Digital Sciences for High-Tech
The Iby and Aladar Fleischman Faculty of Engineering
Tel Aviv University

Student: Elad Shneor
Mentor: Roy Frumkis
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ORCA AI

Synthetic Dataset Generation and Object Detection Model for Marine Mammal Identification

This project focuses on generating a high-quality synthetic image dataset for training a computer vision model to detect marine mammals in real-time. The goal is to integrate this capability into OrcaAI's onboard systems to prevent ship collisions with marine mammals. The synthetic dataset was created by embedding segmented marine mammals into open-sea background images collected by OrcaAI's onboard system. Various image processing techniques were applied to maintain realism. The trained YOLOv8 model demonstrated strong performance in recognizing and localizing marine mammals under varied conditions.

Motivation:

The need for automated detection of marine mammals stems from both environmental and operational challenges. Collisions between ships and marine mammals pose significant threats to biodiversity and can damage a company's reputation.
Additionally, current detection methods rely on manual observation or expensive sensors. This project offers a lightweight, scalable, and AI-powered solution that reduces environmental impact while aligning with global sustainability trends in the maritime industry.

Future Work:

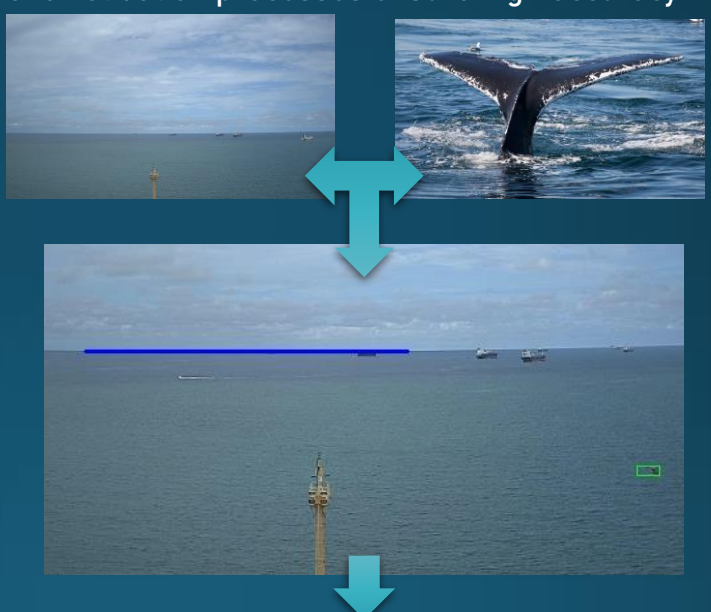
To integrate the model into OrcaAI's live system, it must be tested on the company's extensive image database. This stage will allow us to test the model's recognition capabilities and see if it is able to identify whales in images recorded by various vessels. Further improvements could include to improve and fine-tune the model's performance by expanding the training database and using additional visual information. Ultimately, the model will be integrated as a discrete recognition unit, functioning as an integral part of the real-time system, alongside additional image processing modules.

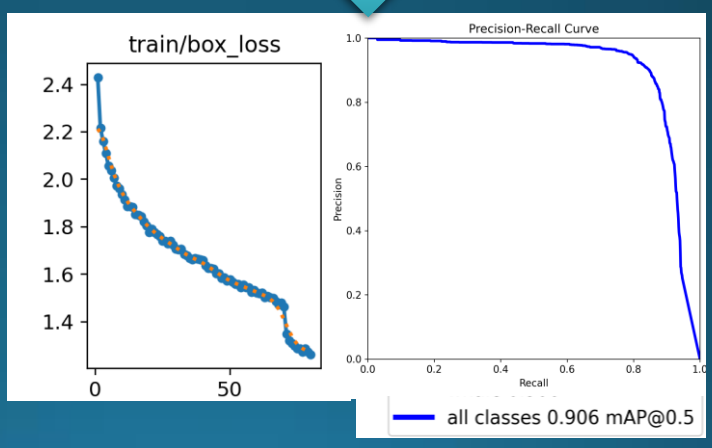
Conclusion:

This project successfully delivered a synthetic image generator, a labeled dataset, and a trained object detection model for marine mammals. It lays the foundation for a new feature in OrcaAI's system and ability to embed object automatically in OrcaAI's original dataset. Providing value both in marine life conservation and in enhancing the company's competitive advantage. The project highlights the power of synthetic data and computer vision in solving real-world problems.

Workflow:

1.Receiving unprocessed background and marine mammal images.
2.Using image processing and classic CV tools (OpenCV, REMBG) and AI GEN tools, dataset of synthetic images was generated by placing segmented marine mammals into realistic ocean settings.
3.Special effects like edge softening and wave simulation implemented to enhance realism. Augmentation implemented to insure verity.
4.The dataset was annotated using YOLO format.
5. the YOLOv8 model (nano version) was fine-tuned for detect marine mammals .
Multiple training iterations, while using augmentation techniques to avoid overfitting, and validation processes ensure high accuracy.





Tools:

ultralytics YOLO OpenCV