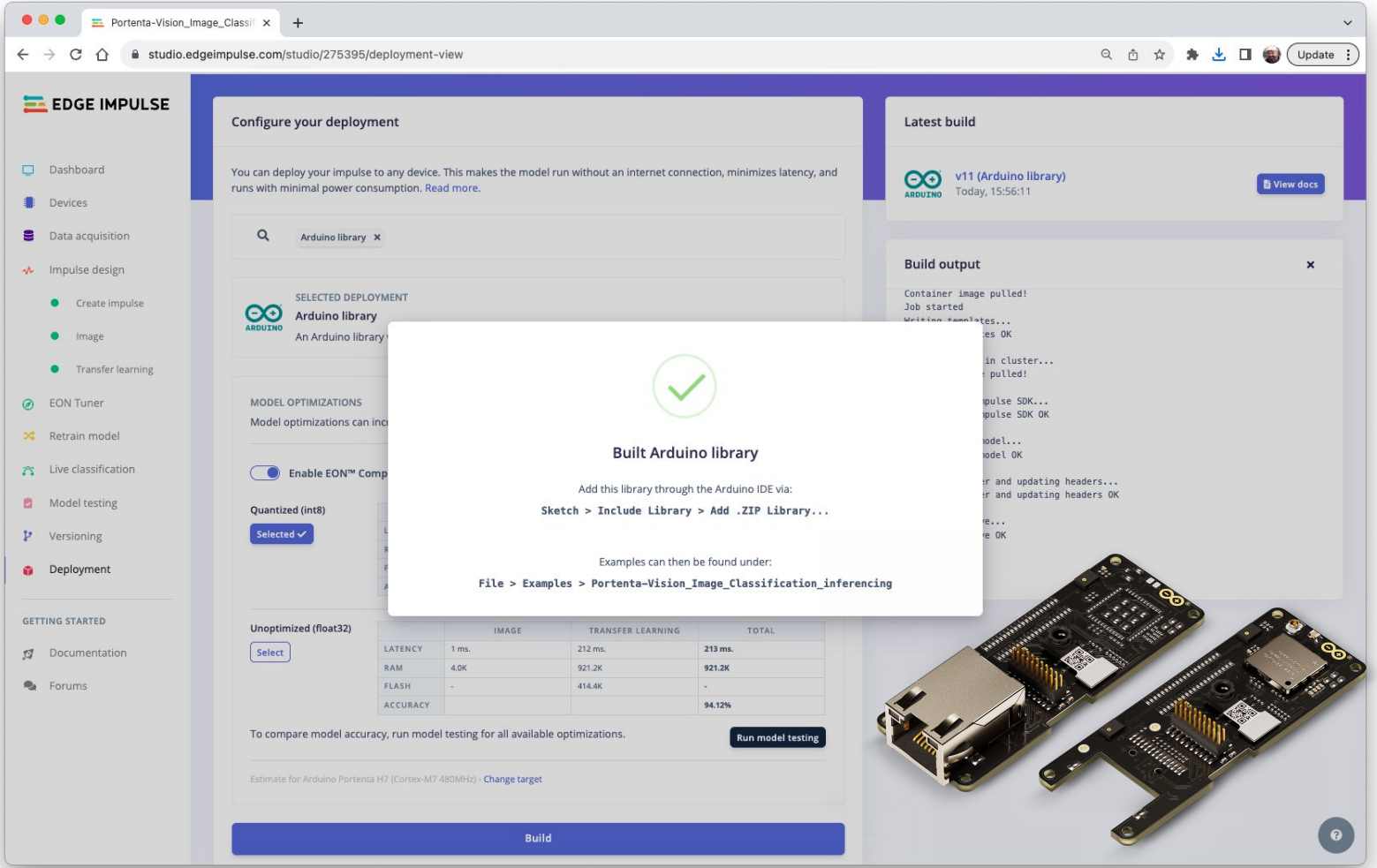
Addendum

Deploying models as **Arduino Library**

& Benchmarks


Portenta-Vision_Image_Classif
studio.edgeimpulse.com/studio/275395/deployment-view
Update
EDGE IMPULSE
Dashboard
Devices
Data acquisition
Impulse design
Create impulse
Image
Transfer learning
EON Tuner
Retrain model
Live classification
Model testing
Versioning
Deployment
GETTING STARTED
Documentation
Forums
Configure your deployment
You can deploy your impulse to any device. This makes the model run without an internet connection, minimizes latency, and runs with minimal power consumption. Read more.
Arduino library
SELECTED DEPLOYMENT
Arduino library
An Arduino library
MODEL OPTIMIZATIONS
Model optimizations can inc
Enable EON™ Comp
Quantized (int8)
Selected
Unoptimized (float32)
Select
IMAGE
TRANSFER LEARNING
TOTAL
LATENCY
1 ms.
212 ms.
213 ms.
RAM
4.0K
921.2K
921.2K
FLASH
-
414.4K
-
ACCURACY
94.12%
To compare model accuracy, run model testing for all available optimizations.
Run model testing
Estimate for Arduino Portenta H7 (Cortex-M7 480MHz) - Change target
Build
Latest build
v11 (Arduino library)
Today, 15:56:11
View docs
Build output
Container image pulled!
Job started
Built Arduino library
Add this library through the Arduino IDE via:
Sketch > Include Library > Add .ZIP Library...
Examples can then be found under:
File > Examples > Portenta-Vision_Image_Classification_inferencing

/dev/cu.usbmodem1101

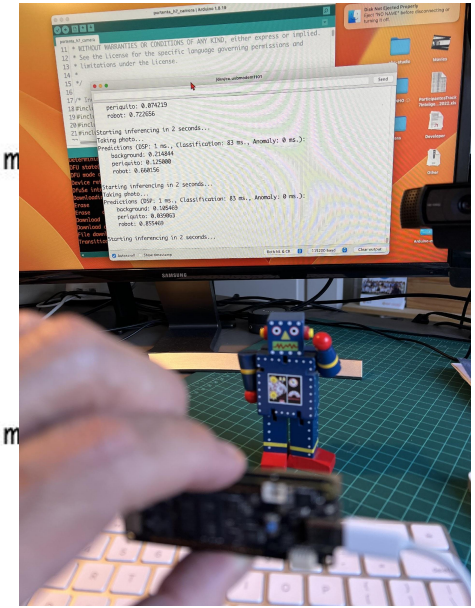
Send

```
    periquito: 0.015625
    robot: 0.089844

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 83 ms., Anomaly: 0 m
    background: 0.019531
    periquito: 0.042969
    robot: 0.941406

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 83 ms., Anomaly: 0 m
    background: 0.003906
    periquito: 0.015625
    robot: 0.980469

Starting inferencing in 2 seconds...
```



Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

/dev/cu.usbmodem1101

Send

```
    periquito: 0.691406
    robot: 0.179687

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 83 ms., Anomaly: 0 m
    background: 0.089844
    periquito: 0.804687
    robot: 0.105469

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 83 ms., Anomaly: 0 m
    background: 0.066406
    periquito: 0.859375
    robot: 0.074219

Starting inferencing in 2 seconds...
```

Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

/dev/cu.usbmodem1101

Send

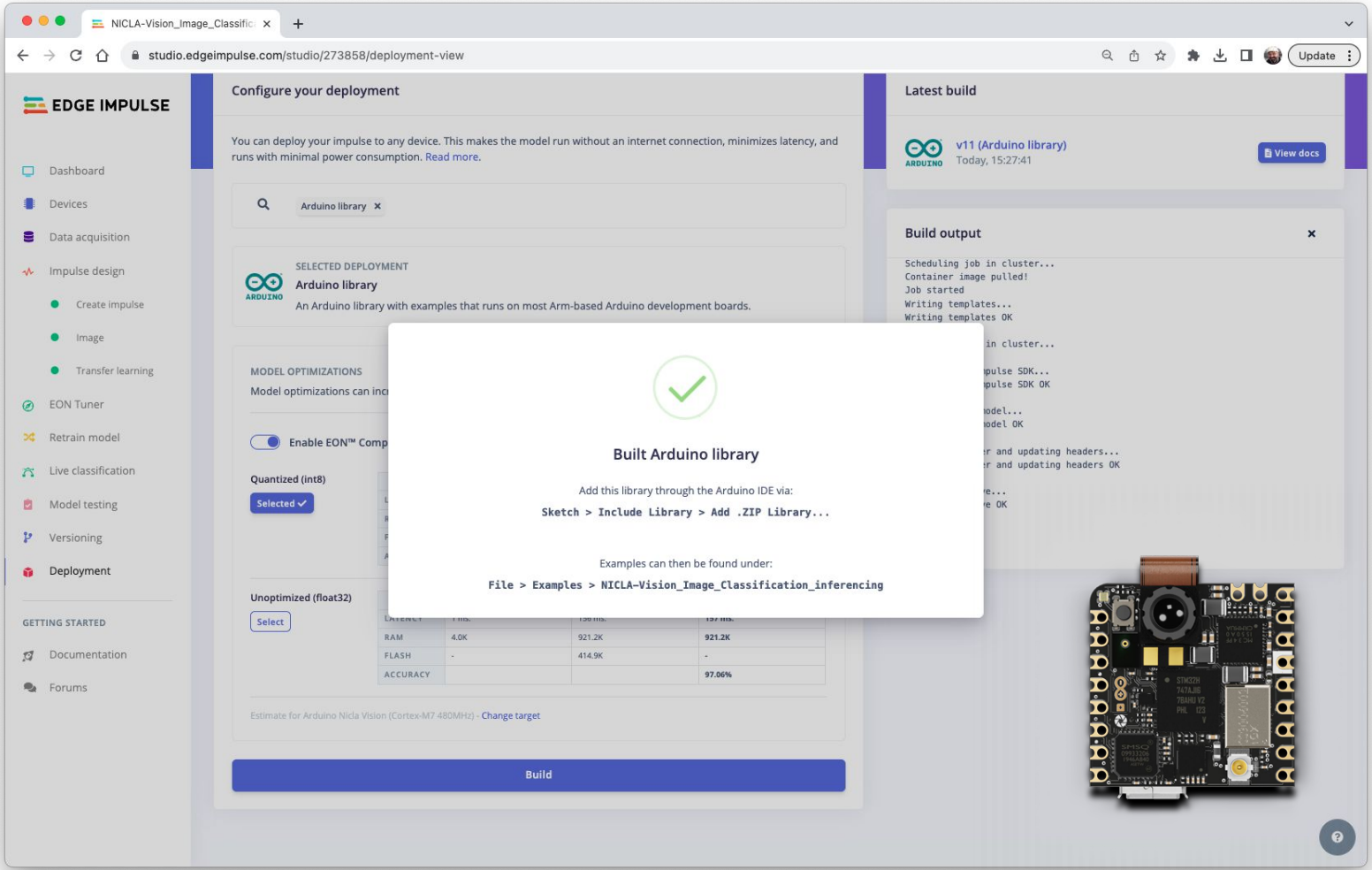
```
    periquito: 0.109375
    robot: 0.113281

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 83 ms., Anomaly: 0
    background: 0.941406
    periquito: 0.015625
    robot: 0.042969

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 83 ms., Anomaly: 0
    background: 0.953125
    periquito: 0.011719
    robot: 0.035156

Starting inferencing in 2 seconds...
```

Autoscroll Show timestamp Both NL & CR 115200 baud Clear output


NICLA-Vision_Image_Classific
studio.edgeimpulse.com/studio/273858/deployment-view
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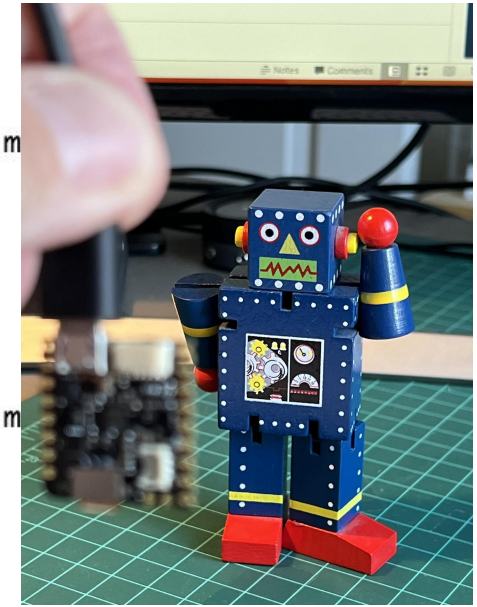
Model optimizations can inc
Enable EON™ Comp
Quantized (int8)
Selected
Unoptimized (float32)
Select
RAM 4.0K 921.2K 921.2K
FLASH - 414.9K -
ACCURACY 97.06%
Estimate for Arduino Nicla Vision (Cortex-M7 480MHz) - Change target
Build
Latest build
v11 (Arduino library)
Today, 15:27:41
View docs
Build output
Scheduling job in cluster...
Container image pulled!
Job started
Writing templates...
Writing templates OK
Built Arduino library
Add this library through the Arduino IDE via:
Sketch > Include Library > Add .ZIP Library...
Examples can then be found under:
File > Examples > NICLA-Vision_Image_Classification_inferencing

/dev/cu.usbmodem101

Send

```
    periquito: 0.261719
    robot: 0.730469

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 86 ms., Anomaly: 0 m
    background: 0.019531
    periquito: 0.433594
    robot: 0.542969

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 86 ms., Anomaly: 0 m
    background: 0.015625
    periquito: 0.210937
    robot: 0.773437

Starting inferencing in 2 seconds...
```



Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

/dev/cu.usbmodem101

Send

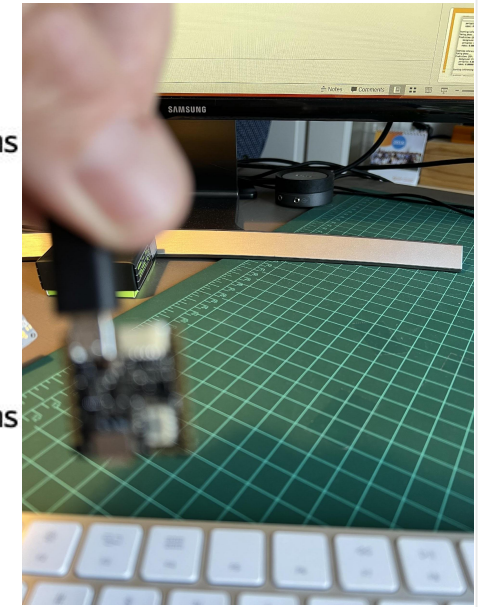
```
    periquito: 0.945312
    robot: 0.046875

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 86 ms., Anomaly: 0 ms.
    background: 0.007813
    periquito: 0.984375
    robot: 0.011719

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 86 ms., Anomaly: 0 ms.
    background: 0.000000
    periquito: 0.992187
    robot: 0.007813

Starting inferencing in 2 seconds...
```

Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

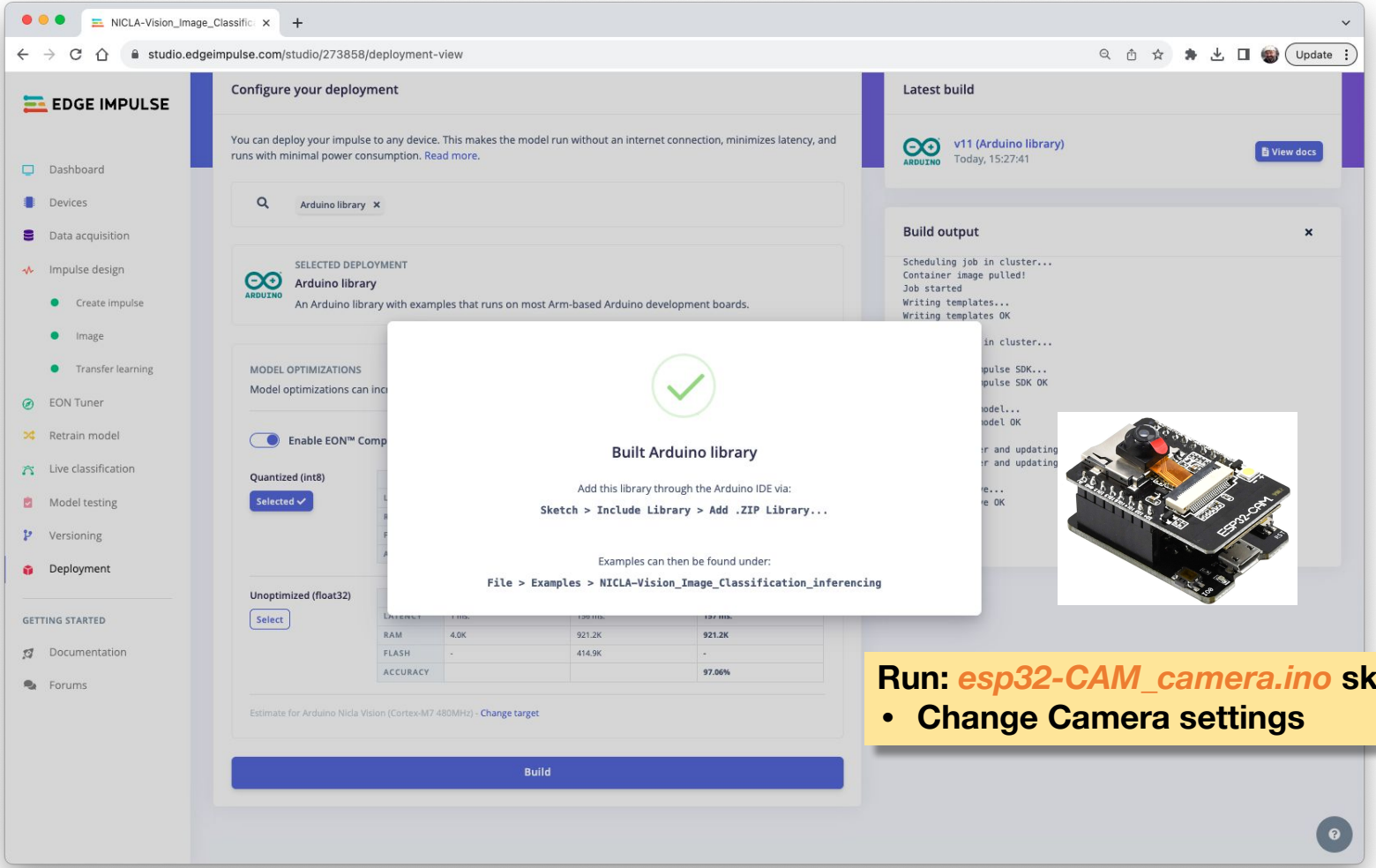
/dev/cu.usbmodem101

Send

```
    periquito: 0.023437
    robot: 0.007813

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 86 ms., Anomaly: 0 ms
    background: 0.996094
    periquito: 0.003906
    robot: 0.000000

Starting inferencing in 2 seconds...
Taking photo...
Predictions (DSP: 1 ms., Classification: 86 ms., Anomaly: 0 ms
    background: 0.992187
    periquito: 0.007813
    robot: 0.000000

Starting inferencing in 2 seconds...
```



Autoscroll Show timestamp Both NL & CR 115200 baud Clear output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Unoptimized (float32)
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RAM 4.0K 921.2K 921.2K
FLASH - 414.9K -
ACCURACY 97.06%
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Built Arduino library
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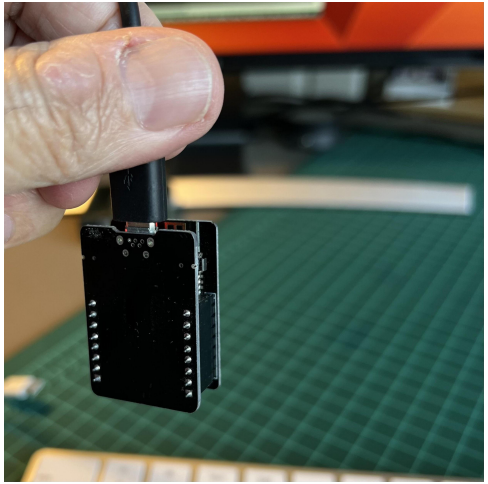
Examples can then be found under:
File > Examples > NICLA-Vision_Image_Classification_inferencing
Latest build
v11 (Arduino library)
Today, 15:27:41
View docs
Build output
Scheduling job in cluster...
Container image pulled!
Job started
Writing templates...
Writing templates OK
Run: esp32-CAM_camera.ino sketch
Change Camera settings

/dev/cu.usbserial-10

Send

```
    periquito: 0.01172
    robot: 0.00781
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly: 0 ms.):
    background: 0.97656
    periquito: 0.00391
    robot: 0.01953
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly:
    background: 0.87109
    periquito: 0.02344
    robot: 0.10547
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly:
    background: 0.94922
    periquito: 0.00781
    robot: 0.04297
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly:
    background: 0.87109
    periquito: 0.01172
    robot: 0.11719
```



Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

/dev/cu.usbserial-10

Send

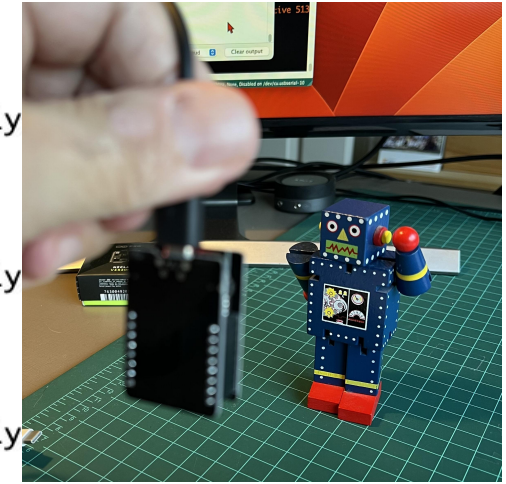
```
    periquito: 0.46484
    robot: 0.23828
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly: 0 ms.):
    background: 0.23047
    periquito: 0.42969
    robot: 0.34375
Predictions (DSP: 9 ms., Classification: 687 ms., Anomaly:
    background: 0.11719
    periquito: 0.66016
    robot: 0.22656
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly:
    background: 0.19531
    periquito: 0.64844
    robot: 0.15625
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly:
    background: 0.29297
    periquito: 0.57422
    robot: 0.13281
```

Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

/dev/cu.usbserial-10

Send

```
    periquito: 0.15625
    robot: 0.67578
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly: 0 ms.):
    background: 0.07031
    periquito: 0.26953
    robot: 0.66016
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly
    background: 0.14844
    periquito: 0.22266
    robot: 0.62500
Predictions (DSP: 8 ms., Classification: 687 ms., Anomaly
    background: 0.12109
    periquito: 0.21484
    robot: 0.66406
Predictions (DSP: 9 ms., Classification: 687 ms., Anomaly
    background: 0.14844
    periquito: 0.16406
    robot: 0.68750
```



Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

NICLA-Vision_Image_Classific

studio.edgeimpulse.com/studio/273858/deployment-view

Update

EDGE IMPULSE

- Dashboard
- Devices
- Data acquisition
- Impulse design
  - Create impulse
  - Image
  - Transfer learning
- EON Tuner
- Retrain model
- Live classification
- Model testing
- Versioning
- Deployment

GETTING STARTED

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- Forums

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Arduino library ×

SELECTED DEPLOYMENT

Arduino library

An Arduino library with examples that runs on most Arm-based Arduino development boards.

MODEL OPTIMIZATIONS

Model optimizations can increase on-device performance but may reduce accuracy.

Enable EON™ Compiler *Same accuracy, up to 50% less memory. Learn more*

Quantized (int8)

Selected ✓

	IMAGE	TRANSFER LEARNING	TOTAL
LATENCY	1 ms.	77 ms.	**78 ms.**
RAM	4.0K	320.2K	**320.2K**
FLASH	-	284.6K	-
ACCURACY			-

Unoptimized (float32)

Select

	IMAGE	TRANSFER LEARNING	TOTAL
LATENCY	1 ms.	156 ms.	**157 ms.**
RAM	4.0K	1.1M	**1.1M**
FLASH	-	471.8K	-
ACCURACY			-

To compare model accuracy, run model testing for all available optimizations.

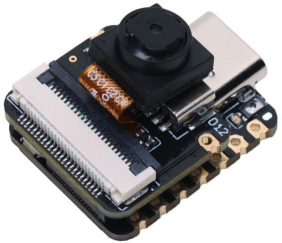
Run model testing

Estimate for Arduino Nicla Vision (Cortex-M7 480MHz) - Change target

Build

Scan QR code or launch in browser to test your prototype

Launch in browser



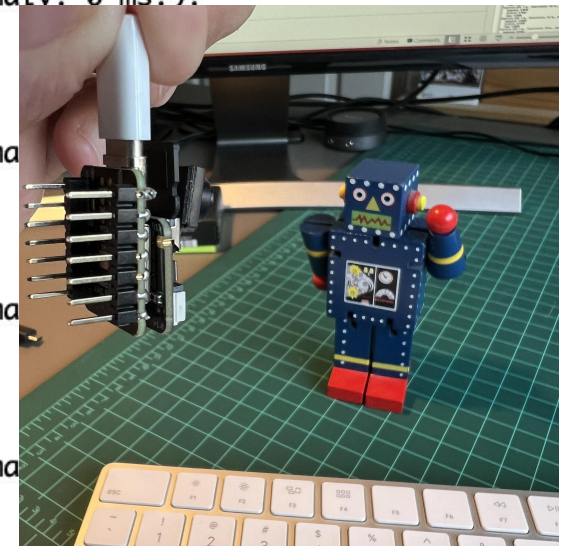
Run: *esp32-CAM_camera.ino* sketch

- **Change Camera settings**
- **Change ESP-NN on library**

/dev/cu.usbmodem1101

Send

```
    periquito: 0.04688
    robot: 0.40234
Predictions (DSP: 4 ms., Classification: 142 ms., Anomaly: 0 ms.):
    background: 0.38281
    periquito: 0.07031
    robot: 0.54688
Predictions (DSP: 4 ms., Classification: 142 ms., Anoma
    background: 0.05078
    periquito: 0.03516
    robot: 0.91406
Predictions (DSP: 4 ms., Classification: 142 ms., Anoma
    background: 0.25000
    periquito: 0.02344
    robot: 0.72656
Predictions (DSP: 4 ms., Classification: 142 ms., Anoma
    background: 0.09766
    periquito: 0.01562
    robot: 0.88672
```



Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

/dev/cu.usbmodem1101

Send

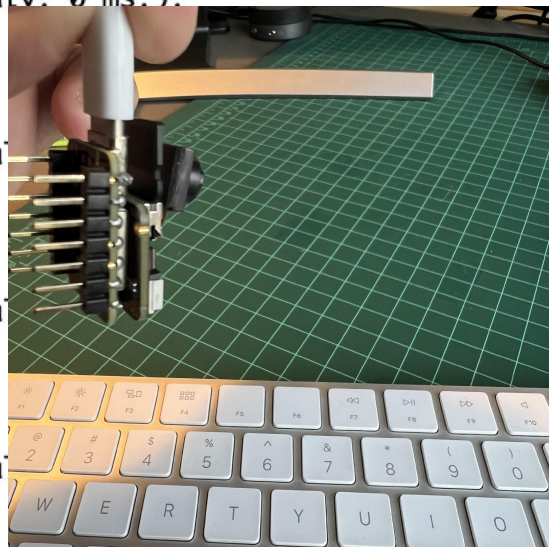
```
    periquito: 0.85938
    robot: 0.11328
Predictions (DSP: 4 ms., Classification: 142 ms., Anomaly: 0 ms.):
    background: 0.00391
    periquito: 0.96875
    robot: 0.02734
Predictions (DSP: 4 ms., Classification: 142 ms., Ano
    background: 0.00781
    periquito: 0.95312
    robot: 0.03906
Predictions (DSP: 4 ms., Classification: 142 ms., Ano
    background: 0.04688
    periquito: 0.87109
    robot: 0.08594
Predictions (DSP: 4 ms., Classification: 142 ms., Ano
    background: 0.01562
    periquito: 0.96484
    robot: 0.01953
```

Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

/dev/cu.usbmodem1101

Send

```
    periquito: 0.00781
    robot: 0.00781
Predictions (DSP: 4 ms., Classification: 142 ms., Anomaly: 0 ms.):
    background: 0.99219
    periquito: 0.00391
    robot: 0.00000
Predictions (DSP: 4 ms., Classification: 142 ms., Anoma
    background: 0.99609
    periquito: 0.00391
    robot: 0.00000
Predictions (DSP: 4 ms., Classification: 142 ms., Anoma
    background: 0.99609
    periquito: 0.00000
    robot: 0.00000
Predictions (DSP: 4 ms., Classification: 142 ms., Anoma
    background: 0.99609
    periquito: 0.00391
    robot: 0.00000
```



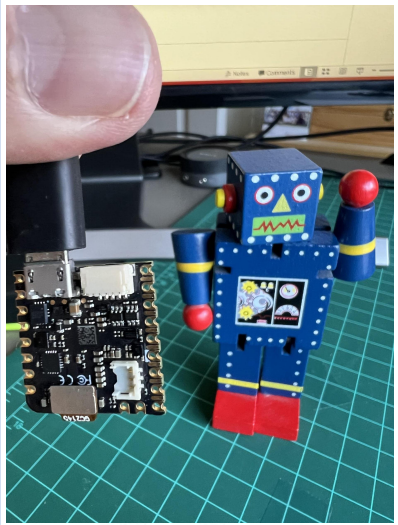
Autoscroll Show timestamp Both NL & CR 115200 baud Clear output

Tiny Image Classification Benchmark (Model* deployed as an Arduino Library)

Classification: 83 ms

12.0 FPS

Portenta H7
ARM M7
480 MHz



Classification: 86 ms

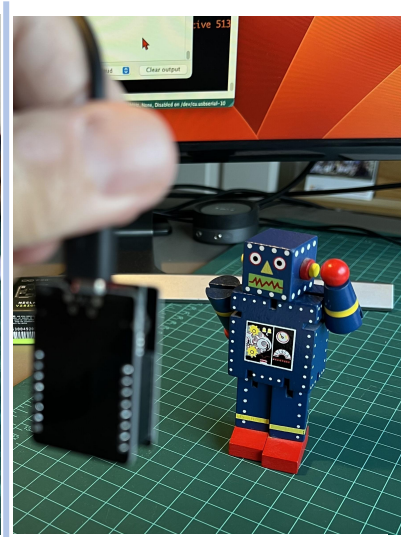
11.6 FPS

Nicla-Vision
ARM M7
480 MHz

Classification: 142 ms

7.0 FPS

XIAO ESP32S3
Xtensa LX7
240 MHz



Classification: 687 ms

1.5 FPS

ESP - CAM
Xtensa LX6
240 MHz

* **Model**: MobileNetV2 96x96 0.1 **Hyperparameters**: Epoch: 20, Lr: 0.0005, 12 Neurons on final Dense layer, dropout rate: 0.1

Thanks

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