A Case Study on Application of Fish Re-identification using Siamese Neural Networks

Hyun Seung Son
Department of Computer Engineering
P.O. Box 58554
Republic of Korea
hson@mnu.ac.kr

Han Kyu Lim
Department of Marine & Fisheries Resources
P.O. Box 58554
Republic of Korea
limhk@mnu.ac.kr

Seok Won Jung
Department of Information Security
P.O. Box 58554
Republic of Korea
jsw@mnu.ac.kr

Han Suk Choi
Department of Computer Engineering
P.O. Box 58554
Republic of Korea
chs@mnu.ac.kr

ABSTRACT

Aquaculture industry is continuously growing due to the decrease in fish resources such as climate change and overfishing. The fish monitoring is a major topic for the fish management and diseases prevention in the aquaculture. To monitor the entire aquaculture, the several cameras are required, and one fish object must be continuously tracked in this environment. But most of the research focuses only on fish object detection using one camera. The object detection using one camera is useful when the viewing can cover the whole area in aquaculture. However, when the fish is out of the camera's viewing area and comes back within the area it is recognized as a new object. This has a problem of losing information on fish previously identified. In this paper, we show a case study on application of fish re-identification based on Siamese Neural Networks (SNN) to continuously monitor the fish object in multiple camera environments.

KEYWORDS

Smart Aqua Farm, Re-identification, Deep Learning, Fish Disease, Fish Monitoring

1 INTRODUCTION

According to statistics of the Food and Agriculture Organization (FAO), fishing production was 90.3 million tons, down 1.9 million tons from 92.2 million tons in 2019. The production of aquaculture was 87.5 million tons, up 2.3 million tons from 85.2 million tons in 2019 [1]. Aquaculture production is smaller than fishing production, but it continues to increase to the decrease in fish resources such as climate change and overfishing.

In aquaculture industry, to monitor a fish is an important role in predicting diseases and preventing mass death. The causes of mass death of fish are complex due to the nutritional imbalance of fish, high or low water temperatures and infectious diseases [2]. Therefore, to prevent mass death of fish, it is important to continuously monitor fish to detect problems early and to control.

But the existing research focus only on object detection for one image, and research on fish re-identification for tracking an object in multiple images are small. The object detection using one image is useful when the viewing can cover the whole area in aquaculture. Most aquafarm need several cameras to cover the whole. when the fish is out of the camera's viewing area and comes back within the area it is recognized as a new object. This has a problem of losing information on fish previously identified.

In this paper, we describe a case study on application of fish re-identification based on Siamese Neural Networks (SNN) to continuously monitor the fish object in multiple camera environments.

2 CASE STUDY

2.1 Methodology

We choose a library model [3] that is widely used on web site [4] in the field of Person Re-identification. As a result of applying the library to fish in our previous work [5], the fish image was not properly classified unlike expected. In this paper, we applied the Siamese Neural Networks (SNN) to find the problem. The SNN is original mode of our previous work.

The SNN [6] is a deep learning model conceived in human Siamese twins. This model is characterized by the similar structure of the two networks, and the two networks share weight as shown in figure 1. The model consists of a sequence of 4 convolution layers and 3 max-poring layers. Also, the model applies a ReLU activation function with filters of a fixed stride of 1. This model is trained in the following order: 1) Input two images to Convolution Neural Networks (CNN). 2) Obtain a Feature vector for each input.

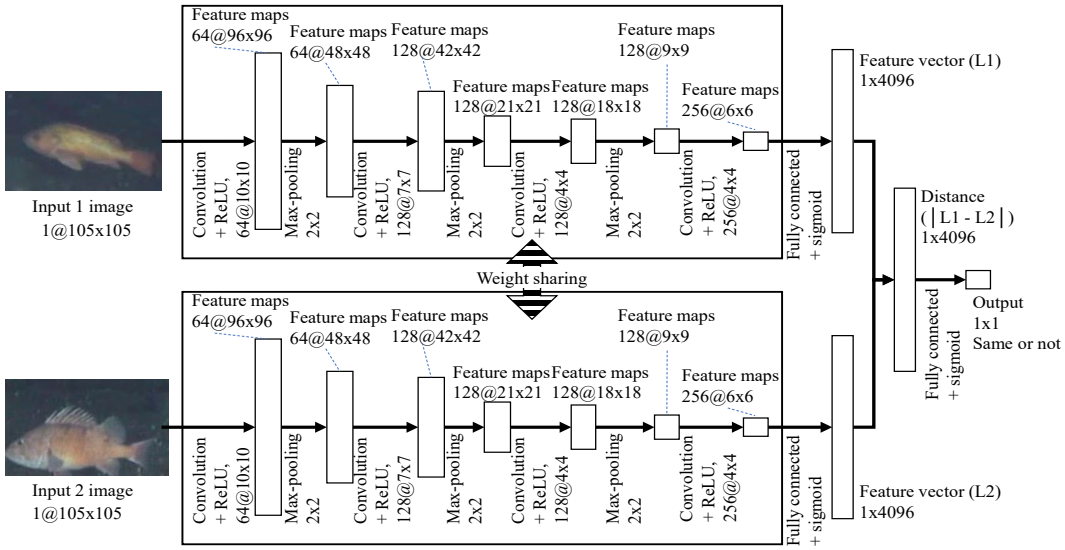

Figure 1: The structure of Siamese Neural Network (SNN).

3) Calculate the distance between the two Feature vectors. 4) Calculate the loss rate to make the distance close if the two inputs belong to the same class, and to make the distance distant if they belong to different classes.

2.2 Data Description

We extracted the training image from fish's activity video from the "Labeled Fishes in the Wild" directly taken by Remotely Operated Vehicle of the NOAA Fisheries [7]. We constructed 5 types of fish and 313 images into a dataset from this image data as shown figure 2.

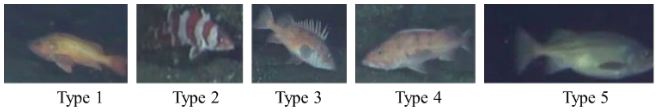

Figure 2: The training images of fish.

2.3 Using SNN for Fish Re-identification

The hyperparameters used for training are the learning rate 0.0003, Adam optimizer, batch size 128, and epochs 200. Our test results (300 times) show an accuracy of 100% (in the problem of choosing one out of 20 way) within the dataset as shown figure 3. The prediction rate for each image is an average of 83.06%.

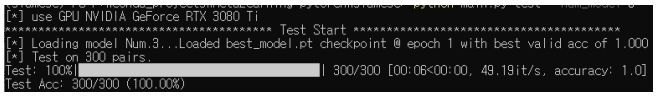

Figure 3: The result of performing the SNN.

3 CONCLUSIONS

In summary, we have performed with a case study of the fish re-identification using Siamese Neural Network (SNN) To enable monitoring of fish's activity patterns. Therefore, the training dataset is constructed by cutting the image of the bound box portion of the fish object detection from the video and training is performed through the SNN model.

The accuracy was 0% in our previous results [5]. In contrast, the SNN was able to obtain 83.06% accuracy results in this paper. Even, the correct answer rate for the problem of choosing one out of 20 way was an average of 100%. We are currently looking for the reason why the experimental results (that the results of simple model were better than the complex model) were different from our expectations (that the complex model extended from basic model are better).

ACKNOWLEDGMENTS

This research was supported by Korea Institute of Marine Science & Technology Promotion (KIMST) funded by the Ministry of Oceans and Fisheries, Korea (20220579)

REFERENCES

[1] FAO. 2022. *The State of World Fisheries and Aquaculture 2022*. Towards Blue Transformation. Rome, FAO. https://doi.org/10.4060/cc0461en

[2] D. C. Lee, K. M. Won, M. A. Park, H. S. Choi, and S. H. Jung. An Analysis of Mass Mortalities in Aquaculture Fish Farms on the Southern Coast in Korea. Ocean Policy Research 33, 1 (2018), 1-16

[3] Z. Zheng, X. Yang, Z. Yu, L. Zheng, Y. Yang, and J. Kautz. 2019. Joint discriminative and generative learning for person re-identification. In *IEEE Conference on Computer Vision and Pattern Recognition (CVPR)*. 2138-2147.

[4] Person Re-Identification Libraries, https://paperswithcode.com/task/person-re-identification

[5] S. B. Park, J. Y. Kang, H. S. Son, H. K. Lim, and H. S. Choi. 2022. A Study on Fish Re-identification based on Deep Learning. In *2022 Conference of Korean Institute of Smart Media (KISM)*. 53-54

[6] G. Koch, R. Zemel, and R. Salakhutdinov. 2015. Siamese neural networks for one-shot image recognition. In *Proceedings of the 32nd International Conference on Machine Learning*.

[7] G. Cutter, K. Stierhoff, and Jiaming Zeng. 2015. Automated Detection of Rockfish in Unconstrained Underwater Videos Using Haar Cascades and a New Image Dataset: Labeled Fishes in the Wild. *In 2015 IEEE Winter Applications and Computer Vision Workshops*, 57-62.