Rip Current Detection and Early Warning System Based on AI Object Detection Model

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Rip currents pose significant hazards to beach safety. They are unpredictable and strong, quickly pulling swimmers away from shore, often leading to drowning. To mitigate the harm of rip currents, this study develops a rip current detection and early warning system integrating AI object detection models with real-time alert mechanism. In this research, we develop an AI detection model by YOLOv8 based on a dataset utilizing international image databases and local coastal videos provided by Taiwan GoOcean platform. Through data augmentation, including randomly adjusting rotation, brightness, blur, and contrast, a robust rip current detection system is developed and application to Taiwanese coastline situation is proven. For building early warning models, we construct separate datasets, and develop the system based on YOLOv8 and Transformer. The YOLOv8 detection model achieves an average precision (AP) of 99%. According to this study, white foam with a trailing tail pointing toward the sea was observed before rip current occurrence. Training by using this feature, YOLOmov8-based and Transformer-based early warning models can achieve APs of 98% and 95%, respectively. The early warning system can send alerts about 30 seconds before rip current occurrences, together with accurate localization predictions. Upon detecting rip currents, the system immediately transmits alerts via Discord. Together with the self-trained human detection model, visitor safety can be enhanced. In summary, an accurate rip current detection and early warning system based on image detection models is developed. An alert system with a self-trained human detection model is also built based on this system.

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