Industrial Electronics

Watch: E-nose uses AI to sniff out spoiled meat

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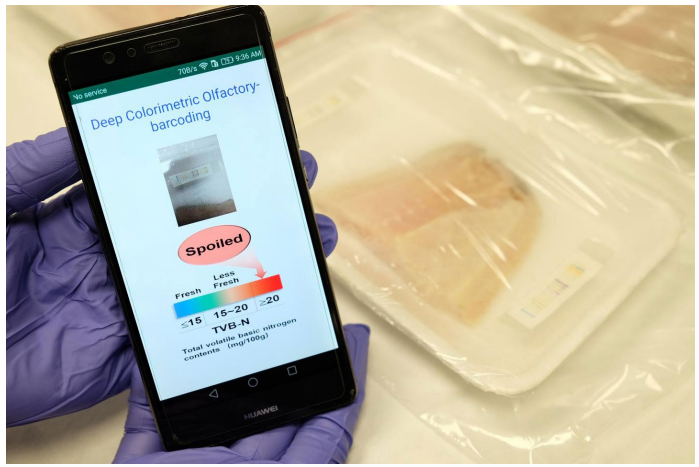
Researchers from Nanyang Technological University have created an artificial olfactory system that mimics mammal noses to detect meat freshness.

In mammal noses, the gases produced by decaying meat bind to the receptors in the nose and signals sent to the brain. The brain then collects responses and organizes them into patterns, which enables m to identify if an offensive odor is present. The new e-nose operates in a similar manner.

The new system is an electronic nose, or e-nose. It has a barcode that changes color over time as it reacts to the gases produced by decaying meat. The system has an accompanying AI-powered app that acts as a barcode reader. To make the device portable, the team integrated the barcode reader into a smartphone app that gathers results in 30 seconds. The e-nose is trained to recognize and predict meat freshness based on a large library of barcode colors.

In the e-nose, 20 bars act as a barcode of receptors. The bar is made of chitosan, a natural sugar. It is embedded in cellulose derivative and loaded with different types of dyes that change color in response to different concentrations of decaying meat gases. Color intensity changes with increasing concentration of bioamines as the meat decays.

The AI algorithm was trained with images of different barcodes. The goal of the training was to identify different scent fingerprints that correspond with a category of freshness.



The e-nose has been trained to recognize and predict meat freshness from a large library of barcode colors. Source: NTU Singapore

The team created a classification system for the barcode. The classification levels are fresh, less fresh and spoiled. These levels were gathered by extracting and measuring the amount of bioamines found in fish packages wrapped in transparent PVC packaging and stored at 4° C over five days at different intervals.

The e-nose was tested on commercially packaged

chicken, fish and beef that were left to age. To gauge the accuracy, the team monitored the freshness of commercially packaged meat using barcodes glued on packaging film stored at 25° C. Over 4,000 images of barcodes from six meat packages were taken at different times over 48 hours without opening the packages.

At first, the system was trained to pick out patterns among scent fingerprints in 3,475 barcode images. They then tested the system's accuracy on the remaining images. At the same time, the team monitored the freshness of the fish packages with barcodes clued on the inner side of the PVC film without touching the fish.

The AI algorithm could predict freshness up a 98.5% accuracy. As a comparison, the team assessed the prediction accuracy of a commonly used algorithm that measures the response of sensors, aka a barcode. This had an overall accuracy over 61.7%. The team's new e-nose had an overall accuracy of 98.5 to 100% in identifying spoiled meat and 96 to 99% accuracy for fresh and less fresh.

The e-nose could help reduce food waste by informing the customer that meat is safe for consumption. The new system is more accurate than the "Best Before" label currently used on most meat packages. The e-nose could be integrated into existing packaging. Currently, the team is working to extend the concept to other perishables.

A paper on this research was published in Advanced Materials.

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