CP 330: Edge AI

Project Report : Sign Board Detection

| KUNAL WASNIK | SUBHASIS PANDA | SANJAY KUMAR HB |

Traffic signs provide the necessary information and warn of potential dangers. They are an important part of keeping drivers and pedestrians safe on the road. However, under certain conditions such as high visual clutter, adverse illumination, or rainfall , human factors such as excitement, irritation, or fatigue are known to further reduce the visual concentration.For the above reasons,we trained an image classification model of different sign board and integrated into Nicla Vision.This device was chosen because it comes with 2MP color camera that supports TinyML , 1MB RAM , 16MB QSPI Flash for storage.More importantly the device form factor is very small (22.86 x 22.86 mm) and also supports Micropython and WiFi .

For data collection and training purpose,we connected an external button , powerbank to Nicla Vision and wrote code which will takes picture and store in Nicla vision memory once we press the button . To view camera input of device we used wifi to display it on any other device on web browser. The photos of signboards were taken in IISc campus.

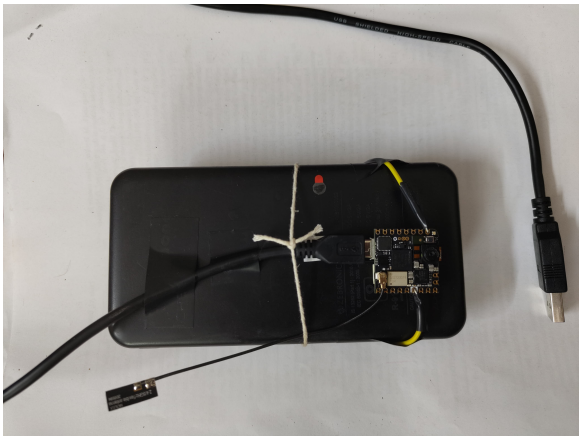


Figure 1: Used Nicla Vision as camera for collecting data

The complete block diagram has been given below(Figure 2).Augmentation Techniques like Crop, Shear, Gray scale, Hue, Satuaratio, Brightness, Exposure, Blur, Noise were performed on the pictures of sign boards captured to help improve the model accuracy with the help of Robo Flow. The models were labeled in Edge Impulse . To accelerate and automate labeling process we used the AI-powered auto-labeler for object detection model available in edge impulse which used yolo model. Others were labeled manually where the yolo model failed.

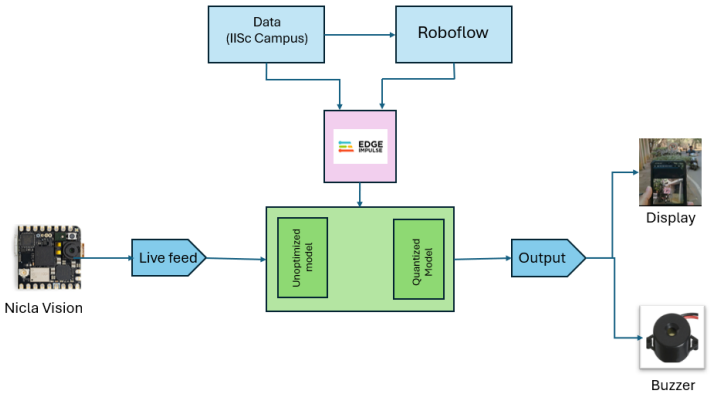


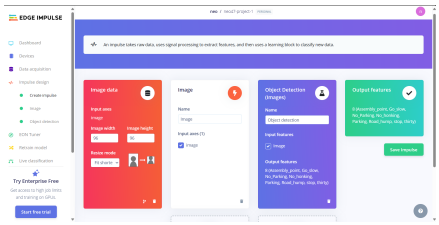
Figure 2: Block Diagram

At the end our dataset consisted of the following classes (Along with the number of samples). One extra class background was also present for no signboard detection case.

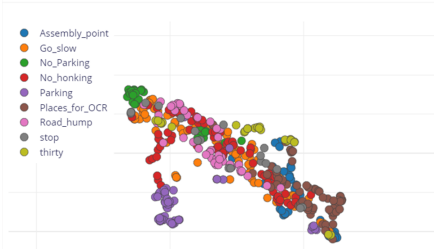
1. Assembly point (38)
2. Go Slow (73)
3. No Honking (82)
4. No parking (32)
5. Parking (42)
6. Place Identification (47)
7. Road Hump (46)
8. Stop (19)
9. Speed limit (30)

Edge Impulse FOMO (Faster Objects, More Objects) model was used for object classification. FOMO is a novel machine learning algorithm that brings object detection to highly constrained devices. It lets track multiple objects in real-time using up to 30x less processing power and memory than MobileNet SSD or YOLOv5.

The scatter plot obtained is given below(Figure b).Accuracy and F1 score didn't change much for unquantized and quantized model.Figure c and d shows the comparision between two.

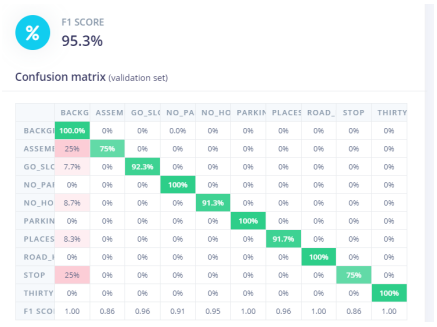


(a) Edge Impulse Design



(b) Scatter Plot

(c) F1 Score and confusion matrix for unquantized model



(d) F1 Score and confusion matrix for quantized model

Figure 3

Future Scope:The edge device can be improved by performing OCR on place identification sign boards , including dataset of adverse weather conditions.

Working Demo :https://youtube.com/shorts/v9UbFSp_xE8

Github repository:https://github.com/subhasisp1/Sign-Detection

References

- https://edge-impulse.gitbook.io/docs/edge-impulse-studio/learning-blocks/object-detection/fomo-object-detection-for-constrained-devices
- https://docs.arduino.cc/hardware/nicla-vision/
- https://docs.micropython.org/en/latest/