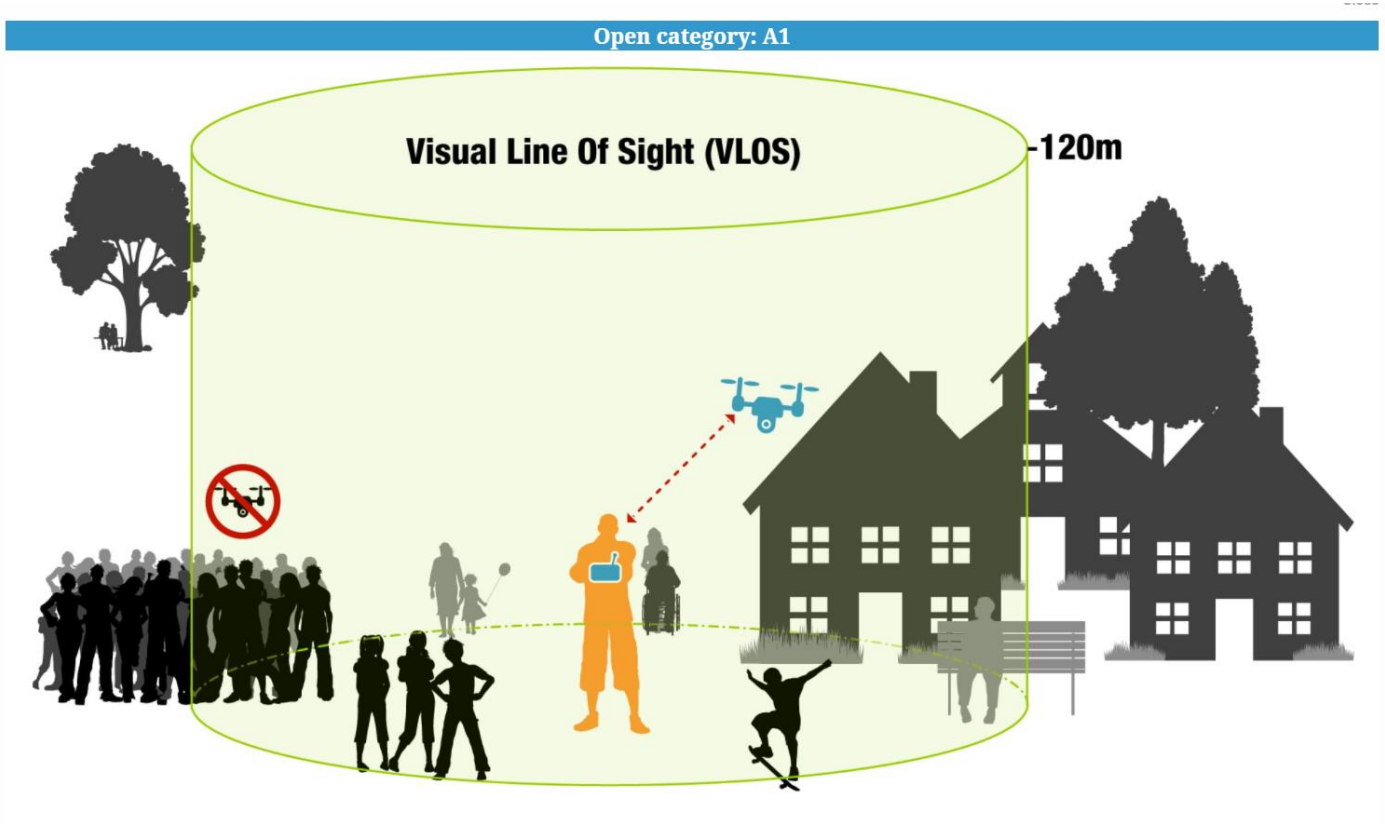
Lightweight YOLO for Real-Time UAV Detection in Urban Places

Justin-Marian Popescu

Alfred-Andrei Pietraru

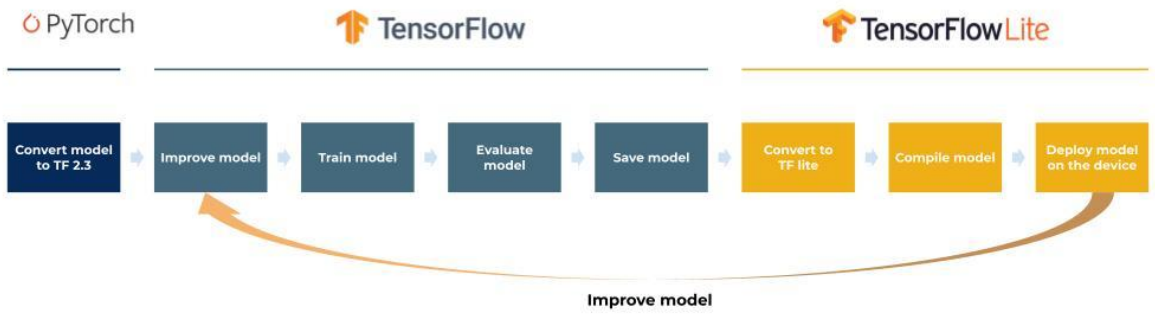
Problem



- Safety legislation in Europe for UAVs
- Open Category Drone type - small, up to 25kg, height less than 120m
- Object detection task - real time, high image resolution, small objects

Software

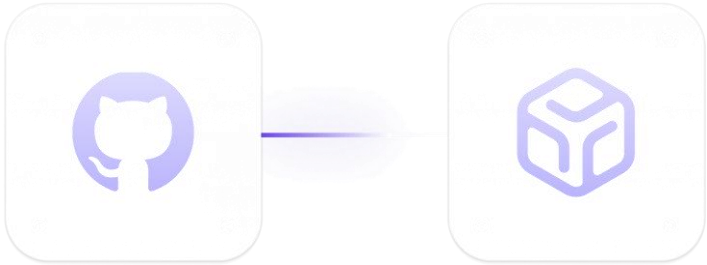
- **PyTorch** for model training and validation
- **TensorLite** (TensorFlow Lite) for lightweight, on device inference.
- **Voxel51** - results visualization
- **Tensorboard** – real-time training visualization scores
- **ONNX, Tensorflow, TFLite** – exporting model to the embedded device



Hardware

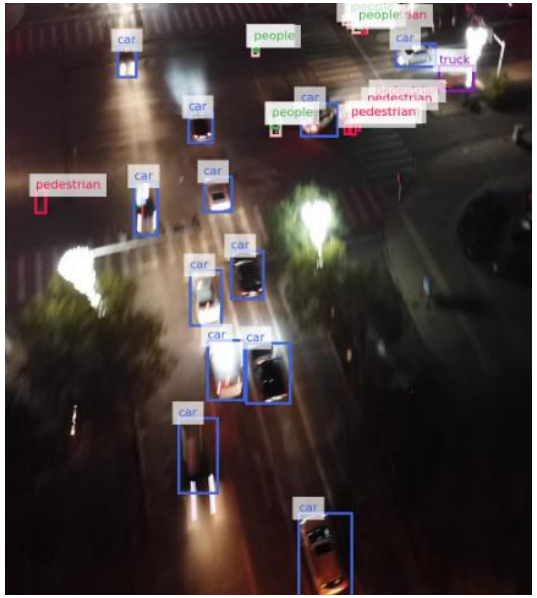
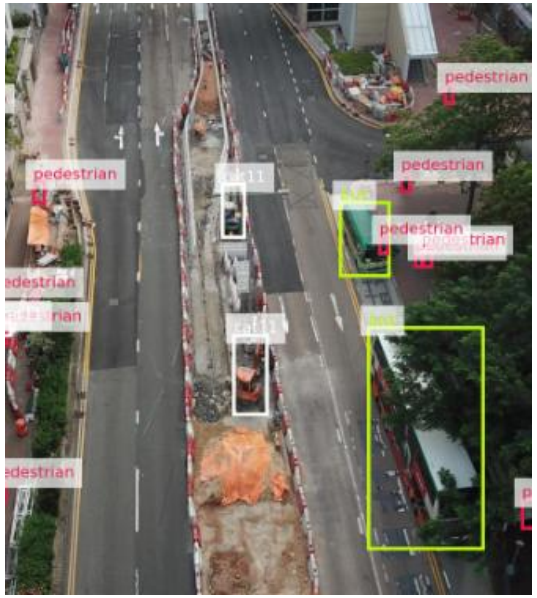
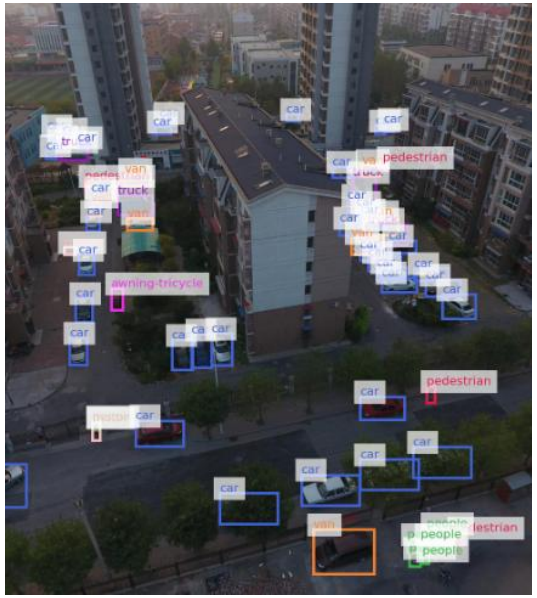
- Google Coral USB accelerator for testing with **8MB** total space for model with quantization settled on **INT8**, only inference support
- Model training is performed on a **GeForce RTX 5090 GPU** using the **RunPod** cloud platform, with all project code, experiments, and configurations managed through **GitHub** for version control and collaboration.

RunPod



YOLO architecture

- As an **open-source architecture**, YOLO has evolved through multiple optimized versions (**v5 to v11**) offering improvements in **speed, accuracy, and deployment efficiency**.
- Extensive community support, wide range of research material
- Metrics: *mAP50, mAP95, F1-Score, parameter number, inference speed, GFLOPs.*


Datasets

- **Visdrone** 10 classes, 10000 images
- **Standford Drone Dataset (SSD)** 6 classes, 19000 images
- **AU-AIR** 7 classes, 32000 images
- **UAVDT** 4 classes, 78000 images