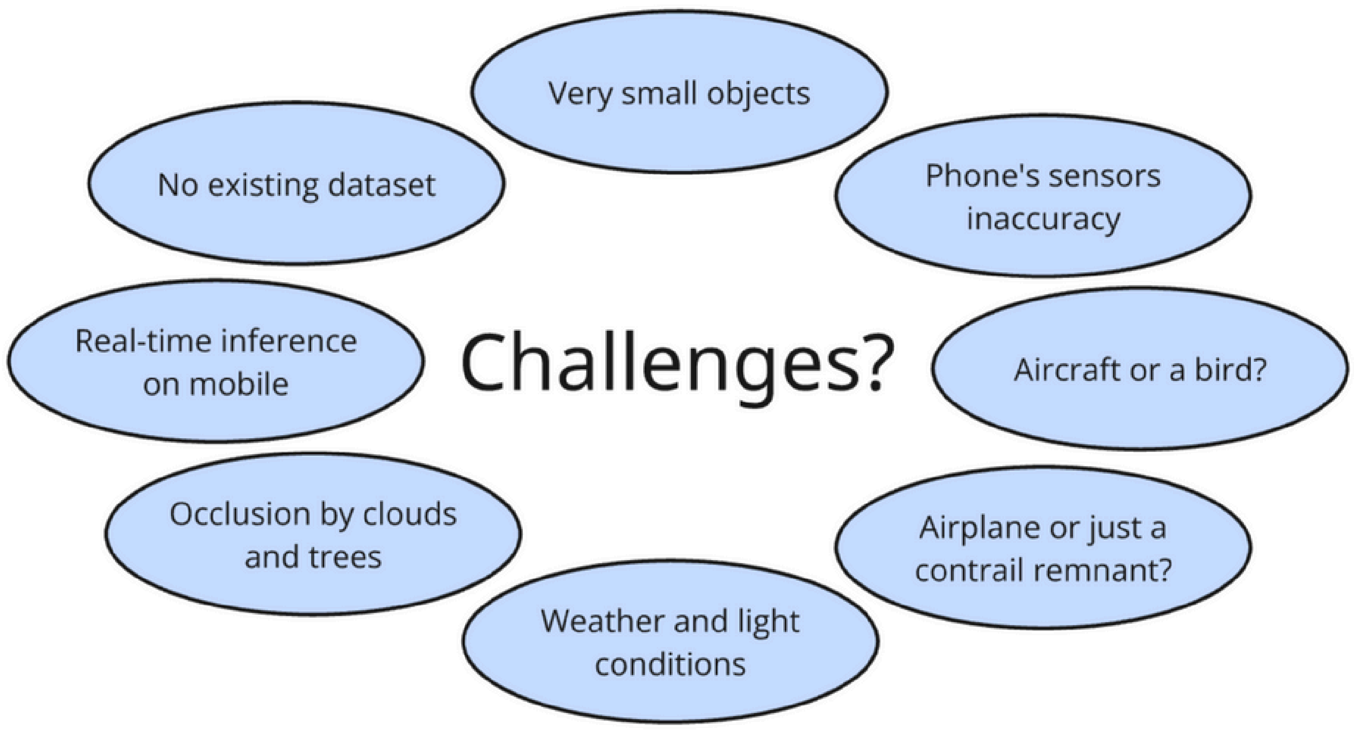
Mobile aircraft detection with ADS-B integration

Lauri Warsen, Szymon Gołębiowski, Vladimir Petkov

Introduction and Problem Analysis

What aircraft is it?

Just point your phone at the sky!



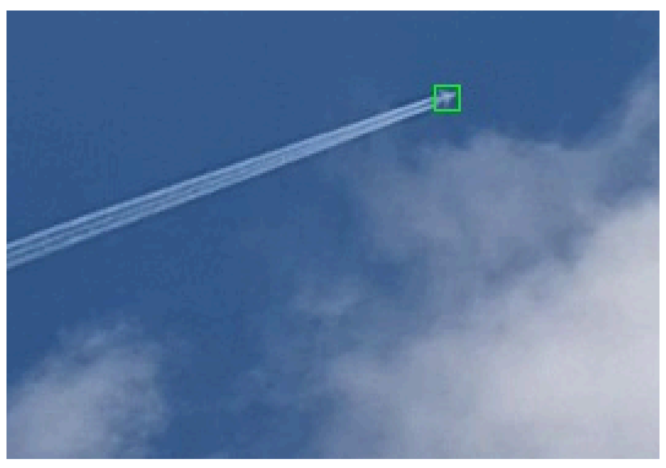
Dataset

- 29 data collectors from various locations in 9 countries
- 931 videos, ~7 s each, manually labelled with CVAT
- Data split - 70% training, 15% validation, 15% test
- Videos recorded by one person only in one split

Classes	
aircraft	27.5%
contrail	72.5%

Potential issues	
contain birds	12.6%
contain other contrails	10.8%
filmed through glass	13.4%
during sunset	7.4%

Weather	
clear sky	45.3%
clouds	46.2%
overcast	8.5%



Contrail

Aircraft and contrail

Model - YOLOv8 Nano (2023)

- Lightweight: 129 layers; 3 mln parameters; 8.2 GFLOPs
- Multi-scale Feature Fusion - combines features from different layers
- Anchor-free - direct keypoint prediction more effective for small objects
- Data augmentation: translations, flips, rotations, mosaic combinations

Evaluation

Model trained on every second frame using resolution 960, batch size 32, 20 epochs

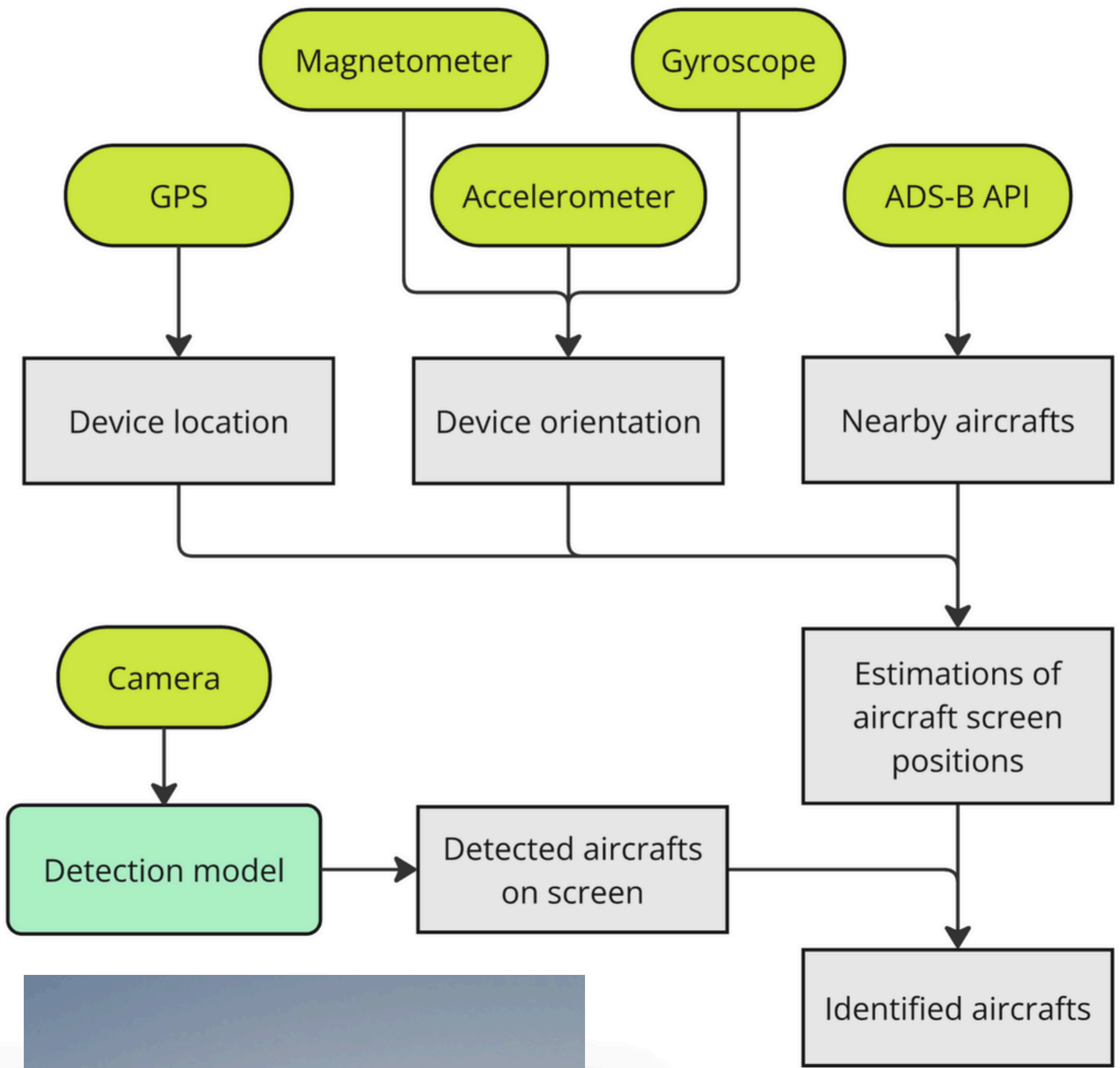
class	Precision	Recall	F1
both	0.567	0.467	0.256
contrail	0.492	0.334	0.199
aircraft	0.642	0.600	0.310

aircrafts easier to detect than contrails

Research questions:

- How resolution (640, 960, 1440, 1920) affects results?
- Could collecting more data help to achieve better results?
- What are the most hindering factors? Weather? Birds? Other contrails?

Mobile App in Flutter



Accurate if a magnetometer is properly calibrated

Conclusions

Orientation + Location + ADS-B = Aircraft Positions works	The inaccuracy of a phone's magnetometer is the main limiting factor (needs calibration)
Our detection model is a good starting point, but needs further, tailor-made improvements	No ready-made Flutter packages for serving a real-time detection model