CSE 455 Final Project Report

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Project Topic:

Whale Identification – Few shot learning

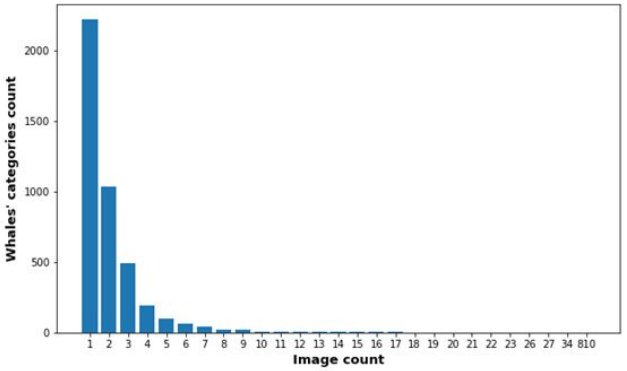
Project Overview

Scientists are using the photo surveillance system to log the whale activities and tail shape in the photos to determine the species of whales. While the current manual identifying lacks efficiency and accuracy. Hence, an automated algorithms is needed to identify the whale species by the shape of tails.

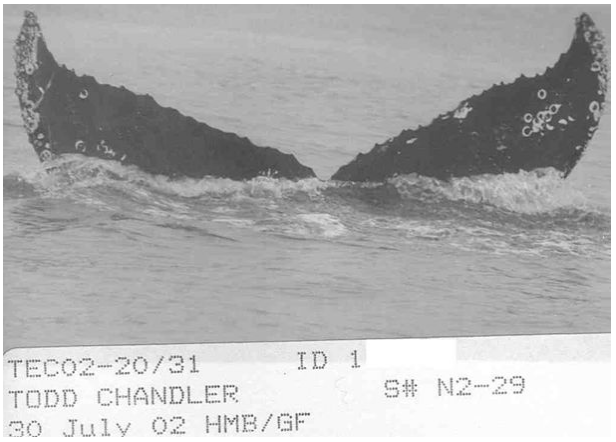
Dataset overview

The training data contains 9850 distinct pictures of whale tails, paired with 4251 different kinds of whale species.
Challenges:

1. The distribution of picture numbers among whale classes are uneven. There are more than 2000 kinds of while only have single image in training dataset, and there are 810 images divided into ‘new whale’ category.



2. Some pictures are given along with notations and comments, which may affect our feature extraction.



Solution

Based on the condition that: 1) the distribution of training data to classes are uneven and the majority of classes only has one training picture; 2) some pictures contains elements other than whale tail details, we propose the usage of 1) Siamese network and 2) Bounding Box Model, to tackle the issues respectively.
Also we tired classical way like Densely Connected Convolutional Networks (DenseNet) to compare the results.

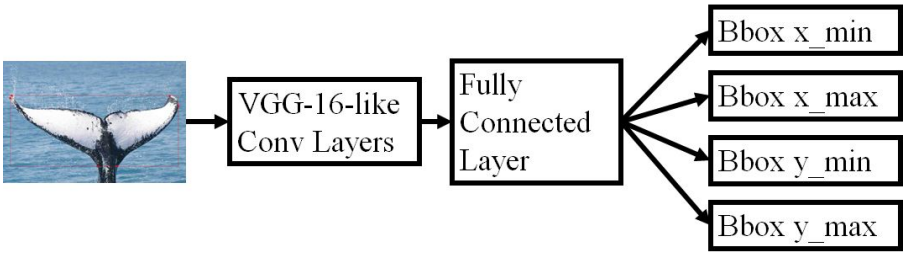
Data Processing

For the processing of data, we did:

1. Exclude ‘new whale’ class from dataset to improve the training result.
2. Horizontal flip and do Affine transformation to orient the tails

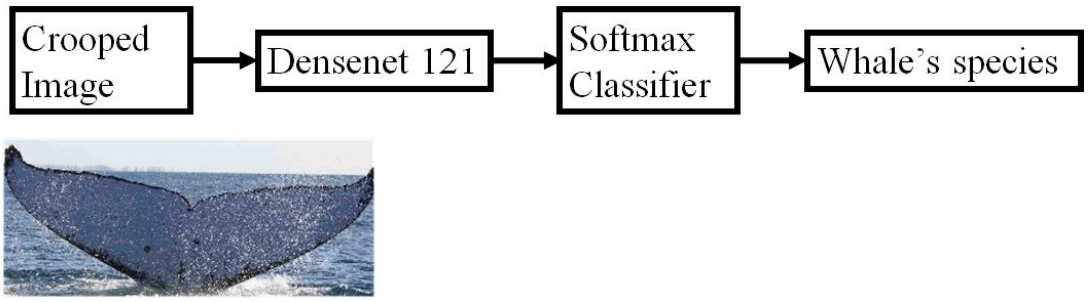

Bounding Box Model

We labeled around 500 bounding boxes in the training set, and use these data to train following neural network to get bounding box.



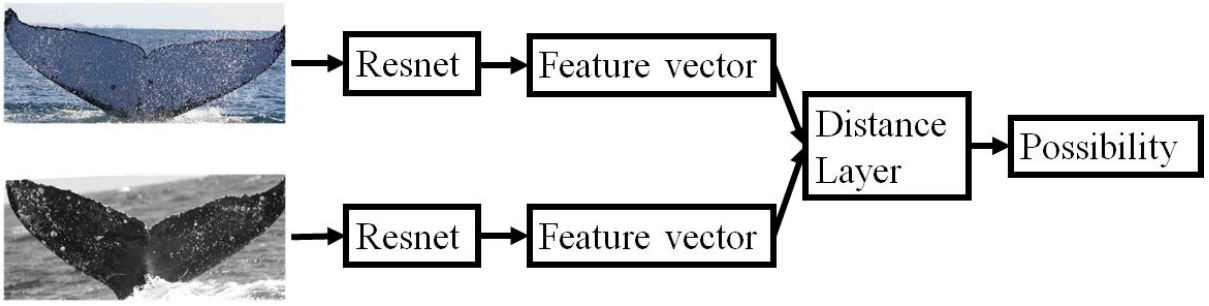
DenseNet Network

First of all, we tried to implement pre-trained densenet121 on ImageNet to classify the whale species by images. The neural network is showing as following.



Siamese Network

Then we tried to use Siamese Neural Network for few shot learning. The neural network is showing as following.



In this network, we used pretrained resnet50 to get feature vector, then use L1 to calculate the distance between two vectors in distance layer. Then compute the possibility (from 0 to 1) through sigmoid function.

For training process, we construct the training set by match same whale's category pairs and different whale's categories. For matching pair, we constructed by using the right order of a specific whale category and derangement order of this category. For mismatching pair, we just simply pick up two seperate images from different categories randomly. For testing set, we compared each image in testing set and each image in training set to get the top 5 possible categories.

Evaluation Metrics

It is evaluated according to the Mean Average Precision @ 5 (MAP@5)

$$MAP@5 = \frac{1}{U} \sum u = 1^{U} \sum k = 1^{min(n,5)} P(k)$$

Project Evaluation

In this project, the bounding box model is inspired from here, while we labeled around 500 images to get better results. Then we implemented Denset121 model and SNN model to classify the whale's species.

Results

The DenseNet will provide an accuracy of 0.40514 and SNN will provide an accuracy of 0.59073.

Obviously, using SNN can boost the results greatly. In the future work, we are going to try different backbone and data augmentation ways to get better results.

References

Huang, Gao, et al. "*Densely connected convolutional networks.*" Proceedings of the IEEE conference on computer vision and pattern recognition. 2017.
Koch, Gregory, Richard Zemel, and Ruslan Salakhutdinov. "*Siamese neural networks for one-shot image recognition.*" ICML deep learning workshop. Vol. 2. 2015.