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Object Detection for Katsuwonus Pelamis based on ExeML ModelArts

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Abstract: Indonesia is one of the countries with the largest export of fish commodities in the world. *Katsuwonus Pelamis* (Cakalang or Tuna Skipjack) and *Euthynnus Affinis* (Tongkol or Mackarel tuna) have high economic value and are Indonesia's most significant foreign exchange earners. There is a need to measure the length and weight of the caught *Katsuwonus Pelamis* to help the Ministry of Marine Affairs and Fisheries achieve sustainable fishing. The existing method still relies on traditional data recorded by the person conducting the survey, and the calculations are frequently inaccurate. This paper proposed an object detection for *Katsuwonus Pelamis* based on ExeML ModelArts. The 4.000 images were divided into 80:20 for the training and validation set. The overall average errors are 5.19% for the estimated length of the fish and 21.98% for the estimated weight.

Keywords: *Data collection, Deep learning, Object detection, Sea fisheries, Sustainable fishing*

1. Introduction

Indonesia is the largest archipelagic country in the world [1],[2] and one of the largest countries in producing tuna worldwide [3], [4]. Skipjack is also considered an essential commodity in Indonesia, especially in small-scale fisheries [5]. As seen in Fig. 1 and Fig. 2, fishery management areas are in Indonesia. Fishery activities are increasing in eastern Indonesia [6], for example, in Sulawesi, Maluku, and beyond northern Papua. The Ministry of Marine Affairs and Fisheries focuses on increasing the export of fisheries products.

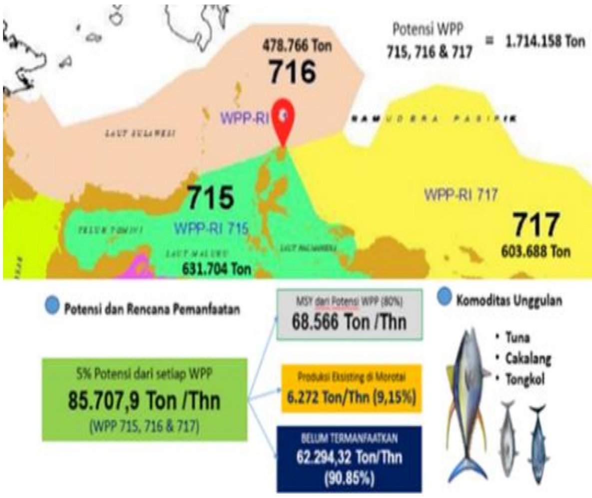

Figure 1. Fishery management areas

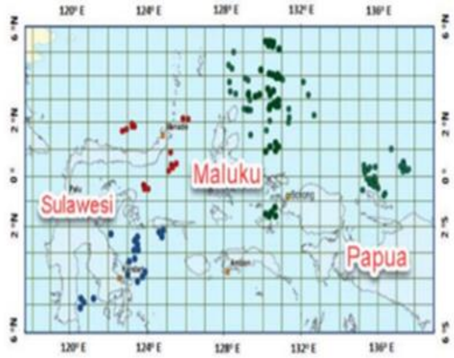

Figure 2. Fishing locations [7]

Fishermen usually catch Cakalang (Tuna Skipjack), Tongkol (Mackarel Tuna), and Lemadang, the second largest fish catch for export based on kpp.go.id, Marine Fisheries Analyst. Sometimes captain hesitates to fill in the logbook correctly because it only uses estimates [8]. At the fish landing base (PPI), several enumerators record each fisher, such as the type and weight of a fish. Skipjack is a pelagic fish that make up the group called schooling [9]. It is classified as a type of tuna fish found on the main catch in the Ocean Indies [10]. The fish were available in almost all Indonesian water, especially in eastern Indonesia [11]. Seeing the potential of marine resources in Indonesia, foreign ships are also trying to illegally earn income from Indonesian seas [12], [13]. This paper proposes an "automatic fish detection system" which will contribute to helping Indonesia's Ministry of Maritime Affairs and Fisheries improving the technology and innovation in fisheries and marine affairs for capturing and data on the fish that has been caught by creating a fish object detection with the help of Huawei Cloud's ExeML ModelArts.

2. Method

The species length and weight estimation can be measured and

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done by using the formula W = a L^b which is, transformed into natural logarithmic form lnW=ln a+b (lnL) [14],[15], Length-weight relationship (LWR) is used for estimating the weight corresponding to a given length [16]. The length-weight relationship is analyzed using the Allometric Linear Model (ALM) to calculate the parameters a and b through measurement of weight and length changes. Overall length can be measured from the snout or the tip of the lower jaw. The length estimation can be done with the help of a digital camera and computer vision [17]. Finding the fish growth based on population characteristics has been conducted on the Tuticorin waters [18], where a monthly length analysis showed a marginal drift of mean length. Data collection for Skipjack located at the fishing port of Kutaraja, Lampulo, and Banda Aceh was measured with a stratified random sampling method [19]. Because of that, the size measurement by machine vision technology will become more efficacious [20] with the help of powerful recognition results achieved by Convolutional Neural Networks (CNNs) [21].

2.1. Object Detection Method

The method used to detect the Skipjack (Katsuwonus Pelamis) is by using Object detection with the help of Huawei Cloud ExeML ModelArts and the EXIF datEXIFside the picture data that has been taken with Canon DSLR Camera EOS Kiss X7. Object detection is one of the most fundamental tasks in computer vision. Object detection is different from image classification, where image classification classifies the targeted object while object detection classifies the image and locates the object's position. It is an important computer vision task that deals with detecting instances of visual objects of a particular class (such as humans, animals, or cars) in digital images [22], [23]. Besides detecting the object, the writer will create a program to predict the weight and length of the fish by finding the distance between the digital camera and the object.

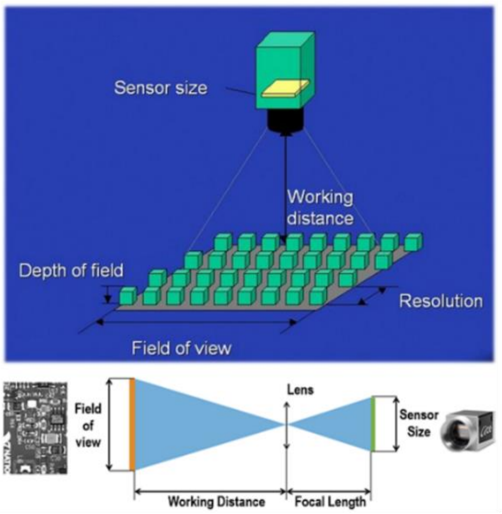

Figure 3. How to object capturing works.

As shown in Fig. 3, the camera distance to the object is calculated by Equation (1), and the actual object width is calculated by Equation (2). W and H are Width and Height in Equations (1) and (2).

$$Distance\ to\ Object\ = \frac{f\ x\ real\ object\ W\ x\ image\ W}{sensor\ H\ x\ object\ H} \tag{1}$$

$$Real\ object\ Weight = \frac{distance\ to\ object\ x\ sensor\ W\ x\ object\ W}{f\ x\ image\ W} \tag{2}$$

From there, based on Fulton's Condition Factor [24] was based on Equation (3) explains that to find the weight, it needs the length of a fish and the regression a and b variables. W = a L^b.

$$W = a\,.\,L^b \tag{3}$$

2.2. Object Detection Process

To compute the weight of the fish, the width of the bounding box must be measured and combined with the regression variable. The data processing stage up to the deployment model can be seen in Fig. 4. The first stage involves gathering fish datasets, in this case, Skipjack, which will be stored in a cloud storage system called OBS Browser+. When connecting data to Huawei Cloud servers, OBS Browser+ is used as an intermediary. The procedure of manually assigning a bounding box to the target object is then performed, followed by nine types of augmentation such as flip, rotate, scale, blur, crop, histogram equal, light contrast, and light arithmetic to improve detection ability. The data used include 400 photos before and 4,000 images after augmentation, comprising four classes: Cakalang, Tongkol, Lemadang, and Squid. The detection goal is skipjack tuna; however, because Tongkol, Lemadang, and squid are frequently caught while fishing, data is supplied so that the model can accurately discriminate these types of fish. The training and deployment process begins when all the information is ready. The training results of the exeML model on Huawei cloud can be seen in Fig. 5. Accuracy obtained is 0.94, recall is 0.891, precision is 0.986, and F1-score is 0.936.

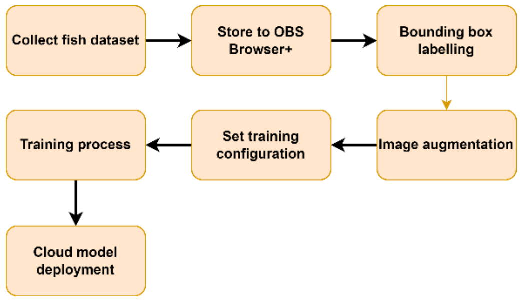

Figure 4. Block diagram of data processing and object detection model training

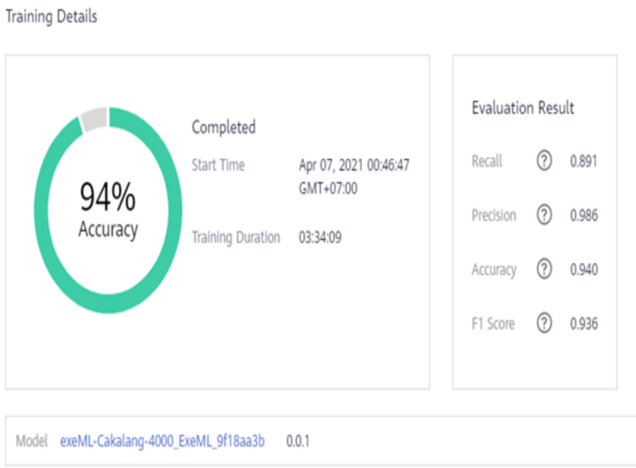

Figure 5. exeML model training results from Huawei cloud

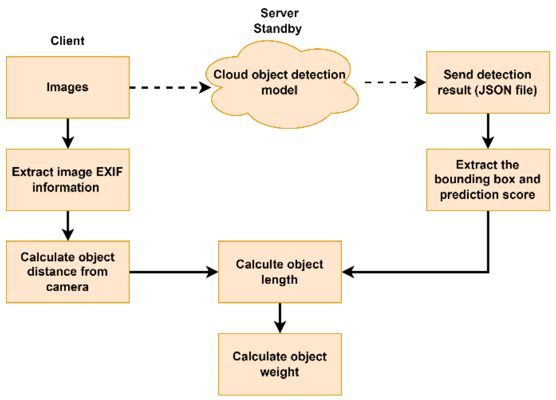

Figure 6. Detection and calculation process

Fig. 6 shows the operation of the detecting method. The deployed model is in standby mode, waiting for data requests from the client. When the client sends data, the Model detects it and sends the results in a JSON file comprising detection information such as object class and bounding box detection results. The bounding box coordinate data from the JSON file will be combined with the EXIF data to find the estimated actual object length. EXIF is digital data embedded in an image produced by a digital device. Important information in EXIF for measuring object distance is the approximate distance of the farthest object from the camera and the approximate space of the closest thing from the camera. After getting the estimated length of the object, the estimated weight of the object can be calculated.

3. Result and Discussion

Fig. 6 shows ExeML Modelarts can detect a fish with a scored of 0.994 and then will be tested to get the weight by finding out the length received from the original image's Exif data.

Figure 6. Skipjack detection result

Figure 7. Images of skipjack were utilized in testing to determine the fish's original weight.

From noting the result that has been tested, the estimation, and the weight of an object have been received; the process starts with the picture of Skipjack that will be used for the trial. The test data is an image of skipjack tuna with different inclination angles, which can be seen in Fig. 7. Images with varying slope views are used to assess the estimated length and weight calculation accuracy.

```
# realobjectwidth_cm = (distance x sensorwidth_mm x objectwidth_pixel) / (focallength x imagewidth_pixels)
#distance approx from exiv

distanceUpper = int(exif['Exif.CanonFi.FocusDistanceUpper'])
distanceLower = int(exif['Exif.CanonFi.FocusDistanceLower'])
distance = (distanceUpper + distanceLower)//2
print ("distanceUpper = {} \ndistanceLower = {} \ndistance = {}".format(distanceUpper, distanceLower, distance))
```

Figure 8. Code snippet to perform EXIF data extraction

Fig. 8 is a code snippet for extracting the approximate distance of the object to the camera. This distance estimate is needed to get the approximate length of the object and the estimated weight of the object that will be entered in the calculation function in Fig. 9.

```
#function for search real object length
def obj_length(focallength, imagewidth_pixels, sensorwidth_mm,
               bbox_width, distance, score, object_name,
               calibration_factor50_tongkol): length_stored = []

    for i in range(len(bbox_width)):
        realobjectwidth_cm = (distance * sensorwidth_mm * bbox_width[i])
                            / (focallength * imagewidth_pixels * calibration_factor50_tongkol)
        format_float = "{:.2f}".format(realobjectwidth_cm)
        print("Real {} length (cm): {} ".format(object_name[i], format_float))
        length_stored.append(realobjectwidth_cm)

    return length_stored

def obj_weigth(real_length, consta, constb):
    weigth_stored=[]
    for i in range(len(real_length)):
        w = consta*real_length[i]**constb
        format_float = "{:.2f}".format(w)
        print("Real Weight (gr): {}".format(format_float))
        weigth_stored.append(w)

    return weigth_stored
```

Figure 9. Function of calculating length and weight of fish in python

After getting the length and weight of a fish, it's time to do testing to see how accurate the fish's length and weight are. In this test, the Skipjack's actual length is 38,5 cm, and the importance of the fish is 925 grams, with the distance not set at a certain distance; after taking the picture with the Canon Kiss X7, the concept that resulted from the camera is contained with a data that is used to calculate the distance between the camera and the object, that data is called image EXIF.

No	Output	Estimated length (cm)	Difference (cm)	Difference %	Estimated weight (gr)	Difference (gr)	Difference %
1		42.76	4.26	11.06	1,324.74	399.74	43.22
2		42.46	3.96	10.29	1,295.62	370.62	40.07
3		39.61	1.11	2.88	1,043.77	118.77	12.84
4		37.59	-0.91	-2.36	886.46	-38.54	-4.17
5		38.95	0.45	1.17	990.11	65.11	7.04
6		39.1	0.60	1.56	1,002.73	77.73	8.40
7		40.15	1.65	4.29	1,088.29	163.29	17.65
8		38.44	-0.06	-0.16	950.87	25.87	2.80
9		44.49	5.99	15.56	1,499.08	574.08	62.06
10		41.45	2.95	7.66	1,201.99	276.99	29.94
Average		**40.50**	**2.00**	**5.19**	**1,128.36**	**203.36**	**21.98**

Figure 10. Estimated actual length and weight result

As shown in Fig. 10, the overall average error is 5.19%, where the calculation to find the fish length is done by calculating object distance percentage error where the real value or the actual size of

Skipjack is 38,5 cm, and the experimental value is 40,5

$$\%Error = \frac{real\ value - experiment\ value}{real\ value}\ x\ 100 \quad (4)$$

$$\%Error = \frac{38.5-40.5}{38.5}\ x\ 100 \quad (5)$$

$$Error = -5.19\% \quad (6)$$

The estimated length of the fish strongly influences the size of the error in the estimation of fish weight.

4. Conclusion

From doing the process augmentation where the 100 pictures of Cakalang that had been labeled manually went through 9 types of filters, it produced 900 new image data plus the previous where in total it is 1,000 image data of Cakalang that is going to be used for object detection prediction. Based on the calculations made by the program, it has succeeded in calculating the estimated weight of the fish based on the estimated length of the fish that has been obtained. However, the magnitude of the average error in the estimated weight of each class is caused by the use of an inaccurate data constant where the constant is based on the regression data from the Pelabuhan Ratu port. Suggestions for further development are to continue research by receiving input in the form of video and conducting direct trials by placing cameras on fishing boats and conducting direct tests by placing cameras on fishing boats where the project will be undertaken in Real-Time.

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Author contributions

Suryadiputra Liawatimena: Conceptualization, Methodology, Software, Field study, Data collection, Writing-review
Franz Adeta Junior: Data labeling, Software, Validation, Writing-Editing, Field study
Derrell Hasan: Data labeling, Software, Wrote the first draft

Conflicts of interest

The authors declare no conflicts of interest.

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