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AquaLink in HAB Detection: Integrating IoT and 3D-Printed PETG for Monitoring Aquaculture Conditions Conducive to HAB

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Abstract

Harmful algal blooms (HABs) pose a serious threat to aquaculture and environmental health, often resulting in considerable ecological and economic impacts. Conventional water quality monitoring techniques, often manual and time-consuming, are inadequate for the timely detection of conditions that promote HAB formation. To overcome these limitations, the AquaLink system was developed by integrating the Internet of Things (IoT) technology with 3D-printed polyethylene terephthalate glycol (PETG) enclosures, enabling scalable, real-time, and cost-effective monitoring of water quality. The system employs sensors to measure essential parameters, including atmospheric pressure, temperature, and turbidity, with data transferred through Raspberry Pi and ESP32 controllers to an

IoT dashboard for real-time analysis and visualisation. PETG-based casings were combined with IoT-enabled sensors to improve durability and reduce biofouling in aquatic environments. Prototypes were tested across different water bodies to validate performance under real-world conditions. The results demonstrated that the system effectively provided real-time monitoring of aquaculture environments, allowing the early identification of HAB risks through continuous tracking of water quality indicators. Beyond its technical contributions, AquaLink offers societal benefits by serving as a low-cost, efficient tool that reduces fish mortality, limits environmental degradation, and enhances food security. The flexibility and scalability of the system make it applicable to small-scale and industrial aquaculture operations, fostering sustainable practices through advanced environmental monitoring. © 2025, ECTI Association. All rights reserved.

Author keywords

3D Printing; Aquaculture; Dashboard; Environmental Monitoring; ESP32; Harmful Algal Blooms; Internet of Things; PETG; Raspberry Pi; Real-time Data; Sensor Integration; ThingsBoard; Water Quality

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