Sea Urchin Detection

Introduction

Welcome to the Sea Urchin Detection repository. This project is a proof-of-concept model developed in collaboration with the National Institute of Ocean Technology (NIOT) to detect sea urchins in underwater images using state-of-the-art deep learning techniques. The primary goal of this model is to aid in the monitoring and conservation of marine ecosystems by accurately identifying sea urchins among other underwater entities.

Key Features

Model Architecture

- The core of the model is a custom-built Convolutional Neural Network (CNN), specifically tailored for image classification tasks.
- The architecture consists of multiple convolutional layers, each followed by max-pooling layers, designed to progressively capture the spatial hierarchies of the underwater images.
- The model is finalized with fully connected layers that classify the images into two categories: 'urchins' and 'not-urchins.'

Real-Time Model Implementation

- In addition to the proof-of-concept model, a real-time detection model was developed for deployment in underwater robotic systems.
- This real-time model is optimized for performance, with a focus on low-latency processing to enable live detection of sea urchins during underwater missions.
- The model is integrated with an onboard camera and processing unit, allowing it to analyze video feeds in real-time, making instant classifications to guide the robot's actions.
- The implementation leverages GPU acceleration and efficient data pipelines to ensure that the model can process high-resolution video streams without compromising on speed or accuracy.

– The real-time model has been tested in simulated underwater environments and is currently undergoing further validation in actual field conditions.

Dataset Creation

– The dataset was meticulously compiled through a combination of field data collection and image sourcing. NIOT provided extensive underwater footage from various marine environments, which was used as the primary source of data.

– The raw footage was then segmented into individual frames, and a team of marine biologists and data annotators manually labeled each image to ensure high accuracy in the identification of sea urchins.

– The dataset includes a diverse range of underwater scenes, capturing different species, environmental conditions, and lighting scenarios to make the model robust and adaptable to various real-world situations.

– The images were preprocessed to normalize lighting variations and enhance contrast, which helped in improving the model's performance during training.

Proof of Concept

– This model is presented as a prototype to demonstrate the potential of using AI and deep learning for marine species detection.

– While the current version of the model shows promising results, further refinement, additional data, and model tuning are recommended for deployment in a production environment.

– The model serves as a foundational step towards building a comprehensive tool for marine ecosystem monitoring.

Application

– The model can be integrated into existing marine monitoring systems, providing a valuable tool for researchers and conservationists.

– By automating the detection of sea urchins, the model can assist in tracking population changes, identifying ecological patterns, and supporting conservation strategies.

– Potential future applications include expanding the model to detect a wider range of marine species, contributing to broader ecosystem assessments.

Collaboration with NIOT

This project was developed in collaboration with the National Institute of Ocean Technology (NIOT), leveraging their expertise in marine technology and data collection to ensure the model's relevance and accuracy in real-world applications.

Contributing

Contributions to improve the model, expand the dataset, or enhance the documentation are welcome. Please refer to the CONTRIBUTING.md file for guidelines on how to contribute.

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