Using TinyML to Classify Playing Cards Types

Israel Rodrigues Dutra

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Objective

Make an artificial intelligence model to classify four types of playing cards and use edge devices to run the model.

Materials

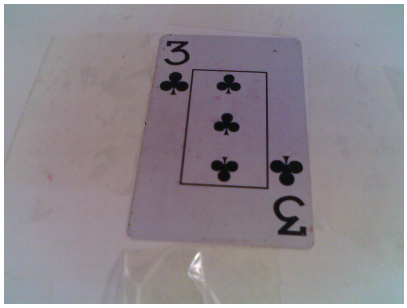
- ESP 32 CAM micro controller;
- Smartphone;
- Playing cards deck;
- Edge Impulse platform;
- Google Colab platform;
- Arduino IDE platform.

Methods

First, it was needed to create a dataset. Using ESP32 CAM to take images and store them in a SD card, it was possible to create folders with images of cards from A-K going through all types. Photos were also taken with a smartphone to add more data to the model. With a created dataset, it was uploaded to the edge impulse platform to create a machine learning model and finally the model was deployed on the smartphone and the ESP32 CAM.

Results

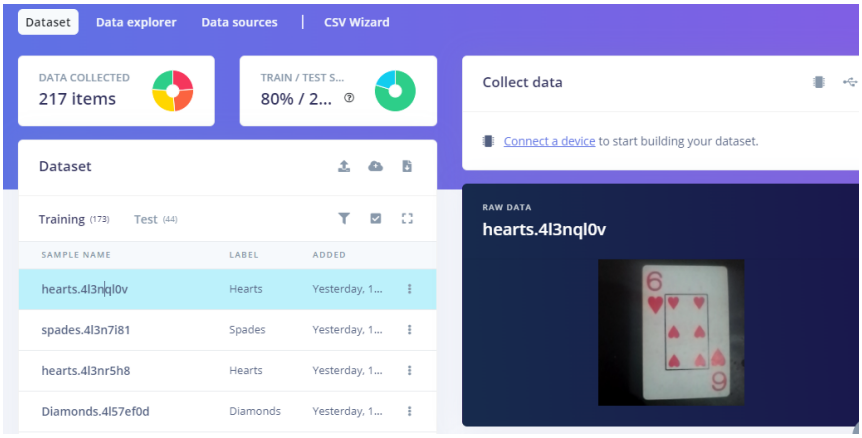
ESP32 CAM dataset image example



Smartphone dataset image example

Edge Impulse Model

Data acquisition



Impulse design

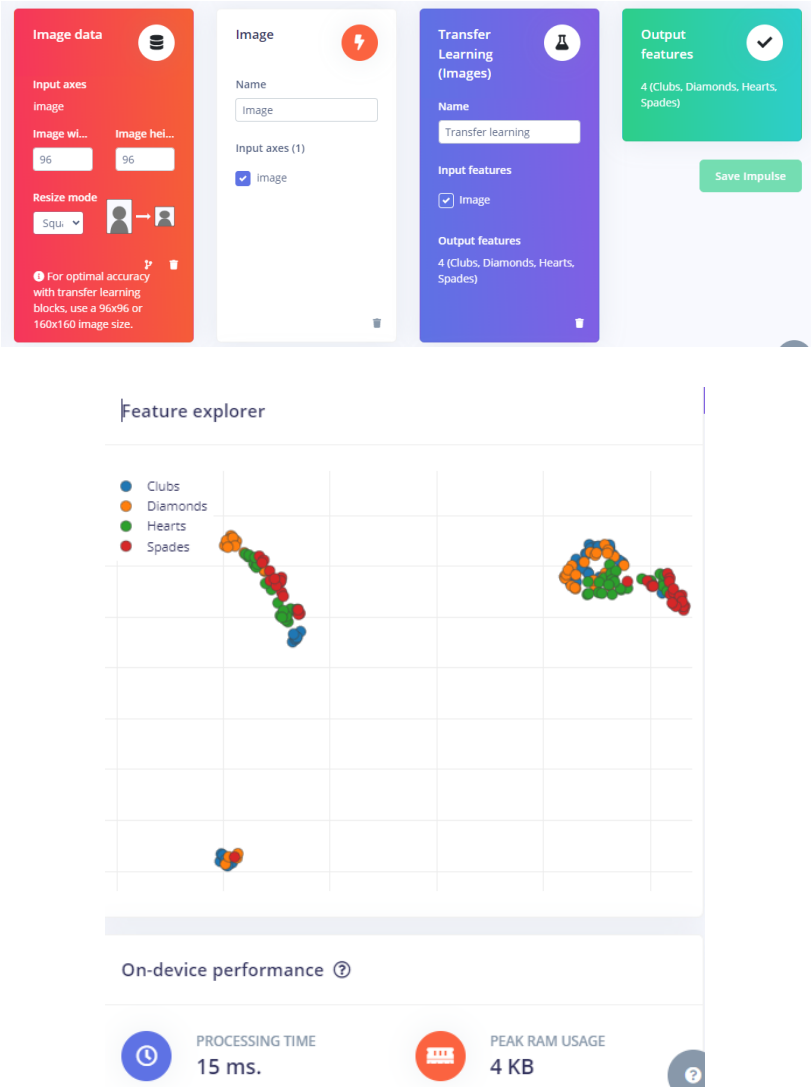


Figure 1: Target device ESP-EYE

Transfer Learning

Training settings

Number of training cycles: 70

Use learned optimizer: ☐

Learning rate: 0.0005

Data augmentation: ☑

Advanced training settings

Neural network architecture

Input layer (9,216 features)

MobileNetV2 96x96 0.35 (final layer: 16 neurons, 0.1 dropout)

Choose a different model

Last training performance (validation set)

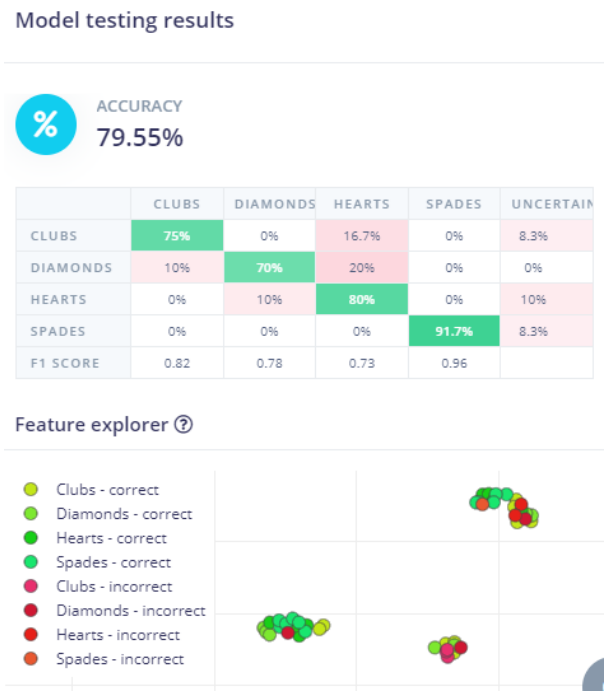
ACCURACY
88.6%

LOSS
0,31

Confusion matrix (validation set)

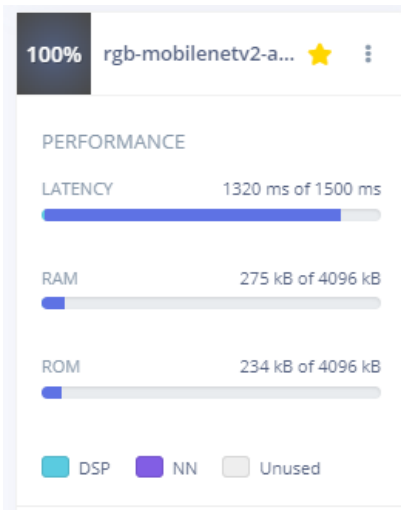
	CLUBS	DIAMONDS	HEARTS	SPADES
CLUBS	**81.8%**	0%	0%	18.2%
DIAMONDS	0%	**85.7%**	14.3%	0%
HEARTS	0%	14.3%	**85.7%**	0%
SPADES	0%	0%	0%	**100%**
F1 SCORE	0.90	0.86	0.86	0.91

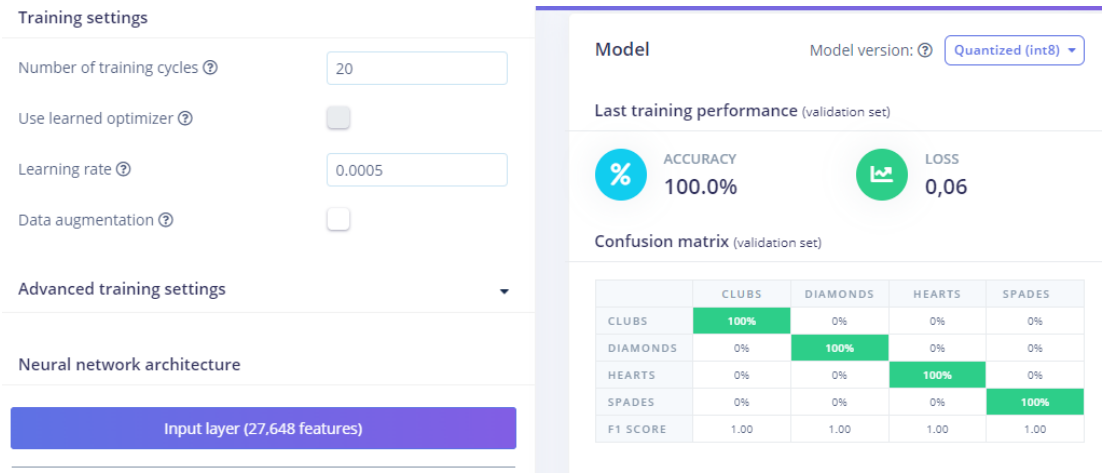
Model testing

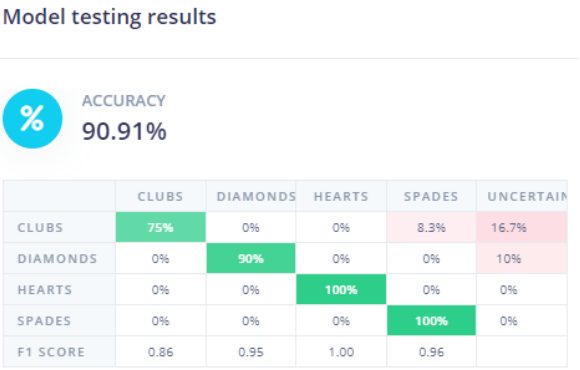


EON Tuner

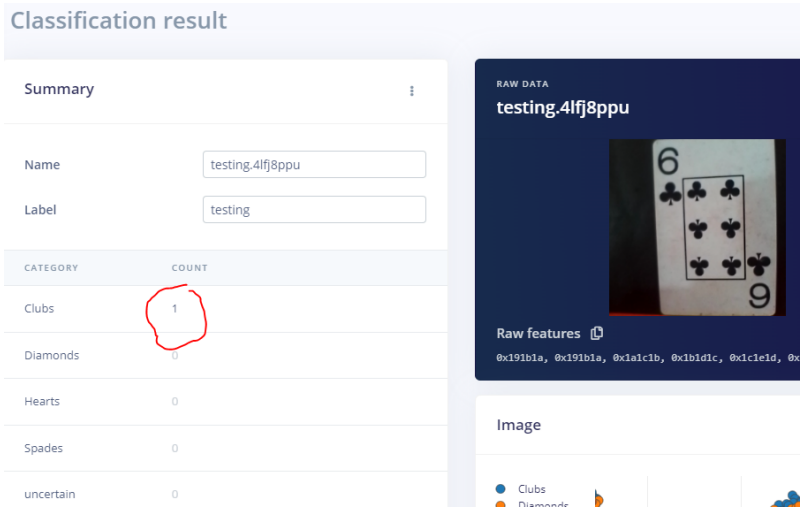
EON Tuner is used to find the best model possible based on your target device.



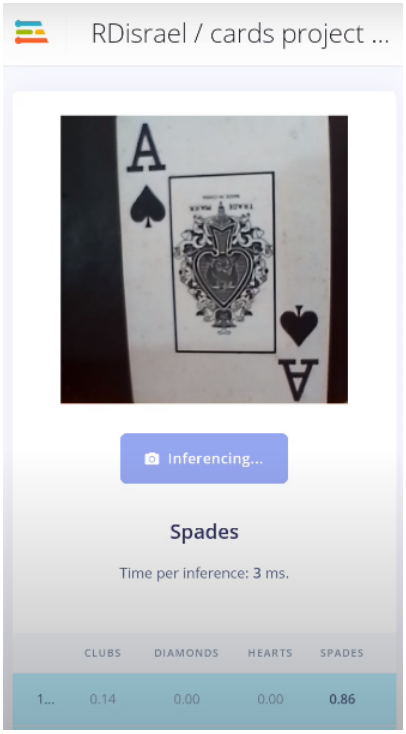




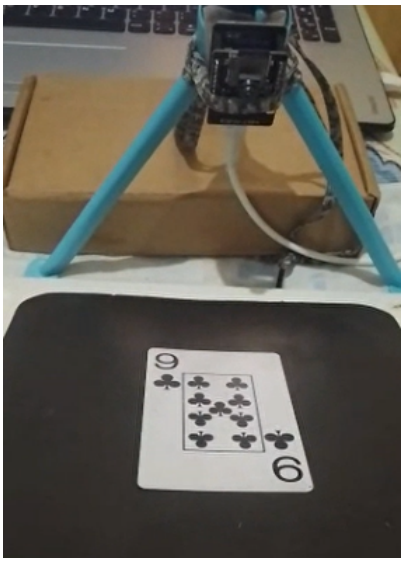
Live classification using smartphone



Live classification from smartphone model



ESP32 classification



esp32_camera.ino

```
1   /* Edge Impulse Arduino examples
```

Output Serial Monitor ×

Message (Ent New Line 115200 baud

```
Predictions (DSP: 17 ms., Classification:
    Clubs: 0.89062
    Diamonds: 0.00391
    Hearts: 0.00391
    Spades: 0.09766
Predictions (DSP: 17 ms., Classification:
    Clubs: 0.70312
    Diamonds: 0.00000
    Hearts: 0.00000
    Spades: 0.29688
```