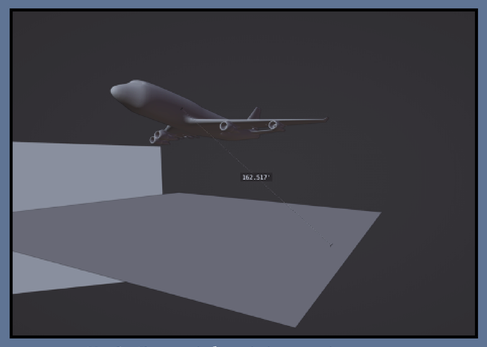
Advanced Aerial Mapping with Computer Vision: Enhancing Aircraft Recognition and Location Estimation using Monocular Depth Estimation and Deep Learning

By Logan Luna

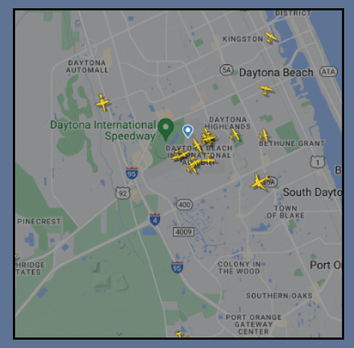
This research is being done under the mentorship of Professor Richard Stansbury



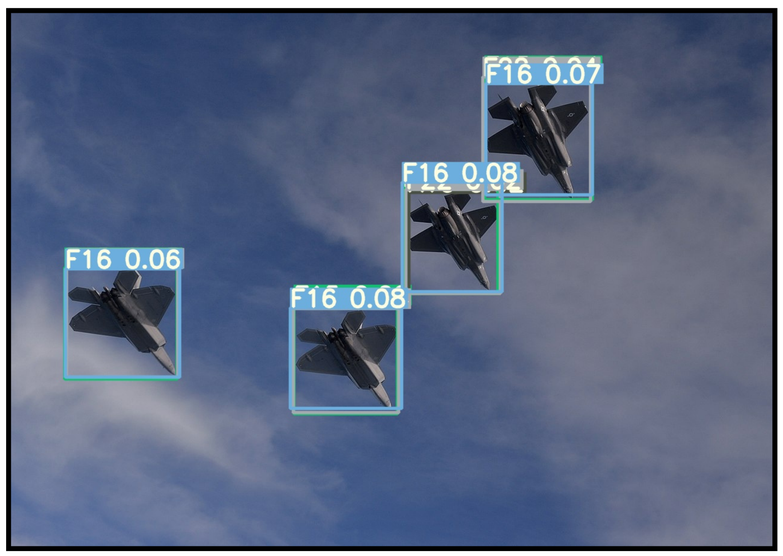
Fg 1. Potential training environment

Objective

The research aims to devise a neural network that not only bounds and classifies aircraft with precision but also predicts their proximity and positions them in context with an aircraft map.



Fg 2. Aircraft Maps to eventually localize aircraft on



Fg 3. Display of current Yolo V 7 Model performing semi-accurately (F 22, F 35)

01. Introduction

In the cutting-edge field of computer vision, the automation of aircraft identification and localization is essential. This project zeroes in on:

- Enhancements in identification and localization from computer vision advancements.
- Application of Convolutional Neural Networks (CNNs) for system accuracy improvement.
- Utilization of depth estimation to overcome complex environmental challenges.
- Investigation of performance in scenarios with visual obstructions.

Related literature

Deep Learning:

- Yann LeCun, Y. B. (2016). Deep learning. Springer Nature.
- Mash, R., Becherer, N., Woolley, B., & Pecarina, J. (2016). Toward Aircraft Recognition with Convolutional Neural Networks. IEEE, 8.

MDE (Monocular Depth Estimation):

- Armin Masoumian, H. A. (2022). Monocular Depth Estimation Using Deep Learning: A Review. A Review. Sensors (Basel, Switzerland).

02. Methodology

- Utilizes convolutional neural network principles
- Integration of monocular depth estimation techniques
- Utilizing Yolo V7 learning for improved detection and classification
- Tracking, segmentation, and potential pose detection of aircraft

Fg 4. Application of YoloV8 Tracking

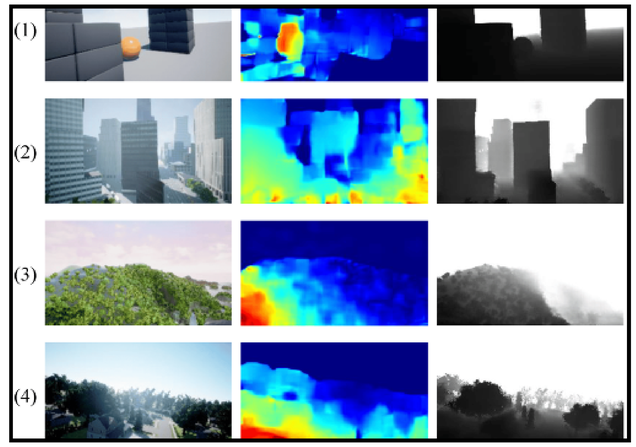
03. Results/Findings

Current Findings:

- The presented YoloV7 model offers a foundational approach to object detection and classification.
- Initial low accuracy after only 20 Epochs of training
- Continuous growth in accuracy and a notable reduction in loss
- Showcases learning capability and evident room for enhancement.

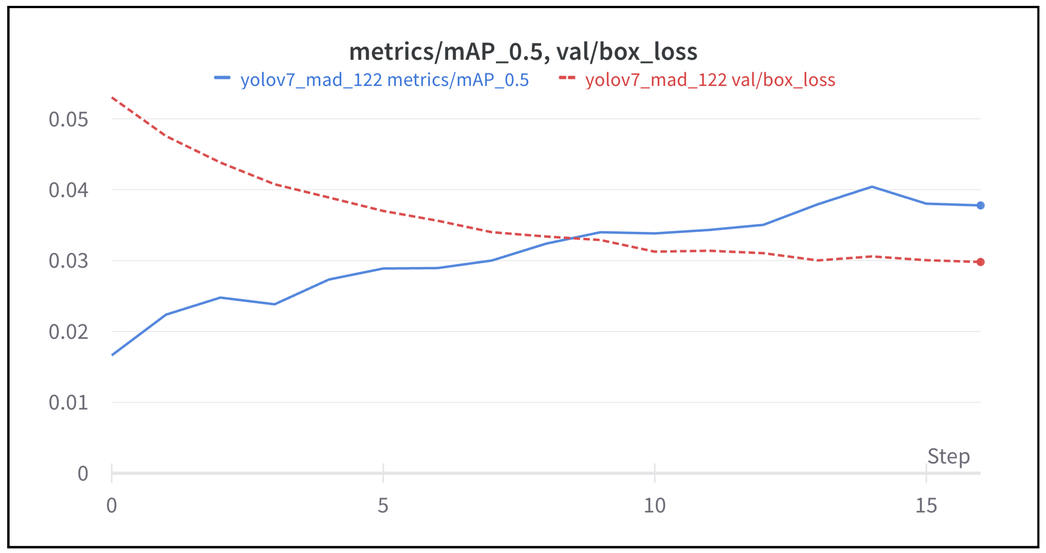
Potential Improvements:

- Data Augmentation: Techniques like rotations and zooms can help the model generalize better.
- Transfer Learning: Leveraging pre-trained models and fine-tuning them can provide a strong performance lift.
- Depth Estimation: Testing the MDE methods in various scenarios



Fg 6. Example of MDE applied on landscapes to display effectiveness at distance. Fast and High-Quality Monocular Depth Estimation with Optical Flow for Autonomous Drones

In essence, while the model serves as a starting point, its optimization requires continuous training, architecture tweaks, and leveraging existing research in computer vision.



Fg 7. Aircraft Maps to eventually localize aircraft on

04. Conclusion

- Advances in detection, bounding, and classification of aircraft
- Room for improvement in classification accuracy
- Refinement of neural network architecture
- Integration of advanced depth estimation for real-time identification
- Potential comprehensive solution for distance prediction and mapping in complex scenarios
- Future work includes deeper literature insights and potential pose detection

Fg 8. Application of YoloV8 Pose Model