



Marine Garbage Detection Using Deep Learning

Mr. Vijayananda V Madlur¹, Abhishek V², Adithya K³, Amin Ashresh⁴, Darshan M⁵

Assistant Professor, Dept. of Computer Science & Engineering, Mangalore Institute of Technology & Engineering, Moodabidri, India¹

Student, Dept. of Computer Science & Engineering, Mangalore Institute of Technology & Engineering, Moodabidri, India^{2,3,4,5}

Abstract: The persistent issue of marine litter represents a significant environmental challenge, endangering aquatic life and disrupting ecosystems. Traditional monitoring methods, which rely on manual identification, are both time-intensive and resource-demanding. To address these limitations, advanced computer vision techniques such as YOLOv8 (You Only Look Once) offer a promising solution. This research explores the implementation of YOLOv8 for real-time marine debris detection, emphasizing its precision, speed, and efficiency. By leveraging publicly available datasets and employing transfer learning, this study provides a robust framework for automating marine garbage detection, thus contributing to global conservation efforts.

Index Terms - YOLOv8, marine garbage detection, deep learning, computer vision, environmental sustainability

I. INTRODUCTION

The accumulation of waste in marine environments is a growing concern globally. As marine debris proliferates, it poses severe threats to biodiversity, navigation, and even human health. Traditional monitoring systems, though effective to a degree, are hampered by scalability issues. With the advent of AI, particularly deep learning-based object detection models, automating this process has become increasingly viable. YOLOv8, one of the most advanced object detection models, provides an efficient approach for real-time identification of marine litter in diverse environmental conditions. This study focuses on implementing YOLOv8 for detecting and categorizing marine debris, bridging a critical gap in monitoring and cleanup initiatives.

II. LITERATURE SURVEY

[1] Highlighted the potential of earlier YOLO versions for object detection in natural environments but lacked emphasis on marine settings.

[2] Demonstrated the use of transfer learning with deep learning models to enhance detection accuracy for marine objects.

[3] Focused on marine debris detection by integrating YOLOv7 with various attention mechanisms, comparing lightweight coordinate attention, CBAM, and a bottleneck transformer. Results show CBAM achieved superior performance in box detection and mask evaluation, with F1 scores of 77% and 73%, respectively. Interestingly, while the bottleneck transformer had lower overall performance, it revealed areas missed by manual annotation, showcasing potential use in specific scenarios.

[4] Presents APM-YOLOv7, an enhanced method for detecting small-target water-floating garbage. It addresses challenges such as limited information and complex backgrounds by incorporating advanced features like an adaptive Canny algorithm for river channel extraction and a multi-scale gated attention mechanism. The results demonstrate significant improvements in detection precision, with a 7.02% increase in mean

Average Precision (mAP) and an 11.82% improvement in recall. This supports efficient water management through precise garbage detection.

III. SCOPE AND METHODOLOGY

3.1 Scope

This study focuses on developing an automated system for marine litter detection that can operate efficiently in real-world scenarios. Key objectives include:

- Leveraging YOLOv8's capabilities for high-precision and low-latency object detection.
- Addressing challenges such as debris occlusion, diverse underwater lighting, and varying water clarity.
- Creating a scalable framework applicable to drone-based or underwater robotic systems.

3.2 Methodology

- **Data Collection:** Open-source datasets containing annotated images of marine environments with various types of debris were utilized.
- **Preprocessing:** Datasets were augmented to include transformations like scaling, rotation, and varying brightness to simulate real-world conditions.
- **Model Training:** YOLOv8 was fine-tuned using transfer learning. The training process emphasized optimizing hyperparameters to improve precision and recall.
- **Evaluation:** The model was tested against unseen data to measure performance using metrics such as mAP (mean Average Precision), FPS (Frames Per Second), and precision-recall curves..

IV. SYSTEM ARCHITECTURE

The proposed system consists of two main phases:

1. **Training Phase:** Includes data preprocessing, feature extraction, and model optimization using labeled datasets.
2. **Detection Phase:** Utilizes the trained YOLOv8 model to perform real-time detection and categorization of marine debris.

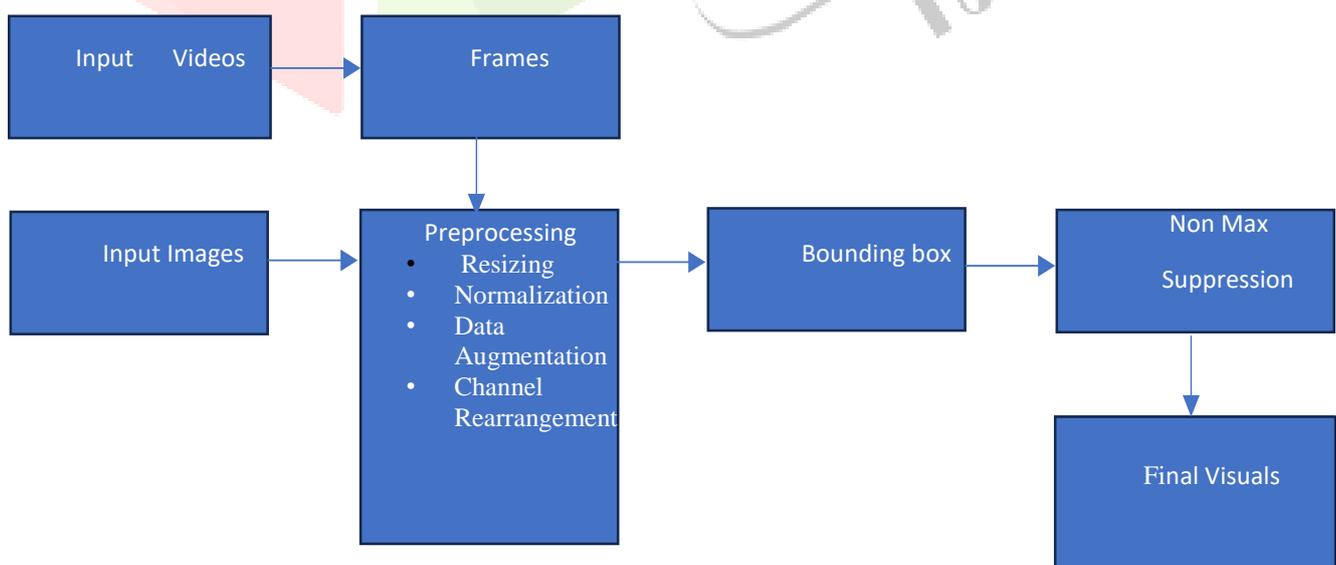


Figure 4.1: System Architecture

V. CONCLUSION

By harnessing the capabilities of YOLOv8, this research underscores the potential of AI in addressing environmental challenges. The system provides an efficient solution for marine garbage detection, paving the way for broader adoption in environmental conservation efforts. Future work will focus on enhancing detection accuracy for microplastics and integrating the model into autonomous monitoring systems.

References

- [1] Redmon, J., Farhadi, A. (2018). YOLOv3: An Incremental Improvement. arXiv preprint.
- [2] Jocher, G. (2023). YOLOv8 Model Documentation. Ultralytics.
- [3] Shen, A., Zhu, Y., Angelov, P., & Jiang, R. (2024). "Marine Debris Detection in Satellite Surveillance Using Attention Mechanisms". IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing.
- [4] Jiang, Z., Wu, B., Ma, L., Zhang, H., & Lian, J. (2023). "APM-YOLOv7 for Small-Target Water-Floating Garbage Detection Based on Multi-Scale Feature Adaptive Weighted Fusion". Sensors, 24(1), 50.

