ABSTRACT

The freshness of seafood products is crucial in determining food quality and safety, especially in the fishing and seafood industries. Rapid spoilage processes in these products often cannot be detected visually, necessitating more accurate and efficient methods for quality evaluation. One of the main challenges in the seafood industry is assessing freshness in real-time practically and reliably. Therefore, there is a need for technology that can detect changes in air quality caused by spoilage gases as an indicator of freshness.

This research proposes using an electronic nose equipped with gas sensors and machine-learning algorithms to detect and classify the freshness of various types of seafood, including tuna, salmon, shrimp, cod, and crab. The system works by detecting the gas produced during the spoilage process and analyzing the sensor data using machine learning algorithms such as Random Forest, KNN, Naive Bayes, Decision Tree, Ada Boost, Gradient Boosting, and XGBoost. The XGBoost algorithm was selected based on comparison results that showed superiority in terms of accuracy, speed, memory usage, and reliability.

From the PSS analysis, the four gas sensors selected were MQ-137, MQ-2, MQ-8, and MQ-9, which were able to reliably detect changes in decay-related gas concentrations. The results show that the XGBoost algorithm has the best performance by having a consistent value of 1.00 in precision, recall and f1-score in each class in the classification and has a cross validation value of 0.998 in tuna, 0.9993 in salmon, 0.9981 in cod, 0.9967 in shrimp and 0.9995 in crab. The XGBoost regression test results also have high R^2 score and RMSE values, with cross validation values of 0.0064 in tuna, 0.013 in salmon, 0.014 in cod, 0.0049 in shrimp and 0.013 in crab. The proposed system is able to provide an effective solution to detect the freshness of seafood in real-time, so as to improve product quality and competitiveness in the seafood industry.

Keywords: Ada boost, Decision tree, Electronic nose, Gradient boosting, Seafood freshness, KNN, Machine learning, Naive bayes, Gas sensor, XGBoost