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The use of Artificial Intelligence in the restaurant business

Abstract. The study aimed to explore how artificial intelligence (AI) is applied in the restaurant industry, particularly in enhancing operational efficiency, personalizing customer interactions, and predicting demand. Using qualitative methods, interviews were conducted with industry experts in Odesa, Ukraine, including professionals from major chains and a case study with a Ukrainian chef. Findings revealed that global brands like McDonald's, Starbucks, and Marriott use AI for demand forecasting, offer personalization, and streamlining communication. Chef Yevhen Klopotenko's use of AI to prepare a gourmet dinner showcased its innovative potential in cuisine. The research enriches the existing literature on AI in hospitality with practical examples, offering valuable insights for industry professionals. It highlights the significance of AI in predicting demand and automating customer interactions to boost efficiency. The originality of the study lies in its analysis of AI applications and its comprehensive list of AI tools for content generation. However, the qualitative focus and regional scope limit generalizability, suggesting future research could broaden to include other regions and quantitative methods.

Keywords: Artificial intelligence (AI), restaurant business, ChatGPT cooking with AI, neural networks

Introduction

In the highly competitive hospitality industry, organisations strive to attract customers and provide exceptional service. Artificial Intelligence offers a solution by analyzing vast amounts of data and utilizing machine learning algorithms to make informed decisions. These technologies can analyze customer data, including preferences, purchase history, and location, enabling personalized services and enhanced customer experiences. Crucial to mention, that modernization of the hospitality industry was accelerated by pandemic (Chen et al., 2022).

The restaurant industry faces intense competition and evolving customer expectations in today's technology-driven era (Roy and Pagaldiviti, 2023). Advanced technologies have revolutionized and automated every aspect of the travel experience, bringing significant changes to the tourism and hospitality sectors (Loh, Perdana and Lee, 2024).

However, employing AI can also present challenges. Process automation may lead to job reductions, impacting the economy and employment within the industry (Zarifhonarvar, 2023). A lack of human interaction could result in decreased service

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quality. Overreliance on AI and automation can pose risks to the security and privacy of customer data, leading to customer churn and damaging the business's reputation (Limna, 2022).

It is important to study the implementation of artificial intelligence in the restaurant industry to identify how various AI services can optimize processes and improve the efficiency of restaurant operations. This research, based on specific case studies, will help restaurateurs better understand the potential of new technologies to enhance operational activities and improve customer service.

Theoretical background

The use of robots, neural networks and artificial intelligence in hotels and restaurants has been investigated by many scientists and research groups. For example, the implementation of service robots in tourism and hospitality industry has been studied by Ivanov and Webster (2020). Murphy et al. (2017) studied the use of robotic applications in hospitality, and in Belanche et al. (2020) considers robots that perform more complex advanced tasks involving interaction with customers on a social level (e.g., talking, serving food). Studies are also known about Pepper and Relay robots, which perform the tasks of concierges and waiters in hotels and restaurants (Mende et al., 2019). It is also worth noting interesting works on the use of artificial intelligence in the restaurant business (Berezina et al., 2019), hotel and restaurant marketing (Davenport et al., 2020) and directly to transform customer behaviour (Khatri, 2021).

Also, the authors of this article have studied and analysed many practical cases of well-known restaurants that actively use artificial intelligence to predict demand for their services, as well as to personalise offers to guests in restaurants based on historical data about the number of orders, order time, price, weather conditions, events and other factors. This allows companies to minimise costs and ensure a high quality of service.

One of the first companies to apply neural networks to predict food demand was the Chipotle Mexican Grill (Chipotle Newsroom, 2022). Using artificial intelligence and machine learning, the system monitored raw material quantities in real time and notified the team of how much new raw materials needed to be purchased, how much semi-finished products needed to be prepared and when to start cooking for each restaurant. This helped them avoid overflowing the warehouse and reduce storage costs for products.

Starbucks uses Atlas, an application based on the ArcGIS platform, to analyze data and determine the best locations for new shops (ESRI, 2014). The application includes data layers such as shopping zones, retail clusters, transport hubs and demographic data to make decisions about where to open new shops. Starbucks also uses GIS for marketing activities, recruitment, inventory planning and analysis of where customers spend more money than the national average, allowing them to include high-end items in their shop offerings.

Pizza Hut uses AI to predict demand for different types of pizza (Lazzro, 2021). They use analytics and AI to analyse ordering data and other factors such as weather, day of the week and time of year to determine which types of pizza will be popular in the future.

KFC is already actively using artificial intelligence to enhance its operations. Through its partnership with Manthan, KFC centralizes data across all aspects of its business, including dynamic demand, inventory management, operations, e-commerce, and customer experience. AI enables KFC to perform real-time analytics and make decisions, allowing the company to quickly adapt to market changes and improve customer service. This technology is already implemented in over 600 KFC restaurants across Canada, helping the company to manage its business more efficiently and enhance the overall customer experience (CRN, 2020).

AI personalize offers to guests through machine learning algorithms, guest data analysis, facial recognition, chatbots, and personalized recommendations for events/ /excursions. For example, the world's largest hotel company, Marriott International, uses the Marriott Bonvoy mobile app, which uses AI to offer personalised food recommendations to guests, and allows them to order food and drinks directly from the app (Forman, 2021).

Major hotel chain Hilton uses the Hilton Honors food and drink ordering app, which also uses neural networks to offer personalised food recommendations (Hertzfeld, 2018).

An example of the use of AI to personalise restaurant recommendations could also be the system used by McDonald's. McDonald's has implemented and tested technology at some drive-through locations that can recognise car number plates (Lively Impact). This information allows the company to record previous customer orders based on the number plates, allowing it to run a food recommendation algorithm.

The use of artificial intelligence in the Starbucks app offers customers thoughtful, personalised choices of products based on their own preferences as well as factors such as weather and time of day (Starbucks Stories, 2020).

Also, neural networks and artificial intelligence can help optimise restaurant kitchen operations and improve employee efficiency in hospitality and restaurant businesses. They can be used to automatically manage food inventories, staff schedules, staff satisfaction and more. Such technologies can significantly speed up and improve kitchen processes, reduce the risk of errors and increase guest satisfaction. For example, as part of its partnership with VivaTech, Accor has awarded two start-ups and implemented their solutions: Orbisk, an artificial intelligence-based tool with connected scales that reduces cooking waste, and MapLab, a tool that improves employee impact and quality of life through teleworking (ACCOR, 2021). A literature review shows that hotels and restaurants are increasingly using robots and AI to predict demand, personalise offers for guests, and manage business. Some companies, such as Chipotle Mexican Grill, Starbucks, Pizza Hut, KFC, Marriott International and Hilton, are already actively using these technologies for purposes ranging from data analysis to virtual hotel prototyping to providing personalised food recommendations to guests.

An interesting example of the chef collaboration with AI is a unique culinary venture at Taras Shevchenko National University on March 29, 2023, in Kyiv, Ukraine (Klopotenko, 2023b). Renowned Ukrainian chef and restaurateur Yevhen Klopotenko organized a unique gastronomic event, merging his culinary prowess with the innovative capacities of artificial intelligence (AI). In collaboration with ChatGPT, he developed an impressive seven-course menu. Yevhen Klopotenko, a Ukrainian chef, MasterChef Ukraine winner and Le Cordon Bleu graduate, is renowned for promoting Ukrainian cuisine and his innovative ”100 Years Back to the Future” restaurant. (Klopotenko, n.d.).

March 12, 2023 Yevhen Klopotenko announced a unique dinner event at Taras Shevchenko National University in Kyiv, in collaboration with ChatGPT (Klopotenko, 2023a). The event, integrating a scientific conference theme, involved participants who bought tickets for 50 euros, supporting charity. Participants submitted a food ingredient, which ChatGPT used to categorize into seven groups and suggest dishes for the menu (TV Pershy Zahidny, 2023).

The results from AI left Klopotenko feeling they lacked complexity. The textures were basic, combinations traditional. To enhance the dishes, he added his signature sauces and used foodpairing.com. This method, based on molecular ingredient compositions, refined the flavor profiles of the courses (Klopotenko, 2023c). Subsequently, a gastronomic set of seven meticulously curated dishes: Salad of eel and shrimp with sun-dried tomatoes and parmesan, Beetroot cream soup with duck pieces and croutons, Salad with avocado, carrots, pomegranate and kumquat, Potato gratin with asparagus and mushrooms baked with gouda, Lamb cutlets with a side dish of corn and soft cottage cheese, Lobster with truffles and sesame oil (later Lobster was replaced with catfish and truffle with truffle oil due to the high cost of the ingredients), Panna cotta with white chocolate and kiwi.

Further, prompts were compiled for the Midjourney, on the basis of which the AI created photos of the dishes of the proposed menu (Figure 1). These images, conceived as presentations, would be embodied and brought to life during the gourmet dinner. The entire collaborative process between Chef and AI was filmed, later to be shared with the event’s attendees.

On March 29, 2023, in Taras Shevchenko National University, the conference transpired as an exclusive dinner event, boasting the active participation of ChatGPT and other AI services. Assisted by his team, Yevhen Klopotenko, in anticipation of the event, executed the essential preparations. The team proficiently orchestrated the execution and presentation of dishes, intricately designed in collaboration with AI (Figure 2 and 3).

The gastronomic event led by Klopotenko and AI was a huge success, with guests enjoying the dishes and the overall experience. He noted that AI, while helpful, cannot yet match human creativity in cooking. The event highlighted the benefits of integrating AI in culinary arts and emphasized the importance of personal branding and adopting new technologies for restaurant growth, blending the future with culinary traditions. The chef posted a comprehensive video report on his Facebook Page (Klopotenko, 2023d).

Figure 1. Photos of dishes created by AI Midjourney

Source: Danilenko (2023).

Figure 2. Photos of the real dishes cooked by Chef Klopotenko

Source: Klopotenko (2023c).

Methodology

In this review article, content analysis, integrative review and semi-strucutred interview methods were used. These methods have been chosen to provide the most comprehensive insight into the use of neural networks and artificial intelligence in the hospitality industry.

Content analysis is one of the methods used in qualitative research. Content analysis is the study of documents and communication artifacts, which might be texts of various formats, pictures, audio or video (Bryman and Bell, 2011). The main advantages of content analysis are that it is content-sensitive, can be applied in highly flexible research designs, and used to analyse many types of qualitative data (Kyngäs, 2020).

Integrative literature reviews offer several benefits to scholarly reviewers, including assessing scientific evidence strength, identifying research gaps and future needs, bridging related areas, pinpointing central issues, generating research questions, establishing theoretical frameworks, and exploring successful research methods. The 5-stage process involves problem formulation, data collection, data evaluation, analysis, and result interpretation. Maintaining scientific integrity entails addressing validity threats (Russell, 2005).

Qualitative elements of research are especially suitable in cases where the phenomenon is poorly studied (Ţydţiűnaitë and Sabaliauskas, 2017). Selection of informants was carried out during the course of the research. During the research were interviewed 8 experts of restaurant business, with more than ten years experience in the hospitality sectors. The interview process took place in the period June - December 2023. The interview process with the informants was suspended when it was observed that no new empirical data was found (Alshenqeeti, 2014; Žydžiūnaitė and Sabaliauskas, 2017).

Results

Artificial intelligence (AI) technologies are extensively utilized in restaurant business, benefiting customer service, operational capabilities, and cost reduction. AI adoption is crucial for economic development in this sector. However, risks include job losses in low-tech sectors, reduced control due to robot autonomy, and concerns regarding data security and privacy. AI technologies have mixed effects on workforce and employment in the hospitality industry, presenting both positive and negative outcomes.

All of the above shows examples of the use of AI by large brands that are making huge investments in these technologies. However, at the end of 2022, ChatGPT triggered a revolution in the field of AI (Duranton, 2023). ChatGPT, introduced in November 2022 by private AI research institute OpenAI, is the latest product based on the institute's GPT3, the third iteration of its large language model Generative Pretrained Transformer.

Following ChatGPT, neural networks capable of generating content in the form of text, images, video and audio began to emerge and gain in popularity. Whereas in the past, AI could only be used by IT specialists with professional skills, now neural networks

have become available to ordinary users without programming skills or knowledge of high technology.

Below we look at some AI-services that can help users without special IT skills or knowledge to generate unique content in the restaurant industry:

- ChatGPT (Generative Pre-trained Transformer) is a deep learning model that is trained to generate text responses based on input messages (OpenAI).
- Jasper is an artificial intelligence trained to write original creative content for blogs, social media posts, websites and more. The service allows you to write voluminous content that is original and free of plagiarism. Integration with SurferSEO.com helps optimise text for search engines so that it ranks at the top of search results (Jasper).
- DeepL is an online machine translation service that uses deep learning to translate texts into different languages. DeepL uses deep learning neural networks to automatically identify terms and context, allowing it to generate more accurate translations, especially in specialised areas of expertise such as medicine, law, finance and technology (DeepL).
- DALL-E (Dali+CLIP) neural network that is able to generate unique images and texts based on a given textual description (OpenAI).
- Midjourney is an independent research lab and the name of its own AI programme that creates digital images from natural language descriptions. The lab is self-funded and focuses on design, human infrastructure and artificial intelligence (Midjourney).
- Deep Dream Generator (DDG) is an online service that uses artificial intelligence algorithms to create deep and psychedelic images from existing photographs. It allows users to upload their images and apply various filters and effects to them, creating unique and creative results (Deep Dream Generator).
- Artbreeder is an online service that uses artificial intelligence technologies, including generative models and neural networks, to create and combine images based on colour, shape and texture (Artbreeder).
- Looka.com – helps create artificial intelligence-based graphic design without taking away the creativity, vision and fun that is needed to create brand identity. The neural network can be used to create unique logos, corporate identity packages, social media creatives and other promotional materials (Looka).
- Synthesia.io is a voice and video synthesis platform that uses deep learning and neural networks. In the hotel and restaurant business, synthesia.io can be used to create video ads, training videos for staff, and to create audio materials such as podcasts or audio guides for guests (Synthesia).
- Pictory.ai is a neural network that can automatically create short branded videos based on longer content. The network can also convert text into a video clip (Pictory).
- Murf.ai - helps you make studio-quality voiceovers in minutes using realistic AI voices for podcasts, videos and any professional presentations (Murf).

- WellSaid Labs is an online service that allows you to turn text into speech at a human voice level using AI. Users can supplement their stories and digital experiences with a wide variety of voice styles, accents and languages - at any scale (WellSaid Labs).
- VEED.io, with its robust artificial intelligence technology and user-friendly interface, allows you to quickly create stunning videos online. It can be used as a video editor to cut, trim, add subtitles, etc. or convert any text into video (VEED).
- RunwayML provides the user with the ability to quickly and easily create and use various artificial intelligence models, such as generative models and image and text recognition models. It also integrates with other applications and tools (Photoshop, Blender, Unity, Max MSP and others), allowing the creation of more complex and powerful projects such as games, movies, music compositions and more (RunwayML).
- Repurpose.io - helps you automatically create multiple short videos from a long one and publish it on multiple platforms at once, such as YouTube, Facebook, TikTok, LinkedIn and many others (Repurpose).

The qualitative research methodology used in our study provided valuable insights from eight experts in the restaurant business. The analysis of interviews revealed key findings:

- There’s a division among respondents between those who understand and actively use AI and those skeptical and not using it, mainly due to a lack of information and knowledge about AI.
- Most respondents learned about AI capabilities by chance, not through research. However, those who delved into it fully maximized AI use and were highly satisfied with the experience.
- Respondents commonly mentioned using AI for restaurant advertising, like photo processing, video editing, and ad campaign ideas. For instance, the Synergy network uses Dalle and ChatGPT integration for social media ad designs and creative ideas.
- Chef Mikhail Sosnovskikh shared a case where he used ChatGPT to brainstorm Halloween menu ideas, resulting in resource-efficient and creative dish presentations.
- Synergy’s automation head, Andrey Furman, shared his experience with AI, noting his company’s positive outlook on AI and its development potential. His department is launching projects like a chatbot for training new employees and using AI to analyze incoming calls to improve hostess and operator efficiency.
- Synergy group's training manager, Viktor Tsoi, uses GPTchat for preparing lectures and staff tests. The company also uses AI for thematic evening menus and wine pairings.
- Bartender Ivan Silantyev uses AI for innovative cocktail ideas, with AI-generated cocktail images guiding ingredient and equipment selection. Customers highly appreciate these visually and taste-wise.
- Svetlana Ruban from “Savva Libkin Restaurants” uses ChatGPT for texts like job descriptions and staff standards. The company also employs AI in marketing and advertising for idea generation and promo material handling.

All respondents acknowledged AI's positive impact on the restaurant business, but agreed that AI can't fully replace humans, instead serving as a tool for optimizing operations, automating monotonous tasks, and generating interesting ideas.

Conclusions

The study concludes that AI in the restaurant business brings practical benefits, fostering innovative solutions and process efficiency while maintaining the importance of human creativity and adaptation. This research paper analyses fifteen AI services, available both for free and for a fee, that can be used without specialised IT skills. These AI services have potential applications in the restaurant industry, including content creation and business optimisation. The study identifies various AI applications in the restaurant industry, grouped according to business challenges.

Group 1. Conceptualising and launching new projects: AI can generate restaurant names, suggest project concepts and USPs, identify target audiences, create business plans, logos, and promotional materials, and analyse competitors to improve business strategies.

Group 2. Menu optimisation and management: AI can generate dish descriptions, create menus that enhance sales and customer satisfaction, develop new dish ideas, analyse ingredient costs, and generate realistic food photos for presentation.

Group 3. Content creation for websites and social media: AI can assist in content planning, writing social media posts, creating banners, enhancing images, and producing video content, including animations and editing.

Group 4. Campaign development and brand promotion: AI helps analyse advertising campaigns, write sales texts, create slogans, automate advertising processes, and develop sales funnels and loyalty programmes.

Group 5. Staff training and standardisation: AI can create video tutorials, checklists, job descriptions, trainings, and interactive exercises to improve staff performance and learning.

In conclusion, AI is a powerful tool for optimising the restaurant industry and creating content. When used effectively, it enhances competitiveness, boosts customer satisfaction, and drives profits. However, AI is not a substitute for industry expertise, and proper management and task formulation are essential for maximising its potential.

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