

A Study on the Utilization of Artificial Intelligence (AI) to Enhance the Food and Agriculture Sector

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ABSTRACT: "Artificial intelligence" (AI) refers to the study of, and work toward creating computer systems with the "intelligence" necessary to carry out, activities traditionally requiring human intellect. The food sector is embracing artificial intelligence (AI) technology to increase revenues and find novel ways to connect with and service customers in the face of fierce competition and rising consumer demand. Artificial intelligence has been used to improve the efficiency and cost-effectiveness of many processes, including the classification of fresh produce, the management of the supply chain, the monitoring of food safety compliance, the establishment of efficient cleaning in place systems, the prediction of customer preferences, and the creation of brand-new products. The goal of this study is to describe the relevance of artificial intelligence as a predictive interdisciplinary approach integration to enhance the food and agricultural sector; nevertheless, there are certain limits that stakeholders must address. AI might enhance packaging, storage stability, meal combinations, and food standards by creating a more accessible system for managing supply chains. Precision agriculture, robotic farming, as well as drones are the potential of food sectors with AI.

KEYWORDS: Artificial Intelligence (AI) Agriculture, Food safety, Food Sector, Soil Monitoring.

1. INTRODUCTION

By definition, Artificial Intelligence (AI) is a computer-generated system with human-level cognitive abilities such as learning, planning, perceiving, and processing natural language. Artificial intelligence (AI) refers to the study and creation of machines that can perform mental functions usually reserved for humans. It is common knowledge that human beings need food or rations to survive. Food may be thought of as the most beneficial product of farming since it is created after farmers distribute the numerous commodities they have cultivated. The goods produced by the food business are very important to the economic growth of any nation [1].

It's also crucial to the growth of the national economy and the global economy as a whole. As a result, there is a pressing demand for improved food product quality and distribution safety. Artificial intelligence (AI) and other forms of cutting-edge technology created in recent decades have proven successful in helping people accomplish their goals. As a result, it is critical to research AI-based smart agricultural and innovative food industry features. Such strategies meet societal needs while still delivering high-quality items on the schedule. Using current technology, the food business can create a big quantity of food goods in less time, increasing the company's economy exponentially [2].

The key to ensuring food security and ending hunger for the world's expanding population lies in the long-term viability of the agricultural sector. Bovine spongiform encephalopathy and dioxin in the chicken are only two examples of the many food safety controversies and accidents that have recently come to light. Water shortage and the resulting need for sustainable water management pose serious difficulties in the coming years. This is why it is of the utmost importance to immediately institute a paradigm change from a focus on increasing agricultural output to one that emphasizes ensuring agricultural sustainability. The adoption of sustainable agricultural techniques, particularly via the use of digital technologies like the Internet of Things (IoT), Artificial Intelligence (AI), as well as cloud computing, may assist farmers and stakeholders forecast efficient strategies. Machine learning and deep learning algorithms, which are a subset of Artificial intelligence, are also often utilized in conjunction with position intelligence technology [3].

Artificial intelligence (AI) and machine learning have been at the forefront of public discourse for quite some time now. The use of such instruments was constrained to the domain of the digital world or technological advancement. Furthermore, in recent years it has made its way into some other industries, including education, healthcare, economics, advertising, entertainment, gaming, and transport, among others. In a similar vein, the food industry is gradually adapting to the breakthroughs that have been made in AI [4].

2. DISCUSSION

Global food security is becoming more precarious as a result of rapid population growth, depleting natural resources, environmental change, shrinking rural grounds, and imbalanced commercial sectors. Therefore, today's agricultural and food systems should be more productive in terms of output, efficient in terms of activity, resilient in the face of environmental change, and sustainable for future generations. This makes the need for a fresh approach to a problem more pressing than at any point in recent history. Artificial intelligence (AI), a recent breakthrough in computer science, may help us deal with the challenges of this fresh perspective. Thus, it may be crucial to the journey towards achieving global food security to have a firm grasp of the importance and usefulness of AI in the agricultural and food field [5]. The primary objective of this research is to develop AI and a methodology for analyzing and enhancing food quality and safety programs. This study shows the following about the relative costs of the various strategies:

- Considerations of broad technical and economic significance for assessing the efficacy of interventions to enhance the quality and safety of food
- Improvements in food quality using artificial intelligence (AI) approaches, with a quantitative emphasis on their performance at the farm level.
- Optimal (low-cost) AI strategies for improving food quality at different stages
- The effect that the size of the farm has on the extra costs is connected with the application of AI approaches to enhance the quality of food and its distribution throughout the different stages in the supply chain.

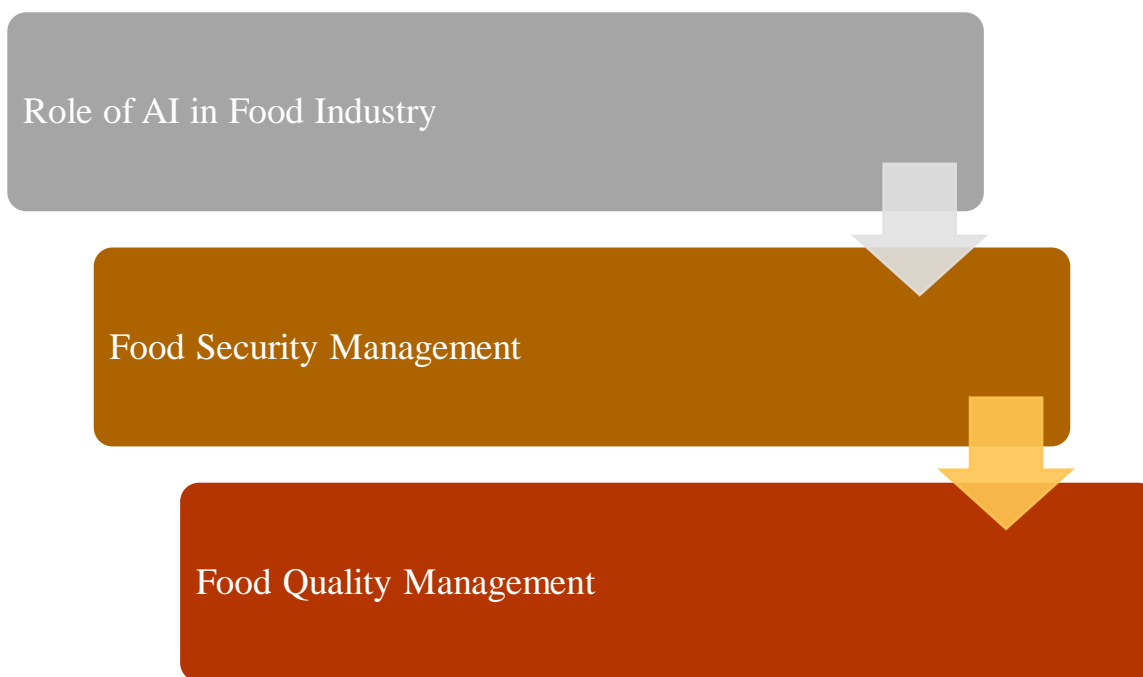


Figure 1: Displays the function of AI in the food sector.

The applications of AI are not restricted to the items listed above. In addition to this, it may be used in the storing and transporting of food products as well as the processing of food. There is also the potential for intelligent devices, like as robots and intelligent drones, to play a very important and substantial part in the process of reducing the cost of packing. In addition to this, it will assist in the transportation of food goods, the accomplishment of the mission despite the hazardous conditions, and the provision of products of an exceptionally high standard [6–8]. The applications of artificial intelligence (AI) that are most significant in the food industry fall into two main categories: the first is the management of food safety, and the second is the control of food quality. The amount of space used by each category is shown in Figure 1. This study presents a literature analysis of machine learning and AI in the food business. To do this, every facet of AI in the food industry was taken into consideration [6].

2.1. Applications of artificial intelligence in the food industry:

2.1.1. Fresh Produce Sorting:

Consistent supply of feedstock is a major issue for food processing facilities. Because of the high labor cost and low effectiveness of manual sorting, vegetable manufacturing factories must rely on it. Organizations in the food industry may greatly improve the efficiency of their food sorting operations by adopting AI solutions that use a mix of cameras, lasers, and machine learning to automate the cataloging of their products. Using AI to implement sensor-based optical sorting systems, for example, may eliminate the inefficient and time-consuming procedures of sorting fresh produce, resulting in a larger output of higher quality with less waste. To handle several product sizes while cutting down on waste and expenses, AI is being utilized to fine-tune machinery.

2.1.2. Management of the Supply Chain that is Efficient:

As the need for openness in the food industry grows, management of supply chains has become an absolute necessity for every food company. In the food business, artificial intelligence is being used to enhance supply chains by food standards monitoring and evaluating products at every stage of the process to verify conformity to industry and customer criteria. Improved pricing and inventory management would benefit from more precise predictions. Image identification technologies powered by AI make it possible to buy food in a more effective and time-saving manner. AI also assists in the monitoring of food in a way that is cost-effective and transparent, all the way from the farm to the customer, which leads to a rise in customer trust [7].

2.1.3. Observance of Food Safety Regulations:

In food processing facilities, cameras equipped with AI are utilized to monitor employees' compliance with safety regulations. This makes use of face recognition and objects recognition software to ascertain whether or not employees are adhering to the standards of proper personal hygiene that are mandated by the legislation governing food safety. If a violation is discovered, it pulls the relevant screen pictures out for evaluation so that the problem may be fixed in real-time. Greater than 96% precision can be achieved using this method [8].

2.2. Smart Farming:

Soil monitoring, robotic cropping, and predictive modeling are just a few of the many ways that AI is already making an impact in the agricultural production sector. In Figure 2, the author sees some of the most cutting-edge uses of AI in the culinary world.



Figure 2: Shows that AI has several important applications in the food service industry.

2.2.1. Soil Monitoring:

Food sectors are now investigating the advantages of AI-based solutions. The computer vision and deep-learning algorithms are highly significant in the AI-based system and are utilized to study the sequence of data or information acquired by the AI-based agents to track the development of soil and crop health. Computerized methods are employed to provide customers with an understanding of their soil's limitations and strengths. The primary goal of developing the system is to detect faulty plants and determine the most likely way for healthy crop growth [9]. The Internet of Things plays an essential role in agricultural and soil monitoring decisions. SM with IoT is an AI tool that helps farmers and food manufacturers maximize their economics, reduce the

likelihood of illness, and improve the use of current properties. Sensors are used in these to detect soil temperature, nitrogen, phosphorus, and potassium (NPK) contents, moisture content, water holding capacity, prospective in soil, the quantity of photosynthesis radiation, as well as the oxygen concentration in soil.

2.2.2. *Robocrop:*

The food business, like many others, is increasing output via the use of technological innovations. Many research teams have created a technology they call robocrop. This robotic device, powered by artificial intelligence, speeds up the yielding procedure by making it more efficient and consistent. Easily and quickly, it lines up harvesting equipment. A high-resolution and accurate technology is keeping an eye on the food industry's product right up front. A powerful computer processes the acquired picture to pay special attention to the green band pixels closest to the crop line. An excellent typical crop center-line tracking is achieved because of the large area recorded by the user input and also a large number of processing lines. Many writers have done excellent work on the subject of harvesting robots for robocropping, often known as agricultural automation, which has greatly enhanced production over the last few decades. Improvements in productivity and a less need for workers contributed to the rise in popularity of these systems [10].

2.2.3. *Predictive Analysis :*

To track and foresee the impacts of environmental factors on agricultural output, like weather, learning models are constructed. This is due in large part to Machine Learning (ML) algorithms. Together, satellites and ML algorithms study agricultural sustainability, provide weather forecasts, and evaluate farms for the presence of pests and illnesses. The model excels at providing timely, high-quality updates to data or information. Furthermore, the company has a high level of confidence in the data it delivers for its clients since it has regular access to over a billion stacks of agricultural information. The predictive analysis relies heavily on past data and data sources like precipitation, wind direction, solar radiation, and temperatures. The results of this research play a significant role in determining the best time and crop to plant on a given plot of farm production [11].

3. CONCLUSION

The use of AI offers a practical answer that may extend the life of agricultural operations. Thus, the idea of artificial intelligence is utilized in farming, making the work very efficient and easy. These automated systems provide consistent information across a wide range of time intervals, from hours to months, which may aid in the development of models of cycles that are time-specific. The inferred intelligent concepts are also quite straightforward to transfer to a commercial context, where they may be developed over time, and the concepts can be employed immediately in company settings. AI's capacity to improve sanitation, food safety, and garbage collection is making it more important in daily life. Artificial intelligence (AI) has the potential to greatly improve the food processing sector in the future by fostering affordable and healthful production for customers and workers. Already, the use of AI and ML in the food production and restaurant industries is revolutionizing the sector by reducing the number of manufacturing errors and, to a lesser degree, excess product that is thrown away.

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