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Capstone Title: AquaDetect: A CNN for Coral Recognition

Capstone Abstract: In this paper, we propose creating and training a Convolutional Neural Network (CNN) to automate the differentiation between healthy and bleached corals, as coral reefs are severely threatened by pollution, disease, and habitat destruction. Our proposed model aims to increase accuracy and efficiency, as current visual surveys and traditional image processing methods could be labor-intensive and time-consuming. We also suggest that the proposed model could be used in Remote Operated Vehicles (ROVs) to automatically detect and mark vulnerable reef habitats, providing critical information for timely decisions, conservation efforts, and environmental analyses.

In the paper, we highlight the challenges we faced in the initial stages of the project and the modifications we made to the approach. We shifted our focus to differentiating healthy corals from bleached ones using a larger dataset, and used the “Healthy and Bleached Corals Image Classification” dataset from Kaggle. CNN architecture was our primary approach to solve the problem. We provide details of the pre-processing, model building, and training stages, as well as the testing and evaluation results. Furthermore, we compare multiple learning models in their accuracies. We conclude that our proposed approach could make a significant improvement in detecting and monitoring coral bleaching and provide a better opportunity for mitigating potential threats to these delicate ecosystems.

AquaDetect: A CNN for Coral Recognition

by Micah Lessnick, Mohammed Khan, Serdar Sungun, Zeynep Aydin

Motivation

Protect coral reefs and fisheries by developing a model to identify bleached coral in underwater images.

Problem Definition

Bleached coral detection is challenging due to the complexity of coral reefs and underwater environments.

Goal

Build a model to identify bleached corals with high enough accuracy that it can be used in Remotely Operated Vehicles.

Data

Kaggle dataset specifically curated for the classification of healthy and bleached corals

Challenges and Changes to Initial Proposal

Our initial proposal was to have a multi-class dolphin identification model, once again inspired by our concerns about protecting the underwater environment. Due to the small size of the available datasets, we could not achieve classification accuracy above chance. If curious, below you can find the methods we used with the previous dataset collected by DARWIN project in Eckerd College.

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graph LR; A[preprocessing] --> B[normalization and data augmentation]; B --> C[Build the CNN model]; B --> D[Build the Swinse Model]; C --> E[Set up the training set & train]; D --> E;
```

Insights into the Current Problem

When we switched to bleached coral identification, our task now became that of binary classification. We had enough images thanks to our data augmentation and were able to successfully train our model.

```
graph LR; A[preprocessing] --> B[normalization and data augmentation]; B --> C[Build the CNN model]; C --> D[Set up the training set & train];
```

Results

We were able to reach 70% accuracy in our classifications.

Epoch	Train Accuracy	Val Accuracy
0	0.50	0.50
10	0.65	0.60
20	0.70	0.65
30	0.72	0.68
40	0.70	0.68
50	0.70	0.68

Capstone Results

We compared multiple classification methods, such as SVM, Random Forest, KNN, Linear Regression, and Gradient Boosting.

Model	Accuracy
SVM	0.48
Random Forest	0.72
KNN	0.65
Logistic Regression	0.68
CNN	0.70

References

<https://www.kaggle.com/datasets/vencerlan209/healthy-and-bleached-corals-image-classification>
http://darwineckerd.edu/?page=project_info.html

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