Fish Species Discriminative Recognition Using Artificial Intelligence

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Abstract— **In order to maintain the quality of the fishery industry, it is essential to improve the efficiency. In particular, automation of fish species discriminative recognition can be expected to be particularly efficient. In this paper, we propose a system that recognizes fish species by using artificial intelligence.**

Keywords-Image-processing; deep learning; fish species recognition;

I. INTRODUCTION

In recent years, the number of fishery workers in Japan has been declining due to the declining birthrate and aging population. Therefore, high efficiency becomes essential to maintain the present quality of fisheries. Although there are fishing methods aim at specific fish species in the ocean, due to the particular environment, it is not possible to prevent other fish species from from being caught in the same net.

While this fact is creating employment, it can be a cause of business closure in fishing areas that suffer from labor shortages. Under these circumstances, if an image recognition system can be used to automate processes that require the work that needs manpower, it can be expected to contribute to higher efficiency in the fishery industry [1].

Image recognition method using artificial intelligence such as deep learning is considered to be especially effective for recognizing complex and diverse fish with various shapes and colors. In this paper, we propose a technique to identify and locate fish species with images.

II. METHOD

To perform good accuracy in discriminative recognition system, the image should include only object image pixels. Unrelated pixels should be as few as possible, because the pixels of background can cause disturbance of correct recognition in some cases.

In order to accurately recognize fish species, it is necessary to estimate the position of the fish from an image. Therefore, our method can be roughly divided into two parts, position estimation part and fish species discriminative recognition part.

A. Position estimation model

Our position estimation model uses DeepLabV3+ [2], a network specialized for semantic segmentation. In order to improve the accuracy of position estimation and shorten the processing time, the input image is divided into four parts, and each enlarged image is used as the input image.

The trained model used in DeepLabV3 + was the one trained in PASCAL VOC 2012. The learning value at the start was specified to the PASCAL VOC data set, but it showed sufficient performance to estimate the position of the fish in the image.

B. Fish species discriminative model

As a fish discrimination model, we used a network incorporating with VGG16, a learned model specializing in object discrimination. By adding a full-connected layer and a dropout-layer to the output-layer of VGG16, the network can be trained as a fish discrimination network using the excellent learning values. The number of epoch is 50. The layer construction we used for Fish species discriminative model are shown in Table 1. In our study, we aim to discriminate two types of mackerels: blue mackerel and chub mackerel. Therefore the last layer has only one output.

As mentioned before, during the learning phase, the learning values of VGG16 are not changed, only the learning values of added layer are enabled to be changed.

TABLE I. LAYERS OF FISH SPECIES DISCRIMINATIVE MODEL

No.	Layer	Output shape
1~18	VGG16 layers	(None, 7, 7, 512)
19	Flatten layer	(None, 25088)
20	Dense layer	(None, 256)
21	Dense layer	(None, 256)
22	Dropout layer	(None, 256)
23	Dense layer	(None, 1)

III. EXPERIMENT

A. Position estimation model experiment

The input image, mask image and estimated image for the first attempt are shown in Figure 1. The mask image covers main part of a group, but fishes far from the group were not detected completely. Considering this result, we analyzed the pixel ranges of the object should be smaller than the images of the first experiment. Therefore, we divided the input images into four parts to improve the recognition accuracy in the second experiment.

The results of the second experiment are shown in Figure 2. The input images used in the second experiment still have some fishes far from the group, but these were detected correctly. In addition, fishes which is partly cut off by a frame were detected as well.

(a) Input image (b) mask image (c) estimated image

Figure 1. First attempt result

(a) Input image (b) mask image (c) estimated image

Figure 2. Position estimation result

B. Fish species discriminative model experiment

The fish species discrimination experiment was done with images of two species of mackerels. Both of these two species belong to the mackerel family, and shapes and colors are very similar to each other.

Some results are shown in Figure 3. At the top of each image, first line indicates each confident value of recognition, second line shows the file name which displays the ground truth.

The pattern of the belly skin, which is the difference between two mackerels, was correctly identified, and the fish species of each image can be output correctly without being affected by the brightness and darkness tone.

The input image of the lowest confidence value is shown as the bottom right image in Figure 3. The low confidence scores were obtained from the images similar to this one. Although the normal images (its belly facing to camera side) generated high scores, the reversed images (its back facing to camera side) did not. This result suggests that the belly skin pattern of normal images is more conspicuous than reversed images.

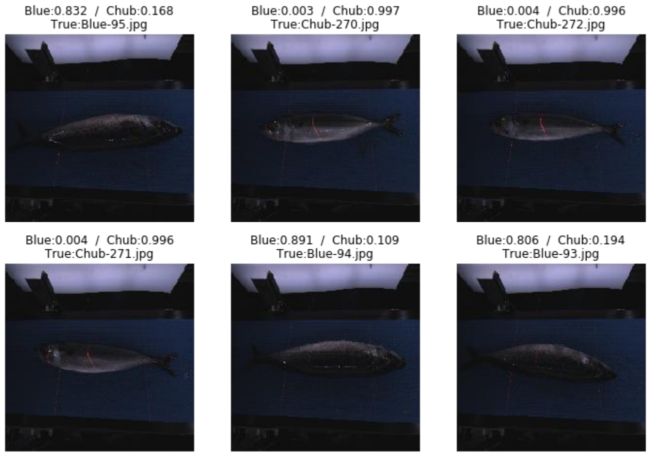

Figure 3. Mackerel species recognition result

IV. CONCLUSION AND FUTURE TASKS

We proposed two methods of discriminative recognition using DeepLabv3+ and VGG16. We still have several future works to improve.

About the images shown in Figure 2, output images still contain background pixels, and there are some results that the model could not detect pixels of fishes overlapping each other. In this experiment we tested two types of mackerels, but there is hybrid (mixed) species of blue mackerel and chub mackerel. To expand network model in order to recognize more species will be necessary to our project.

In addition, we are going to reexamine the learning method, input image normalization and contour detection method, because some pixels of the background were not sufficiently separated. Also, we expect accuracy improvement by letting the proposed two recognition parts into a unified system.

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