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Computer vision-based approach to floating waste detection

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Water pollution, especially from floating waste like plastics, metals, and organic matter, poses a severe threat to aquatic ecosystems and environmental health. This study aims to develop a computer vision-based model for detecting floating waste in water bodies, utilizing recent advancements in deep learning to enhance detection accuracy and efficiency. This paper presents a study toward the development and implementation of the You Only Look Once model (YOLOv8n) to improve accuracy and efficiency in detecting floating waste. The primary objective is to develop a better model for the detection of various floating waste of concern, including glass, metal, plastic, and water hyacinth. The Research involves collecting datasets from publicly available sources as well as web scraping to collect additional images. After data collection, several preprocessing steps were applied, including cleaning and normalization to ensure consistency across the dataset. Data augmentation techniques were used to increase the diversity of images and improve model reliability. Finally, the dataset was labeled using annotation tools. The YOLOv8n model was trained on this dataset with iterative parameter optimization and various experiments to improve detection performance. Experiments included creating a model from scratch, fine-tuning it, using a pre-trained model, and transferring weights to new configurations. The experiments demonstrate that the YOLOv8n model is highly effective for detecting floating waste. The model achieved a mean average precision (mAP50) of 0.932, with a precision of 0.904 and recall of 0.852, indicating strong accuracy in detection. The YOLOv8n model has shown exceptional performance, particularly in detecting water hyacinth, highlighting its effectiveness and efficiency in floating waste detection. Moreover, the model has the ability to detect floating waste precisely and potentially can also be used in real-time applications for monitoring the water environment. These findings have a huge potential for real-world applications involving rapid responses in aquatic environments and further conservation. Future work will focus on further training with iterative adjustments and dataset augmentation to improve the adaptability and accuracy of the model across different water conditions. This includes expanding the dataset through additional data collection efforts and increasing the diversity and number of identification classes. This study contributes to the wider discourse of environmental conservation by calling for innovation in technological solutions to reduce the adverse effects of floating waste in aquatic environments and also promotes sustainable management of water resources.

Keywords: Computer Vision, Object Detection, YOLOv8n, Floating Waste, Environmental Monitoring