

Improving food processing in the fifth generation industry based on artificial intelligence

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Abstract

With the revolution in the field of virtual space and artificial intelligence, the new framework of the fifth generation industries should be considered, which aims to combine the value chain of cooperation, human importance and long-term durability in an industrial environment. In today's world, human-robot cooperation is considered one of the best aspects. By doing this cooperation, the risk of accuracy is reduced and humans save both labor and time. Machine learning includes artificial intelligence, which continues to be an important and motivating factor in many different types of 5G industries. Food, health, pharmaceutical and other companies consistently produce positive results and continue to benefit consumers. This article deals with the promotion of food processing in the fifth generation industry based on artificial intelligence. In this research, based on the model of Maharajan et al. (2024) and designing and distributing a questionnaire among 200 experts in the field of food production in Tehran, a field study has been conducted. After collecting the data, they were analyzed with the help of SmartPLS software, and the results of the structural equations showed that the said model had validity, reliability and good fit.

Keywords: Artificial intelligence; machine learning; fifth generation food industry; Flexible food production.

Introduction

Food, often referred to as resources, is accepted as a human need and as the highest point of agriculture, which is grown through the delivery of products to farmers. Industrial food products are vital for the realization of any nation. Besides, it plays an important role in how the global and national economy develops. As a result, there is a strong need for food sector solutions to be secure and efficient if provided adequately. Artificial intelligence, along with other recently invented technologies, has shown interest in achieving goals in the past few decades. Consequently, it is important to investigate the complex food sector and innovative agriculture based on artificial intelligence. These strategies meet social demands and produce premium products on a timeline. By applying these modern innovations, the food sector will instantly produce much more nutritious goods, which will dramatically increase business revenue. In Figure (1), the area under each category is specified.

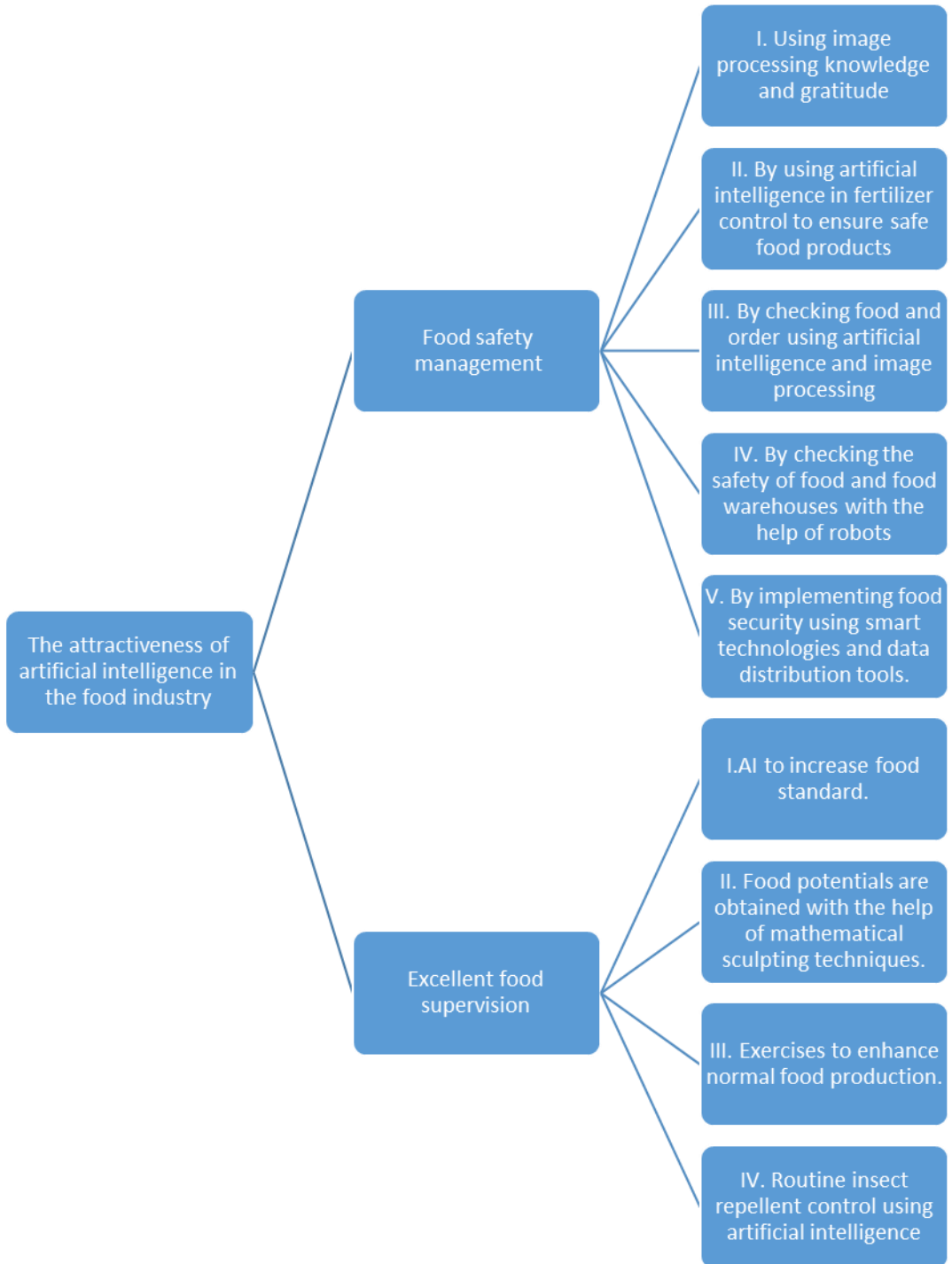


Figure (1) the role of artificial intelligence in the food industry [16]

This research provides an overview of machine learning and artificial intelligence research in the food industry, covering every aspect of modern technology. Artificial intelligence is not only used in this type of operation. In addition, it may assist in the preparation, storage and supply of food. Robotics and smart drones are a manifestation of smart machines that can be very useful in reducing packaging costs. In addition, it encourages the transportation of food, supplementing labor in hazardous conditions, and providing very high quality goods. Major advances in artificial intelligence in the food industry can be broadly classified into two main groups:

1. Food security management and
2. Governance of food quality [1].

Given the growing interest in using such technologies for a range of potential categories, to the best of our ability, few previous works have focused on the implementation of 5G technologies in terms of food safety. This conclusion encourages us to make an assessment of fifth generation industry gadgets and how to implement them at each stage of the food supply chain, with the anticipated benefits for consumers using the potential of these technologies as well as the possibilities in Let's develop every part of it. The food system of fifth generation industries will implement robots to cooperate with people. The aim of the current piece was to provide an overview of the supposed benefits of 5G technologies in the food supply chain, including the stages of agriculture, production, transportation and sales. It demonstrated the benefits of using these important technologies – AI, big data analytics, the Internet of Everything, etc. – in a human-centric way to work together to integrate them into the food system and achieve longevity. Supply chain, quality, integrity and privacy. As far as we understand, this issue has not yet been studied by another work [2].

Despite this, this field has a diverse and non-linear course of work that is repaired by a real computer method such as artificial intelligence and reproducibility. Artificial intelligence uses computational methods that embody cognitive skills and intellectual solutions to a wide variety of food business challenges, increasing the visibility of food security. Food production lines have the advantage of automation, and massive amounts of data are captured, maintained, analyzed for predictable supply chain improvements, and used for risk analysis. However, putting these innovations into practice fools hackers and adds a level of vulnerability to the sector [3].

The next article contains an overview of each part of this professional work. The primary research focus on applicable previous studies is clearly stated in Section 2. The unique features of AI in the food industry are discussed in Section 3, with particular relevance to aspects of system programming, statistical research, and intuitive theoretical frameworks. and graph-based technique. This third part explores AI and ML methods to ensure the sustainability of the mining process. Section 4 presents a variety of distinctive illustrations and diagrams that suggest artificial intelligence in fifth generation industries. Part 5 maintains the ultimate power when it addresses the beneficial effects of artificial intelligence and the smart innovations that modern companies are adopting.

Research literature

Wang, L. And. al [4] The use of augmented reality equipment to create a dynamic bridge between goods and consumers is exceptional. This digital media technology is often found in food packaging, especially in the packaging of dairy products. It is very important to integrate the visual effect factors of the food which emphasize the attractiveness of the food packaging. Customers can access AR-enabled materials, such as a 3D image of food history, via smartphones or other electronic devices to scan the AR verification control mechanism they encounter on food containers. Passengers can see the origin of the food in a widescreen 720-degree view to get distinct visual effects of the travel process. Bin Eid, R. And. al [5] At this point, there is an increasing emphasis on the use of machine learning strategies in the four main groups of the supply chain for the agricultural sector: primary production, manufacturing, packaging and transportation. In addition, the use and installation of artificial intelligence offers several advantages that can revolutionize the food industry and related organizations. Subsequently, innovations in artificial intelligence technology have made it possible for food-based companies to operate more effectively by improving management techniques. This has encouraged many hospitality companies to invest in formulas that are discovering applications throughout the restaurant and food industry. The distinctive feature of intelligent operation and higher profit margins that this artificial intelligence offers is beneficial. Han, J., Lee, T. W. al [6] This work proposes a system for food traceability developed around the supply chain that allows real-time data exchange and quality analysis in relation to traceability quality. It also used the big data generated by the Internet of Things to rapidly eradicate low-quality food from the supply chain while minimizing food waste and increasing transportation efficiency. Due to the strengthening of consumers' need for fresh fruits, using the Internet of Things, fresh fruits can be observed to reduce waste during transportation. Uma Maheswaran, S. K., Kaur et al. al [7] AI technologies offer numerous benefits to food and confectionery companies, including production, warehouse convenience, safety, and precision monitoring. These benefits are also useful for other health industries. Many researchers believe that AI innovations have tremendous potential for the health and food sectors. They may improve automation in the food industry, in turn increasing efficiency and reducing waste. Lu, X. and al [8] Nevertheless, several backbone technologies centered on Industry 5.0 may help improve performance and ensure food safety. In addition, the Internet of Things is essential for human survival, with possibilities for applications in environmental, agricultural, and other fields. But unlike the field of pioneering seeds, there are not many studies that focus on food governance and address current problems. Importantly, seed sector creativity promotes food security and is not a weak link in the agricultural value chain. Consequently, examining food security issues through the lens of product development is certainly of great importance. Guiache, F., Bahamond, A. And. al [9] is interesting to draw attention to the fact that artificial intelligence in the food sector has numerous applications beyond the creation of trained systems to facilitate and manage food quality management. We want to highlight the different ways in which ML techniques may help researchers and experts to identify the subjective characteristics of food commodities and the primary food characteristics that inspire their classification depending on consumer and market needs. Sikder, MR, Saif and. al [10] an additional research focuses on how I5.0 can promote circular economy. According to the authors, I5.0 innovations can be used to monitor the environmental impact of an item throughout its life cycle, which may help identify potential sustainability. The use of advanced technology, which includes cloud computing, artificial intelligence and the Internet of Things, distinguishes the current industrial revolution, nicknamed "I5.0". Fosso Wamba, S., Queiroz et. al [11] This research topic presents an interesting investigation using a design

science approach, which includes a detailed investigation of drone swarm recognition in agricultural technology (AgriTech) examples. Research shows that smart agri-food activities, anchored by drone swarm scenarios, have the potential to increase agricultural yield and efficiency in isolated areas and address food security concerns. Manning, L., Brewer, S. And. al [12] Creating a framework for understanding the other terms in this article requires us to first consider "ethics" as a whole concept. It seems difficult to properly assess the ethical implications of any choice made to incorporate AI into agriculture and food chain programs without fully examining each of the ethical considerations listed above. When adopting multiple meanings to describe the use of artificial intelligence, actors such as food technologists, engineers, farmers, and others must properly consider human-technology interaction.

Research methodology

As stated in the last chapter, the researcher studied the literature of food processing research in the fifth generation industry based on artificial intelligence, investigated their dimensions and tried to model a multifaceted model by following the research of Maharajan et al. (2024) in 2024. present to use artificial intelligence to investigate food processing in the fifth generation industry. The current research method is based on the purpose of applied research and based on the method of data collection, it is considered to be a descriptive method of the survey branch. Based on this, firstly, the aspects and research topics related to food processing in the fifth generation industry based on artificial intelligence and similar studies and researches are investigated about the research subject, then by using field studies, the hypotheses are explained. It will be done in accordance with the title and purpose of the research. According to the four methods of theorizing, i.e. expansion or improvement of existing theories, comparison of different theoretical viewpoints, investigation of a specific phenomenon using different theoretical viewpoints, and finally investigation of a documented and repetitive phenomenon in a new environment and conditions, the current research is placed in the fourth group. In this research, structural equation model method and SmartPLS software will be used to test the model. The implementation steps of this research are:

1. Library studies (thematic literature review),
2. Extracting structures, variables and factors related to food processing in the fifth generation industry based on artificial intelligence.
3. Design of measurement tools,
4. Preliminary field studies,
5. Adjustment and correction of the measurement tool,
6. Field data collection,
7. Analyzing the collected data and testing the model.
8. Conclusion and presentation of suggestions and recommendations.

Finding

At this stage, in order to evaluate the conceptual model of the research and also to ascertain the existence or non-existence of a causal relationship between the variables of the research and to check the suitability of the observed data with the conceptual model of the research, the research model was also tested using the structural equation model. The results of the model test are reflected in the graph.

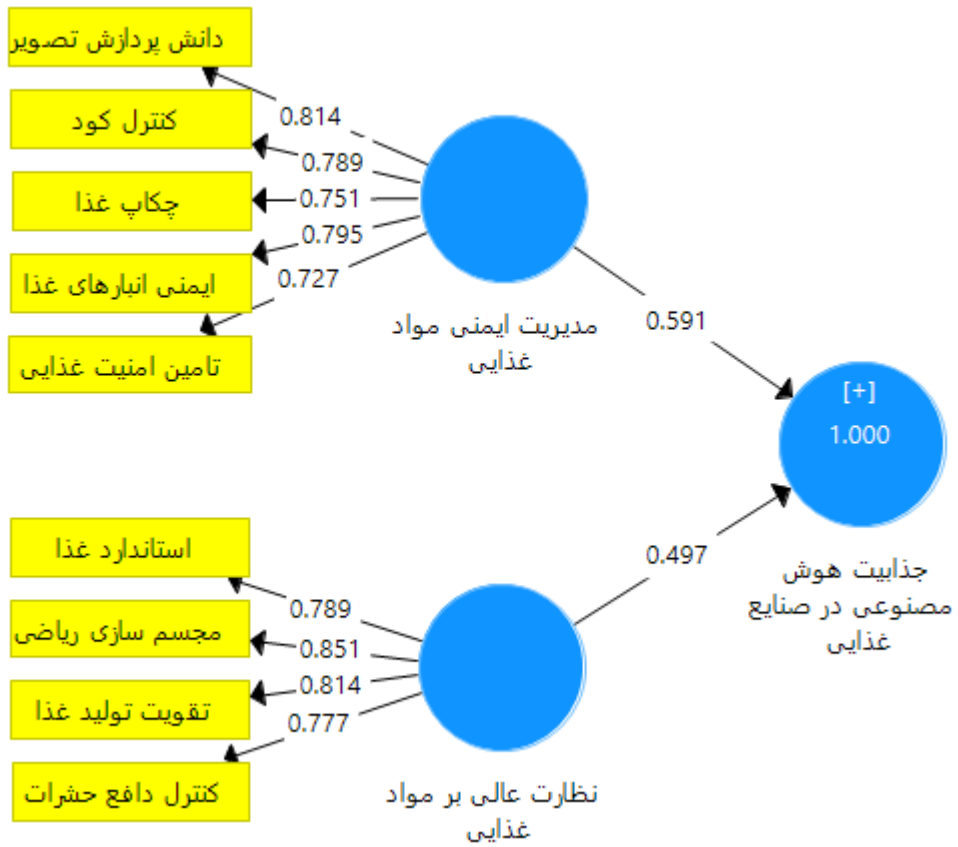


Diagram (1) Measurement of the overall model in standard mode

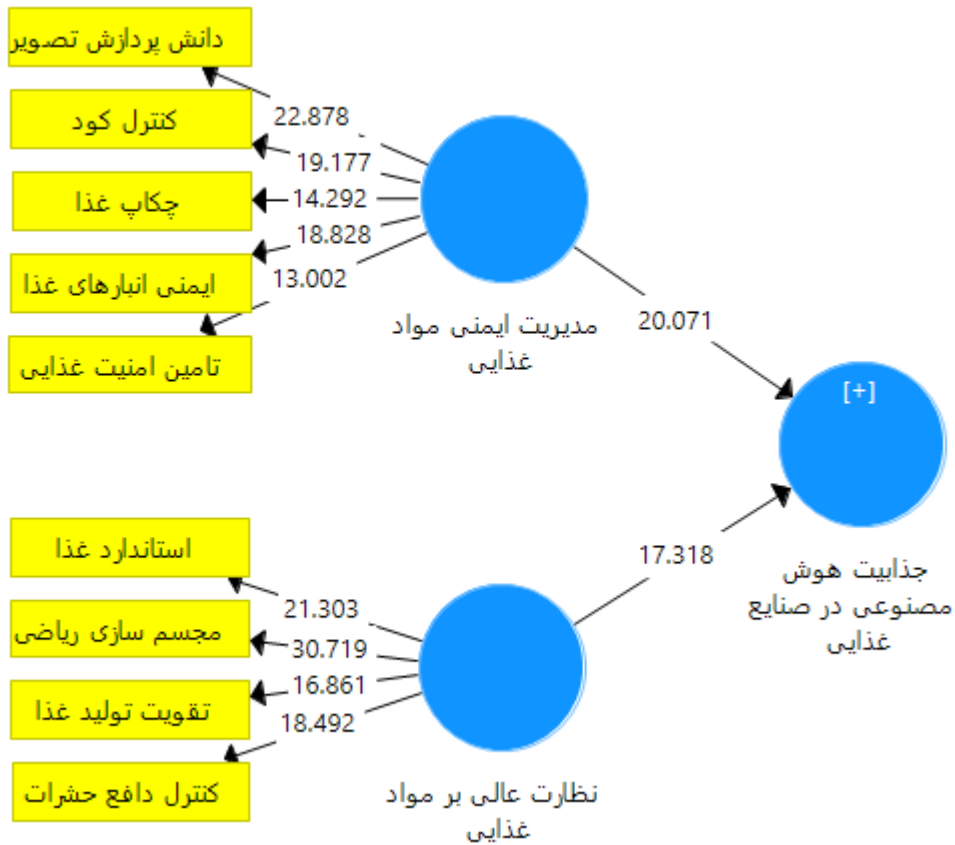


Chart (2) measurement of the overall model in the meaningful state
Cronbach's alpha and composite reliability were used to measure reliability, convergent validity was used to measure validity, and GOF index was used to measure model fit:

Table (1) reliability and validity of external models

Fornell Lavker Matrix			MSV	AVE	CR	Variable
3	2	1				
		0.743	0.193	0.552	0.787	The appeal of artificial intelligence
	0.803	0.342	0.478	0.644	0.844	Food safety management
0.807	0.47	0.331	0.423	0.651	0.918	Excellent food supervision

- ✚ A value of Cronbach's alpha higher than 0.7 is an acceptable indicator of reliability.
- ✚ If the value of CR for each structure is above 0.7, it shows the internal stability suitable for the measurement model.
- ✚ AVE value above 0.5 indicates acceptable convergent validity.
- ✚ Considering the three values of 0.01, 0.25 and 0.36 as weak, medium and strong values for GOF, the result of 0.62 shows the strong fit of the model.

Conclusions

It can be seen that the food processing and production industry requires a lot of money. System-based artificial intelligence can find multiple defects in food production faster than human-based methods. In addition, it has been observed that this field is highly research oriented. Global expansion creates obstacles for food production chains, which are created due to computerization.

There is none, with health and safety representing the primary concerns. When the detectors are combined with the microcontroller, the output spikes are generated by the microcontroller, resulting in an affordable and user-friendly framework for a range of neural robotics projects. It may be very useful for the food industry. In agribusiness, AI-based tools targeting agricultural outcomes, yield estimation, disease monitoring, and attainable traits combine machine learning and big data to provide enhanced information for decision-making and action. Artificial intelligence and machine learning methods provide numerous opportunities for various sectors to improve and mechanize treatments, save costs and eliminate human errors. Artificial intelligence and machine learning may help food creators in bars, cafes and restaurants. Both of these departments provide several neat examples of AI applications in food. Keeping a step ahead of competitors is more important than ever because customers and market demands are rapidly fluctuating [14].

To maintain food standards in the food industry, automated technology will be an essential element to effectively increase industrial efficiency. Artificial intelligence will be critical to food production in the coming years. Another part of artificial intelligence is robotics. Food and beverage companies are rapidly advancing by applying creativity to tasks and organizational reduction before emphasizing how to meet customer needs. As the world progresses beyond COVID, AI will be used in increasing amounts to increase food production, and with the human population growing faster than ever before, the requirements for speed, effectiveness and durability will also increase. Arranging food requires careful attention to subtle aspects, such as size or color. These features enable food suppliers to make reliable choices about how to source different food items, ultimately improving consumer purchase rates. Using sensor capabilities such as cameras and near-infrared sensors, these modern systems perceive food with human perception. The food industry has many CCTV cameras. This is just an illustration of the complex features of artificial intelligence. Using this artificial intelligence function, it is possible to assess whether people are fully committed to food hygiene standards using dedicated cameras equipped with facial recognition and object recognition functions [15].

Researchers are now focusing on the futuristic implications of artificial intelligence in the food business. Many different types of research on multiple applications have been conducted up to this point, most of which are still in the development phase. When it comes to food processing – which includes grading, classification, forecasting, quality assessment, etc. – both AI and DL are effective tools. These strategies are successful methods for simulating complex tasks related to food hygiene and safety. Although several approaches have been designed to solve the problems that have emerged in the food industry, artificial intelligence and machine learning have given people access to advanced technology in the real world. The AI controls a set of heterogeneous systems that measure multiple parameters that indicate quality, appearance, texture, consumer popularity, and other qualities. The unique strategy involves evaluating data patterns and modifying the technique to obtain accurate, reliable, competent results, requiring less

human resources and supporting long-term operator prediction of future events. As a result, the food industry uses the idea of artificial intelligence, which reduces any task and does it successfully.

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