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Underwater Plastic Detection System

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Abstract: *Underwater Plastic Detection System' is an advanced computer vision-based solution designed to identify and classify plastic waste in underwater environments using deep learning techniques. The system utilizes Convolutional Neural Networks (CNNs), particularly state-of-the-art object detection models such as YOLO (You Only Look Once) and Faster R-CNN, to process underwater images and video streams captured through cameras or remotely operated vehicles (ROVs). It incorporates image preprocessing methods including noise reduction, color correction, and contrast enhancement to address challenges such as low visibility, light attenuation, and water turbidity. The model is trained on annotated datasets containing various types of plastic debris to ensure accurate detection and classification in real-time scenarios. The backend is implemented using Python with deep learning frameworks like TensorFlow or PyTorch, while the frontend interface enables visualization of detected objects with bounding boxes and confidence scores. The system may also integrate GPS and IoT components for tracking pollution hotspots and enabling environmental monitoring. By automating the detection of underwater plastic waste, the system supports marine conservation efforts, improves data collection efficiency, and contributes to sustainable environmental management..*

Keywords: Underwater Plastic Detection, YOLOv11, Deep Learning, Computer Vision, Django, MongoDB, Marine Pollution, Environmental Monitoring

I. INTRODUCTION

Plastic pollution has become one of the most significant environmental challenges worldwide. Millions of tons of plastic waste enter water bodies each year, affecting marine organisms and degrading aquatic ecosystems. Detecting and monitoring underwater plastic waste is essential for environmental protection and sustainable resource management.

Recent advancements in artificial intelligence and computer vision have enabled automated object detection systems capable of identifying specific objects within images. Deep learning models such as YOLO (You Only Look Once) have demonstrated remarkable performance in real-time object detection tasks. This project leverages these technologies to develop a web-based system for underwater plastic detection and monitoring.

The '**Underwater Plastic Detection and Monitoring System'** leverages these technologies to provide an automated solution for detecting plastic waste in underwater images. The system enables users to upload images through a web application, where the YOLOv11 model analyzes the images and identifies plastic objects. The generated results help environmental organizations and researchers monitor pollution levels effectively and support marine conservation activities.

II. BACKGROUND

- **Python** is a high-level programming language widely used in machine learning, artificial intelligence, and web development. Its extensive libraries and frameworks make it suitable for implementing computer vision and deep learning applications.

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- **Django** is a powerful Python-based web framework that enables rapid development of secure and scalable web applications. It provides built-in features for authentication, database integration, and URL management.

- **MongoDB** is a NoSQL database that stores data in flexible JSON-like documents. It provides efficient storage and retrieval of image metadata, user information, and detection results.

- **OpenCV** is an open-source computer vision library used for image processing and analysis. It assists in image preprocessing before object detection.

- **YOLOv11** is an advanced object detection model capable of detecting objects in real time with high accuracy. It is used in this project to identify plastic waste present in underwater images.

III. EXISTING SYSTEM

Currently, underwater plastic monitoring is primarily performed through manual observation, underwater surveys, and laboratory analysis. These methods require significant human effort and resources.

A) Disadvantages

- Manual monitoring is time-consuming.
- High operational cost for underwater inspections.
- Possibility of human error.
- Difficult to perform large-scale monitoring.
- Delayed identification of pollution hotspots.

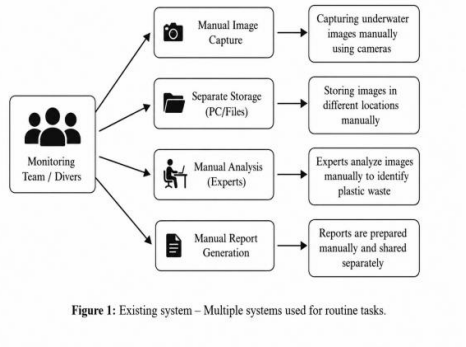

Figure 1: Existing system – Multiple systems used for routine tasks.

IV. PROPOSED SYSTEM

The proposed system provides an automated platform for detecting underwater plastic waste using deep learning techniques. Users can upload underwater images through a web interface, and the YOLOv11 model processes the images to identify plastic objects.

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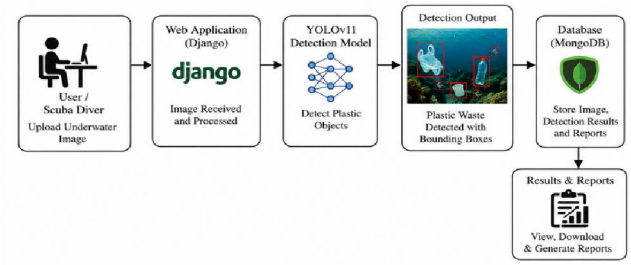

Figure 2: Proposed system – AI-based underwater plastic detection and monitoring using YOLOv11.

Advantages

- Automated plastic detection.
- Improved accuracy and efficiency.
- Reduced human intervention.
- Scalable and user-friendly platform.
- Supports environmental conservation efforts.

V. RESULT AND DISCUSSION

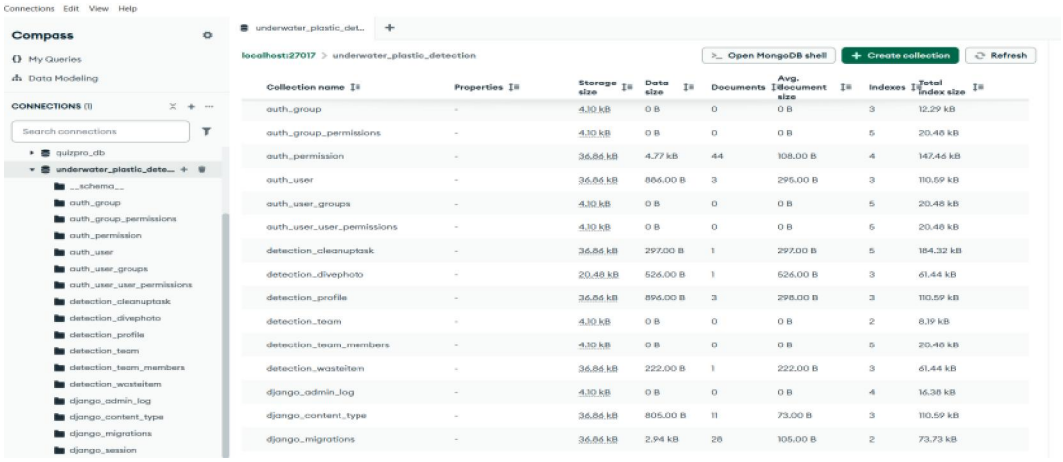

Figure 3: Database Design

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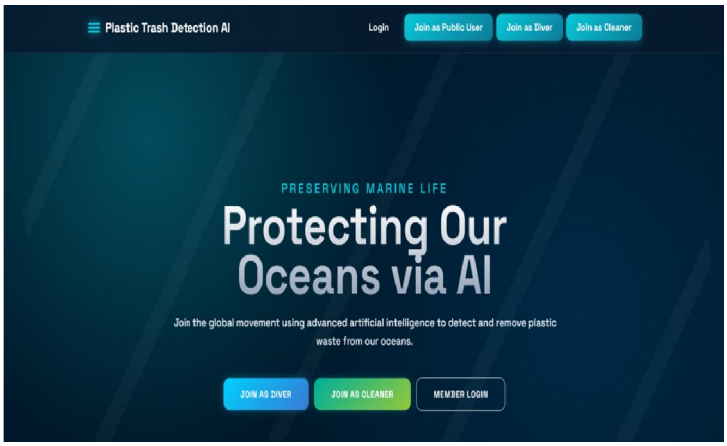

Figure 4: Home Page

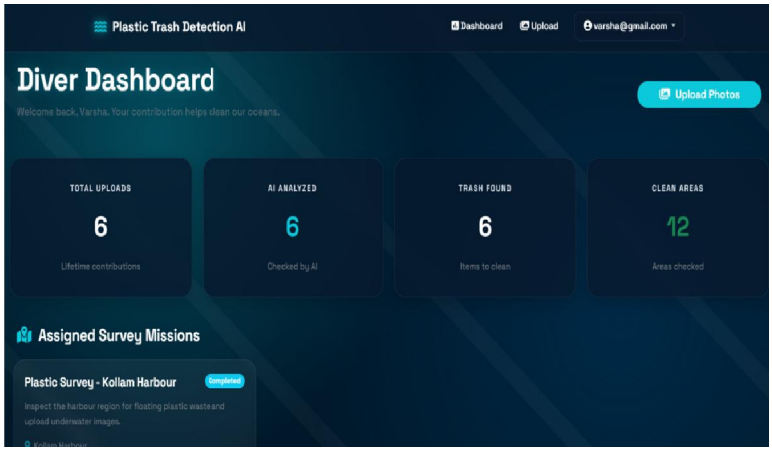

Figure 5: Diver Dashboard

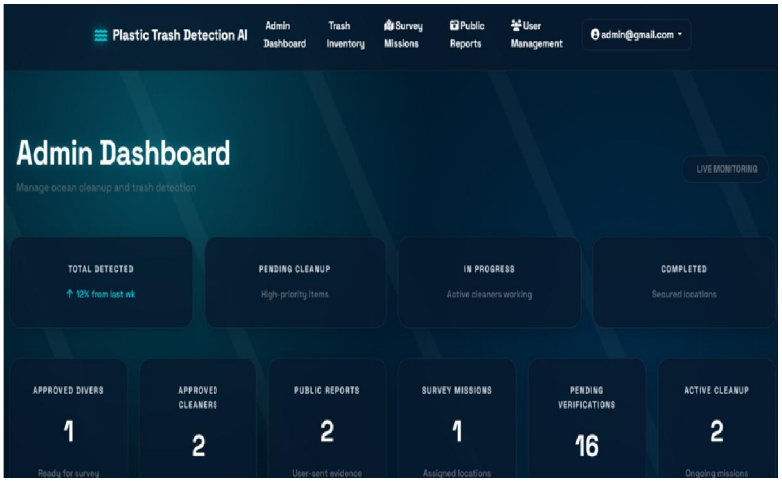

Figure 6: Admin Dashboard

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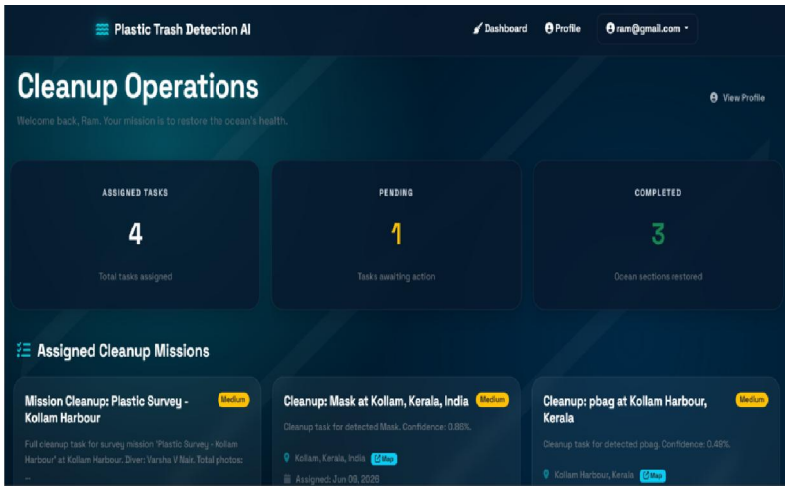

Figure 7: Cleaner Dashboard

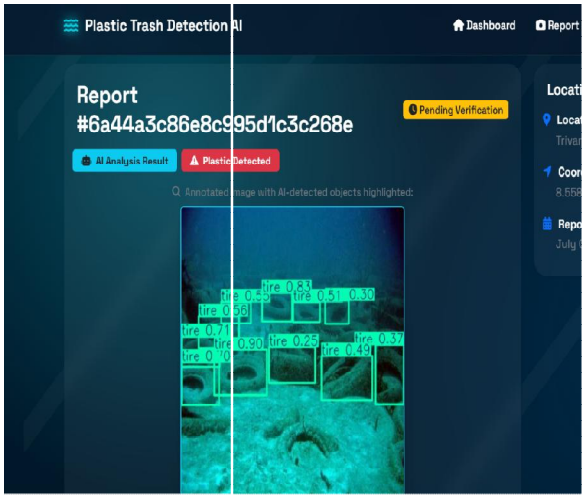

Figure 8: Detection Page

VI .CONCLUSION

In the present generation, plastic pollution in oceans, rivers, and other water bodies has become one of the most serious environmental challenges, causing significant harm to marine ecosystems and aquatic life. Conventional methods of detecting underwater plastic waste are often manual, time-consuming, expensive, and inefficient, making large-scale monitoring difficult. The **"Underwater Plastic Detection and Monitoring"** project provides an effective solution to these challenges by integrating artificial intelligence and computer vision into a web-based platform. The system enables users to upload underwater images, which are then analyzed using the **YOLOv11 deep learning model** to accurately detect plastic waste. The detected objects are highlighted with bounding boxes, allowing users to easily identify polluted areas and understand the extent of underwater plastic contamination.This project serves as a valuable tool for researchers, environmental organizations, and marine conservation authorities by reducing manual effort and improving the accuracy and speed of plastic detection. The integration of **Python, Django, OpenCV, and MongoDB** provides a reliable, scalable, and user-friendly platform for storing and managing detection results. Furthermore, the proposed system creates a strong foundation for future enhancements such as real-time underwater monitoring, IoT-

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enabled sensing devices, autonomous underwater vehicles, and advanced pollution analytics. By combining deep learning with environmental monitoring, the project contributes to sustainable marine conservation and supports global efforts to reduce plastic pollution in aquatic environments. Hence, the proposed system offers an intelligent, efficient, and practical solution for underwater plastic detection and monitoring, making it a significant step towards protecting marine biodiversity and preserving the health of aquatic ecosystems.

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