



James Pinter

The Seed of Advanced Air Mobility

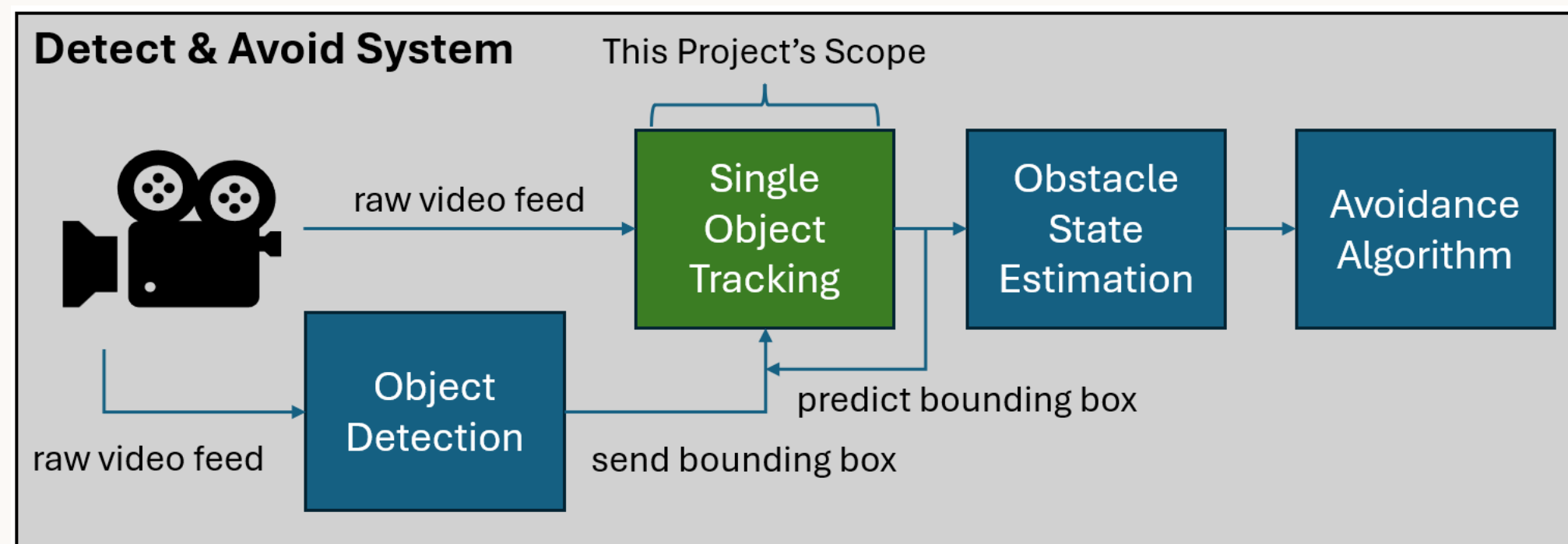
Building a Single Object Tracking Prototype for Air Platforms

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Problem Statement

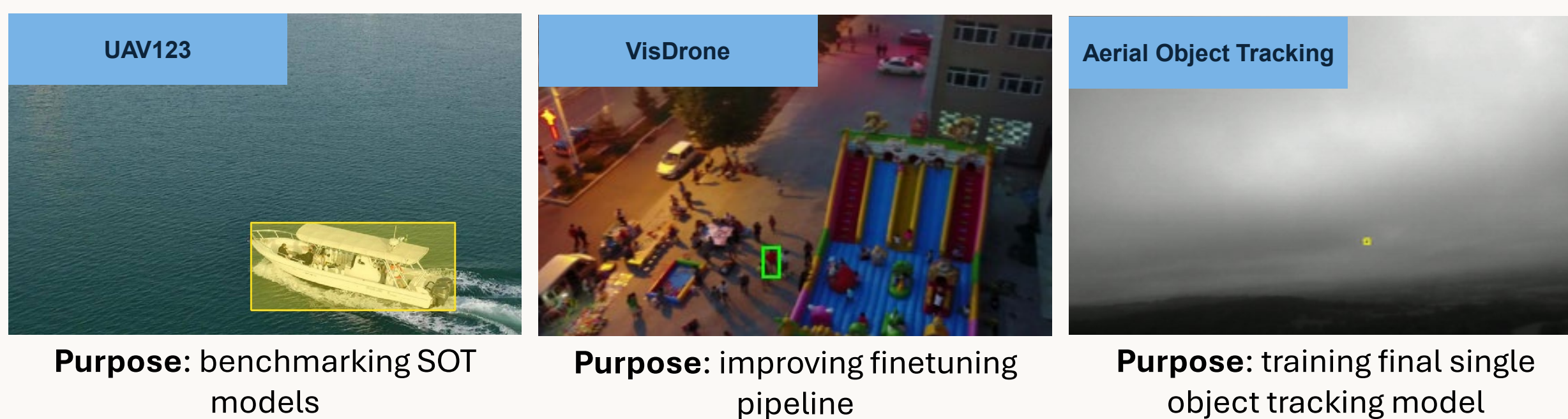
Background: Advanced Air Mobility is a new era of aviation that uses autonomous aircraft to increase the safety and efficiency of air transportation. Autonomous aircraft require “Detect & Avoid” (DAA) systems to navigate crowded airspace. Visual object tracking is a novel capability that can enhance DAA systems by informing the aircraft of airborne obstacles at a low computational cost.



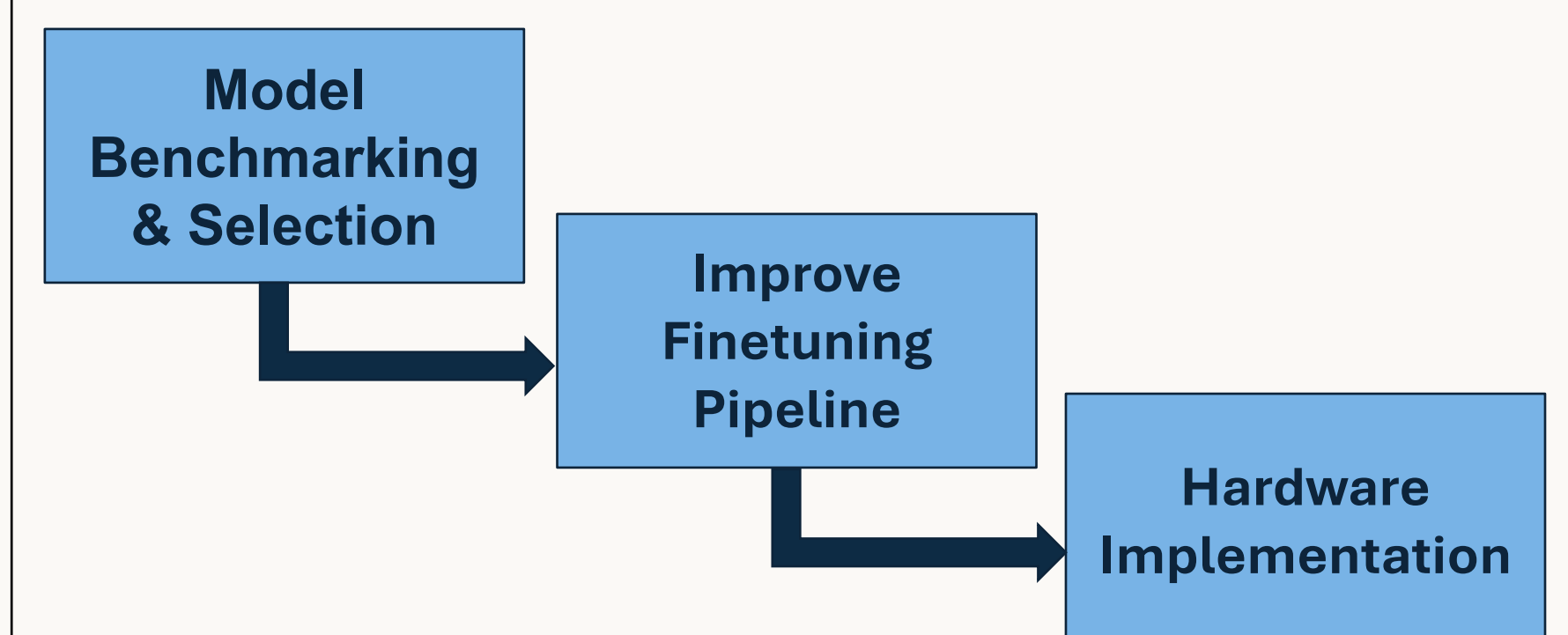
Enhance the utility of a DAA system for autonomous aerial vehicles by evaluating, improving, and deploying a state-of-the-art Single Object Tracking (SOT) deep learning model on a representative edge compute module.

3 Open-Source Datasets

Level of Difficulty & Representativeness of Use Case



Methodology



Model Benchmarking & Selection

Model	Release	Arc.	Qualitative Criteria		
Liquid Time Constant	Jun 2020	LNN	1) Assumed Implementability 2) Stakeholder Familiarity 3) Relevance to Use Case		
MixFormerV2	May 2023	ViT			
E.T. Track	Jan 2023	ViT			
ORTrack – DEIT	Jun 2025	ViT	Success Rate	Size	Speed (FPS)
SGLATrack	Mar 2025	ViT	66.1	7.9M	226.4
GRM	Mar 2023	ViT	66.9	~9M	224.7
SmallTrack	Aug 2023	ViT	70.2	~95M	45.0
OSTrack	Mar 2022	ViT	63.7	~35M	72.5
			70.7	92M	93.1

After literature review, 8 models were selected for qualitative benchmarking. 5 moved on to a more rigorous quantitative benchmarking.

Quantitative Criteria
OSTrack Selected for Finetuning

Results

Successfully Deployed Functional Prototype

- Proof-of-concept system on NVIDIA Jetson
- Processes live video feed at 16 FPS inference rate

Established Validated Finetuning Pipeline

- Experiments created reusable training pipeline
- Improved performance on VisDrone by 4.5%

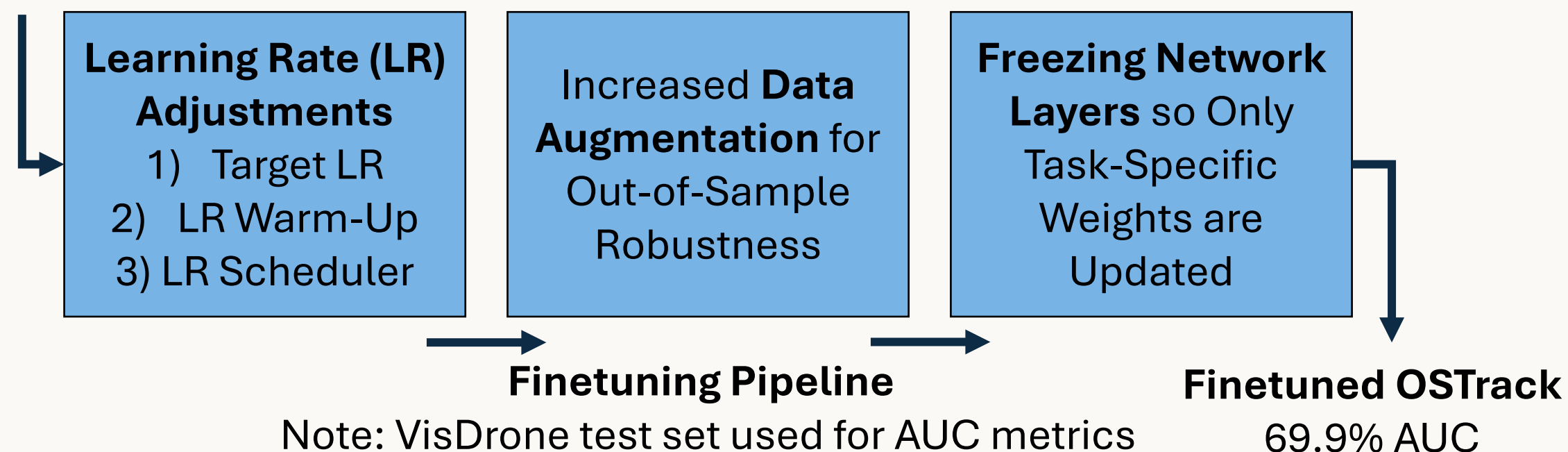
Revealed Difficulty of Use Case

- Saw no improvement in performance on AOT data
- Necessitates continued research into advanced model architectures for air-to-air tracking

Improve Finetuning Pipeline

Baseline OSTrack

65.4% AUC

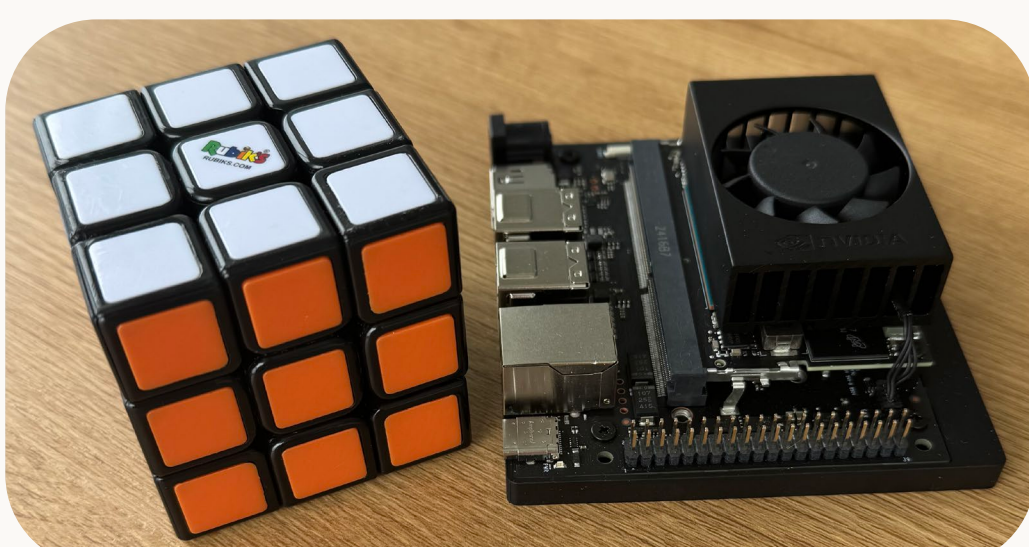


Note: VisDrone test set used for AUC metrics

Finetuned OSTrack 69.9% AUC

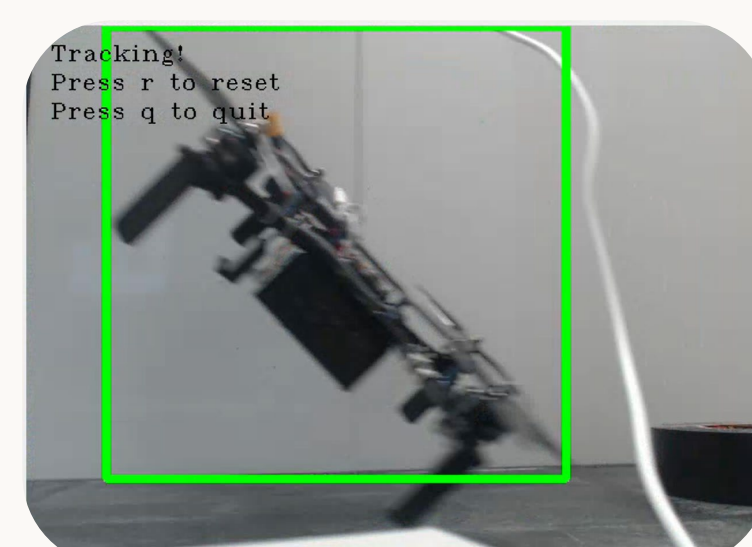
Hardware Implementation

NVIDIA Jetson Orin Nano GPU & Logitech WebCam used to deploy OSTrack



The GPU is about the same size as a Rubiks Cube, making it great for airborne platforms.

Our prototype tracks objects in real time (16 FPS). A YOLOv8n is used for the initial detection & seed bounding box.



The prototype tracks an airborne object with a bounding box.

Mission Impact

18 August 2020:
2 remote-controlled USAF MQ-9 Reapers collide mid air

Source: Forbes

Estimated \$66M in damages

Source: Military Times



MQ-9 Reaper (\$33M)

Our Prototype



= \$400

ROI of 165,000:1 by implementing SOT system