Food & Beverage Management: The Integration of AI and Robotics in Transforming Guest Dining Experience

Ms. Rafiya Banu
e-Mail: rafiya786banu@gmail.com

Abstract

'AI and Robotics', the new sensation, a glorified trend and an uprising substitute, this paper indulges and briefly explores all the mentioned inclusion of AI and Robotics and its variations especially in the hospitality sector. The solitude purpose of any hospitality department is to satisfy and introduce comfort to the guests with a team that carries the operation smoothly. The introduction of AI and Robotics in the hospitality industry is said to provide a helping hand in those operations, to make systems run smoother.

In this paper, a thorough evaluation of the growth in usage and rise of adaptation of AI and Robotics in the hospitality sector is done. And the impacts resulted from the integration of AI and Robotics in different tasks that then led to contrasting Guest dining experiences as well as from the perspectives of servers.

Keywords: Artificial Intelligence; Robotics; Hospitality Industry; Guest Dining Experience; Automation in Service; Human-centred Hospitality

Introduction

Artificial Intelligence (AI) and robotics are transforming the hospitality industry, especially in guest dining experiences. These technologies are improving efficiency, streamlining operations, and changing how guests interact with businesses. However, while AI and robotics bring many benefits, they also present challenges – particularly when it comes to preserving the emotional and cultural elements that have long defined hospitality. This paper explores how these technologies are being adopted in the dining sector, their role in improving efficiency and guest experiences, and the challenges of maintaining human connection in an increasingly automated environment.

The hospitality industry has always been quick to adapt to trends, and automation is no exception. Robotic chefs, AI-powered ordering systems, and service robots are becoming more common, helping businesses cut costs, enhance personalization, and improve service speed. However, this shift raises important ethical and operational concerns. While automation can optimize efficiency, it also risks diminishing the human interaction that makes dining experiences memorable. After all, hospitality is not just about delivering food – it is about creating connections and meaningful moments for guests.The rise of AI and robotics in hospitality is part of a larger trend toward automation in various industries (Benavides-Chicón & Ortega, 2014). Many restaurants and hotels are using AI for food preparation, order management, and personalized dining recommendations, aiming to reduce errors and offer innovative experiences. However, a key question remains: Can AI and robots truly replace the warmth, intuition, and cultural authenticity that human staff bring? (C. X. Zhang et al., 2019b). For instance, celebrity chefs and experienced waitstaff often add a personal touch that no machine can replicate – whether it is through storytelling, humour, or culinary creativity.This paper critically examines the impact of AI and robotics on guest dining experiences, particularly in terms of operations and emotional engagement. It seeks to answer key questions: How do these technologies influence efficiency in restaurants? Do they enhance or take away from the guest experience? And ultimately, can AI and robotics ever match the emotional intelligence that defines human-led hospitality? (Koo et al., 2021). By exploring these issues, this study contributes to the ongoing discussion on the future of hospitality. It examines the delicate balance between automation and human-centred service, offering insights into how technology can enhance the industry without losing the warmth and authenticity that make hospitality unique (Roy & Pagaldiviti, 2024).

Literature Review

Artificial Intelligence (AI) and robotics have become hot topics in the hospitality industry, with researchers exploring both their benefits and challenges. As these technologies advance, they are no longer limited to behind-the-scenes operations – they are now playing a direct role in guest experiences, especially in dining.

AI and Robotics in the Hospitality Sector

AI and robotics are being increasingly used in the hospitality industry, particularly in food and beverage (F&B) operations, to boost efficiency and cut costs. Lavi (2023) notes that AI is transforming the sector by automating routine tasks like order taking, food preparation, and payment processing, allowing businesses to streamline operations and improve efficiency. Karagiannis (2024) adds that AI-powered systems can analyse guest data to predict demand, optimize inventory, and provide personalized dining recommendations, ultimately enhancing the guest experience.However, the use of robotics in hospitality remains a debated topic. While robots excel at repetitive tasks such as serving food

and managing inventory, many researchers question whether they can truly replicate the warmth and emotional intelligence of human employees. Ivanov and Webster (2022) point out that while robots can improve service efficiency, they often lack the personal touch, creativity, and problem-solving skills that human staff bring. Emotional engagement, particularly in guest interactions and food preparation, plays a key role in customer satisfaction – an element that Cheong et al. (2021) argue remains difficult to replace with technology.

Impact on Guest Experience

Research indicates that AI and robotics can enhance guest satisfaction in specific situations. AI-powered chatbots and virtual assistants, for instance, provide instant access to information and services, making interactions more convenient and efficient (Ingram, 2023). Robots used for food delivery or room service can further improve convenience by reducing wait times. However, despite these advantages, many guests still prefer human interaction, especially in dining settings, where a personal touch is often seen as essential (Punpongsanon, 2023).

AI-driven systems also enhance guest experiences through personalized services, such as customized meal recommendations based on dietary preferences or past dining history (Karagiannis, 2024). While this level of personalization can boost satisfaction, it also raises concerns about data privacy and over-reliance on technology. Studies by Ujjwal (2023) and Ivanov and Webster (2022) highlight ethical concerns related to AI in hospitality, particularly regarding data collection and the potential alienation of guests who prefer traditional, human-centred experiences.

Operational Efficiency vs. Human-Centred Service

The use of AI and robotics in hospitality is often seen as a trade-off between efficiency and maintaining the human touch. AI can boost operational efficiency by cutting labour costs, reducing errors, and streamlining tasks. However, some researchers argue that these benefits might come at the cost of emotional intelligence and personalized service. Barten (2023) notes that while robots excel at routine tasks, they lack the empathy, intuition, and creativity that human staff bring to the dining experience.

Beyond service quality, automation also raises concerns about job displacement and the future of the hospitality workforce. Studies by Karagiannis (2024) and Ivanov and Webster (2022) suggest that while AI can reduce costs and improve efficiency, it may also eliminate entry-level jobs traditionally filled by human workers. To address this challenge, many researchers advocate for a hybrid model where technology supports, rather than replaces, human staff – allowing businesses to benefit from automation while preserving the personal connections that define hospitality (Mubin et al., 2013).

Gaps in Existing Literature

While AI and robotics in hospitality have been widely studied, key gaps remain in the research. For example, little is known about their long-term impact on guest loyalty and brand perception. Additionally, small and medium-sized hospitality businesses face unique challenges when adopting these technologies, yet there is limited research on their specific operational struggles.

This paper aims to address these gaps by exploring how AI and robotics influence both efficiency and guest dining experiences, highlighting the distinct challenges and opportunities for various types of hospitality establishments (Nam et al., 2020).

Objective:

This study aims to analyze the integration of Artificial Intelligence (AI) and robotics in the guest dining experience within the hospitality industry. Specifically, it focuses on the impact of automation on operational efficiency, customer satisfaction, and the balance between technological advancements and maintaining the human touch in service delivery.

The paper will evaluate the benefits and challenges posed by these technologies, considering their role in enhancing efficiency while preserving the warmth, creativity, and emotional engagement that have long been key components of the hospitality experience. Additionally, the study explores the ethical concerns surrounding automation, such as job displacement and data privacy, in order to propose solutions for a hybrid model that integrates both technology and human interaction.

Methodology

This study uses a mixed-methods approach to assess how Artificial Intelligence (AI) and robotics are shaping guest dining experiences in the hospitality industry. By combining qualitative and quantitative data, it provides a well-rounded view of the benefits, guest perceptions, and challenges that come with integrating these technologies.

Research Design

This research examines how AI and robotics impact both operational efficiency and guest experiences in dining settings (Bendel & Peier, 2023). It gathers insights from restaurant owners, employees, and guests through case studies, surveys, and interviews.

Case Studies: The study will analyse a selection of restaurants that have integrated AI and robotics, covering both high-end and budget-friendly establishments. This approach ensures a diverse perspective on how these technologies are used across different market segments.

Ethical Considerations

This research follows strict ethical guidelines, ensuring the privacy and confidentiality of all participants. It also considers the broader ethical implications of AI and robotics, particularly concerns about job displacement and reduced human interaction – key issues in the hospitality industry (Veruggio & Operto, 2008). The findings will explore these challenges and offer recommendations on how to integrate technology while preserving the human touch in service.

Clarity of Contribution

The use of Artificial Intelligence (AI) and robotics in hospitality dining offers new ways to improve efficiency and enhance guest satisfaction. While automation has been widely studied across industries, this paper focuses on striking the right balance between technology and human interaction in guest dining experiences (Buhalis et al., 2019). By examining how AI and robotics impact both operational performance and emotional intelligence in service, this study explores how these technologies can support, rather than replace, human staff. It also addresses a key gap in understanding – while AI-powered systems improve efficiency, they may struggle to replicate the warmth and creativity that make human service unique.

In-depth Literature Review

Recent Advancements in AI and Robotics in Hospitality

AI has rapidly expanded in hospitality, transforming everything from personalized guest services to predictive analytics in food and beverage operations. AI-driven tools like chatbots and recommendation systems enhance guest satisfaction by tailoring experiences to individual preferences (Karagiannis, 2024). Robots have also evolved beyond basic tasks like serving food, now taking on more complex roles such as autonomous cooking and concierge services (Ivanov & Webster, 2022).Despite these advancements, there is ongoing debate about whether AI and robotics can truly maintain the human touch in hospitality. For instance, while robotic chefs can efficiently prepare meals, they may lack the creativity and intuition that human chefs bring to the table. Similarly, service robots may struggle to provide the empathy and warmth that define great guest interactions (Barten, 2023). This paper explores these contradictions, examining how AI and robotics enhance efficiency while also raising questions about the role of emotional intelligence in hospitality service.

Addressing Gaps in Existing Research

While research on AI and robotics in hospitality is expanding, long-term studies on their impact on guest loyalty and brand perception remain limited (Maurer et al., 2016). Most existing studies focus on short-term efficiency gains but overlook how prolonged reliance on automation might influence guest satisfaction, especially in terms of emotional engagement. This paper aims to bridge that gap by exploring how AI and robotics affect both operational efficiency and guest dining experiences over time.

Case Studies

Case Study 1: Henn-na Hotel, Japan – Full Automation with Robots

Background: Henn-na Hotel in Nagasaki, Japan, is one of the first hotels in the world to be fully staffed by robots, aiming to transform hospitality through AI and automation (Karagiannis, 2024). At this futuristic hotel, robots manage check-ins, room service, and cleaning, all designed to create a smooth and high-tech guest experience. In the dining area, robots assist with food delivery, offer menu recommendations, and interact with guests, bringing automation directly into the restaurant setting.

Key Findings and Analysis:

- **Operational Efficiency:** The integration of robots significantly reduced labour costs. Robots in the dining section can deliver food to guests with precision, minimizing human errors and improving delivery time. However, challenges in the technical functioning of robots were noted, leading to occasional delays and dissatisfaction among guests.
- **Guest Experience:** Guests were fascinated by the futuristic nature of the hotel. However, many guests noted that while the robots performed well, the lack of human interaction led to a less personalized experience, which they felt was crucial in a hospitality setting. This highlights the balance between efficiency and emotional engagement that AI and robotics in hospitality need to strike.
- **Challenges:** One of the main challenges observed was the technical reliability of robotic systems. Periodic malfunctions and the inability of robots to handle complex guest inquiries reduced their overall effectiveness. Additionally, the high upfront cost of implementing such technology posed a significant challenge for other establishments trying to adopt similar models.

Although the robot-driven hotel model proved effective in reducing costs and improving efficiency, it also highlighted the essential role of human interaction in delivering a memorable and authentic hospitality experience (Remountakis et al., 2023). Future efforts may need to strike a balance, integrating technology while preserving the warmth and personal touch that define great service.

Case Study 2: Flippy – Robotic Chef by Miso Robotics

Background: Flippy, a robotic kitchen assistant developed by Miso Robotics, is designed to streamline cooking tasks in fast-food restaurants. It can flip burgers, grill meat, fry food, and handle other kitchen duties traditionally performed by human chefs.

To improve efficiency and maintain consistency in food preparation, Miso Robotics has introduced Flippy in several restaurant chains, including CaliBurger.

Key Findings and Analysis:

- **Operational Efficiency:** Flippy significantly improved kitchen efficiency by automating repetitive cooking tasks. The robot's ability to maintain consistent cooking quality and speed reduced the chances of human error, leading to higher food quality and faster service.
- **Guest Experience:** Guests appreciated the speed of service and consistent quality of food, but some expressed concerns about the loss of the "human touch" in food preparation. As dining experiences become more personalized and focused on culinary artistry, there was some pushback from guests who believed that the lack of a human chef diminished the authenticity of their meals.
- **Employee Impact:** While Flippy created efficiencies in the kitchen, it also raised concerns among employees about job displacement. Some kitchen staff initially resisted the technology due to fears of job loss, although many adapted by taking on more managerial and creative roles, such as focusing on menu innovation.
- **Challenges:** The high upfront costs of implementing Flippy and maintaining the system were significant barriers for smaller establishments. Moreover, while Flippy was efficient in cooking, it was unable to handle creative tasks such as plating or adjusting to complex guest preferences, which are integral to creating a unique dining experience.

Flippy showcases how robotics can enhance food preparation by improving efficiency and consistency. However, it also underscores the limitations of automation, particularly in creativity and guest interaction. A balanced approach – where robots take on repetitive tasks while humans focus on the creative and personal elements of dining – may be the most effective solution.

Case Study 3: The Rise of Service Robots at Hilton Hotels

Background: Hilton Hotels, a global leader in hospitality, introduced Connie, a robot concierge powered by IBM Watson, to assist guests with check-ins, provide information about hotel services, and offer local recommendations (Yadav et al., 2024). As part of a trial to explore the potential of robotic assistance in hotel operations, Connie was stationed in the lobby of Hilton's McLean, Virginia, location.

Key Findings and Analysis:

- **Operational Efficiency:** Connie, the AI-powered concierge, provided faster check-ins and could answer common guest queries, reducing the workload on human staff. This allowed hotel employees to focus on more complex tasks that required human intervention, thus increasing operational efficiency.
- **Guest Experience:** Guests were generally impressed with the novelty of interacting with a robot. However, feedback revealed that while Connie was effective at handling routine tasks, it was not able to replace the personalized service provided by human staff, particularly for guests seeking emotional engagement or more complex assistance.
- **Employee Impact:** Hilton's employees expressed mixed feelings about the introduction of Connie. While some saw it as a tool that enhanced their efficiency, others felt that it could not fully replace the warmth and human touch of a concierge. Additionally, there were concerns about the robot's maintenance, training, and potential technical failures.
- **Challenges:** While the robot enhanced convenience for guests, it struggled with tasks that required empathy, creativity, and adaptability. The challenge lies in finding a balance between technological convenience and the personal touch that guests expect from a luxury hospitality brand.

Hilton's introduction of Connie highlights how AI-powered robots can enhance efficiency and guest convenience, but they still fall short of delivering the personalized, nuanced service that human staff provide (Y. Zhang et al., 2019). Moving forward, the focus should be on integrating robots into tasks where automation adds value while ensuring that the emotional connections guests cherish in hospitality remain intact.

Case Study 4: Sushi Robots at a Restaurant Chain in Japan

Background: A well-known restaurant chain in Japan introduced sushi-making robots to automate tasks like rice preparation, rolling, and cutting. By streamlining these repetitive processes, the restaurant aimed to serve customers faster while minimizing human error in the kitchen.

Key Findings and Analysis:

- **Operational Efficiency:** The sushi robots increased production speed and consistency, enabling the restaurant to serve a higher volume of customers while maintaining a consistent product. This was particularly beneficial during peak hours.

- **Guest Experience:** While the quality of sushi remained consistent, some guests felt that the experience lacked the traditional artistry and engagement of watching a skilled sushi chef prepare the dish. The robots' inability to interact with customers or offer a personalized touch led to some dissatisfaction among guests who valued the human connection in the culinary process.
- **Employee Impact:** While the robots took over the more repetitive aspects of sushi preparation, human chefs continued to handle creative tasks and quality control. Some employees expressed relief at being able to focus on higher-level culinary tasks, while others were concerned about the long-term implications of automation on job security.
- **Challenges:** The main challenge was ensuring the robots were capable of adjusting to customer preferences and handling non-routine orders, something that human chefs could more easily accommodate. The robots also required constant maintenance, which added to operational costs.

The sushi robots demonstrated how automation can enhance efficiency in food preparation, but they also underscored the limitations of robots in areas that require human creativity and customer interaction (H. Robinson et al., 2014). A balanced approach – where robots handle repetitive tasks while humans bring artistry and personal engagement – may be the most effective way forward for similar settings.

Conclusion of Case Studies:

These case studies highlight the many ways AI and robotics are reshaping the hospitality industry, especially in dining experiences. While these technologies improve efficiency, consistency, and cost-effectiveness, they also bring important questions about guest satisfaction, emotional intelligence, and the future of human roles in hospitality.

As technology continues to evolve, the most effective approach will likely be one where AI and robotics support, rather than replace, human service.

In-depth Case Study Analysis

These case studies aim to assess how AI and robotics impact both operational efficiency and guest satisfaction in real-world settings. By comparing their implementation in luxury and budget-friendly establishments, the research will provide valuable insights into how these technologies are used across different market segments and how they influence the guest experience.

Operational Impact

Each case study will track key operational metrics, including labour cost reduction, order fulfilment speed, and customer feedback. This data will help illustrate how AI and robotics can improve efficiency, minimize human error, and enhance cost-effectiveness in hospitality operations.

Guest Experience

This paper will examine guest feedback from each case study to understand how AI and robotics impact the dining experience. It will highlight both the strengths and limitations of automation, focusing on guest preferences for human interaction versus automated service. Additionally, it will explore any shifts in guest loyalty and brand perception resulting from AI integration (Kandampully et al., 2015).

Challenges and Opportunities

The challenges faced by each establishment – such as technical malfunctions, employee resistance, or ethical concerns – will be highlighted. This section will also explore the potential for these technologies to open new avenues for guest engagement, such as AI-driven personalized dining recommendations or robots providing entertainment and novelty experiences.

Ethical and Social Considerations

The use of AI and robotics in hospitality brings important ethical concerns, particularly around job loss and data privacy. The potential displacement of lower-skilled workers remains a significant issue for the industry, while AI's reliance on data analytics raises questions about guest privacy and security. This study will take a critical look at these challenges and explore ethical ways to integrate AI and robotics, ensuring that technological advancements do not come at the cost of human dignity and privacy.

Conclusion and Future Research Direction

This study concludes that while AI and robotics offer significant advantages in improving operational efficiency and guest convenience, they are unlikely to replace the human element in hospitality, particularly in high-touch areas like guest dining. The findings suggest that the most effective approach for the industry is a hybrid model, where AI supports and enhances human service rather than replacing it entirely. Maintaining the warmth, creativity, and personal engagement that define hospitality will be key to successfully integrating these technologies. Looking ahead, future research could explore the long-term effects of AI and robotics on brand loyalty and how guests perceive hospitality brands that rely on automation. Additionally, further studies are needed to examine the broader social impact of automation on the hospitality workforce, particularly regarding job displacement, changing skill requirements, and the ethical concerns surrounding data collection and privacy. As technology continues to evolve, understanding how to strike the right balance between automation and human service will be critical for the future of the hospitality industry.

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