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AI and Food Safety

Content

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by Lifei Lu, Senior Associate

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Artificial intelligence (AI) has become a game-changer in many industries, and the food industry is no exception. With concerns about food safety and quality increasing, AI has become an indispensable tool for food safety professionals, researchers, and businesses. From monitoring food production and supply chains to predicting and preventing risks, AI is revolutionizing the food industry in many ways. In this article, we'll explore some of the ways AI is being used to enhance food safety and quality, and how it is transforming the food industry as we know it.

The food industry has benefited significantly from the progress made on the Internet of Things (IoT) and Artificial Intelligence (AI) applications, especially during the post-pandemic period. Sensors, cameras, and other electronic devices have become widespread, and optical fluorescent imaging and ultrasonic sensing technology have been employed to recognize food residue on equipment and prevent contamination of entire product lines. AI, which can collect, summarize, and analyze vast amounts of data, has become an essential tool in food safety, including quality assurance, storage, transportation, etc. It has been used to provide a feedback loop for existing food safety and quality programs, to determine whether they are fulfilling the goals and expectations of business quality assurance management.

AI has also eliminated minor errors from repetitive tasks, thanks to automation and programming. Factories, logistics, and other streamlined parts of food production are where AI can save the most labor cost while increasing efficiency. The AI Packaging System of the food industry is an excellent example of this. Deep learning algorithms embedded in modern IoT systems allow more qualitative analyses. Such a system requires no rest, and no large number of technicians is needed, leading to significant reductions in labor costs. Programmers, with the help of AI, can improve the parameters of the system depending on the situation flexibility.

What makes AI outstanding from traditional programming tools is predictability and adjustability. AI models can monitor, analyze, and predict risks across the food value chain, preventing possible issues. Models can automatically filter out the best solutions against risks and adjust only with the help of program engineers. FOODAKAI, an intelligent online system

that minimizes food safety risks, claims its FOODAKAI models have been able to predict trends or accurate influence of pesticide residues, chemical contamination in cereals, heavy metals in food products, and other important factors regarding food safety.

The increasing affordability of AI-based equipment and rising labor costs have led to more companies and research institutions investing in AI to enhance food safety. Research and Development (R&D) have also benefited from AI in producing safer new varieties. ANFIS is an excellent example of AI applications in food R&D. ANFIS is a 5-layer model that combines the human-like reasoning Fuzzy Logic (FL) system and computationally capable Artificial Neural Network (ANN), enabling ANFIS to propose possible solutions based on past food variety development and adjust to the specific parameters determined by researchers.

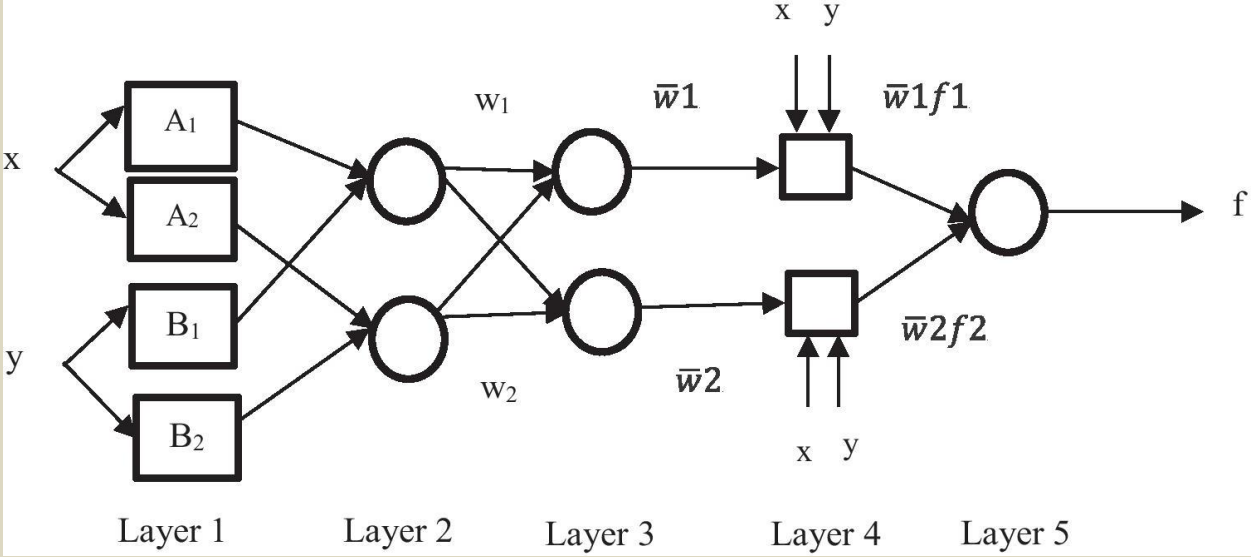

Figure 1 ANFIS General Structure[1]

ANFIS has been applied to many steps of food R&D, including food property prediction, and microbial growth regarding food safety, and it is efficient for prediction and classification purposes.

AI can also be applied to supply chain management, where it can cut forecasting errors by 20% to 50%, such that the boost in predictive accuracy, cutting "lost sales due to stock-outs by up to 65%, while safety stock inventory can be reduced by as much as 50%,"[2] according to McKinsey

[1] https://link.springer.com/article/10.1007/s12393-021-09290-z
[2] Better Accuracy, Fewer Stock-Outs, Happier Customers: How Six Companies Use AI For Demand Planning - MHI Solutions (mhisolutionsmag.com)

research. AI-enabled inventory management software can analyze historical and real-time data to anticipate stock-outs and suggest optimal adjustments to demand and supply. AI can help manage inventory and waste created during the production of excess food. In terms of logistics, AI can help track food items and contaminations to reduce food waste and enhance food safety. The advancement of blockchain technology has pushed AI tracking into the next stage, as all delivery information has been encrypted in a decentralized manner, making it easier to identify possible threats and contaminations. Some companies have been implementing "Blockchain+AI" solutions, especially food supply chain firms. Walmart, for instance, is trying "a blockchain project to track pork products"[3] and predict a 4-week forward demand of relative products by AI computation. Therefore, many opportunities for AI involvement along the chain have emerged and are needed by the market. Food sorting, monitoring, quality control, and output maximization are becoming the pain points that AI models are trying to solve.

After food products reach end users, such as cafes, restaurants, and food carts, AI can continue to improve food safety by providing market analysis and optimizing merchant resources. For example, the prediction analysis model used by Walmart could be used to help restaurants adjust their stock and order to better fit the market demand. In addition to market analysis, AI can assist with the intelligent allocation of merchant resources, including hygiene, labor, and cash flow, to help reduce costs and maximize output. Although AI in this scenario may not directly improve food safety as much as it does in the supply chain, it can still help to create a better environment for food production, which ultimately benefits food safety as a whole.

Another way in which AI can benefit the food safety of the end users is through predictive maintenance. Equipment used in food processing, packaging and storage can be quite expensive and critical to the production process. Failure of such equipment can cause major production delays, product spoilage, and revenue loss. Predictive maintenance involves the use of sensors and AI algorithms to monitor equipment performance and predict potential failures before they occur. This enables maintenance teams to schedule maintenance in a timely manner, minimizing downtime and improving overall equipment efficiency. Predictive maintenance has been shown to increase equipment reliability and reduce maintenance costs by up to 40%.

[3] How Blockchain And AI Can Help The Food Supply Chain? (onpassive.com)

Despite the numerous applications already implemented, several issues continue to impede the commercial progress of AI in food safety. The primary issue is the lack of data sharing and limited research collaboration. A research paper noted that the "low speed and high cost of microbial data collection and limited sharing of microbial data"[4] due to data privacy and reputational risks hinder the development and evolution of AI models. Additionally, some food industry stakeholders may be hesitant to embrace these models if they perceive a threat to their business interests. In addition to industry reluctance, the lack of systematic assembly of AI tools also makes it difficult to maximize their output. Many AI tools in the food safety space focus on only a few metrics and are often developed in labs with limited practical application, making it difficult to integrate all AI tools and APIs effectively.

In conclusion, AI is transforming food safety by improving food quality and efficiency across the value chain. From R&D and supply chain management to production and maintenance, AI is helping food companies to increase productivity, reduce waste, and improve profitability. While AI adoption in the food industry is still in its early stages, the potential benefits are clear. As technology continues to advance and become more affordable, we can expect to see even more innovative applications of AI in the food industry in the future.

[4] How Can AI Help Improve Food Safety? (annualreviews.org)