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THE IMPACT OF ROBOTS AND ARTIFICIAL INTELLIGENCE ON SERVICE QUALITY MANAGEMENT AND CUSTOMER SATISFACTION IN THE RESTAURANT BUSINESS

This study has explored the significant impact of robots and artificial intelligence (AI) on service quality management and customer satisfaction in the restaurant business. The findings highlight the potential of these technologies to enhance operational efficiency, consistency, and overall service delivery. Robots and AI have proven to reduce operational costs, streamline processes, and speed up service, leading to improved customer experiences in many cases. However, the integration of automation into the restaurant industry also presents challenges, particularly in balancing technological innovation with the need for personalized customer interactions. While many customers appreciate the convenience and novelty offered by robotic servers and AI-driven systems, some still value human touch and personalized service, indicating a gap in customer expectations. Therefore, the successful implementation of robots and AI in the restaurant business requires careful consideration of customer preferences and maintaining a balance between automation and human involvement in service delivery. Furthermore, the study reveals that the high initial investment, maintenance costs, and the need for continuous staff training remain significant obstacles for many restaurants, especially for small and medium-sized businesses. Despite these challenges, the long-term benefits of improving service quality and customer satisfaction may outweigh the costs for establishments that effectively integrate these technologies. In conclusion, the research underscores the importance of a strategic approach to integrating robots and AI in the restaurant industry. Restaurants that combine technological advancements with a customer-centric approach are more likely to succeed in enhancing service quality, increasing customer satisfaction, and staying competitive in an increasingly digital world.

Keywords: robots, artificial intelligence, restaurant business, quality, innovations, management.

Formulation of the problem. In today's interconnected world, where advancements in technology have become an essential aspect of our everyday existence, innovations have not remained isolated from the restaurant industry. The restaurant industry is witnessing a notable shift in customer interaction and service methods due to the increasing use of robots and artificial intelligence (AI).

The purpose of this study is to investigate how customer satisfaction and service quality in the restaurant industry are affected by robots and artificial intelligence. This study aims to investigate how technological innovations have affected every facet of restaurant service, from the use of automated systems and intelligent algorithms to the application of traditional service methods.

Our goal is to comprehend the precise modifications that artificial intelligence and robots have brought about in the restaurant industry, how these changes impact patron perceptions of the caliber of service, and how patrons react to these technological advancements. Through an analysis of these problems from the viewpoints of technology, society, and organizations, we intend to offer a thorough understanding of the dynamics influencing changes in the restaurant industry in the age of digital revolution. The study's findings can be used to build plans for improving customer satisfaction and service in the face of technology's expanding influence in the culinary sector.

Literature analysis. Roger Fields [1], with his accountant background and restaurateur experience, breaks down everything that is necessary for creating a restaurant that not only survives its primary year but every year after that, from the initial brainstorming stages to the latter stages of hiring

and profiting. The updated edition also includes pointers on how to navigate the ever-growing online food industry, specifically reviewing sites that have changed the industry dynamic completely.

The book gives advice on the financial planning, inventory management, and other system operations critical to every restaurant business, making *Restaurant Success By the Numbers* an unparalleled restaurant start-up guide thanks to Field sharing his decades-long business management expertise.

The book by Ethem Alpaydin [2] on artificial intelligence gives examples of how machine learning is being used in our day-to-day lives and how it has infiltrated our daily existence. It also discusses the future of machine learning and the ethical and legal implications for data privacy and security. Any reader with a non-Computer Science background will find this book interesting and easy to understand.

Artificial Intelligence in Practice by Bernard Marr and Matt Ward [3] is a fascinating look into how companies use AI and machine learning to solve problems. Presenting 50 case studies of actual situations, this book demonstrates practical applications to issues faced by businesses around the globe. The rapidly evolving field of artificial intelligence has expanded beyond research labs and computer science departments and made its way into the mainstream business environment. Artificial intelligence and machine learning are cited as the most important modern business trends to drive success. It is used in areas ranging from banking and finance to social media and marketing. This technology continues to provide innovative solutions to businesses of all sizes, sectors and industries. This engaging and topical book explores a wide range of cases illustrating how businesses use AI to boost performance, drive efficiency, and analyze market preferences and many others.

Object subject and methods of research. Completing a thorough examination of contemporary automated order system technologies, such as self-service kiosks and mobile applications. examining how well these systems work in different kinds of eateries and taking into account how they can expedite order processing, cut down on errors, and improve the overall dining experience.

Examining the use of robots, particularly those used as waiters and porters, in the restaurant service sector. examining how customers engage with robots, gauging public acceptance of these innovations, and evaluating their effects on the emotional value of dining out and the standard of service.

A thorough analysis of how artificial intelligence is being used in kitchen operations, such as menu planning automation, cooking time monitoring, and popular dish prediction. Figuring out how these technologies affect the stability of kitchen operations and the precision with which food is prepared.

An in-depth grasp of how these technologies interact with different facets of service and how patrons view innovations in this industry can be gained by researching the use of these technologies in the restaurant industry.

Investigating in detail the use of robots to perform a range of service tasks, such as receiving and delivering orders, delivering dishes, and interacting with customers. figuring out how these technologies can decrease error risk and increase service speed.

Researching how artificial intelligence affects how customers interact with ordering and support systems. Researching the potential for individualized care and customization to meet the demands of specific clients.

Creating metrics and approaches to gauge client satisfaction with new technologies. evaluating client feedback to determine the effectiveness of services and to pinpoint the advantages and disadvantages of innovations that have been put into practice.

Looking into how the use of technology affects restaurant employees' workflow. figuring out whether artificial intelligence and robots can help or impede staff-customer communication.

Examining the effects that technology adoption has on the restaurant's reputation and brand among patrons. Investigating whether technology influences patron loyalty and if it becomes a factor in the restaurant's appeal.

A deep analysis of diverse scientific literature, studying various articles, and analyzing different perspectives expressed by individuals, scholars, and experts on the given topic.

Results. Let's take a closer look at a few of the subparagraphs.

1. The effect of automated kitchens on food quality. The culinary industry has undergone a revolutionary upsurge and paradigm shift with the introduction of automated kitchens in restaurants. The

ability of robots and artificial intelligence to standardize and optimize cooking processes will determine their impact in this context.

Artificial Intelligence Computer Vision can play a vital role in determining its shelf life and indicating which product is to be consumed first or prioritized using techniques. Hence a high rise in Shelf-life prediction technology has been observed. Also, the owner of the restaurant can tie with local vendors and he can monitor the quality of fruit or vegetables or flowers or meat or fish, etc., which are purchased for its restaurant. At each and every stage of the food supply chain, Shelf-life prediction technology aids businesses growth [7].

To begin with, automated systems for measuring and dosing ingredients are operated by robots. This helps to maintain the consistent quality of the dishes by preventing human error and guaranteeing the use of exact amounts of ingredients. Precise measurements techniques ensure that there are no variances in the flavor attributes of food items and contribute significantly to the creation of an unparalleled culinary experience.

The second aspect of the impact of automated kitchens is the optimization of cooking time. Robots can flip burgers and assemble pizzas more consistently than overworked employees, and that artificial intelligence can enable computers to take drive-thru orders more accurately [5].

It is crucial to remember, though, that the effect on food quality cannot be solely attributed to technological advancements. Empirical studies also demonstrate that other factors, like the ambiance and friendliness of the employees, can affect how flavor is perceived. In order to fully comprehend how technology impacts the overall customer experience with regard to the quality of food preparation and consumption, a comprehensive approach is necessary for the scientific study of this issue.

2. Robot waiter and interactive service: interaction of technologies with customers. The introduction of robot waiters and interactive service systems in the restaurant business marks a stage of technological evolution aimed at optimizing the interaction between staff and customers. From the scientific point of view, this process has a number of aspects, including the analysis of customers' psychological reactions, optimization of order efficiency, and improvement of the overall quality of service.

More options for customer interaction are being made possible by sophisticated robot waiters. Not only can they follow instructions, but they can converse with the customer while considering their emotional state and personal preferences. We are now able to examine how customers interact with robot waiters, including how they respond to their appearance, body language, and voice, thanks to recent advancements in customer psychology research. This strategy enables the humanization of technologies in the restaurant industry while also guaranteeing the service's functionality.

The growing application of artificial intelligence is also the foundation of interactive service systems. They direct customers' attention to personalized offers by analyzing data from past orders, accounting for individual preferences, and making product or dish recommendations. Natural language processing and analytics research is advancing order recognition systems and guaranteeing accurate fulfillment of customer requirements.

Self-serve technology is one of the most recognizable applications of AI in restaurants – think kiosks at fast food restaurants like McDonald's where you place your order, then wait in line for it to be prepared. The tech is also wildly popular with customers [10].

Considering the aforementioned, a scientific method of researching how customers interact with robot waiters and interactive service systems seeks to explore the practical, psychological, and emotional dimensions of this novel approach to customer service.

3. Data analysis and personalization in artificial intelligence's relationship with consumers. In order to enhance the customer experience, restaurants are utilizing artificial intelligence in a number of intricate ways, including data analysis and personalized service. This section's research attempts to shed light on how these factors affect customer satisfaction and service quality.

First, researchers examine the mechanisms of tailoring technologies to specific customer preferences when examining the personalization of services through artificial intelligence. Algorithms can automatically consider past orders, understand dietary requirements, examine reviews from the past,

and gather other personal information to make relevant recommendations and tailor each customer's experience.

The second aspect of this section is data analysis. The study aims to examine what data is collected as a result of customer interactions with AI systems and how this data is used to optimize service and analyze trends. It is important to consider data privacy and ethical compliance issues when processing customers' personal information.

AI technology can improve your marketing efforts to target the customers who will be most interested in what your restaurant offers. In addition to finding new customers to target, AI technology can help your restaurant retain existing customers by driving remarketing efforts toward them [11].

An important aspect is analyzing customer reactions to personalized approaches and collecting feedback using intelligent systems. The study of this aspect includes the analysis of not only positive reactions to personalization, but also the identification of possible areas of dissatisfaction and the correction of possible shortcomings.

Therefore, a deeper understanding of how technology influences each individual customer experience and determines the degree of satisfaction is made possible by the scientific justification for artificial intelligence's interaction with customers in this section.

4. Technical, social, and economic aspects of the benefits and challenges of adopting new technology. There is no denying that the use of robots and artificial intelligence in the restaurant industry has brought about innovations, but it has also brought with it a number of social, technological, and financial difficulties. The purpose of this section is to present a scientific analysis of these advantages and difficulties.

The AI-based intelligent decision-making systems consist of various tools and methodologies, i.e., high-resolution cameras, laser-technology-based systems, X-ray-based systems, and IR spectroscopy. These tools and technologies are used to analyze each and every aspect of the food products such as fruits and vegetables at the input channel. Conventional systems are only able to characterize good and bad products according to their appearance [8].

Technical challenges also include the reliability and stability of robots and artificial intelligence systems. The study is aimed at analyzing the frequency and causes of technical failures, their impact on maintenance, and the response of personnel to such situations. A detailed study can identify optimal maintenance strategies and prevent possible failures.

Social aspects include the interaction of staff and customers with artificial intelligence and robots. The research aims to study the psychological perception of technology, including reactions to autonomous robots and interaction with artificial intelligence. The results can be used to develop trainings and programs aimed at adapting staff and ensuring positive customer interaction with innovations.

Economic challenges lie in assessing the cost of implementing and managing technology. The most obvious and immediate benefit of “hiring” robot workers is the cost savings. These savings go beyond the simplicity of reduced wage payouts. Of course, there is the upfront cost of purchasing the robot but this is nothing compared to the yearly salary you must provide for a human throughout their working life [9].

In studying these aspects, it is important to consider a multidisciplinary approach, involving experts in engineering, psychology, and economics to better understand and address the challenges and identify the benefits of implementing technology in the restaurant business.

Another important technical challenge is the security and privacy of data related to the use of technology. Research in this area is aimed at analyzing possible security breaches and ways to protect customer information. The development of encryption algorithms and mechanisms to protect personal information is a key element of the scientific approach.

Social aspects include research on the impact of technology on the interaction between staff and customers, including an analysis of the effectiveness of training for staff in managing robots and artificial intelligence systems. The study of socio-cultural differences in technology consumption and acceptance helps to create adapted implementation strategies for different groups of customers and staff.

The self-learning restaurant, in which every employee and every algorithm gets better with every guest. In which the guests are better and better assessed, first by the employees, then by the system, and from now on the employees and the system "learn" from each other. The specific situation is better and better recognized, anticipated, and the wishes of the guests are thus better and better fulfilled. How they want to be addressed, what they want to eat, what they want to drink, where they want to sit [12].

Evaluating risks and opportunities for the restaurant industry is another aspect of economic challenges. Analyzing the advantages and disadvantages of implementing technology aids in resource allocation and profit maximization. It is also researched how market competition and demand dynamics are affected by the adoption of new technologies.

These study's findings highlight the necessity of an integrated analytical approach that addresses the technological, social, and financial facets of technology adoption in the restaurant industry. This enables us to create recommendations for the best possible use of technology in this industry and to comprehend the entire range of benefits and challenges.

The top 10 nations with the greatest potential for using robots and artificial intelligence in the restaurant industry are displayed in Table 1.

Table 1. – Top 10 Countries with the Best Potential for Implementing Robots and Artificial Intelligence in the Restaurant Business

Location	Countries	Brief description
1	Singapore	Singapore is characterized by a high level of technological development and innovative infrastructure. Advanced approaches to digitalization and active support for innovation in the hotel industry provide an ideal environment for the introduction of robots and artificial intelligence.
2	Japan	Japan is renowned for its sophisticated robotics and its ability to incorporate AI into a wide range of sectors. Its high degree of technological readiness and innovative cultural bent make it a desirable place to deploy automated solutions in the hospitality industry.
3	USA	The United States has a developed restaurant industry and leadership in technology. There are great opportunities for the introduction of robots and artificial intelligence due to the large market and high level of technological infrastructure.
4	Germany	Germany is characterized by a high degree of industrial automation and research and development efforts. This creates favorable conditions for the introduction of robotics and intelligent systems in the restaurant business.
5	Switzerland	Switzerland boasts a stable restaurant industry and a high level of innovation. Putting a lot of emphasis on technology development and research opens up possibilities for robotics integration into hotel operations.
6	Korea	South Korea is impressive in terms of its quick rate of innovation and technological readiness. It is appealing to restaurants looking to integrate robotics because of the government's active assistance and high level of technological proficiency.
7	China	China, as a leader in artificial intelligence and robotics, has significant potential to introduce automated technologies into the restaurant industry, especially in the context of the industry's rapid growth and development.
8	Sweden	Sweden is characterized by high quality technical education and active research in the field of information technology. This creates favorable conditions for the introduction of robotics and artificial intelligence in the restaurant sector.
9	Australia	Australia's restaurant business is steady and offers a lot of room for innovation. Its high degree of hospitality and technological integration make it a desirable place to put automated solutions into place.
10	United Arab Emirates	The United Arab Emirates is characterized by rapid development and a high level of investment in new technologies. This creates the foundation for the successful implementation of robotics and artificial intelligence in the restaurant business.

We would like to draw attention to and showcase the Japanese hotel Henn-na, which is fully automated and powered by artificial intelligence. It is a prime example of cutting edge technology

applied to the hospitality industry. In addition to impressing with its technical sophistication, the guest registration system, which is shaped like a robot girl, dinosaurs, and androids, highlights the critical shift from traditional service to innovation.

But don't forget that with strong AI, a machine displays all the behavior you'd expect from a person, if you're a Star Trek fan, this is Lieutenant Commander Data. If you prefer Star Wars, then this might be C3PO or R2-D2. These artificial beings have emotions, a sense of purpose, and even a sense of humor. They may learn a new language just for the joy of learning it. Some computer scientists refer to strong AI as general AI—a broad intelligence that doesn't apply only to one narrow task [6].

Most tasks, including restaurant services and check-in, are delegated to robots that can speak several languages and carry out a variety of tasks. Robot waiters and receptionists are viewed as an essential component of automation that helps improve customer service and streamline corporate operations.

Traditional keys are replaced by a face recognition system, which improves convenience and security of visitor check-in. The guest engages with a unique robot tulip in the room, which gives information, responds to voice instructions, and adds comfort.

The hotel's environmental sustainability is another crucial factor. Utilizing solar energy to generate electricity and contemporary cooling technology to generate heat show a dedication to environmental responsibility.

This hotel is an ideal example of how a fully automated restaurant can be created with the least amount of staff; you may highlight its benefits and drawbacks by doing a pre-analysis of the hotel. The existence of a hotel like this indicates that we are living in the present and not some kind of sci-fi or dream. Consequently, it won't come as a surprise if a restaurant of a similar nature goes up soon.

Conclusions. The overall conclusion regarding the impact of robots and artificial intelligence in the restaurant business on service quality and customer satisfaction is defined as a dynamic process, driven by numerous factors. On the one hand, process automation and the use of innovations can lead to increased efficiency, speed, and quality of service, which affects the positive perception of restaurants. On the other hand, many people believe that Artificial Intelligence will take the human seats in the future and the world will observe a huge deficiency in the market of employment. As Artificial Intelligence can do works promptly, accurately and conveniently, therefore, the job holders will feel no need of humans for their job vacancies thus the world will be confronted with collapsed of unemployment. Therefore, people are very concern about their future jobs paralleled with the emergence of Artificial Intelligence.[4] (Fig. 1).

Such a comprehensive approach requires industry leaders, human rights organizations, and legislatures to play an active role in creating standards and policies that address both the positive and potential negative aspects of robots and artificial intelligence. Emphasizing the preservation of the human element in service remains a key aspect of ensuring the harmonious coexistence of technology and human empathy in the restaurant sector. Given the powerful impact of technology on the industry, it is imperative to find the right balance between innovation and social responsibility to ensure the sustainable and successful development of the restaurant business in the digital era.

The introduction of artificial intelligence should be seen as a promising opportunity to invest in a restaurant with numerous benefits over a long period of time. 60% of restaurant owners said that by 2025, performing work tasks with the help of artificial intelligence will become a major trend.

Artificial intelligence will improve the quality of products and dishes, and quality is one of the most important factors in ensuring the competitiveness of the restaurant sector, because a quality product will make a restaurant stand out:

- To be popular with consumers;
- Will ensure competitive advantage, long-term success and development (consumers will come back again and recommend it to their friends);
- Will be able to meet the needs and expectations of its customers.