

Advancing Underwater Exploration: The Integration of Augmented Reality Technology in Smart Snorkeling Masks for Enhanced Safety, and Marine Environmental Awareness

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This project presents the development of an Augmented Reality (AR) snorkeling mask that enhances underwater safety through real-time marine species detection and biometric health monitoring. The system integrates artificial intelligence (AI) with wearable AR technology to help snorkelers identify dangerous marine life and track vital signs during dives. A YOLO-based AI model was trained to classify 366 fish species, including venomous and aggressive types. Detected species are displayed on an AR interface worn by the snorkeler, offering immediate visual alerts without obstructing vision. Additionally, integrated biometric sensors continuously monitor heart rate and oxygen saturation, providing real-time health data. The project included designing the hardware system, integrating biometric monitoring, and testing the AI model's performance using both PC-based and Raspberry Pi-based platforms. PC-based testing showed high fish detection accuracy (89–95%) with low latency (1–3 seconds). Raspberry Pi testing achieved lower accuracy (65–85%) and higher latency (6–8 seconds) due to limited processing capacity, but demonstrated portability and real-time functionality. The AR display successfully presented both species and health information without distraction. These results confirm the AR mask's effectiveness in improving diver awareness and safety. The system functions reliably and offers a compact, cost-effective solution with real-world potential for both recreational and scientific diving. Future work will focus on enhancing low-light detection performance, expanding the fish species database, and reducing power consumption to extend usability.

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