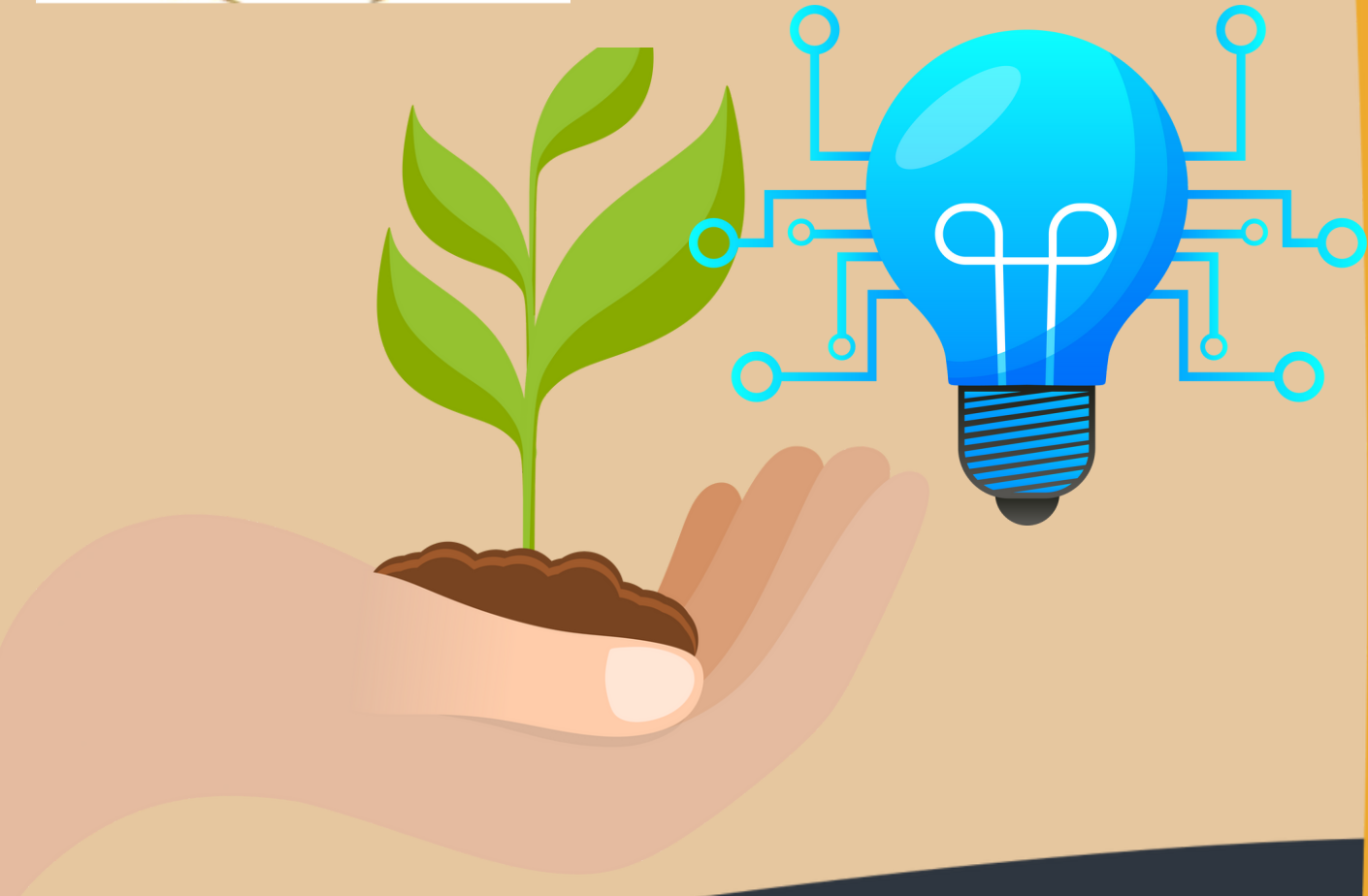




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Food Safety and Artificial Intelligence

Artificial Intelligence Applications for Food Safety

By

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Artificial Intelligence (AI) began to assess food safety over a decade ago, but in recent years it has become more widespread and useful as the technology connected with it improves (Liu et al., 2023). However, less than a third of food retailers are currently utilizing AI technology, and many companies are only using AI to leverage customer data and make decisions on either price or promotions (Beecher, 2023). Some examples of companies utilizing AI in the food industry include; Zume Inc. to ensure fresh food delivery, Mcdonald's changing their digital menus based on various factors such as weather or time of day, and Baskin-Robbins offering personalized flavors to customers (Roberti, 2023). Recently Mars Inc. partnered with a life science company, PIPA, to further the development of plant-based ingredients in new products through the use of AI. While AI clearly has multiple potential benefits aside from reducing health concerns (i.e., significantly reducing business costs associated with food recalls and liability by swiftly and accurately detecting pathogens), organizations and consumers would both benefit from AI improving health and safety.

Schneider Electric is a French multinational company currently trying to implement AI systems within other organizations in order to streamline supply chains and improve overall quality (Casey, 2023). AI can assist companies involved in the food industry through the use of key data points, which would help them further understand their consumers and product preferences. The correct use of data can reveal which products are most desirable to consumers and when companies should run promotions. AI in food supply chains requires organizations to share their data sources and other relevant information, such as food consumption and waste reduction to make the technology more impactful (Monteiro and Barata, 2021). Due to the food industry containing complex supply chains and multiple stakeholders, it has been a challenge to widely implement these systems (Guthrie, 2023). Nonetheless, advancements have been made in other important areas.

Luyao Ma (a researcher with the Department of Food Science and Technology at the University of California, Davis) and her team recently discovered a technique using both AI and optical imaging that can swiftly and accurately identify bacteria in food (Beecher, 2023). The research took digital images of lettuce, a vegetable that has been frequently involved in E. coli outbreaks, with a standard microscope equipped with white light. AI-enabled software was then used to detect and identify bacterial microcolonies. This method of detecting bacteria was found to be straightforward, cost-effective and fast compared to previously used methods (Dobbyn, 2023). Standard culture-based detection methods take between 5 to 7 days, while the AI approach allows for an analysis to be completed in 3 hours. Utilizing this new method, the research team was able to correctly identify 11 of the 12 lettuce samples that were contaminated with E. coli. Additionally, the research team also discovered that AI was able to differentiate E. coli from seven other common food-borne bacteria, such as Salmonella, with an average precision of 94%.

Microbial growth is the most typical cause of food spoilage and can cause textural changes, unappealing smells or change the flavors of products (Ferone et al., 2020). With nearly a third of all food waste stemming from microbial growth issues, it is important that the time-to-detection is improved, especially with goods that have short shelf lives. Traditional methods of detecting pathogens involve culturing microbes using a range of enrichment techniques, while newer methods include the utilization of spectroscopic techniques, such as “matrix-assisted laser desorption ionization-time of flight mass spectrometry (MALDI-TOF MS) along with hyperspectral imaging protocols” (Ferone et al., 2020 pg 3106). MALDI-TOF MS is used to identify a microorganism through the use of its unique protein profile. The technique has already been used in food microbiology for the identification of spoilage, and has gained popularity due to its speed and low cost. Other methods for microbial detection are currently under development, however, they require further optimization before they can be consistently and effectively utilized.

This innovative technology would have a better chance of making a noticeable impact on food safety if food safety was integrated into the initial design of AI and robotic solutions (Friedlander and Zoellner, 2020). There are multiple different ways AI can be used to improve food safety, such as text based AI services and predictive analytics. Text based AI services are capable of stopping recently recalled products from being sold to customers, predicting upcoming food recalls by using current information such as online reviews, translating food safety information into different languages and digitizing the traceability of fresh produce. Predictive analytics could improve retail food safety and decision-making by purchasing goods with “improved supplier risk assessment and supply chain reliability, transparency, and responsiveness” (Friedlander and Zoellner, 2020 pg 275).

Additionally, the widespread use of AI on current issues would likely result in new discoveries and applications of the technology. Retailers and food safety professionals should be willing to work alongside the technology so that it is able to collect sufficient information and improve food safety (Friedlander and Zoellner, 2020). AI should not be seen as a replacement for humans involved in food safety, but viewed as a useful tool to ensure that food safety standards are improved and efficiently enforced. There are multiple barriers to widespread AI usage in food safety, such as perceived liability, accessibility and data quality. Through the use of AI, companies involved in food safety can improve data quality and accessibility while also setting an example for their peers by showing how useful and effective this technology can truly be.

Furthermore, there is potential for AI applications to improve food traceability systems as many food safety issues stem from cross-contamination in food processing and distribution facilities (Liu, et al., 2023; Qian et al., 2022). Traceability systems allow food manufacturers to pinpoint sources of safety, assess the scope of potential food safety issues, reduce the production of unsafe or low-quality foods, while also reducing liability and recalls. Sensors and other devices can monitor environmental factors like the temperature, light level and humidity (Guthrie, 2023). Radio-frequency identification tags enable easy tracking and identification of goods as they progress through segments of the supply chain, giving organizations real-time information. However, using AI to improve traceability has proved to be challenging in the food industry partially due to the volatility of goods. An automated traceability system must be somewhat flexible to accommodate changes and seize relevant data.

By improving the digitalization of retailers' supply chains and general traceability through the use of AI, goods like fresh produce and meat could be properly monitored from farm to table by using key data elements and important tracking events (Friedlander and Zoellner, 2020). Utilizing blockchain technology alongside AI protects data integrity while also reducing the risk of fraud and counterfeit products being sold (Dombroski, 2023). Furthermore, AI technologies could be applied to food nutrition as dietary issues can lead to severe chronic diseases and potentially death (Liu, et al., 2023). Companies should thoroughly consider investing in their traceability systems to improve food safety and reduce business risks (Qian et al., 2022).

AI technology is relatively new, so it is understandable that many organizations are hesitant to invest in something that is not well-tested and fully understood. However, some companies are already beginning to implement these innovative systems into their food safety and traceability systems. If certain organizations obtain advantages for both their business and consumers ahead of their competitors, it will be extremely difficult for companies who ignored AI to recover.

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