

Sustainability in tourism and hospitality: Artificial intelligence role in eco-friendly practices in Indian hotels

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Abstract

This study explores the impact of artificial intelligence (AI) on the growth and competitiveness of regional tourism and hospitality destinations. AI's application has both positive and negative effects on sustainable tourism. On the positive side, AI enhances accessibility to tourist sites, provides detailed information about attractions, simplifies understanding of costs and amenities, boosts local economies, and increases federal income. A notable downside is the replacement of human workers by machine learning technologies, which may necessitate remedial measures such as training. This review examines AI's foundational IT principles, current applications, and systems in the industry, focusing on the hotel sector. It concludes with an overview of AI's challenges in this field, proposes a research agenda, and suggests future directions for AI development in tourism and hospitality.

Keywords: Artificial intelligence, Eco-friendly practices, Tourism competitiveness, Hospitality

1. Introduction

The tourism and hospitality industries are inherently focused on providing services and engaging with people. Therefore, to gain customers' loyalty and satisfaction, the aim is to guarantee that consumers maintain favorable perceptions concerning the caliber of services rendered by companies operating within this industry. In this context, providing tourists with excellent service is becoming increasingly crucial daily. Robotic technology and artificial intelligence applications are increasingly utilized in travel and hospitality to enhance operational efficiency and deliver superior services. These technologies are becoming increasingly prevalent, particularly in the lodging, food and beverage, travel, and transportation sectors. Despite some criticism from stakeholders, these technologies are becoming increasingly prevalent in various sectors. The benefits and drawbacks of these technologies on service quality in these industries are still debated, but businesses are increasingly adopting them. The use of robotic technologies in tour guiding and physical locations like airports and museums is also a significant aspect of these industries. Despite the debates, these technologies are crucial for businesses to adapt and thrive in the ever-evolving market. Furthermore, it is imperative to underscore

the utilization of these technologies in tour guidance and tangible environments like airports and museums.

The tourism and hospitality industries invest in robotic technology and artificial intelligence to maximize operations and improve service delivery. This research evaluates the domain of robotics and artificial intelligence by looking at the advancement of technologies and present uses. It includes chatbots and robots, the identification of faces, language translation, optimization of solutions, and other applications of artificial intelligence. The study aims to fill gaps in the literature and provide practitioners with valuable information. Big data, computing power, and algorithms are the foundation of artificial intelligence (AI). The last few years have witnessed noteworthy progress in all three of these domains because of several trends that have combined: (1) the development of AI algorithms; -, (2) a notable rise in processing power; -, and (3) The development of new, more efficient information sources and architectures for the processing and storage of massive quantities of data, within the context of big data. Due to these developments, the Fourth Industrial Revolution has witnessed substantial advancements in robotics and artificial intelligence (AI) systems (Li et al., 2019).

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Artificial intelligence (AI) is revolutionizing travel and tourism by integrating various systems, such as voice recognition, natural language processing, robots, personal travel assistants, and language translation applications. These systems are crucial for travel, as they make travel decisions, such as destinations, transportation, lodging, and activities. Travel agencies and organizations need help matching products to demand due to the vast pool of potential clients. This can also help travelers navigate unfamiliar environments, such as customs, languages, habits, and food. It can also help businesses customize experiences to visitors' preferences.

Despite the rapid adoption of AI, there are few real-world examples of its use in the industry. Artificial intelligence (AI) is incorporated into systems for data processing in real-world scenarios. During the design stage, many configurations, including speech recognition, robots, conversational systems, and forecasting systems, will soon permeate every facet of the travel and tourist industry, emphasizing employment, privacy, and the provision of necessary connections. Intelligent automation and artificial intelligence are keywords in the tourism industry. Assessing the design, visualization, creation, and implementation of artificial intelligence solutions for travel and tourism companies is a complex task due to the intricacies of intelligent automation.

As discussed by Zhao et al. in their 2011 research, AI is aware of the kinds of systems that the tourism industry may rely on and how best to build them for visitors in the future. The issue is that AI systems require a lot of energy and focus to maintain the structure. This justifies developing an intelligent automated system to enhance the travel and tourism industries. The tourism sector is increasingly focusing on integrating intelligent automation, environmental, social, and governance (ESG) standards, artificial intelligence (AI), and the Internet of Things (IoT) to enhance its operations. AI is transforming tourism by improving traveler experiences and understanding through advanced technologies. This study investigates how AI interacts with emerging technologies to uphold ESG standards and address common traveler issues, as well as its potential to boost enthusiasm for travel among tourism departments and clients, as suggested by Yue et al. (2012).

Integrating AI with other forms of intelligence is essential for creating sustainable, smart, automated systems in tourism. Various academic disciplines, including human-computer interaction, anthropology, psychology, behavioral science, and design research, are exploring AI automation's impact on the tourism industry (Ionescu et al., 2019; Martelaro & Ju, 2018). Researchers like Churchill et al. (2018) and Tuomi et al. (2019) advocate for an interdisciplinary approach that combines AI automation and speculative techniques to improve tourism. Designing tourist experiences should consider all phases of travel, from planning to post-trip evaluation, focusing on enhancing engagement and attendance. Lindvall et al. (2018) highlight the potential for AI to improve or replace visitor interactions, potentially transforming tourist destinations and social structures. Further

research is necessary to establish the causal relationship between AI and automation in tourism, even though AI systems, IoT, and ESG investments can contribute to a more sustainable tourism future. Designing intelligent automation environments using AI concepts could shape the future of travel.

2. Literature review

The focus of useful AI design is creating technological solutions for long-standing design issues in information systems, cognitive and behavioral sciences, and psychology. These solutions might provide insight into travelers' recurring behavioral issues, such as lack of self-control, inattentiveness, or cognitive decline. AI systems should be required to prevent users from making poor decisions that result in mediocre actions to address these problems (Tussyadiah, 2020). To achieve this objective, digital nudging (Schneider et al., 2018) and nudge theory aspect engagement (Thaler & Sunstein, 2009) may be implemented in the tourism industry (Tussyadiah et al., 2019; Tussyadiah & Miller, 2019). ESG investors should get ready for the deployment of human-computer interaction as a lens, according to Tussyadiah's (2017) quantitative analysis (Law & Tung, 2017). Loureiro et al. (2021) conducted a study that leverages guests' significance on intelligent voice assistants (IVAs), their relationship with them, and the human-VAT bond in the hospitality sector. Positive effects on customer satisfaction eventually lead to the desire to use digital platforms, corroborated by internet research on tourists' use of travel agencies and their ongoing development plan (Fileri et al., 2021).

It is essential to prioritize critical artificial intelligence technologies to ensure effective AI solutions' development, as Russell et al. (2015) and Tadapaneni (2020) emphasized. Here's a reframed version of your text with the citations integrated smoothly: "Various factors, including resilience to demands, vulnerabilities, errors, and cyber security risks, must be considered, as highlighted by He et al. (2019), Luo et al. (2020), Shao et al. (2020), Fan et al. (2021), Khan et al. (2021), and Wang et al. (2021). To optimize data usage, prevent privacy breaches, and promote a sustainable environment, ESG norms should be established, as suggested by Lords (2018), Sethu (2019), and Tussyadiah et al. (2019).

Theoretical frameworks such as the gravitational lensing theory by Mori (2017) and Murphy et al. (2019), technological phobia by Brosnan (2002), and social inclusion through technology by Wang and Wu (2021), among others, provide a foundation for understanding and advancing AI technologies." These theories provide a deeper understanding of how staff and visitors feel about intelligent robots in tourism service settings. According to Kurtessis et al. (2017), management or organizational support theories may persuade employees to accept intelligent automation in the workplace. Li et al. (2019) examined employee intentions, while Tussyadiah and Park (2018) and Lu et al. (2019) investigated customer opinions and intentions regarding the utilization of smart devices. The aspects that impact an organization's

acceptance of innovation must be identified to expedite and ease the introduction of smart automation in the tourist sector. Therefore, understanding the barriers to sector acceptance may be aided by being aware of the limitations on innovation dissemination inside enterprises.

The management literature has information on transformative leadership (Bass, 1990; Haeruddin et al., 2021). Research has shown that this type of leadership plays a role in expediting the advancement of company technology, as evidenced by studies conducted by Frambach and Schillewaert (2002), MacVaugh and Schiavone (2010), and El-Kassar et al. in a forthcoming publication. It also details the tenets that encourage innovation adoption and dissemination inside organizations. Integrating intelligent automation with the strategic aims of commercial and public tourism organizations and the competitive landscape across industry sectors should be the subject of further research (Rydzik & Kissoon, 2021). To encourage adoption, ESG investors work with the current administration to provide money and advocacy.

According to Oyewole (2021), offering training programs for prospective users can help break down barriers and encourage the responsible integration of intelligent automation within the organization. Before capitalizing on the potential benefits and drawbacks of intelligent automation in the tourism industry, it is essential to assess the effects of automation on society, employees, visitors, and the industry as a whole. To ensure sustainability, it is critical to acknowledge the effects and roles of intelligent systems within the tourism sector, as emphasized by Gretzel (2011) and Gajdošík and Valeri (2022). Furthermore, Lin et al. (2011) name safety and errors, law and ethics, and societal repercussions as the three domains of ethical concern that arise from the implementation of robotics. Visitor contact with intelligent devices is essential to guarantee service safety and reduce potential injury.

The changes smart automation can bring to the tourism industry are also a central research focus. These changes can include adjustments to organizational decision-making procedures when portfolio managers are replaced by artificial intelligence (Javelosa, 2017) and the inadvertent consequences of judgments made with AI assistance (Jarrahi, 2018). Collaborative decision-making, task distribution, and the involvement of specialized scientists are emphasized by Larivière et al. (2017) as crucial steps in evaluating the ethical implications and societal impact of intelligent systems before their development. Automation revolutionizes the travel industry, enhancing client and staff roles and work performance. It can increase profits, revenue redistribution, gender issues, and wealth.

However, concerns include potential unemployment and loss of knowledge due to over-reliance on technology (Chesell, 2018; Lin et al., 2011; Pham et al., 2018; Samuels, 2021). Let's make the sentence human-friendly: *“The idea of technological singularity sparks significant worries about*

what could happen as intelligent machines advance. It suggests that technology might get beyond our ability to manage, potentially surpassing human capabilities and leading to the downfall of human society” (Eden et al., 2012; Roli et al., 2021). The same is true when assessing the social impacts, especially those related to guest-host interactions and community support for expanding tourism. To make business estimation and forecasting more effective, combining machine learning with other strategies like envisioning future possibilities and influencing future developments (Hajer & Pelzer, 2018; Szántó, 2018; Szántó et al., 2020) can be helpful. This viewpoint is backed by Ahmed et al. (2010) and Kamolov et al. (2021).

Academic research could ideally uncover ways that clever automation may help the tourism sector become more resilient to future changes. The next stage is to identify the different approaches to minimizing adverse effects and optimizing the positive effects of automation in the tourist industry after learning about the numerous benefits and potential problems associated with deploying intelligent automation. The concept of sustainability transition, as discussed by Markard et al. (2012), Safarzyńska et al. (2012), Turnheim et al. (2015), Yue et al. (2021), and Bauer et al. (2022), is vital for researching how artificial intelligence (AI) can support eco-friendly progress in tourism. Intelligent automation may significantly impact tourism by reducing the need for in-person interactions between tourists and local personnel.

However, failure to address environmental conservation and social welfare, including adherence to ESG standards, could jeopardize the shared values necessary for a cohesive social structure (Bao et al., 2020; Han et al., 2019; Pan & Yue, 2021; Yue et al., 2020; Zhuma et al., 2020). This study explores how robots and AI can tackle emerging issues, emphasizing the need to shift perspectives on intelligent agents. Computational systems can enhance public understanding of physical and biological limits, promote responsible behavior, and educate individuals (Fusté & Jamal, 2021; Kopacek & Hersh, 2015). Research should focus on developing scientific, cultural, and technological tools to advance trends that benefit individuals and society while preventing the misuse of AI and robotics (Fusté & Jamal, 2021; Kopacek & Hersh, 2015). Creating resilient AI involves incorporating robotics principles to establish effective feedback loops (Tussyadiah, 2020).

3. Methodology

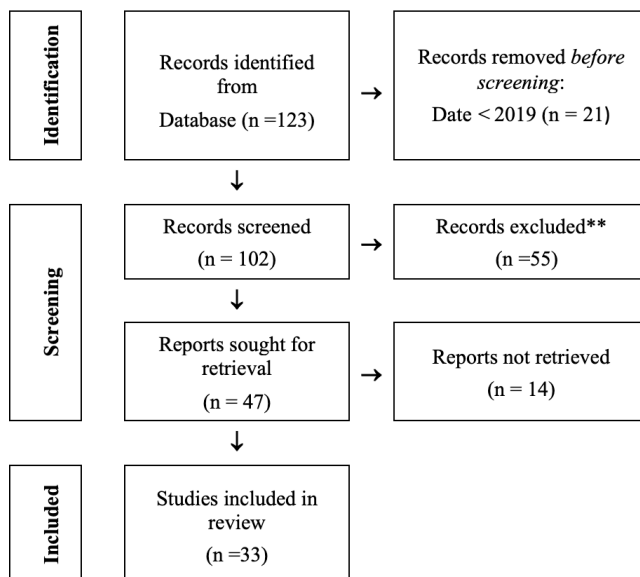
The Ethics Committee Approval was obtained from Eurasian Research Center (ERC) Scientific and Ethics Committee, Taraz, Kazakhstan, with the decision numbered 64-2 and dated 21.08.2024.

The approach is to conduct a literature review. The author completes the vocabulary of concepts and theories during the literature study stage by reading and comprehending the theories used as guidelines and references, which they find in various books, journals, and online sources. This

gives them a solid foundation and knowledge base to solve the problems discussed in the research and acquire research pertinent to the issue. The author employs several methods, including the following, as beneficial supporting information to locate or gather the data required for this study: 1. A note. In February 2024, we thoroughly examined the Web of Science database to get first-hand information regarding tourism and hospitality. The formula that was ultimately applied was "artificial intelligence" or AI or robotics" and "tourism" or "hospitality" in the title, abstract, author keywords, and keywords plus. Afterward, the document type (review article) was used to narrow the search.

There were 123 manuscripts found in all. Following applying the inclusion and exclusion criteria, 102 citations were found in the literature search. Subsequently, evidence screening was done using the title and abstract examination. Working in pairs, the two researchers assessed the titles and abstracts of the papers that the search found relevant in order of relevance. Disputes over the choice of studies and data extraction were settled by debate and agreement. Fifty-five results were removed after screening because they didn't match the study's goal. The qualitative synthesis incorporated 33 documents into summaries, while 14 reports were irretrievable. The identification, screening, retrieval, and inclusion stages of the review decision process are depicted in the inclusion decision flowchart shown in Figure 1. This flowchart complies with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standard.

Figure 1. Identification of studies via databases and registers



4. Discussions

According to Garcia et al. (2023), the tourism and hospitality industry stands to gain significantly from AI advancements. AI-driven chatbots and virtual assistants can instantly and personally address consumer inquiries, boosting customer

satisfaction and reducing response times. Machine learning algorithms can analyze consumer preferences and behaviors to offer tailored travel recommendations, including suggestions for routes, accommodations, and activities. Additionally, AI can streamline operational efficiency by enhancing back-end functions such as inventory management and supply chain logistics. By analyzing historical booking data, occupancy rates, and pricing trends, AI provides critical insights for revenue management. Moreover, AI can assess environmental impacts, waste management, and energy consumption to identify areas for improvement and promote sustainable practices within the industry.

4.1. Defining artificial intelligence

It would be fascinating to define intelligence first before defining AI. The capacity to comprehend one's surroundings and the phenomena that arise, to make the most of prior learning, and to integrate existing knowledge to address novel challenges effectively are all considered components of intelligence (Rudas & Fodor 2008). Li and Hung (2018) state that a typical definition of artificial intelligence is a group of technologies capable of simulating human intellect in problem-solving situations. Similar to how aeroplanes achieve the same goal of flying as birds but employ entirely different processes, artificial intelligence (AI) aims to achieve the same goal of thinking as humans while employing distinct processes. The definition of artificial intelligence (AI) has changed over time (Buhalis et al., 2019). Initially, AI was defined as possessing intelligence. More recently, AI has been defined as having the capacity to act independently on vast data (Sterne, 2017).

The four categories of AI that Hintze (2016) described are referred to by Buhalis et al. (2019). Reactive AI is the first kind; it lacks memory and historical context. The finest illustration of reactive AI is Deep Blue. The second kind is AI with restricted memory or selective/limited recall. The way a self-driving automobile handles its surroundings is one example. The theory of mind is the third kind. Robots capable of simulating emotions and social interactions represent an advanced category of artificial intelligence (AI). The current challenges in AI involve enhancing system memory, emotional and intuitive processing, and decision-making abilities based on past experiences (Bhalidis et al., 2019; Gretzel, 2011; Hintze, 2016). A recent concept, "Hybrid AI," defined by Wirth (2018), describes AI as more advanced than weak AI but not as advanced as strong AI. The travel and tourism industry requires strong AI and hybrid AI to effectively manage the diverse tasks and components necessary to deliver optimal visitor experiences.

4.2. The present application of artificial intelligence in the travel and hospitality sectors

The study analyses the growing implementation of artificial intelligence systems, particularly in-service robots (Samala et al., 2020), in the travel and tourism sector to enhance production and gain a competitive edge, highlighting their

relevance (Tung & Au, 2018: 2685). The study highlights the growing importance of robotic technologies in travel and hospitality, with Japan's Henn-na Hotel being the first to use humanoids as robot receptionists. To assist visitors, handle their baggage, and offer reception services, the Henn-na Hotel uses very effective robots for transportation in the division front office (Lewis, 2016). Bell boy, the robot. One of the service robots, "Sacarino," welcomes guests like a robot bellhop (Zalama et al., 2014). Along with answering taxis, showing patrons to the restaurant or rooms, finding information they've requested online, providing information on things to do in the city and around the hotel (such as restaurant menus and opening hours), and offering video conferencing services, Sacarino also gives information to clients about hotel services. The hotel lobby has a dedicated charging station where it may be used to power itself (Park, 2020; Pinillos et al., 2016; Zalama et al., 2014).

In addition, Yotel New York has put into service YOBOT, the first robotic bag carrier in the world designed like an arm (Yotel New York, 2020). In collaboration with IBM and Robot Concierge Hilton, IBM developed "Connie," a robot whose informative abilities are powered by artificial intelligence with the Watson Foundation. A humanoid robot concierge named Connie gives visitors details about the hotel and surrounding neighborhood (Davis, 2016; Hilton Worldwide, 2016; Park, 2020). With the help of artificial intelligence, Connie can respond to questions from visitors about hotel amenities and suggest local activities. As a result of constant interaction with customers, Connie is always learning new information and becoming more equipped to handle queries in the future (Ivanov et al., 2017: 1506). Italy's first robot concierge, "Robby Pepper," debuted in 2018. Pepper was a Japanese creation from Softbank Robotics that spoke German, English, and Italian. The hotel was located close to Italy's Lake Garda, Barry, Pele, 2018 "Robby Pepper" and "Connie" offer visitors comprehensive advice on where to go, what to do, and when to remain at the hotel depending on the conditions and the dates of their check-out.

"Mario" is the name of another robot concierge at the Ghent Marriott Hotel in Belgium (Chestler, 2016; Reviewer, 2016). Bartender Robot, Tussyadiah, et al. (2020) suggest that a robot bartender might resemble a humanoid or take the shape of a robotic arm. Its two robotic arms are located beneath the bottles in the center of the bar (Berezina et al., 2019: 205). Robotic Butler/Delivery Robot: One example of a robotic butler/delivery robot that brings orders to rooms instead of human workers is seen at Aloft Hotels, a branch of the Starwood hotel firm (Crook, 2014; Markoff, 2014; Park, 2020). Another illustration is "Wally," the Residence Inn Marriott LAX Hotel's delivery robot (Tung & Au, 2018: 2685). Hotel Jen in Tanglin also employs two delivery robots called "Jeno" and "Jena." Wearing uniforms, they are stationed in the lobby area and travel at an average speed of 2.5 km/h, slower than a person's walking pace, to fulfill guest orders (Lin, 2017). According to Ivanov et al. (2017:

1506), these robots can perform various tasks such as taking guest orders, alerting them upon arrival, navigating the hotel premises, and even operating the elevator.

In addition, hotel employees use an order delivery robot to process requests from guests for more towels or toothbrushes. In the hospitality industry, robots and drones increasingly enhance efficiency and customer experience. The "Robie" robot helps with tasks like moving trash and heavy goods, substituting the work of 3.5 full-time employees (Lin, 2017). The robot chef "Ausca" can prepare omelets and eggs at the M Social Singapore Hotel, potentially expanding its cooking capabilities (Crook, 2014; Lin, 2017). Other robots, such as those for making sushi, burgers, noodles, and sausages, are also employed in various food preparation tasks (Filloon, 2016; Sushirobo.com, 2020; Troitino, 2018). Additionally, robotic waiters and buses assist in busy eateries, though there are concerns about job displacement due to the excessive use of robots (Ivanov & Webster, 2020). The Tanuki restaurant in Dubai uses a robot host to enhance guest interactions and promote unique offers (Ivanov & Webster, 2020; Berezina et al., 2019), while robot guides provide information in museums and exhibitions (Yöldz, 2019). Drones are utilized for food and beverage delivery, as seen with Timbre @ The Substation and Domino's Pizza's commercial drone delivery in Auckland (Lui, 2016; Millward, 2015). Drones also support destination marketing and eco-friendly practices by improving energy efficiency (Donaire, Gal & Gulisova, 2020; Hwang & Kim, 2019; Hwang et al., 2019; Stankov et al., 2019).

4.3. Chatbots

Software that allows users or customers to speak with the system in their tongues is known as a Chabot. Abu Shawar and Atwell's study from 2007, on page 29, examines. It is a self-service technological application named "virtual agent" and "chatterbot." It may appear on the company's websites or mobile applications (Melián-González et al., 2019: 1-2). According to the same study's analysis of Trip-Advisor reviews, chatbots are widely used by patrons of lodging facilities, dining establishments, and transportation and entertainment hubs. Marriott International uses a chatbot on Facebook Messenger to facilitate reservations for any of its 4,700 properties (Phaneuf, 2020).

4.4. Facial recognition

Biometric technology relies on analyzing individuals' unique physiological or behavioral characteristics, such as the patterns in their eyes, iris, fingerprints, facial features, palm shape, and voice. These technologies enhance people's quality of life by eliminating repetitive tasks using biometric data. Among these biometric technologies is facial recognition technology. Within the tourist sector, users and customers make use of these technologies. At the UK's Gatwick Airport, travelers utilize facial recognition technology to self-scan their faces for passport checks (Ivanov & Webster, 2019). Similarly, customers at Maryland's Food Grill can

swiftly place orders and complete payments in fewer than 10 seconds thanks to face recognition technology (Marston, 2017). At a KFC restaurant in Beijing, a kiosk employs facial recognition technology to serve meals tailored to customers' gender, age, and mood (Wu, 2017). At Fairmont Singapore and Swissotel the Stamford, facial recognition technology enables Marriott Hotels in China (Revfine, 2020) and Marcus Hanna (Rajagopal, 2019) to check in and leave quickly. In China, visitors to Alibaba's Fly Zoo Hotel may choose and reserve their accommodations using face recognition technology (Wolfe, 2019). Assuming that the travel and hospitality sector will increasingly adopt facial recognition, technology might not be accurate, even though the global market for such technologies was valued at USD 4.05 billion in 2017 and is forecasted to reach USD 7.76 billion by 2022 (Hristova, 2019).

4.5. Language translators

A tourist's biggest issue while traveling overseas is the language barrier. A language translator is one of the most essential technological software for facilitating local-language communication and participation in tourism activities in a given place. These days, several apps may assist with language barriers; one of the most well-known is "Google Translate." When visiting a nation where they are not fluent in the language, tourists can use Google Translate to converse with locals in their tongue. Using Google Translate, tourists can translate sentences from their native tongue into the local language. Alternatively, people may translate phrases spoken by others into their language using the application, making conversation easier to understand. Apart from Google Translate, travelers can utilize other applications such as Say Hi (an Amazon company), Microsoft Translate (Microsoft, 2020), and i-Translate Translator (an Apple application) (i-Translate, 2020) to assist them in comprehending menus at restaurants and hotels.

4.6. Optimization services

According to Samala et al. (2020), service companies can leverage artificial intelligence to improve their offerings by employing the Maximum Likelihood Estimation approach. The travel and hospitality industries commonly employ optimization services, focusing on enhancing service for tourist demand forecasts and tariff and rate forecasting. Companies that implement a dynamic pricing strategy use this method to estimate and modify prices in response to spikes or dips in demand.

4.7. Fare and rate forecasting

Artificial intelligence technologies are optimization instruments in the tourism and hospitality sectors, particularly in fare and rate forecasting. Machine learning algorithms and AI applications now enable the evaluation of room occupancy rates. Various methods for predicting room occupancy rates are utilized, including the PRISMA model (Chow et al., 1998), the neural network approach (Law,

1998), big data analysis (Pan & Yang, 2017), and Bayesian compression approaches (Assaf & Tsionas, 2019). For hotel room rates, AI technologies offer advantages as well. In response to budget-conscious travelers, websites assist in determining the best time to purchase, ensuring tourists obtain the most value for their money (Martin, 2018; Schwahn, 2017). "Now is the right time to buy airline tickets for the best deals." According to Huang et al. (2019), corporate websites such as Hopper and Kayak help travelers foresee unpredictable prices in the travel and hospitality industry.

4.8. Tourism demand forecasting

Predictions of tourism demand frequently depend on models of artificial neural networks known as multi-layer perceptron networks and deep learning (Claveria et al., 2015; Kon & Turner, 2005; Law, 2000; Law & Au, 1999). Moreover, support vector machines (Chen & Wang, 2007; Chen et al., 2015; Hong et al., 2011), a composite search index (Li et al., 2017), fuzzy time series (Tsauro & Kuo, 2011; Wang, 2004), and support vector machines (Tsauro & Kuo, 2011; Wang, 2004) are additional techniques utilized to forecast tourism demand and Gaussian processes (Tsauro & Benoit, 2020). These techniques make it possible to regularly predict the demand for a given area, location, or company. Companies then use dynamic pricing to adjust their rates to these projections. To boost demand, destinations may do more advertising and marketing at times when it is anticipated that demand will be low.

4.9. Search engine

According to Fesenmaier et al. (2011), search engines are becoming a more crucial component of destination marketing organizations' marketing strategies for trip planning in the tourism and travel sector (p. 587). Travelers utilize search engines to organize their itinerary, which includes lodging, local attractions, excursions, dining options, and activities. They also use the search engine suggestions to choose which locations to visit. Travelers utilize them as optimization services while booking hotels or buying airline tickets. Samala et al., (2020). Search engines such as "Avvio" and "U-trip" use machine learning algorithms to assist destination marketing organizations, hotels, conference and visitor bureaus, and airlines deliver customized travel suggestions to their clientele. According to various factors, including their interests, preferences, regions, and budgets, U-trip offers its clients instantaneous travel options based on their requests. Clients may then purchase based on these recommendations (Abadicio, 2019).

4.10. Consultancy services

Businesses that provide advisory services to the travel and hospitality industries might also benefit from deploying AI applications. Similar to search engines, these firms offer suggestions. They collaborate closely with travel or lodging companies, which is the sole distinction. For instance, the Ukrainian B2BN company Altex Soft works closely with the

hotel and tourism industries to develop specialized software and solutions. The teams' proficiency with data and machine learning makes this feasible. Through automation, machine learning, and natural language processing, Altex Soft also provides consulting services to tourism-related businesses on booking and reservations, travel management, and airline management (Abadicio, 2019).

5. Other AI applications used in travel and hospitality industry

This section highlights common examples of self-service visitor technologies in the travel and hospitality industries and references other AI applications.

5.1. Automated machines for check-in and check-out

In the hotel sector, a relatively recent technology that saves customers from having to go to reception is the self-check-in and check-out information kiosk (Kim & Qu, 2014: 227). Yotel New York allows visitors to check in swiftly and conveniently without waiting at the reception desk by utilizing self-service kiosks that mirror those seen at airports, Yotel New York, (2020). Airports also make use of these kiosks. Travelers may check-in, print their boarding cards, and check in their luggage at airport self-service kiosks without needing assistance from a human (Future Travel Experience, 2013; Nicas & Michaels, 2012).

5.2. Virtual assistant with artificial intelligence

The Wynn Las Vegas 2016 intends to install Amazon's Echo system in every room, enabling voice commands for visitors to operate various devices. Virtual assistants can also handle reservations for travel, lodging, and activities at the destination (Ivanov et al., 2017). "Assista," a digital assistant provided by Divan Istanbul, enables visitors to manage lighting and temperature and obtain local information. Through the automated tourist information system supplied by SARA in Singapore, visitors may explore the city without needing help from a human (Niculescu et al., 2014).

5.3. The future of tourism and hospitality: Impacts of AI and robotic technologies

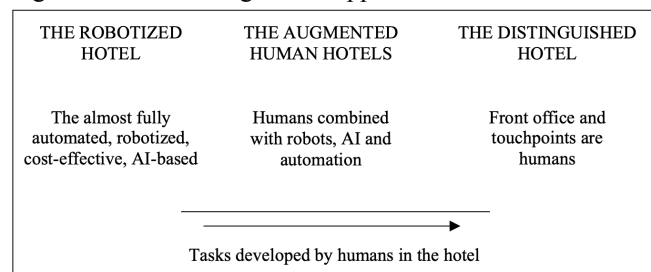
It is anticipated that in the upcoming decades, robotics and artificial intelligence will have a significant influence on the travel and hospitality sectors. Reception areas, food and beverage divisions, laundry facilities, cleaning services, and other areas will use these technologies more frequently. Virtual assistants will allow guests to operate the temperature control, television, air conditioning, lighting, curtains, and innovative room equipment (Yang et al., 2020). Artificially intelligent visual and audio systems will identify visitors' moods and produce scenes on the walls to help them feel more alert. Robotics and AI technologies are set to revolutionize the travel and hospitality sectors, transforming how businesses operate. These technologies include robot receptionists, bellboys, concierges, and self-service check-in

kiosks. They will also be used in food delivery services, meeting and event management, and golf tourism. Travel firms will use AI applications for robot guides, chatbots, and demand forecasts. In the cruise industry, robots will enhance the guest experience by cleaning decks and rooms. AI technologies will also benefit hot air ballooning and virtual guides for museums. However, ethical and risky issues such as staff acceptance, cultural differences, and potential cyber-attacks must be addressed.

5.4. Hospitality and AI's effects

Since the hospitality industry is one of the main drivers of tourism, we decided to look into the technologies and applications previously mentioned about hotels to perform a more in-depth examination of the impact of AI on the industry. The hotel industry embraces AI applications for operations and marketing, enabling robots for room cleaning, employee selection, facility maintenance prevention, resource allocation based on guest value, and guest-centric conversations (Demir & Demir, 2023). AI also improves inventory control, energy use, and financial management. It also enhances personalized services, forecasting, and CRM systems. However, the vast data sets available to hotels are small, and most data is limited to guest activity and website interactions. By the time AI is fully developed, most human activities will be automated, but humans will still play a limited role in the hospitality sector. An adequate hotel fully utilizing automation, robotics, AI, and technology is at one extreme of the spectrum. It operates with a restricted number of persons. Because they can cut the primary costs associated with the hospitality business, these cost-effective hotels will appeal to budget-conscious travelers (Bowen & Morosan 2018; Gursoy 2018). The distinct hotel is at the other end of the spectrum; human beings will be employed to differentiate themselves at many touchpoints. But even at these upscale hotels, visitors will always have the choice to use AI-based self-service technology. There will be a variety of hotel kinds in between that have various configurations of people and technology.

Figure 2. AI technologies and applications in tourism



Source: Bulchand-Gidumal, (2022).

6. Conclusions

The travel and hospitality sectors may only sometimes embrace robotics and artificial intelligence applications. Yet, these technologies have progressively been kept in our daily lives due to technological advancements. Currently, the

issue is, “With the aid of artificial intelligence, will robots be able to offer the services at least as well as humans?” The answer to this issue should be considered in light of the upcoming advancements in robotics and artificial intelligence applications covered in-depth in the study. In actuality, the facts are well known that the robotic technologies and AI applications described above are mostly anticipated, created, and implemented as a result of numerous scientific inquiries. In addition to encountering challenges in recruiting proficient personnel, stakeholders in the tourism and hospitality sectors also need to overcome the obstacle of adopting these technological advancements. Unmanned technologies are rapidly gaining popularity in travel and hospitality, aiming to replace human workers. However, the primary purpose of these technologies is to improve service quality by providing qualified staff. The human touch is crucial for meeting customer expectations and wants, and artificial intelligence cannot elicit these concepts like a human. Despite technological advancements, “service” and “hospitality” cannot exist without humans. Robots and AI programs may be essential components supporting tourist employees, potentially filling new roles. Despite the prevailing cautiousness, the general public exhibits conservatism concerning implementing robotics and artificial intelligence technologies. These technological advancements benefit management, businesses, operators, suppliers, employees, customers, and other stakeholders. Applications can provide accurate tourist policy and planning forecasts, aiding tourism revenue tax management. Service robots can reduce labor turnover and improve service quality, ensuring customer satisfaction and loyalty. They can also boost output and operational costs, enhancing marketing management and competitiveness. The need for a more customized experience among consumers, however, is what is driving the need for robots to provide service, particularly in the hospitality and food and beverage sectors.

Governments must develop infrastructure and legislative rules for these technologies, while further research is needed to maximize human-robot interaction and integrate them into higher education programs. New technologies that meet the needs and desires of customers can be developed by working with engineering departments and encouraging students to learn about robotics and AI applications (Dalgıç et al., 2024). For example, these technologies can be found in food and beverage management or hospitality applications such as automation tools, conveyor belts, or drones and in the service territory’s roles of cooks, serving staff, hosts/hostesses, and bussers. It is only via collaborative working groups between academic circles and industry practitioners that many innovations that have not been considered until now may be made possible. Similar trends may affect transportation businesses, museums, airports, and travel agencies, all crucial players in the tourist and hospitality sectors.

Last but not least, the issue of how well guests and staff accept new technologies should also be viewed as a severe threat. Potential roadblocks include not tech-savvy guests,

staff reluctance to use these technologies, and unwillingness to accept new technologies. The most significant barrier is that these internet-based technologies give rise to ethical concerns such as privacy and confidentiality due to their potential to compromise cybersecurity. These impediments to adopting robots and AI applications are now notable in tourism and hospitality. In the future, internal and external industry stakeholders will adhere to and use these technological advancements due to the absence of uncertainties.

6.1. Practical implications

The studies provide various proper marketing and hospitality takeaways. First, it draws attention to significant problems with the deployment and application of AI in hotel companies. Managers in the tourism and hospitality industries will need to prepare for changes in big marketing tactics in the upcoming years. The emergence of AI-driven services and the possibility for technology to supplant human roles are essential factors to consider. Through highly personalized experiences, AI offers chances to boost customer lifetime value (CLV), which can result in higher conversion rates (Loring, 2018). As Paschen et al. (2020) suggested, producing complicated, high-quality datasets will be essential to preserving a competitive advantage. Businesses will stand out and get a competitive edge if they can create and apply cutting-edge algorithms to leverage these datasets (Grossberg, 2016). The ability to make these databases is now limited to big digital companies like Google, Facebook, Amazon, and Booking.com. Given the circumstances, it is suggested that managers in the hospitality industry look into creative collaborations or alliances to create intelligent ecosystems. As Sivarajah et al. (2017) point out, small businesses may need help to compete effectively due to the high expenses connected with big data. One of the most anticipated innovations in the tourism sector is the disruption of AI-enhanced personal assistants or 24/7 digital butlers/concierges (Loureiro et al., 2020; Pereira et al., 2022). The tourism experience will likely be enhanced, and these AI systems will improve human performance.

Nonetheless, the research also highlights some drawbacks, such as adverse impacts on hotel staff members' job satisfaction, engagement, and intentions to leave the company (Koo et al., 2021; Kozinets & Gretzel, 2021). According to the literature, practical employee training is essential throughout this shift (Li et al., 2019). Employees should be able to use AI more productively and minimize any negative consequences with this training. However, the study also shows that the intricacy of these systems may make them more challenging for marketers to understand when AI is incorporated more deeply into hotel marketing departments (Kozinets & Gretzel, 2021). Managers must adopt novel training strategies that provide a deeper understanding of the underlying technology of AI in addition to covering its operational elements. One strategic way to help AI implementation and improve overall functionality could be to integrate technical experts strategically into marketing organizations.

6.2. Limitations and future research directions

Like every research project, this study has several limitations that point to areas that need to be looked at further. A significant constraint is the possible absence of industry-specific knowledge among the AI experts contacted. It would be advantageous for future studies to involve AI specialists with an in-depth understanding of the travel and lodging industries. These experts could offer more pertinent and valuable insights into how AI interacts with marketing strategies in these sectors, resulting in a more thorough comprehension of the topic (Smith & Jones, 2022). Furthermore, the particular market situation in which the research was carried out impacts the study's conclusions. Future studies should consider creating focus groups in various markets with different degrees of AI adoption to solve this. This methodology could reveal cultural and industry-specific subtleties that would not be seen within the confines of a single market. A more comprehensive understanding of how AI affects marketing strategies in various cultural and economic contexts will be possible by investigating these many situations (Lee et al., 2024).

Moreover, the study's depth may be improved by utilizing the Delphi approach, which entails repeated rounds of expert consultations. Researchers could get a more nuanced consensus on AI's function in marketing by involving marketing experts in this way, which could disclose insights that were missed in the early phases of the study (Williams, 2021). This iterative process may result in more reliable results and a better comprehension of AI's significance for marketing strategy.

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Author contributions

The author declares that they equally contributed to the design and implementation of the research, the analysis of the results, and the writing of the article.

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