Toy Robot Car
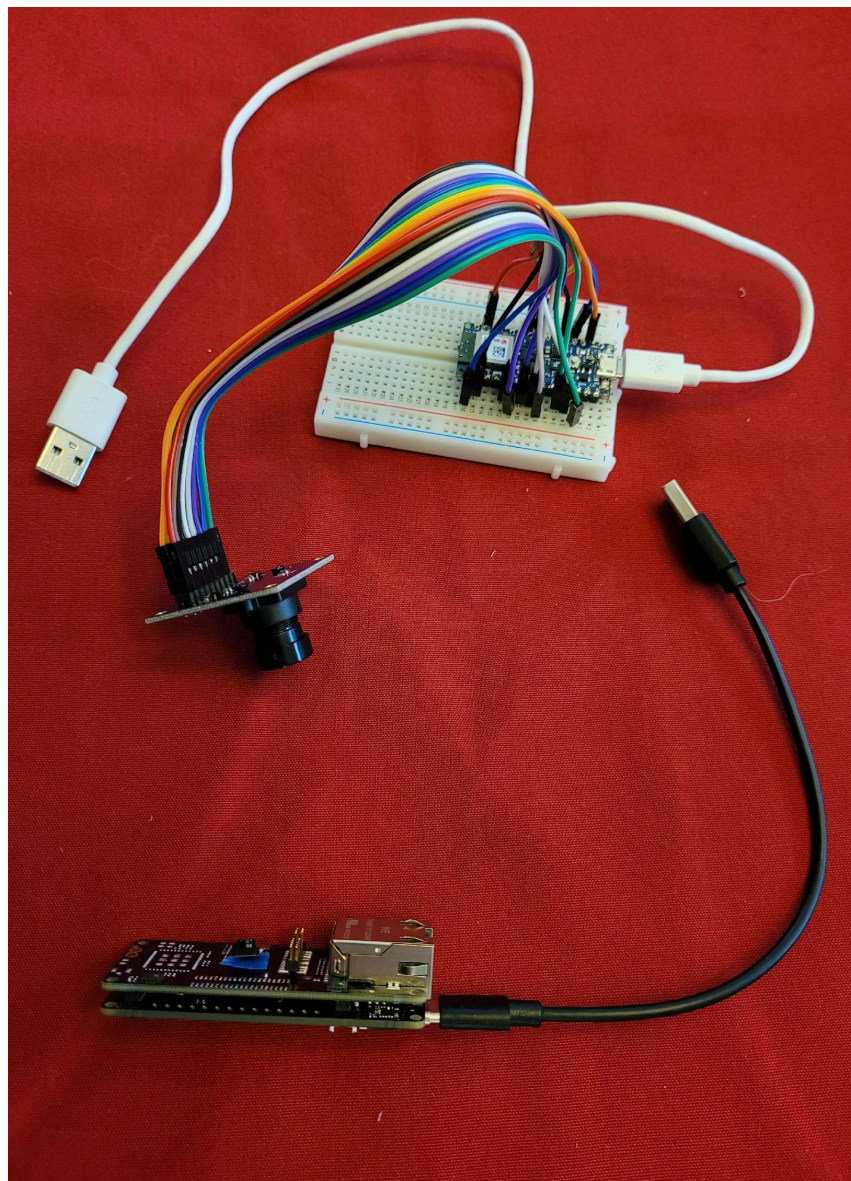# FOMO Observations

FOMO: Faster Objects, More Objects Edgeimpulse.com fast
96px x 96px Vision Model for TinyML Devices

By Jeremy Ellis Twitter @rocksetta

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.
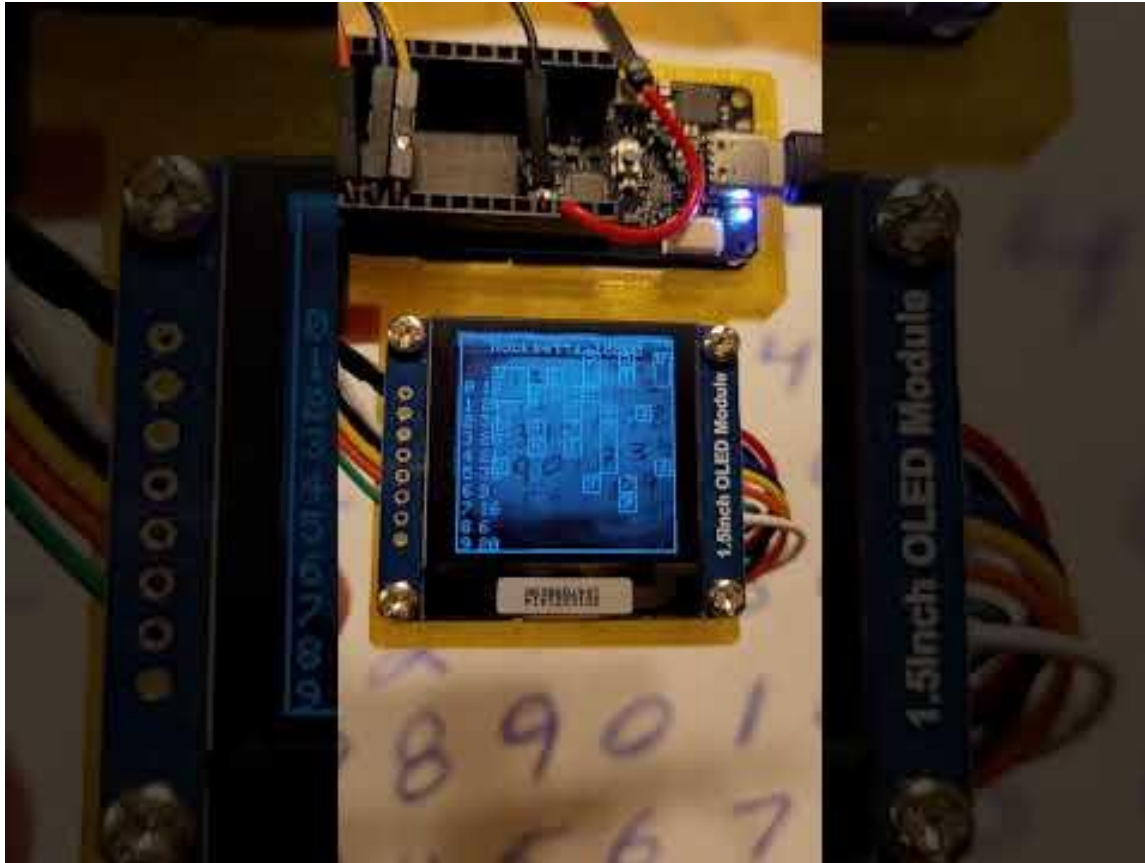
FOMO
RGB vs Grayscale

- 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

Used the professional Version
of EdgeImpulse and 2000 training cycles.
Lots of false positives and negatives.

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.

Object Analysis

3D pop bottles were difficult to analyze

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.

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 edgeImpulse subscription.

- 4th Observation, if you can't control the object orientation, should it have multiple angles of symmetry. Like a star or a circle?

Object Analysis

- 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.

FFT of Images

https://ejectamenta.com/imaging-experiments/fourifier/
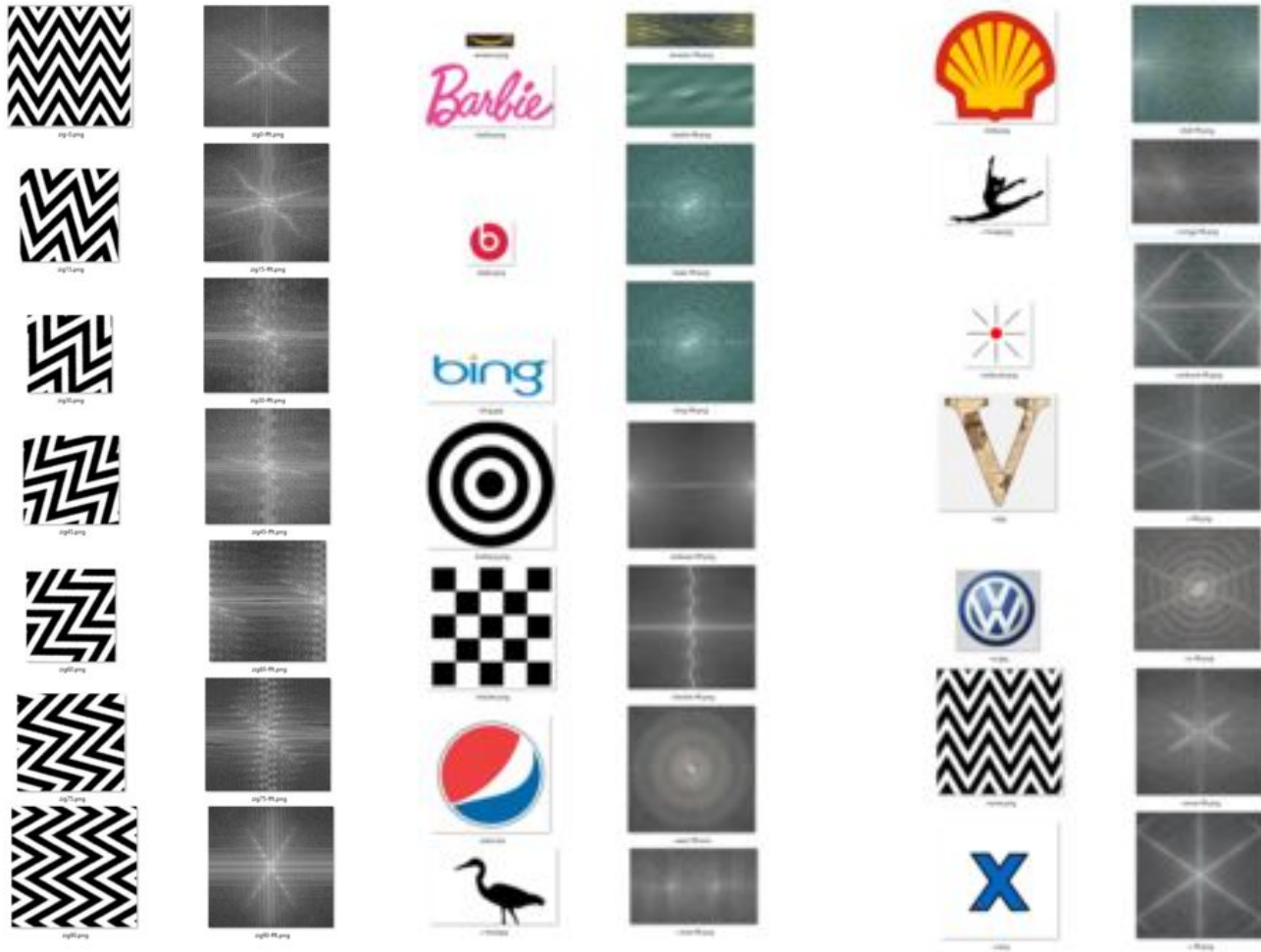
Using an FFT visualizer can help understand the issues FOMO has with your objects.

Data Collection

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.

Dot362-png-to-sd-card on my "Portenta Pro Community Solutions" Arduino Library.
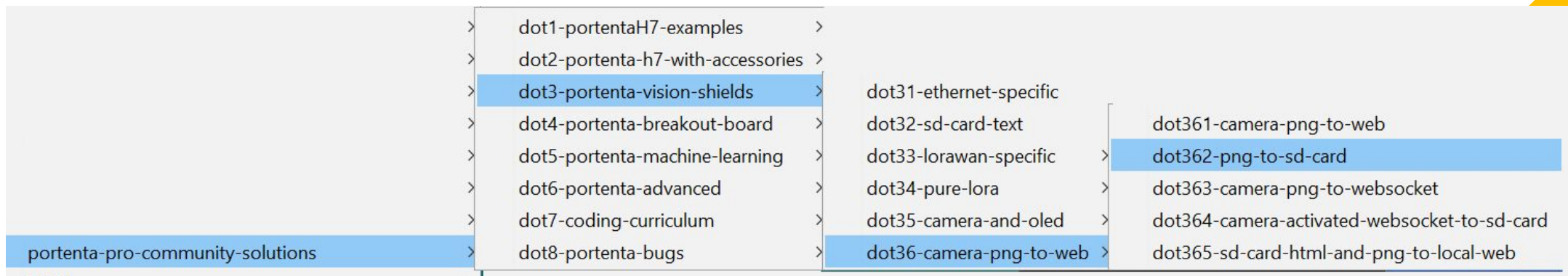
Model Testing

- 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)

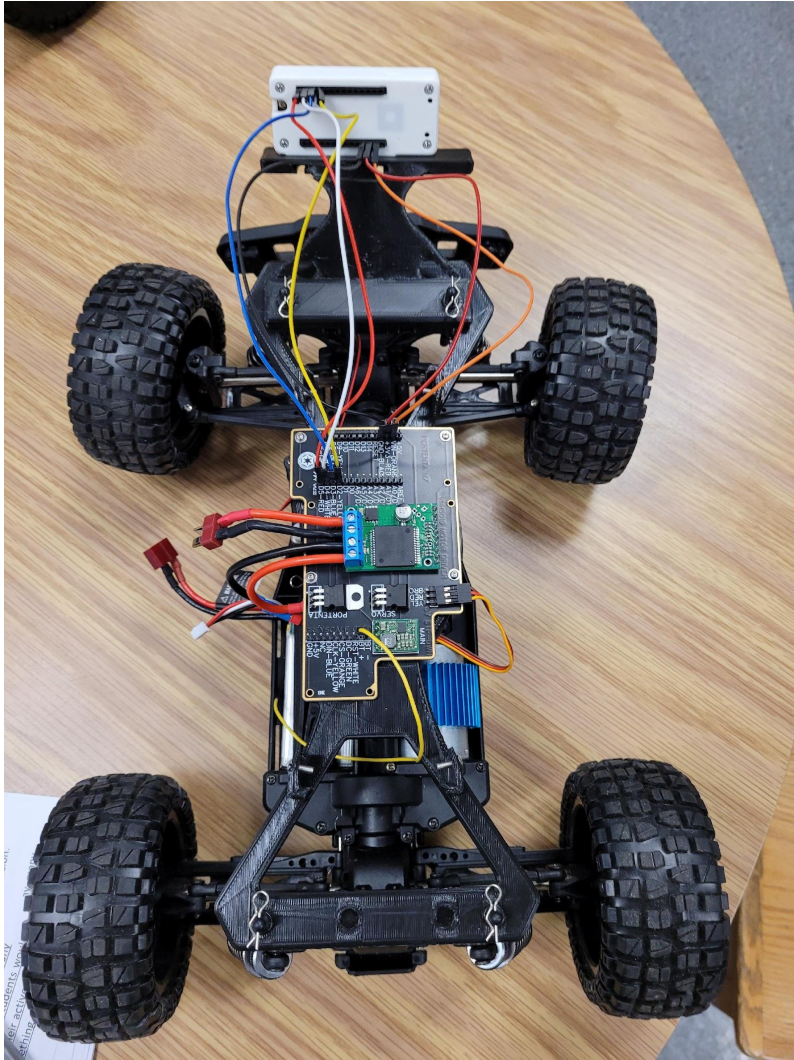- On device full model testing in a realistic environment
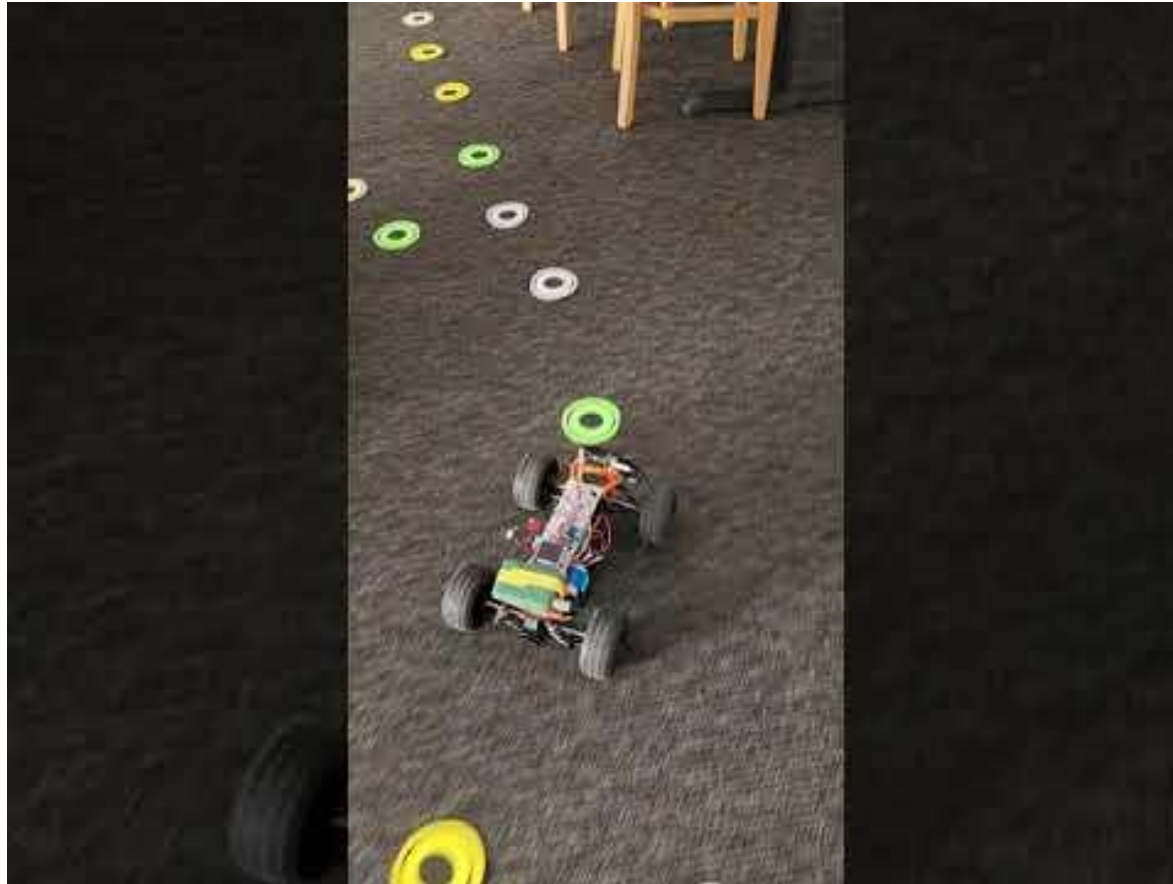
Toy Robot Car Multiple Fails

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

- By Jeremy Ellis, BC, Canada

- High School Teacher.

- Twitter @rocksetta

- https://www.gearbots.org/

- Students from my Gearbots STEM class