Toy Robot Car
FOMO Observations
FOMO: Faster Objects, More Objects Edgeimpulse.com fast
96px x 96px Vision Model for TinyML Devices
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Arduino PortentaH7 with Vision Shield

• About 2 years ago my students switched from the Arduino Nano33BleSense with an OV767X camera to the more powerful dual core Arduino PortentaH7 that has 8 Mb of SDRAM to allow an attached Waveshare grayscale fast OLED screen.

• Vision Shield with Microphone, 320px x 320px grayscale camera, LoRa or Ethernet connectivity and an SD Card.

• This experiment has allowed some unique student learning experiences and observations.
• The Arduino Portenta Vision Shield has a grayscale slight fisheye 320px x 320px camera.
• Since the only FOMO model that runs on it is grayscale 96px x 96px it is fine. The Nano33BLE or Nicla Vision with RGB Color might have to run at grayscale anyway.
FOMO is Fast

• 1st observation:

• Speed of analysis is everything for cars, and FOMO is fast and ideal for toy robot cars
FOMO can have False Positives

• 2nd Observation: FOMO gives false positives. Can your application easily ignore or reduce the effect of false positives?

• If your application is counting objects or turning a toy car, will it handle false positives. How to reduce them.

Used the professional Version of Edgelmpulse and 2000 training cycles. Lots of false positives and negatives.
3rd Observation: Can you make 3D objects more 2D, by positioning your camera in a fixed location? Can the objects lie flat like on a conveyor belt with the camera above?

- Can your objects be oriented in a similar orientation. If detecting a leaf can the leaf always be oriented in the same direction before the classification occurs?

- Can lighting and reflections be controlled? Outside vs Inside, we spent over a year battling false positives from reflections. Sunglasses over the car camera seemed to help.

3D pop bottles were difficult to analyze
Object Analysis

• For our toy robot cars we can choose which objects for the car to detect and follow. Your project may not have that flexibility.

• Are some objects easier for the machine to detect? Reminder after about 300 images you are moving away from the free edgelImpulse subscription.

• 4th Observation, if you can't control the object orientation, should it have multiple angles of symmetry. Like a star or a circle?
5th Observation:
- FOMO is best when you only detect one object.
- If you have multiple objects, and a slight interference between objects is not a problem then FOMO can detect even more than the default 10 objects.

In the file `...src\model-parameters\model_metadata.h`
- define `EI_CLASSIFIER_OBJECT_DETECTION_COUNT
  10`

6th Observation: If you need to detect multiple objects, hopefully they look very different. Similar objects will have a hard time getting classified.
Using an FFT visualizer can help understand the issues FOMO has with your objects.
We tried using a cell phone to collect the images but our models improved when we used the on-device camera. Connecting a car to edgeimpulse using WebUSB was not ideal. Things improved when we took PNG images and saved them on the vision shields SD card.

Model Testing

• Lots of methods to test your Edgeimpulse model:
  
• Download to your cell phone
• Download WASM to a webpage  [WASM to Webpage]
• Waveshare GrayScale 128px x 128px OLED screen (dot5144-vision-OLED in my Portenta Pro library)

• On device full model testing in a realistic environment
Toy Robot Car
Multiple Fails
Success!

Lights and Reverse: Student Project

This student also made the 3D printed objects
Success!

2 students are having success with an RC backup controller for when the ML loses the object.
Success!

Faster more accurate analysis using only one object.
Conclusion: EdgeImpulse FOMO

- EdgeImpulse Vision FOMO model is an excellent TinyML teaching environment.
- There is lots of room for improvement with vision analysis when you consider things like # classifications, orientation, symmetry and reducing reflections.
- My students and I have worked on various issues and solutions for using constrained devices with the free version of edgeimpulse that has a processing time limit of 20 minutes ~300 images.
Credits

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