Fish recognition using deep convolutional neural network and data augmentation

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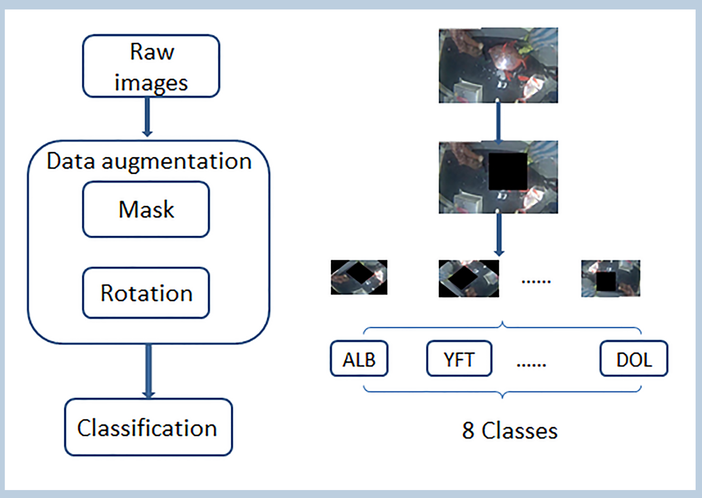
Problem

Nowadays, as a sub topic of computer vision and fishery industry, fish recognition is still a challenging work not only because of various kinds of fish, but also because of the complex background of images.

Introduction

In this paper, we introduce two methods to improve the classification accuracy. We have done some data preprocessing before training our model. The first method is data augmentation and the second is based on some image processing methods. First we make a mask in the fish region and make the fish region black, we regard these processed images as the NoF fish images. Then we achieve data augmentation. At last we use the convolutional neural network (CNN) as the classifier.



Experimental Results

The table shows the test loss in the Kaggle competition. We mainly have used two different architectures of networks. The first two columns indicate the benchmarks. The other columns indicate the test loss with using our methods. Comparing the test loss, we can see our methods have worked.

Method	Model	Test loss
None	Caffenet	1.92
None	GoogleNet	2.56
Rotating	Caffenet	1.77
Rotating	GoogleNet	1.93
Mask	Caffenet	1.87
Mask	GoogleNet	2.25
Rotating + Mask	Caffenet	1.71
Rotating + Mask	GoogleNet	1.85

References

[1] Yangqing Jia, Evan Shelhamer, Jeff Donahue, Sergey Karayev, Jonathan Long, Ross Girshick, Sergio Guadarrama, and Trevor Darrell. Caffe: Convolutional architecture for fast feature embedding. *arXiv preprint arXiv:1408.5093*, 2014.

[2] Alex Krizhevsky, Ilya Sutskever, and Geoffrey E Hinton. Imagenet classification with deep convolutional neural networks. In *Proceedings of Advances in Neural Information Processing Systems*, pages 1097–1105, 2012.

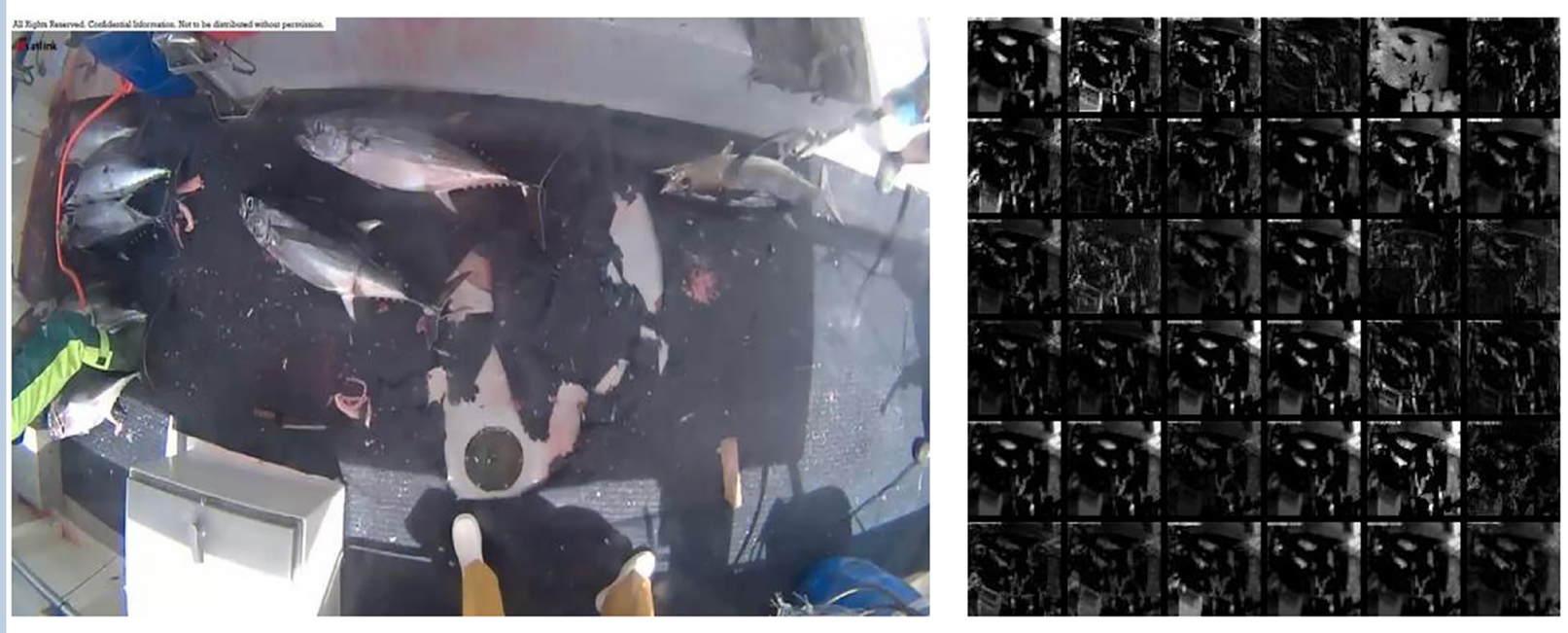
[3] Ali Sharif Razavian, Hossein Azizpour, Josephine Sullivan, and Stefan Carlsson. Cnn features off-the-shelf: an astounding baseline for recognition. In *Proceedings of IEEE Conference on Computer Vision and Pattern Recognition Workshops*, pages 806–813, 2014.

Main Methods

The architecture of our model used in the experiment is the convolutional neural network, which has achieved remarkable performance in image classification and object detection recently[3][2]. There still exists the problem that our model can't distinguish between foreground and background. We make a mask of the area where the fish are located, because the mask can force our model to concentrate on the fish area by comparing the raw images and the processed images. So it can help our convolutional neural network detect the fish region. We have trained our model using both the raw images and the processed images at the same time, which can improve the robustness of the fish recognition. In consideration of the imbalance of the dataset, we got some new images by rotating some selected images. Through this method, we can increase the number of some species of fish images, which can help avoid that our model is over-fitted with some categories of fish images, And rotating the fish images can improve the robustness of detection and achieve sophisticated detection.

Verification

In order to prove that the fish region has really made contribution in the fish recognition, we modified Caffe[1] to get the pooling images. And the figure shows the comparison between the raw images and the pooling images. In consideration of the big number of the pooling images, we have picked up 36 pooling images from 64 pooling images and resized each of all to merge them into one image.



From the two different images, we can see that the fish region is brighter than other regions in most of the pooling images, and this proves that fish make more contribution than the background for the classification. Our research can benefit the development of the marine resources, as well as commercial applications such as fisheries and aquaculture.