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Applying AR Assistive Devices to AI Identification of the Number and Body Length of Ornamental Fish

Chi-Yuan Lin[1], Ju-We Chen[2]

(1. Fisheries Research Institute, MOA, Keelung, Taiwan; 2. Department of Business Administration Shih Chien University, Taiwan)

Abstract: This research attempts to focus on the focus of aquaculture: the number and length of breeding, and develop an artificial intelligence identification module using AR assistive devices to identify the length and quantity of aquatic organisms to reduce the workload of aquaculture operators. When AR assistive devices are used to assist in the breeding of ornamental fish, AI's quantity and length identification will be affected by light refraction. Dynamic ornamental fish will affect quantity identification, and the depth of the breeding pond will also affect length identification. Then grasp the characteristics of the scene, find the appropriate recognition algorithm and parameter tuning, and adjust the recognition strategy. These problems can be effectively overcome and the needs of farmers can be met. Let farmers recognize the application of AR assistive devices in assisting the breeding of ornamental fish. It can be used to count shipment quantities, reduce shipping costs, and improve shipping service quality. It is used in daily growth records to streamline record operations and reduce record management costs. The accumulated information helps to grasp the panorama and life cycle of ornamental fish breeding.

Key words: Yolo, AI length identification, quantity identification, ornamental fish, industrial applications

JEL codes: Q1, Q16

1. Introduction

This research attempts to focus on the focus of aquaculture: the number and length of breeding, and develop an artificial intelligence identification module using AR assistive devices to identify the length and quantity of aquatic organisms to reduce the workload of aquaculture operators.

Light entering water from air will be refracted, which increases the variables and model instability of AI visual recognition research. Therefore, in the past, AI recognition research on aquatic organisms was conducted only underwater (Hu et al., 2021; Petrellis, 2021) using image processing and deep learning technology to measure fish morphological characteristics) or only on the water (White et al., 2006). Of course, because this research project plans to use AR visual aids to assist the breeding operations of the aquaculture industry. Using AR visual aids, breeding workers will look from the air to the water to observe the status of farmed organisms. This is an unavoidable issue in this study. AR visual aids themselves will face the following problem: only the recognized

Chi-Yuan Lin, Ph.D., Fisheries Research Institute; research areas: fisheries research. E-mail: cylin@mail.tfrin.gov.tw.

Ju-Ww Chen, Ph.D., Associate Professor, Department of Business Administration Shih Chien University; research areas: computer graphics and human-computer interaction; cybersecurity. E-mail: jwchen@g2.usc.edu.tw.

images can be used to identify aquatic organisms, which will make identification modeling difficult and may easily lead to model instability. In the past, studies on the identification of aquatic organisms were usually based on photographic identification, and there was no need for precise numbers. However, the need for farmers is to be able to grasp the number of animals in the breeding pond. The length of aquatic organisms will be affected by water depth, and past research has used 3D modeling to solve this problem (Wang et al., 2020).

2. Materials and Methods

The research object of this case is an ornamental fish breeding manufacturer (anonymous code: ST). ST Shengtianhe mainly produces seawater ornamental fish — clownfish breeding farms, which provide a complete life cycle of clownfish breeding, starting from the breeding of breeding fish, fry breeding to adult fish breeding. In order to ensure quality control of the nutritional source of the fry, ST cultivates its own clownfish feed seaweed. Currently, the company cultivates more than 20 strains of clownfish, with 50,000 to 60,000 being cultivated annually. 80% of sales are export orders.

ST uses FRP barrels to cultivate fish bodies. When the fish bodies grow to commercial specifications, they are moved to glass tanks and classified and placed according to strain, size and other price factors.

The research goal of this case is to conduct real-time object detection of ornamental fish in the environment of AR visual aids. When breeding operations need to be performed, the number, length and species of ornamental fish can be quickly identified. Among several mainstream target detection algorithms, the YOLO (You Only Look Once) recognition algorithm can quickly and reliably recognize images (Terven & Cordova-Esparza, 2023; Gao et al., 2002). Yolo v8 became the recognition algorithm selected for this research project.

The recognition models established in this study include “marking target objects”, “calculating the number of organisms”, and “length of analyte targets”. The modeling, verification and implementation steps of the recognition model are shown in Figure 1. The steps for establishing an AI recognition model. The steps are described in Figure 1.

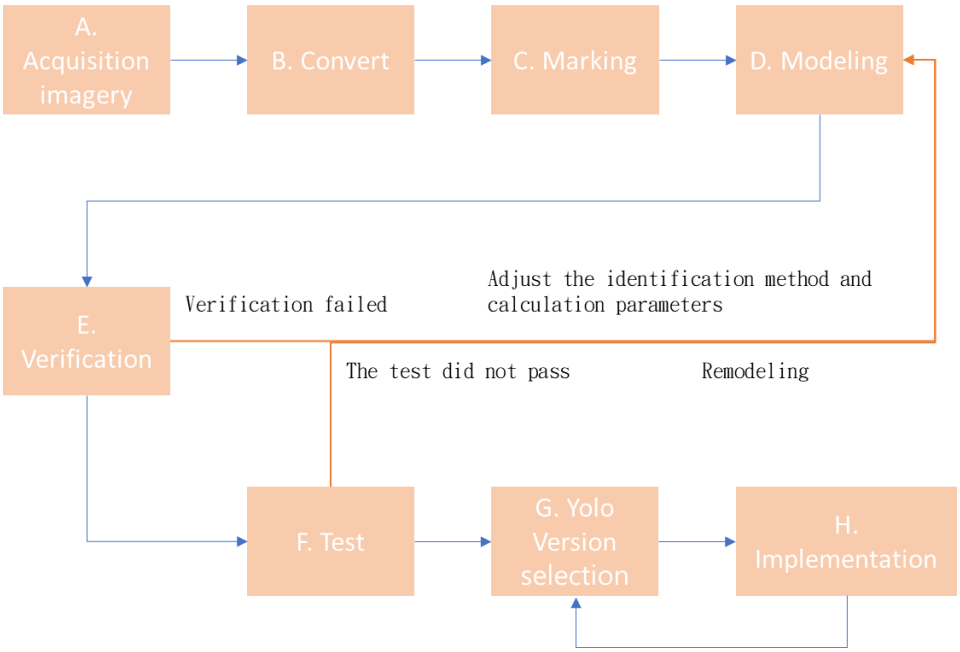

Figure 1 Steps to Establish an AI Recognition Model

How to obtain modeling images: Use a mobile phone to record the target, refer to the perspective when working with AR visual aids, and shoot the FRP barrels for breeding ornamental fish and the fish of adult fish. FRP bucket: Use a mobile phone to shoot multiple videos with a length of 1 to 5 minutes and a resolution of 1080P; Fish tank: 1 video shot with a mobile phone for 3 minutes and a resolution of 8K, and 1 video using an online CCD excerpt of about 1 and a half minutes with a resolution of 1080P. The recorded videos are obtained using PotPlayer format transfer to .jpg image format. After transferring the image file, use labelImg to mark the location and name that need to be identified and mark it. The project assistant and employees and work-study students at the implementation site assisted in marking, labelImg marks the screen, as shown in Figure 2.

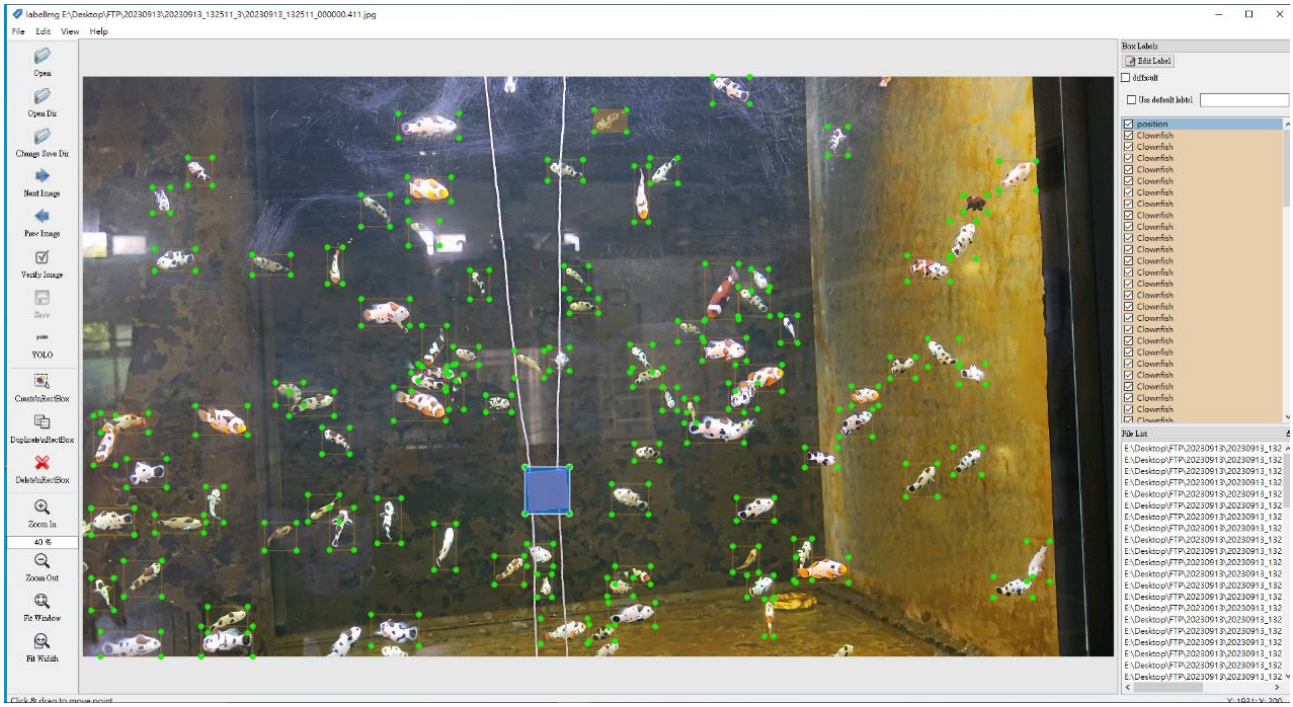

Figure 2 LabelImg Mark Screen

After marking, perform model training (train) and use Yolo V8 for modeling. Use the xml files and pictures marked by labelImg before, a total of 5,510 pictures, and use 75% (4,129 pictures) of the labeled pictures as the training set (Training Set) and 15% (824 pictures) of the labeled pictures as the validation set (Validation Set) and 10% (557 pictures) as the test set (Test Set). The training set is used to train the model and establish the required recognition model. This study uses each of the yolov8 n, s, m, l, and x modules for training. Verify 15% (824) of the marked images. The validation set is used to confirm the correctness of the selected model and use the modeling parameters for tuning. Test the image files marked with 10% (557 pictures). The test set is used to evaluate the ability of the final model to determine whether the model is usable or needs to be retrained. Considering the performance limitations of the front-end device of AR visual aids, the algorithm with the best performance may not be supported. Therefore, in this study, yolov8 n, s, m, l, x times versions were used to train the modeling to understand the impact of the recognition performance of different yolov8 times versions on the recognition of AR visual aids. This research institute uses the AR visual aid (Figure 3) model Epson MOVERIO BT-45CS to identify ornamental fish in the ST implementation site. Implement quantity and length identification.

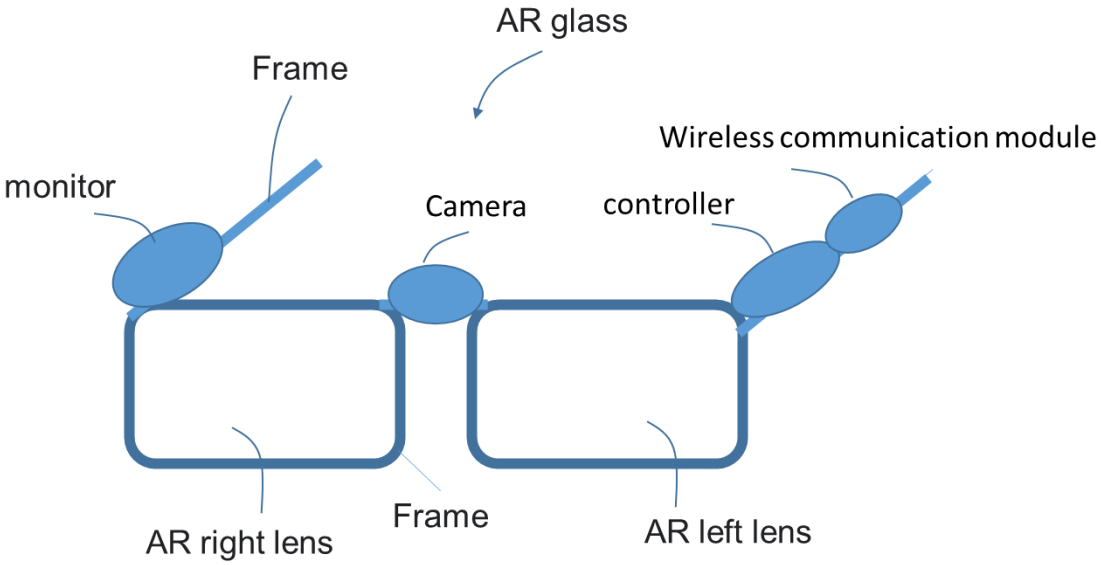

Figure 3 Schematic Diagram of AR Visual Aids

3. Results and Discussion

The results of this research are divided into two parts. The first is the AI identification of the number and body length of ornamental fish using AR assistive devices (Figure 4), and the second is the exploration of the application of AI identification of this AR assistive device in aquaculture.

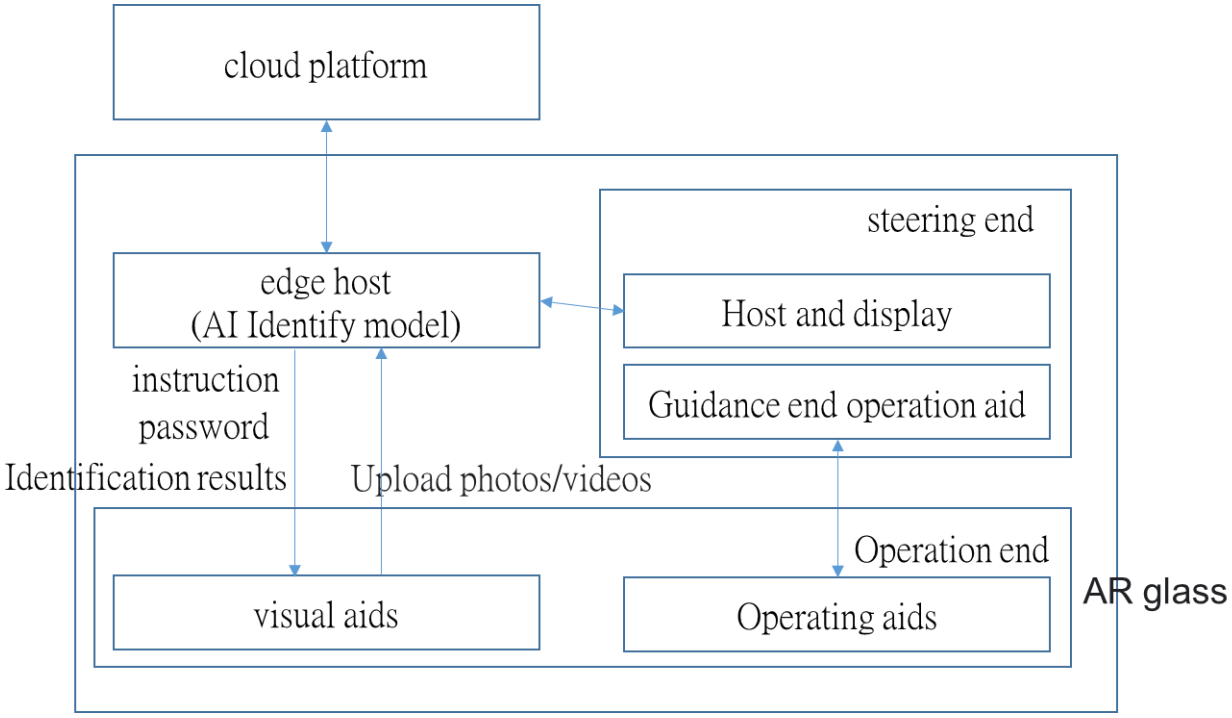

Figure 4 Architecture Diagram of the AI Identification System Using AR Assistive Devices to Identify the Number and Body Length of Ornamental Fish

3.1 AR Assistive Device for AI Identification of Number and Body Length of Ornamental Fish

3.1.1 Performance of Yolo v8 Version Applied to AR Assistive Device Recognition Model

For the marked image files in this study, models of different sizes with scaling coefficients N/S/M/L/X were used to train the modeling to find a suitable segmentation model. Yolo v8X recognition results are relatively accurate but have higher requirements on equipment and often cause delays. Yolov 8M is faster, but less accurate than yolov8X.

3.1.2 Accuracy of Dynamic Quantity Identification

In addition to the problem of water refraction in the quantitative identification of aquatic organisms, living aquatic organisms will swim in the breeding pond. In addition, they will be affected by the breeding procedures, such as feeding and approaching, resulting in concentrated or dispersed behaviors, and may leave the identification range. Dense clustering, etc., increase the difficulty of quantity identification. The location of aquatic organisms: they are deep and become a small point that is difficult to identify, or the aquatic organisms overlap each other, which will make it impossible to identify or reduce the number of identifications. Recognition will also be reduced due to ripples on the water surface caused by pumping or swimming of aquatic creatures.

However, in the scenario of this study, the number of ornamental fish in the breeding pond is fixed, so the identification strategy can be changed. In a rapid identification method, photos are continuously sampled for identification until the identification number reaches a stable value. The highest stable value is Number of breeding ponds. However, this quantity identification strategy requires an identification algorithm that can perform calculations quickly under the constraints of the front-end equipment.

3.1.3 Dynamic Length Identification Accuracy

The expansion or contraction of the body of aquatic organisms will affect length recognition. The characteristics of light cause the depth of aquatic organisms to be located, affecting the length of identification, making it difficult to obtain accurate results.

However, in the scenario of this study, the horizontal depth of the fish tank for adult fish is 50 cm, the height of the FRP bucket for cultivation is one meter, and the water depth is 50-70 cm. In terms of length identification, the impact of depth is not significant. And the breeding owners informed that the length of ornamental fish in the same breeding pond does not vary much. They do not need the precise length of each ornamental fish, only the average value, so that they can grasp the length of the ornamental fish in each fish tank or FRP breeding barrel.

Therefore, the identification strategy is still the same as quantity identification, multiple sampling, rapid identification until the length is stable.

3.1.4 Use AR Visual Aids to Identify Quantities and Body Lengths

The user’s wearable AR visual aid (Epson MOVERIO BT-45CS) is used to identify the number and body length during breeding operations. The operator can see the number and average length of the aquatic organisms in the culture pond being operated on the screen of the AR visual aid (Figure 5).

Figure 5 AR Visual Aid Quantity and Length Identification Implementation System Screen

3.2 Exploration on the Application of AR Assistive Device AI Recognition in Aquaculture

After being implemented in the ornamental fish ST field, the owner is very satisfied with the function of this system and believes that it can be practically applied in the following two scenarios:

3.2.1 Shipment Quantity Inventory

Currently, ST ornamental fish farms use a white shallow counting tray to count shipments. However, this method has a high error rate, which can reach 30%, so more fish must be included to avoid disputes and handling costs after shipment.

The owner's active ornamental fish quantity identification system can be seamlessly applied to the shipping operation, so that the depth variable that affects length identification disappears, the white background increases identification, and the ornamental fish will not overlap. Improve the accuracy of quantity identification and length identification. It can reduce the cost of shipping and improve the quality of shipping services.

3.2.2 Daily Growth Record

Inventorying the number and length of breeding stock is very labor-intensive and can only be carried out on a regular basis. With the help of this AI-assisted identification, coupled with the automatic recording function, ST ornamental fish manufacturers will be able to record the daily growth number of each tank and the length of American and Japanese ornamental fish. Simplifying the record operation and reducing the cost of record management, the accumulated information helps to grasp the panorama and life cycle of ornamental fish breeding (Figure 6).

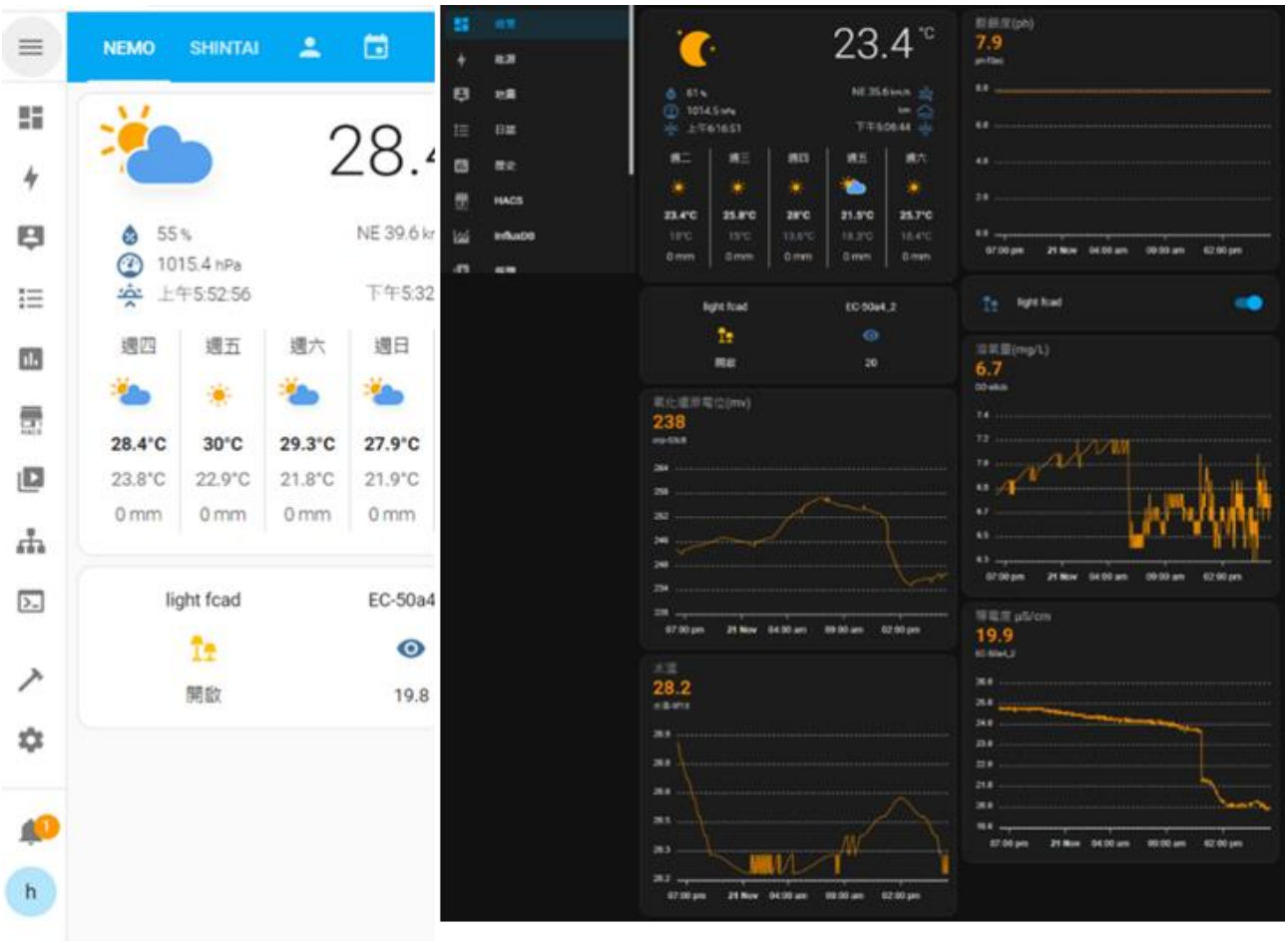

Figure 6 Breeding Recording Platform

4. Conclusion

When AR assistive devices are used to assist in the breeding of ornamental fish, AI's quantity and length identification will be affected by light refraction. Dynamic ornamental fish will affect quantity identification, and the depth of the breeding pond will also affect length identification. Then grasp the characteristics of the scene, find the appropriate recognition algorithm and parameter tuning, and adjust the recognition strategy. These problems can be effectively overcome and the needs of farmers can be met.

Let farmers recognize the application of AR assistive devices in assisting the breeding of ornamental fish. It can be used to count shipment quantities, reduce shipping costs, and improve shipping service quality. It is used in daily growth records to streamline record operations and reduce record management costs. The accumulated information helps to grasp the panorama and life cycle of ornamental fish breeding.

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References

Gao C., Wu J., Yu H., Yin J. and Guo S. (2022). "FIRN: A novel fish individual recognition method with accurate detection and attention mechanism", *Electronics*, Vol. 11, No. 21, p. 3459.

Hu X., Liu Y., Zhao Z., Liu J., Yang X., Sun C. and Zhou C. et al. (2021). "Real-time detection of uneaten feed pellets in underwater images for aquaculture using an improved YOLO-V4 network", *Computers and Electronics in Agriculture*, Vol. 185, p. 106135.

Petrellis N. (2021). "Measurement of fish morphological features through image processing and deep learning techniques", *Applied Sciences*, Vol. 11, No. 10, p. 4416.

Terven J. and Cordova-Esparza D. (2023). "A comprehensive review of YOLO: From YOLOv1 to YOLOv8 and beyond", available online at: http://arXiv preprint arXiv:2304.00501.

Wang C. C., Huang C. Y., Lin C. H., Yeh C. H., Liu G. X. and Chou Y. C. (2020, December). "3D-modeling dataset augmentation for underwater AUV real-time manipulations", in: *2020 IEEE Asia Pacific Conference on Circuits and Systems (APCCAS)*, IEEE, pp. 145-148.

Yin J., Wu J., Gao C. and Jiang Z. (2022). "LIFRNet: A novel lightweight individual fish recognition method based on deformable convolution and edge feature learning", *Agriculture*, Vol. 12, No. 12, p. 1972.

White D. J., Svellingen C. and Strachan N. J. (2006). "Automated measurement of species and length of fish by computer vision", *Fisheries Research*, Vol. 80, No. 2-3, pp. 203-210.