Automated Coral Reef Health Evaluation: Remote Monitoring With CNNs, Unsupervised Machine Learning & Analysis of Hyperspectral Data

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Coral reefs are vital marine ecosystems that face mounting environmental challenges, including climate change and pollution, which contribute to coral degradation and bleaching. This project explores the novel application of unsupervised learning techniques on hyperspectral imagery to assess coral reef health without relying on pre-labeled data. Hyperspectral imagery captures detailed spectral information across numerous wavelengths, enabling the detection of subtle variations in coral composition that signal different health states. The investigation utilized unsupervised algorithms, such as clustering and dimensionality reduction, to analyze spectral datasets obtained from reef environments. These methods automatically identified distinct spectral patterns associated with healthy and stressed coral regions. By grouping similar spectral profiles, the system revealed potential indicators of environmental stress, disease, and bleaching events, offering a rapid, reliable alternative to traditional, labor-intensive manual assessments. Preliminary analyses indicate that this approach enhances both the efficiency and accuracy of reef monitoring while significantly reducing the dependency on human resources. The identification of unique spectral clusters provides a promising framework for continuous, large-scale monitoring of coral reef ecosystems. Ultimately, the implementation of these techniques could transform environmental conservation strategies by delivering timely insights essential for effective reef management and preservation.

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