+0100) webserver 'drilling',  
09.12.21 21:27:19 (+0100) webserver 'engine_idling',  
09.12.21 21:27:19 (+0100) webserver 'gun_shot',  
09.12.21 21:27:19 (+0100) webserver 'jackhammer',  
09.12.21 21:27:19 (+0100) webserver 'siren',  
09.12.21 21:27:19 (+0100) webserver 'street_music'  
09.12.21 21:27:19 (+0100) webserver ]  
09.12.21 21:27:19 (+0100) webserver Express server listening on port 80  
09.12.21 21:27:19 (+0100) webserver Successful connection to the database.
```

**Terminal**

Select a target Start terminal session

Need help



Coral Noise Analysis +

https://58f4c25d498f7dc388bc47cd738906ba.balena-devices.com

Noise Analysis

## Sound Recordings (65)

Filter by:

Not Uploaded  Uploaded  Deleted

Files ready for upload: 0

Upload (No Minio credentials set)

File Created	Status	Top Guess	2nd Guess	Play	Action
2021-12-08 10:07:01	evaluated	children_playing (32%)	dog_bark (24%)	0:00 / 0:02	
2021-12-08 10:06:59	evaluated	siren (47%)	dog_bark (26%)	0:00 / 0:02	
2021-12-08 10:06:52	evaluated	siren (54%)	dog_bark (17%)	0:00 / 0:02	
2021-12-08 10:06:48	evaluated	siren (71%)	dog_bark (12%)	0:00 / 0:02	
2021-12-08 10:06:40	evaluated	siren (42%)	dog_bark (17%)	0:00 / 0:02	
2021-12-08 10:04:59	evaluated	siren (32%)	dog_bark (24%)	0:00 / 0:02	
2021-12-08 10:04:33	evaluated	dog_bark (31%)	gun_shot (17%)	0:00 / 0:02	
2021-12-08 10:04:27	evaluated	siren (48%)	dog_bark (20%)	0:00 / 0:02	
2021-12-08 10:04:22	evaluated	siren (85%)	dog_bark (6%)	0:00 / 0:01	
2021-12-08 10:04:20	evaluated	siren (44%)	engine_idling (14%)	0:00 / 0:02	



The screenshot shows a web browser window with the title "UrbanSound8K - Urban Sound" at the top. The URL in the address bar is <https://urbansounddataset.weebly.com/urbansound8k.html>. The page features a large banner image of a city skyline at sunset with the text "URBANSOUND8K DATASET" overlaid. Below the banner, there is a navigation menu with links to "HOME", "URBANSOUND", "URBANSOUND8K" (which is highlighted), "TAXONOMY", and "PUBLICATIONS". The main content area has a section titled "DESCRIPTION" which provides details about the dataset, including its size (8732 labeled sound excerpts), classes (air\_conditioner, car\_horn, children\_playing, dog\_bark, drilling, engine\_idling, gun\_shot, jackhammer, siren, street\_music), and source ([our paper](#)). It also mentions that excerpts are from field recordings on Freesound and are pre-sorted into ten folds. A CSV file with metadata is provided. The "AUDIO FILES INCLUDED" section states there are 8732 audio files in WAV format. The "META-DATA FILES INCLUDED" section lists "UrbanSound8k.csv" and describes it as containing meta-data information for every audio file. At the bottom, there is a note about the file naming convention and a "POWERED BY weebly" logo.

URBAN SOUND DATASETS    HOME    URBANSOUND    **URBANSOUND8K**    TAXONOMY    PUBLICATIONS

# URBANSOUND8K DATASET

## DESCRIPTION

This dataset contains 8732 labeled sound excerpts (<=4s) of urban sounds from 10 classes: air\_conditioner, car\_horn, children\_playing, dog\_bark, drilling, engine\_idling, gun\_shot, jackhammer, siren, and street\_music. The classes are drawn from the [urban sound taxonomy](#). For a detailed description of the dataset and how it was compiled please refer to [our paper](#).

All excerpts are taken from field recordings uploaded to [www.freesound.org](#). The files are pre-sorted into ten folds (folders named fold1-fold10) to help in the reproduction of and comparison with the automatic classification results reported in the article above.

In addition to the sound excerpts, a CSV file containing metadata about each excerpt is also provided.

## AUDIO FILES INCLUDED

8732 audio files of urban sounds (see description above) in WAV format. The sampling rate, bit depth, and number of channels are the same as those of the original file uploaded to Freesound (and hence may vary from file to file).

## META-DATA FILES INCLUDED

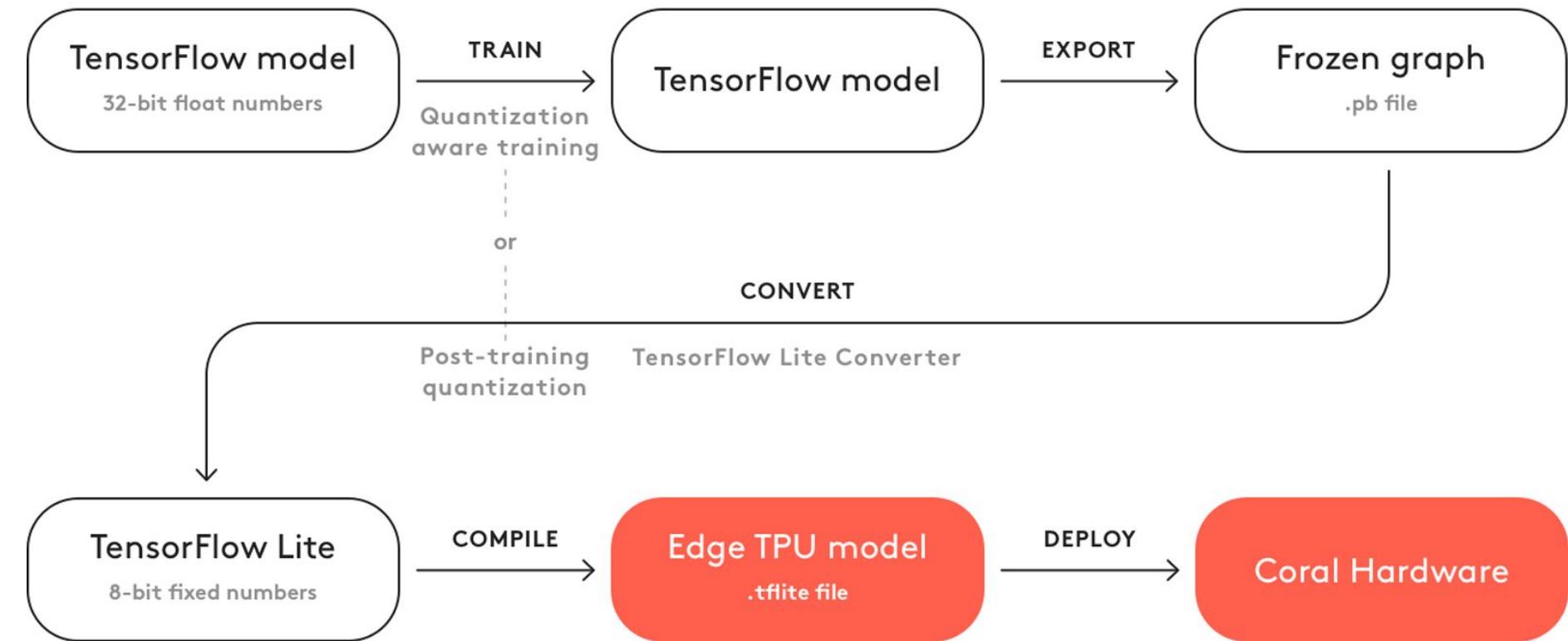
**UrbanSound8k.csv**

This file contains meta-data information about every audio file in the dataset. This includes:

\* slice\_file\_name:  
The name of the audio file. The name takes the following format: [fsID]-[classID]-[occurrenceID]-[sliceID].wav, where:  
[fsID] = the Freesound ID of the recording from which this excerpt (slice) is taken  
[classID] = a numeric identifier of the sound class (see description of classID below for further details)  
[occurrenceID] = a numeric identifier to distinguish different occurrences of the sound within the original recording

POWERED BY **weebly**





3

# Share it, contribute and inspire others



Time to install it :-)  
Please send feedback



Analyze sounds using Coral AI

<https://www.balena.io/blog/analyze-sounds-using-ai-on-the-edge-and-fleet-intelligence-part-1/>

balena Blog

Content

Overview

What is an Edge TPU?

Our setup

Hardware required

Software required

Setting up an edge node

Add a device and download the balenaOS disk image

Flash the SD card and boot the device

Start analyzing noise

Using the noise analyzer

Using the web Interface

Uploading Files

How it works

What's next?

30 November 2020 / Last updated: 19 Feb 2021

## Analyze sounds using Coral AI on the edge and fleet intelligence, Part 1

Execution time: 1hr - 2hr | Difficulty: Medium | Cost: Medium

Can we use AI to help us identify and quantify noise pollution? In this project, we're using a Coral Dev Board or a Raspberry Pi 4 with an attached Edge TPU to listen to ambient sounds 24/7 and categorize them for us.

We'll also demonstrate how we could deploy a fleet of these devices (e.g. across an entire city) and feed new information back to all the devices to make them "smarter."



<https://www.balena.io/blog/analyze-sounds-using-ai-on-the-edge-and-fleet-intelligence-part-1/>

balena-io-examples/coral-streaming-object-detector

Search or jump to... Pull requests Issues Marketplace Explore

Code Issues 8 Pull requests 1 Actions Projects Wiki Security Insights

Code master 2 branches 0 tags Go to file Add file Code

bulldozer-balena[bot] Merge pull request #9 from scottomain/patch-1 163eafe on 10 Jul 2020 20 commits

edge-logic Disabled webRTC 2 years ago

images Update Readme.md 2 years ago

models webserver and obj recog working but not hooked together 2 years ago

.dockerignore Update Readme.md 2 years ago

.gitignore Disabled webRTC 2 years ago

LICENSE Initial working example 2 years ago

README.md README copy edits 2 years ago

docker-compose.yml Split model and logic into services 2 years ago

README.md

## Streaming Object Detector with Coral and BalenaCloud

This guide will help you deploy a streaming camera feed with realtime people detection using the [Coral Edge TPU](#) for on-device ML inferencing. This example is designed to work with the [Coral Dev Board](#), but should work with other balena-compatible devices that have an Edge TPU.



**About**

This example will help you deploy a streaming camera feed with realtime people detection using the Coral Edge TPU for on-device ML inferencing.

ai webrtc coral balena-io  
coral-tpu

Readme Apache-2.0 License 20 stars 3 watching 7 forks

**Releases**

No releases published Create a new release

**Packages**

No packages published Publish your first package

**Contributors 4**

chrisys Chris Crocker-White  
bulldozer-balena[bot]

<https://github.com/balena-io-examples/coral-streaming-object-detector>



# Contribute to the project! (It's open source)

<https://github.com/balenalabs-incubator/coral-audio-analysis>



Ok! Let's wrap-up!

# Takeaways

- Learn about Machine Learning and sound classification.
- Create your IoT / Edge AI fleet, the easy way.
- Contribute and inspire others.



# Questions?



Learn how to use Google Coral for your Edge ML projects with balena

DevFest UK + Ireland - 29th January 2022

