DETECTION OF GIANT CLAM USING YOLOv7 FOR PRECISION BIODIVERSITY

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ABSTRACT

Giant clams, vital to coral reef ecosystems, have experienced significant population declines due to overfishing and habitat destruction. Monitoring these populations poses challenges, as traditional scuba diving surveys are labor-intensive and limited in scope. In this study, a YOLOv7 object detection algorithm was developed and implemented on an underwater remotely operated vehicle (ROV) to address these challenges. A comprehensive dataset of giant clam images was created, enabling the training and evaluation of the model. The system achieved an average accuracy of 79.65% in detecting and counting giant clams across six different underwater scenes, demonstrating its potential for automated population assessment. Accuracy could be improved by expanding the dataset with higher-quality images, enhancing reliability for real-world applications. This approach provides a promising tool for advancing marine life recognition and supporting conservation strategies, particularly in monitoring and studying giant clam populations in marine protected areas.

Key words: YOLOv7, Giant Clam, Precision Biodiversity

INTRODUCTION

Giant clams, also known as Tridacnidae (1), are a group of large, colourful bivalve mollusks that are found in tropical and subtropical waters around the world. These clams are important ecosystem fauna and play a critical role in coral reef health. However, due to overfishing and habitat destruction, giant clam populations have been in decline in recent decades. Conservation efforts to protect and recover giant clam populations are crucial to ensure the survival of these unique and important species. One of the challenges in monitoring and assessing giant clam populations is the difficulty in accurately counting and locating them in their natural environment. Current methods of population assessment are conducted by scuba diving surveys. Recent advances in computer vision and machine learning (2) can be a complementary method for the population assessment to monitor and assess giant clam populations. In this study, we propose YOLOv7 object detection algorithm to detect and assess the population of giant clams in a dedicated Tioman marine protected area. This approach has the potential to assist in the development and implementation of effective conservation strategies for Precision Biodiversity.

METHOD

YOLOv7 Object Detection Algorithm

YOLOv7 is a powerful object detection algorithm that has been shown to be effective in identifying and counting a variety of objects in images. It is a state-of-the-art object detection algorithm that builds upon the previous YOLOv5 and YOLOv4 models. It is designed to be faster and more accurate than its predecessors, with a smaller model size and reduced memory requirements (3). Several research papers have demonstrated the effectiveness of YOLOv7 in a variety of computer vision tasks, including object detection, tracking, and segmentation in wildlife conservation (4), foggy traffic, agriculture, autonomous driving and other application.

MAIN RESULTS

This section presents the integration and operation of the YOLOv7 model with the Remotely Operated Vehicle (ROV) in dedicated area around Tioman Island. The ROV, equipped with its onboard camera system, served as the tool for capturing underwater imagery and providing real-time video feed for our object detection model. Figure 1 shows the ROV used for data collection to identify giant clams and sample of the video footage with calculated giant clams. The real-time video feed facilitated immediate analysis and provided instant feedback on the presence and locations of these remarkable marine species. Table 1 shows comparison of manual and model identification using YOLOv7, and Table 2 shows the accuracy of the model at 6 different scenes using the ROV.

Table 1 shows over calculation of giant clam that may be due to the similar structure detected by the model. This accuracy error is mainly due to relatively small size of dataset used to train the model. Quality of the image from the camera and the clarity of the water could also affect the accuracy. Based on the findings presented in Table 2, the accuracy of the model in identifying giant clams achieved an average accuracy of 79.65%. Overall, the developed model has learned to recognize the distinctive features of giant clams, identified a significant number of giant clams in the dataset and distinguish them from other objects in the images. A larger amount of data will result in a more accurate and reliable model for identifying complex objects such as the giant clams.

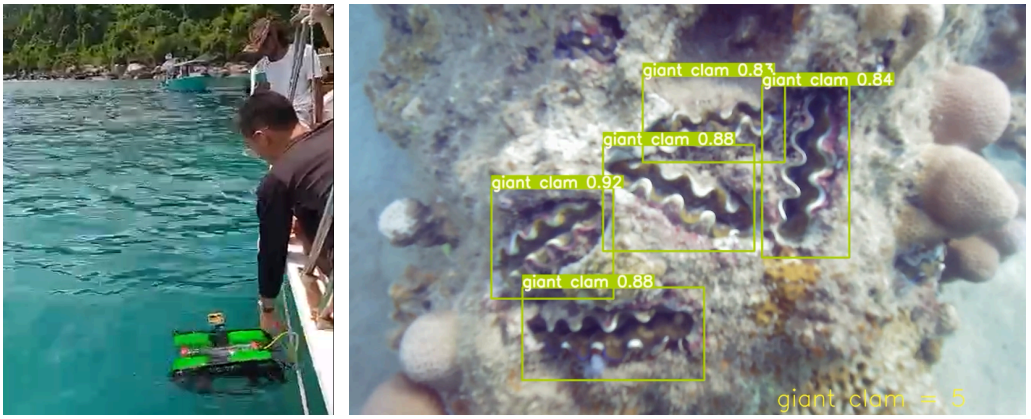


Figure 1 Data collection using ROV and data obtained using YOLOv7

Table 1 Sample of comparison between manual vs YOLOv7 calculation

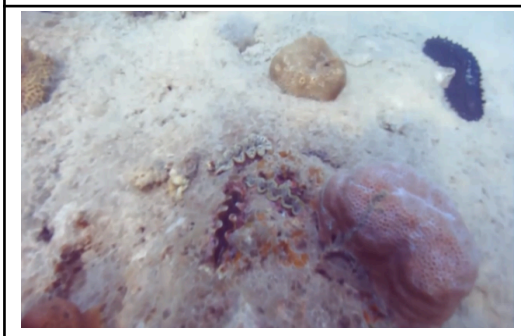
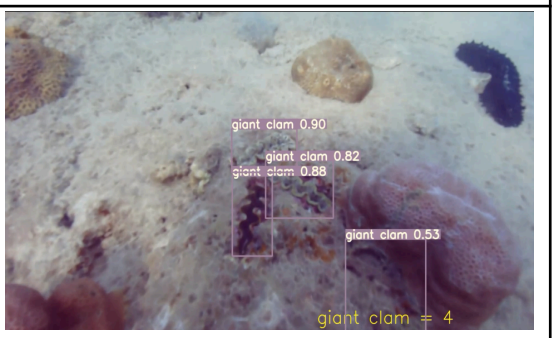
Manual Identification	Model Identification using YOLOv7
	
3 Giant clams identified and counted	4 Giant clams Identified and counted
Remark: A false positive is counted by the model.	

Table 2 Accuracy of the model

No.	**Manual Count**	**Model Count**	**Accuracy (%)**
1	3	4	75
2	7	6	85.71
3	11	8	72.72
4	9	9	100
5	9	4	44.44
6	5	5	100
Average Accuracy of Model			79.65

CONCLUSION

In conclusion, this project has successfully achieved its objectives of creating a comprehensive giant clam dataset, developing an object recognition model using YOLOv7, and implementing the model on an underwater ROV. This work successfully integrated the advanced computer vision techniques and the ROV technology to conduct research and conservation efforts in underwater ecosystems, such as monitoring and studying giant clam populations. Six different scenes were compared between manual counting and model identification and counting using YOLOv7 with an average accuracy of 79.65%. The accuracy can be further improved by enriching the dataset with more data and better-quality images. This would lead to more reliable and accurate identification of giant clams in real-world applications, contributing to the advancement of marine life recognition and conservation efforts.

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