CABMS: The First System Against California Marine Biotoxins Through Deep, Spatiotemporal, Multivariate Prediction and Sensor-Based Data Transmission

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To combat marine biotoxin contamination that threatens California's $15-million shellfish industry, this research establishes the first California Marine Biotoxin Management System (CABMS), a novel AI-based and sensor-enabled system for domoic acid and saxitoxin prediction in California. The system design of the CABMS integrates 5 modules: data collection, apparatus development, multivariate data preparation, AI modeling, and application deployment. The CABMS collects datasets from multiple government agencies and organizes 6 hydrological, geospatial, and oceanographic data types for predictive modeling in California's 6 major shellfish production and forage regions. After comparing 2 deep and 2 classical machine learning algorithms, 10 long short-term memory single-task and multi-task learning models were trained on data for the 6 locations. After constructing two generations of a wireless, sensor-based apparatus, accuracy improved by 3% through real-time data transmission into the CABMS, demonstrating predictive strength with readily available environmental data. Using time series cross-validation in forecast horizon calculation, dissolved oxygen and precipitation proved as key factors in effecting a biotoxin-conducive environment. Now, the CABMS makes predictions with >90% acc. consistently up to 5 weeks. The CABMS is containerized via a web application with a user-centric interface and has immediate impact in shifting the dynamic of biotoxin management from post-event reactivity to pre-event proactivity. Effectively connecting existing hardware devices with innovative software solutions, the CABMS presents a long-term prediction architecture, cuts operational costs, and opens the public to the accessible and timely assessment of shellfish toxicity risk.

Awards Won:
Second Award of $2,000
China Association for Science and Technology (CAST): Award of $1,200