



MACHINE LEARNING ML, DATA SCIENCE & ARTIFICIAL INTELLIGENCE AI IN FOOD INDUSTRY: OPPORTUNITIES, SOLUTIONS & RISING POTENTIAL

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Abstract:

We discover food through applications, and makers produce it with the assistance of robotics and processing. Technology could assist significantly to improve packaging, increasing period of time and food safety [1]. Artificial Intelligence and Machine Learning can benefit Hotels, Restaurants, food manufacturing and domestic users. But now a day's technology within the food industry is a vital part of food production and delivery processes. The food standard is additionally improving while production costs are lower. Robotics, machines, drones, and 3D printings are the factual solutions. Artificial Intelligence offer many possibilities to optimize and automate processes, save money, and reduce human error for several industries [3]. When talking about the food industry, technology isn't usually the primary thing that involves mind [7].

Index Terms: Artificial Intelligence, Machine Learning, Data Science, robotics, Restaurants

INTRODUCTION:

Customer and market demands are changing in no time, so it's even more important to be one step earlier than the competition. Knowing what goods to manufacture in large numbers or what dishes are the simple options to include on your restaurant menu is that the key to extend revenue. Defining the foremost common tastes and preferences is that the dearest thing for a food business owner in addition as for a manufacturer [24]. For example, the latest trends in food tech are linked to a stream of healthy lifestyle followers. So as to detect them, Machine Learning uses the collected information and Classification methods to deduce which foodtech solutions are visiting be the foremost preferred within the near future. The same solution is given by Castograph AI – it predicts the flavors and preferences of consumers at the pre-production stage. AI for food understands the human perception of flavor and preferences, dividing users into different demographic groups and modeling their preference behavior or predicting what they require — even before they are doing.

As long as food manufacturers are concerned with food safety regulations, they have to look more transparent about the trail of food within the supply chain [1].

AI in food manufacturing helps to observe every stage of this process — it makes price and inventory management predictions and tracks the trail of products from where they're grown to the place where consumers receive it, ensuring transparency.

A solution such Retail AI enables us to estimate the demand for transportation, pricing, and inventory to avoid getting an abundance of products that find you wasted. Sorting food: optical sorting solutions: Previously, a manufacturer had to rent many of us to perform the monotonous and routine actions linked to food selection. Now, rather than manually sorting large amounts of food by size and shape (so that it is often canned or bagged), you'll use AI- based solutions to simply recognize which plants should be potato chips and which are better to use for fries. Vegetables of an inappropriate color also will be sorted out by the identical system, decreasing the prospect that they're discarded by buyers. Food Sorters and Peelers developed by TORMA show better processing capacity and availability, which increased food quality and safety [1]. This is often achieved by using core sensor technologies and cameras that recognize material supported color, biological characteristics, and shapes (length, width, and diameter) the camera has an adaptive spectrum that's similar temperament for optical food sorting.

Predictive maintenance, remote monitoring, and condition monitoring:

It is apparent that manufacturing plenty of products demands large, complicated, and intricately constructed the mechanisms. The upkeep of such machines is often rather costly without predictive maintenance – determining the time-to-repair and cost-to-repair indicators through categorizing issues and making predictive alerts. Timely repairs can save to 50% maintenance time and reduce the prices needed for it by almost 10%. To perform remote monitoring on complicated mechanisms, you'll make a Digital Twin of a machine that may show you the performance data on parameters and manufacturing processes and boost the throughput. Machine Learning also allows the identifications of things that affect the standard of the manufacturing process with Root Cause Analysis (eliminating the matter at its very source)[8]. With condition monitoring, you're ready to monitor the equipment's health in real-time to achieve high overall equipment effectiveness.

Data Science in Food Industry

The food industry is stuffed with big brands and highly successful Hotels and restaurants [20]. It's easy to induce lost among the competition, which makes it a less attractive marketplace for new businesses. However, there are some ways in which you'll stay previous the competition. one in every of those ways is technology, so Data Science within the Food Industry can benefit you. Matching customer tastes along with your business strategy: - the very fact that data science can help optimize different processes and also the way the business operates [25]. Customers are with the changing tastes and menu choices. The corporate is relying heavily on data science to predict demand and properly manage correctly the acquisition of supplies. Basically, Company is connecting information on current food preferences in their menus, customer behavior, and buying history to their production. This is often a really exciting, demand-driven example of information science within the food industry that would become the blueprint for similar businesses. Introducing new recipes: the quantity of how we are able to combine ingredients in recipes is limitless. Adding the fact that you just can cook those ingredients in multiple ways makes cooking dishes a section of endless possibilities. Today we've got huge online databases for recipes, which allow the analysis of ingredients in several cuisines. Researchers are able to determine what similarities particular cuisines are sharing. as an example, Western European and North American dishes are supported ingredients that contain similar flavor compounds that Southern European and East Asian dishes tend to avoid. As a result, scientists can determine which food components drive taste and make a dish popular in certain regions. This fundamental understanding also allows intelligent algorithms to advice chefs of latest ingredient combinations, which can ultimately lead to a wider sort of menu offerings.

Reinventing Food Delivery:

Every online food ordering platform contains a large amount of data on ordering patterns and client preferences. Machine Learning algorithms can help facilitate more practical, cost-efficient, and time-efficient dispatching of drivers for food delivery. Data Science during this industry continues to be nascent, but it's already providing companies some valid chances for market domination and that we can hopefully get the food we would like fast and delicious [8].

Machine Learning Applications in Hotels and Restaurant Business

Currently, there are several applications in the food service space that may help predict visitor traffic, food orders, and relevant inventory needs to predict the number of orders needed for a certain period/date. Such applications and solutions collect previous data to engage customers more through examining their habits and preferences: it brings more repeat visits and orders as a result. These are Cloud Big Data solutions, restaurant management platforms to make the paying process easier, and applications that allow connecting and pre-ordering a table in advance.

Food-selling sites and applications:

Once you have defined what to produce, the next step is to make the best online service system for your food and beverage business for people who have discovered your existence through the Internet or decided to examine your menu online [23]. Perhaps it will be an online site that gives the best recommendations and makes the order process really fast or it will be a mobile

application with a convenient and smart AI foods system. E- Commerce is getting more popular in the digital world, so it is a bad thing to forget the promotion of your goods on the Internet. Automated customer service and customer segmentation can significantly increase the accuracy and efficiency of administrative functions such as creating reports, placing orders, dispatching crews, and formulating new tasks.

AI for online restaurant search:

Restaurants, Hotels, cafes, and bars depend on their ratings and feedback on the Internet. Nowadays, many customers get to know about their existence through Google Maps/searches [20]. In these cases, an AI in food service solution offers to unite the data from various food delivery programs to give the user a hint for a café or a restaurant that might appeal to his tastes and is relevant to his location. There are also AI agents that notify clients about any sales and events in their favorite restaurants via their favorite platforms such as Twitter or Slack.

Voice searches: As people begin to prefer voice searching over typing anything into Google (around 27% of the population), voice commerce is gaining more significance. Restaurants can utilize tools such as Amazon Alexa to allow their customers to make an immediate order without even an ordinary “click.” In this method, you can place orders quickly and hands-free [20].

Self-serving system:

Self-service (point-of-sale systems) that enable customers to control the ordering process, carefully examining their choices, and sometimes even check the number of flavors and spices in a dish are being widely adopted by restaurants [20]. It is believed that this technology should be available for all sizes of restaurants, not only for big ones. Applications and terminals for self-service ordering reduce customer wait times, make orders more accurate, and improve the quality of the customer experience.

Innovations in Robotics for the Food Industry:

Some of the most complicated and brightest AI-based solutions like robotics have popped up recently, but are only a privilege affordable for large food businesses [24]. These innovations include drones to deliver orders and robotic hands that can manage many processes in food manufacturing and even cooking. However, these devices can become more popular due to the exponential rise of the wages for human workers; thus, robotics can save restaurants more money in the long run [20]. The international chain of convenience stores 7-Eleven already uses drones and street bots in its delivery service, while Wal-Mart claims that it will soon use drones in warehouses. Another curious robotics implementation is the “Flippy” robot, which actually consists of two mechanical hands that are able to take and turn over fried burger patties and put them into buns along with the other ingredients needed to make burgers.

Restaurant, Hotels Revenue Prediction Using Machine Learning:

Food and service quality are very important but in the long term, restaurant sales prediction is just as valuable. Knowing what to expect, a restaurant owner can make viable plans for future operations [6]. What if you need to create a sales forecast for the next five months? Even finding the most fitting algorithm to do that could take time and effort. Imagine just feeding data to your website or app and getting your sales prediction. Today’s Machine Learning technology allows you to find the best algorithm for your particular case and deploy it wherever you want. With the right dedicated development team, you can easily achieve that.

AI Culinary Uses in the Real World:

Artificial Intelligence is closer to your kitchen than you think. IBM introduced Chef Watson, an AI-enabled digital culinary research assistant [17]. The chef has access to a database of flavor profiles and various recipe ratios, helping create fresh dish combinations like a pro with tech knowledge. Just choose the ingredients you like in the program, pick the style of cooking, and look at the combinations the algorithm presents to you. Watson simulates the preferences of the chef and provides instructions. Machine Learning, in this case, provides real chefs the opportunity to step out of their usual cooking routines and get ideas that will lead to cooking something unique. This assistant uses a quantitative cooking methodology and is able to analyze a user’s taste preferences and suggest ingredients. Also, it has a user-friendly interface. Chef Watson is a really cool example of AI in culinary, and there will be plenty of solutions like this in the future.

- ML in Food Delivery:** Machine Learning is a perfect technology for planning more efficient delivery routes and logistics strategies. Every delivery agent can get optimization that will ensure the best routes for them, providing constant orders and planned break times. Speaking of ML in food delivery, artificial intelligence is definitely increasing the scale for possible data analysis. With modern algorithms, analyses could be performed much faster. Methodologies and strategies for entire companies could change faster, resulting in advantages against competitors.

AI in Food Safety

Probably, one in every of the foremost valid points of using AI and robots in food production is that the robots are sterile [7]. This significant benefit may be a huge think about lowering the number of foodborne diseases. Cereals, spices, and other foods that don’t require refrigerators are in peril of contamination. Previously such foods weren’t at risk of contamination, but now that’s changed. Robots could definitely help here. There’s no way that they might transfer illnesses, as humans do. Moreover, robots are very simple to wash [22].

There are two other ground breaking AI in food safety technologies that are expected to become widespread soon. They're also geared toward reducing the incidence of foodborne diseases [1].

Next Generation Sequencing: Automated processes and workflows make data capturing and also the preparation of lab samples much faster and more precise than ever. The explanation for implementing NGS in organizations just like the CDC and therefore the FDA lies in finding out about dangerous trends more quickly. NGS can even prevent some disease outbreaks before they harm masses of individuals.

Electronic Nose: These are basically the replacement for human noses in production settings. Electronic chemical sensors can accurately distinguish a spread of odors. Imagine these sensors within the food production environment. Powered by an AI/ML algorithm that has access to a database of dangerous odors that are the signals of pollutions or infection, Electric Noses might be the long run of Food Safety and internal control [1].

AI, Robotics, and ML in Food Safety have already proven their worth, and will only evolve and get better in the future [1].

Artificial Intelligence in Food Waste

Humans currently don't use their resources wisely and mono-cropping, the blanket application of synthetic chemical fertilizers and intensive land use may be replaced with "smarter" methods. Information gathered from sensors, drones, and satellites, yet as other equipment, could help farmers make better decisions faster. Here are some ways to scale back waste product with AI. While some solutions analyze the ripeness of the fruits, others determine what microbes could increase crop growth without the involvement of synthetic fertilizers.

Farmers could get eliminate field trials, profiting from advantages of the AI, which is able to save significant amounts of cash. If farm-based food supply chains use visual imagery technology, the food inspection processes are much easier. AI food tracking will enable us to sell food before it becomes waste, through more efficiently connecting farmers with ~~farm~~ or people buying food [20].

The Future Application of AI in Food Industry:

- We already know that among the investments in AI technology, there are significant investments within the Food Manufacturing sector. As an example, AI can more easily predict many issues in agriculture than people can, and investors are starting to notice it [16].

They use drones with hyper spectral cameras that detect changes in water, fertilizer, pests, and crop yields. Then the AI algorithms can find potential threats and alert farmers.

AI algorithms can even suggest certain actions the human must desire best use their resources.

An interesting case of the usage of Machine Learning in harvesting is thru the analysis of satellite data on the Earth's surface. The aim is to search out places that would use some help from investors or the govt for improvement, which allows the providing of more food as a result.

If we speak about the agricultural industry within the context of the food industry, there's plenty of room to grow [5]. Farming remains outdated in many parts of our planet. There are a lot of billion liters of water wasted annually within the crop production process. Computing incorporates a chance to unravel this problem

somehow within the future and reduce this number. Successfully solving this problem could raise the assembly of food by 60% or perhaps more.

Machine Learning and AI are nascent, but there'll be many solutions to eliminate waste in food production. For instance, has already introduced smart bots which will pick food straight from the plant, eliminating the ineffectiveness of human farm labor. There were automated pickers within the past, but these robots are using Machine Learning and may determine the extent of ripeness of fruit, distinguish fruits from other plants during a better manner, and handle fruits more carefully [22].

Benefits of AI in the Food Industry

Recently, more and more companies are trusting computer science to enhance supply chain management logistics and predictive analytics similarly on add transparency. Digitization of the availability chain ultimately drives revenue and provides an improved understanding of true. AI can analyze enormous amounts of knowledge that are beyond human capability. Artificial Intelligence helps businesses to cut back time to plug and better handle uncertainties. Automated sorting will certainly reduce labor costs, increase the speed of the method, and improve the standard of yields.

Conclusion

The implementation of AI and ML in food manufacturing and restaurant businesses is already moving the industry to a replacement level, enabling fewer human errors and fewer wastes of abundant products; lowering costs for storage/delivery and transportation; and creating happier customers, quicker service, voice searching, and more personalized orders. Robotics remains quite a subtle thing to introduce, even for large factories and restaurant businesses, but it'll occupy its niche very soon, bringing a comprehensible benefit within the long term.

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