ARTIFICIAL INTELLIGENCE APPLICATIONS IN TOURISM

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Abstract: *Artificial intelligence (AI) technologies have transformed the travel and tourism industry. The purpose of this study is to systematically analyze the applications of artificial intelligence in tourism and provide an overview of current development trends, challenges, and future directions. We reviewed 290 articles after thoroughly evaluating the literature using relevant keywords. The results show that many sectors within the tourism industry, such as customer service, marketing, and operations management, are utilizing artificial intelligence. Robots, chatbots, and AI-driven systems are becoming useful tools, providing personalized experiences, rapid services, and better decision-making. AI presents significant potential benefits, especially in regions such as Europe, China, and India that are at the forefront of AI adoption. The tourism and travel industry in Vietnam is also gradually incorporating these technological advancements. However, its adoption requires careful consideration of issues such as data privacy, job displacement, and the digital divide between regions. The use of AI technology in the tourism sector can lead to development and competitive opportunities, but we must address its ethical, legal, and social impacts. One of the recommendations of the study is for stakeholders in tourism to invest in AI research and development, ensure collaboration between industry, academia, and government, and promote AI-related skills in the workforce in this field.*

Keywords: *Artificial Intelligence (AI), tourism, chatbots, robots, personalization, efficiency, decision-making, regional trends*

1. INTRODUCTION

The tourism and hospitality industry has undergone significant transformation due to the rapid progress of information and communication technology (ICT). One of the most impact innovations is the use of sophisticated data analysis tools, which enable businesses to make informed predictions and offer customized solutions. These tools are creating new opportunities and challenges for companies striving to meet the diverse needs of contemporary travelers. As the concept of smart tourism gains importance worldwide, systems leveraging advanced technology have shown outstanding adaptability in improving decision-making and personalizing customer experiences in a sector that demands sophisticated approaches.

This review examines the applications and current trends of advanced technology in tourism. It explores the evolution of e-tourism and the influence of ICT on tourist behavior, outlines the development and role of sophisticated data analysis in tourism, and discusses modern implementations such as automated customer service, service robots, enhanced hotel experiences, data insights, identity recognition, social media insights, flexible pricing, and revenue strategies. Additionally, it looks at the future growth of these technologies in tourism, their potential impact on revenue, and their role in promoting sustainable and responsible tourism practices. The goal is to offer a comprehensive overview that helps readers grasp the advantages, challenges,

and possibilities these technologies present for the future of the tourism industry.

To provide a comprehensive foundation for our exploration of AI applications in tourism, we begin by examining the growth and recovery of global tourism alongside the pivotal role of ICT and e-tourism, followed by outlining the methodology of our literature review that underpins this study.

1.1 Growth and Recovery of Global Tourism

The United Nations World Tourism Organization forecasts an average annual growth rate of 3.3% for global international visitors from 2010 to 2030 (UN Tourism, 2017). The COVID-19 pandemic heavily affected the tourism industry, but it quickly recovered. Global tourism concluded 2023 at 88% of the levels seen before the pandemic (UN Tourism, 2024). Today, we often use AI for online customer service, but there's a growing trend of using this technology for in-person interactions as well. This has the potential to cut wait times at information or welcome desks while enhancing overall efficiency.

In the Asia-Pacific region, the average growth rate is 4.9%, which will increase from 204 million in 2010 to 535 million in 2030. Estimates indicate an increase from 21.7% (2010) to 29.6% (2030). In recent years, countries around the world have prioritized tourism as a key economic sector that helps develop the country›s overall economy. "Sustainable Tourism" is currently a top priority for all countries looking to develop tourism. The 2018 Asia-Pacific Economic Cooperation (APEC) Conference in Papua New Guinea emphasized the concept of «smart tourism.» One of the key points is the utilization of digital technology to foster inclusive tourism and foster human connections in the Asia-Pacific region, thereby promoting sustainable tourism. In this regard, each country develops and actively promotes its own specific strategies (Tsaih & Hsu, 2018).

Information and communications technology (ICT) has long shown importance in the tourism industry (Gretzel et al., 2000; Ortega & Rodriguez, 2007; Buhalis & Law, 2008; Shanker, 2008; Gretzel, 2011). The application of ICT is becoming increasingly widespread (Law et al., 2014). The application of ICT in tourism, also known as the e-tourism concept, has initiated a new era in the contemporary tourism and hospitality industry with far-reaching changes (Buhalis & Law, 2008; Xiang et al., 2015). The application of ICT in tourism, also known as the e-tourism concept, has initiated a new era in the contemporary tourism and hospitality industry, presenting a series of completely new opportunities and challenges for tourist organizations and businesses. ICTs enable travelers to quickly search, choose, and order tourist-related goods, and they help the globalization of tourism by providing solutions for developing, managing, and distributing tourism services globally (Buhalis & O'Connor, 2005).Businesses and tourist organizations can use ICT to restructure internal procedures, build transactions with reliable partners through extranets, and facilitate interactions among all stakeholders through online platforms (Buhalis, 2003).ICT also facilitates the integration of relationship building and supply chain management into a single platform, thereby facilitating a wide range of tasks. Easy-to-use technology permits dynamic processes such as product selection, ordering, fulfillment, tracking, billing, and reporting (Bethapudi, 2013).

Moreover, Information and Communication Technology (ICT) expedites

the assessment of tourist behavior through smart systems and enables the processing of vast amounts of data from both tourists and related actors. related to tourism. It also profoundly influences tourist behavior (Xiang et al., 2015) by altering tourists' consumption habits and encouraging them to share their experiences (Gretzel et al., 2006). As a result, tourists and service providers have the opportunity to access more accurate relevant information, with increased mobility and better decision-making leading to a favorable travel experience (Gretzel, 2011).

As shown in Figure 1, according to Statistic (2024), global tourism revenues from 2015 to 2023 display an upward trend with little fluctuation. In 2019, the record-breaking revenue reached $1,459.7 billion, but in 2023, it surpassed it with $1,482.5 billion. In 2020, this figure dropped sharply to $549.2 billion, likely due to the COVID-19 pandemic. It did not fully recover to pre-pandemic levels but reached $626.9 billion in 2021, marking a partial recovery. This date provides insights into the long-term trends and short-term disruptions of the global tourism industry over the past decade.

This article explores tourism AI applications and trends, both current and

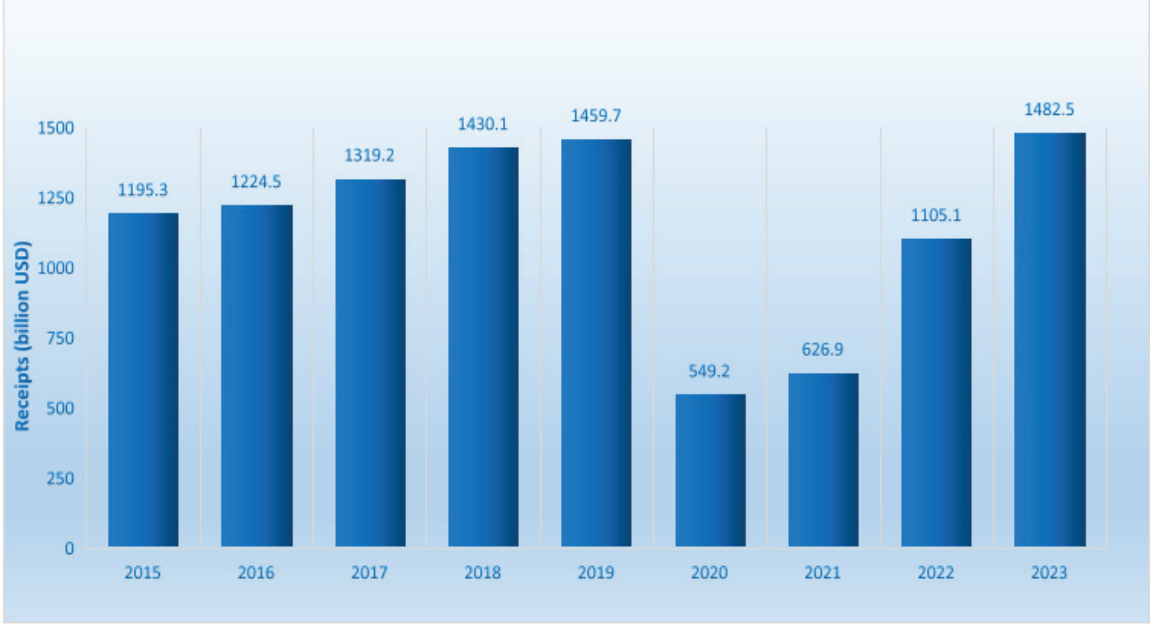

Figure 1. Global revenues from tourists in the years 2015–2023 (Statistic, 2024)

future. We study the interplay between AI and tourism to impart insights about how a technological breakthrough in a passion-driven sector is reconstituting the dynamics of tourism, shaping a smart, sustainable tourism system.

1.2 Methodology of the Literature Review

The process of conducting a literature review involves synthesizing resources relevant to a specific area of interest, including the necessary keywords. However, the presence of numerous experts in the same domain can lead to a proliferation of websites related to that sector, making the task of providing solutions quite burdensome. We have utilized authentic and reliable sources, including scientific databases like Scopus and Web of Science, national statistical organizations, and industry reports. In order to observe the uptake, the authors identified prominent keywords such as "Artificial

Intelligence in Tourism," "E-tourism Applications," "Smart Tourism," and "AI Trends in Travel." The authors consider the publication dates, language, and relevance to AI and tourism as criteria. We applied high standards to the selection of documents for this research to ensure the best possible data.

The documents required a direct connection to AI in tourism, as well as a thorough analysis or extensive reviews. When it comes to where to place the new data to ensure uniqueness, a check was made to ensure that the data already was not presented; otherwise, it will be excluded. The authors focused on the quality of the data, making sure it came from peer-reviewed scientific articles and other reputable sources, which gave them credibility. The process began with a systematic search that yielded 480 documents. Next, we eliminated 190 documents due to their duplication, lack of relevance, or insufficient rigor. We also reviewed a total of 290 studies in the final analysis for key information relevant to the study objectives. This iterative process guaranteed that the chosen documents were pertinent and of top-notch quality, providing the groundwork for the perspective review.

2. ARTIFICIAL INTELLIGENCE AND ITS ROLE IN TOURISM

2.1 Artificial intelligence

Alan Turing first introduced the concept of "artificial intelligence" (abbreviated as AI) in 1936 (Copeland, 2015), and John McCarthy defined it as "science and engineering to create intelligent machines" in 1955 (Wooldridge, 2021). It refers to the wisdom demonstrated by human-created machines. Common computer programs often implement human intelligence technology in relation to the concept of AI.

Although the notion of AI has been existing for a long time, computers and other gadgets have just lately become smart and dependable enough to do complicated tasks without intervention (Phương Trang, 2024). AI closely aligns with the concept of automation, which involves carrying out processes with minimal or no human intervention. Therefore, AI is progressively becoming a part of people's daily lives (Ferreira et al., 2015; Riccio et al., 2016). Intelligent systems stand out from their conventional counterparts due to their ability to comprehend situations, acquire and retain knowledge, and draw conclusions from past experiences, enabling them to react quickly and succeed in new situations (Rudas & Fodor, 2008). In general, intelligent systems have two basic features: being able to sense their surroundings and learn from what they are doing to optimize success in achieving specific goals (Bethapudi, 2013).

AI is known for its complex computing capabilities, as it can handle complex relationships and problems between different concepts (Pannu, 2015) and can easily work with a large number of big data sets (Inanc-Demir & Kozak, 2019). In general, an AI system senses external information, interprets it, acts to achieve specific goals, and learns from its own experiences (Ferràs, 2020). AI works similarly to the human brain, as it thinks, learns, makes decisions, and reasons through the given data using intelligent machines. The main purpose of AI is to enable machines to complete tasks automatically without the need for a human brain (Singh, 2020).

2.2 Artificial intelligence's significant roles in the tourism industry

Gretzel et al. (2006) introduced the concept of AI in the mid-1930s, but it wasn't until the late 1990s that tourism researchers applied AI research to forecast hotel occupancy and tourism demand (Law, 1998; 2000). Researchers in the tourism

discipline began to grow their interest in AI applications in 1991, but at first, only a few articles emerged with a slow growth rate (Kong et al., 2023). It was not until the beginning of the 21st century that there was evidence of the successful use of AI in the tourism industry (Burger, 2001). Scholars began to pay more attention to AI applications in 2015, as evidenced by the increasing number of publications and citations annually; however, the publication of no more than 10 papers per year persisted. There has been a significant acceleration since 2019, transforming the research topic into an excellent archive for academic purposes with 175 publications and 5,003 citations in 2020. That trend indicates a substantial improvement, corresponding with the widespread adoption of Software Requirement Specification (SRS) in the service sectors during the COVID-19 breakout worldwide. Therefore, AI is considered a new aspect in the tourism and hospitality fields, but its attraction is anticipated (Kong et al., 2023).

AI was used to answer a variety of research questions, including managing resources in travel agencies (Casteleiro-Roca et al., 2018), looking at social media data and online reviews (Kirilenko et al., 2018; Topal & Uçar, 2018), guessing reports of tourist numbers and traffic (Zhang, 2020), checking how happy tourists were by reading their facial expressions (González-Rodríguez, 2020), and coming up with smart suggestions (Zheng, 2020). Tourism research is increasingly utilizing AI models due to their increased flexibility and ability to estimate non-linear relationships without the constraints of traditional methods (Hadavandi, 2011).

Considering the complexity of the decision-making process in the tourism sector, AI and tourism are a perfect fit. By collecting and processing information about users' personal needs, they can facilitate the decision-making process and greatly influence travelers' information searches. Therefore, AI technology is considered the next stage of the tourism industry (Bowen & Whalen, 2017; Gajdošík & Marciš, 2019; Kazak et al., 2020). Given the current situation, businesses will collect and store a large amount of data. This could help enable AI, with computers using data to perform tasks ranging from data analysis and problem solving to voice translation, direct messaging, and personal enhancement throughout the customer journey.

AI's ability to perform tasks that would normally require human cognitive functions has made it especially useful for those working in the tourism industry because implementing it can save time and money. AI not only saves money for the business but also eliminates human error, enabling quick task completion at any time of the day.

3. CURRENT TOURISM TRENDS IN THE USE OF AI

3.1. Global Trends in AI Applications in Tourism

Geisler (2018) categorizes AI systems into two types: i) pure digital and ii) integrating digital with physical elements, commonly known as robotics. Various sectors of the tourism and hospitality industries utilize both systems. The last few years have seen much wider adoption of AI in the travel industry. These are the key strategies for implementing AI technology.

The figure highlights ten leading travel companies that are leveraging AI to transform the travel experience, as identified by Makhija (2024). These companies—KAYAK, Expedia Group,

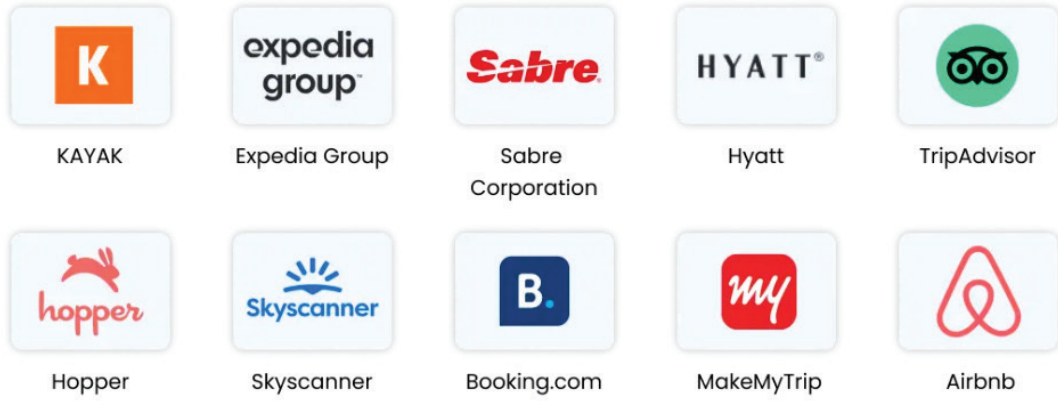

Figure 2. The Most Advanced Travel Companies Leveraging AI (Makhija, 2024)

Sabre Corporation, Hyatt, TripAdvisor, Hopper, Skyscanner, Booking.com, MakeMyTrip, and Airbnb—are utilizing AI to enhance customer service, provide personalized recommendations, optimize search and booking processes, and offer predictive analytics for better pricing and travel decisions (Figure 2).

3.1.1 Chat-bots and online customer support

The words "chat" and "robot" coined the term "chatbot." Chatbots are basically computer programs that can interact and converse with humans using natural language (Law, 2000). In 1966 (Weizenbaum, 1976), developers developed the first chatbot, ELIZA, with the intention of deceiving users into believing they were conversing with a real human (Salecha, 2017). Chatbots have evolved dramatically since then, and their main areas of use are retail, customer service, decision support, modern payment systems, and online community building (Zsarnoczky, 2017).

The travel and tourism industry uses AI extensively in flight forecasting. Users of AI software can benefit from access to accurate and reliable forecasts. Recently, the Dutch national airline KLM Royal Dutch Airlines offered a chatbot, called BB, that can help travelers pack for their trips (KLM Royal Dutch Airlines, 2017). It only needs basic details, including the destination, date, and time of a trip, and will recommend to users whatever they desire to prepare to take with them.

Sam, an AI-powered travel chatbot (Meet SAM, n.d.), serves as another significant example. Similar to many other virtual travel assistants, Sam caters to individual users, but its key features are particularly beneficial for frequent enterprise travelers. First, Sam can assist users in booking flights, after which it will seamlessly combine all excursions into a single route. Sam will alert users to any changes, such as a severe weather forecast, so they can appropriately prepare their belongings. Integration with other apps like Avis and Google Maps enables all these features. Given the complexity of this travel assistant, both iOS and Android users must download this app (Figure 3).

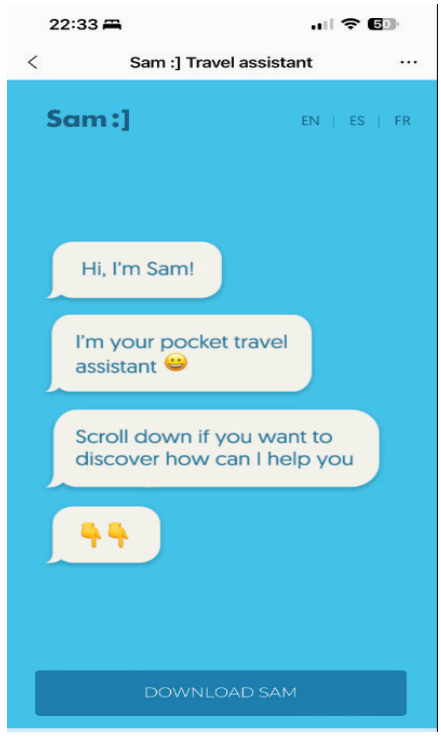

Figure 3. Virtual Travel Assistant - SAM Initial Mobile Screen

Based on considering Chat-bots and online customer support in the tourism industry, Considering chatbots and online customer support in the tourism industry, Figure 4 presents a comprehensive overview of AI applications in tourism operations in 2024. The chart illustrates the degree of integration of various AI services across various categories, showcasing the progress made in improving customer experience and overall effectiveness through the use of AI technologies in the tourism and hospitality areas, according to the synthesized 2024 data from multiple sources, including Adamo Software, Filak, Kolesnikov, Khambholja, and Makhija. Based on considering chatbots and online customer support in the tourism industry, Figure 4 provides a comprehensive overview of AI applications in tourism operations in 2024. Based on the synthesized 2024 data from multiple sources, including Adamo Software, Filak, Kolesnikov, Khambholja, and Makhija, the chart illustrates the degree of integration of various AI services across various categories, showcasing the progress in improving customer experience and overall effectiveness through the use of AI technologies in the tourism and hospitality areas.

The chart illustrates the level of chatbots and online adoption across various tourism activities, with accommodation planning leading the way at 75% of travelers who use AI for this purpose and conversational trip planning at 61%. Hotels' chatbot implementation presents a moderate application (53%), while 39% of travelers get recommendations for destinations from AI. 32% of users employ AI virtual assistants, and 36% use AI-powered devices to search for local places to eat, which is a lower but still noteworthy rate. Mobile trip planning with AI chatbots shows the lowest adoption at 22%, suggesting this area has the most room for growth. This distribution indicates that AI technology is most established in core travel planning functions but still

has significant potential for expansion in more specialized applications, particularly in mobile platforms and local experience recommendations.

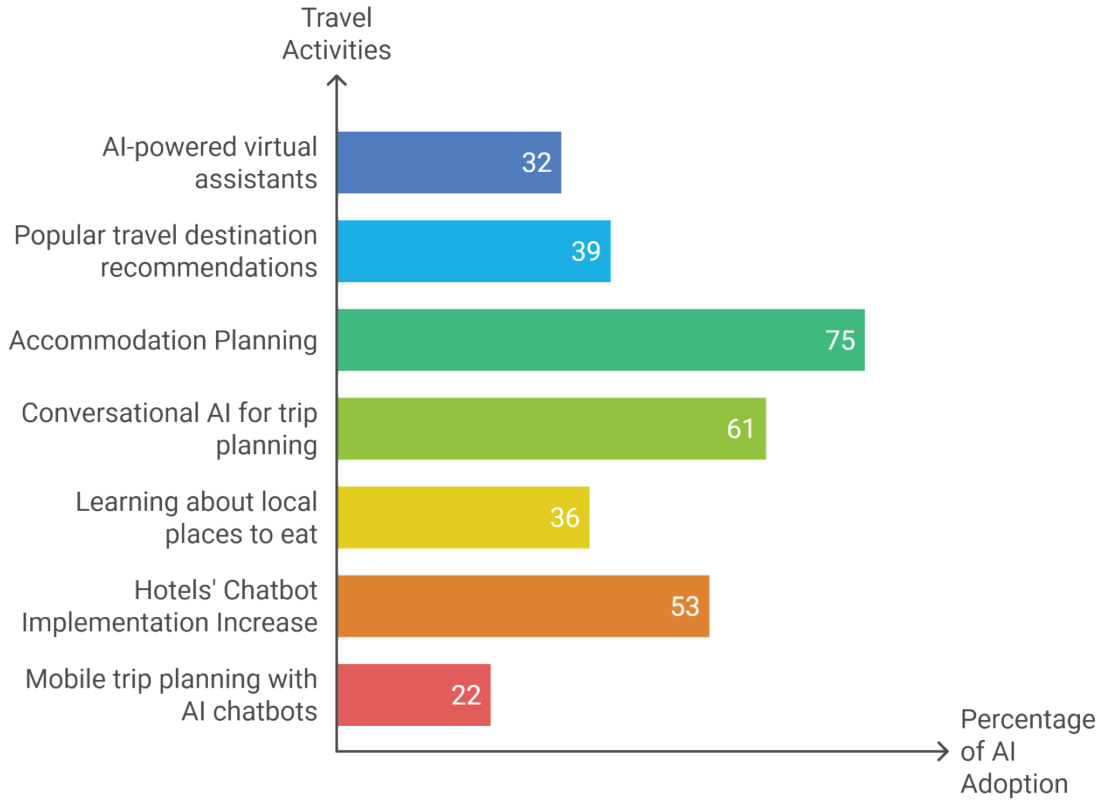

Figure 4. Chatbots and Online Customer Support Adoption in Travel Activities (percentage of use by category)

Note: Synthesized from Adamo Software, 2024; Filak, 2024; Kolesnikov, 2024; Khambholja, 2024; and Makhija, 2024.

3.1.2 Use robots for direct customer service

Today, AI commonly supports online customer service, but a growing trend is applying this technology to face-to-face customer service encounters. Robots are intelligent physical devices (Chen & Hu, 2013) with a certain level of self-determination, flexibility, and sensing abilities that allow them to accomplish prescribed tasks without human assistance (Tan et al., 2016). For at least the past 50 years, the tourism and hospitality sectors have employed the least sophisticated industrial robots in various manufacturing processes, including food preparation. People developed professional service robots and personal service robots about twenty years earlier (Murphy, 2017). They are constantly improving as robot autonomy and social interaction expand. Numerous airports, conveyor belt eateries, and other locations feature housekeeping robots, self-check-in kiosks, and automatic control gates (Tan et al., 2016).

Every day, the number of professional service robots in use, as well as their complexity in the travel industry, increases. For example, there is now a robotic suitcase available, making traveling much easier. Travelmate Robotics (n.d.) states

that the robotic suitcase can follow its owner and avoid all obstacles, eliminating the need for the user to carry it. Travel agents and airport security also use robots (Knightscope, 2023). In 2014, a restaurant in China introduced a serving robot (British Broadcasting Corporation, 2014). Pan et al. (2015) tested robotic hotel information agents in 2015, and Martin (2016) built and programmed a robot server to deliver extra towels, toothpaste, and other necessities to customers' guest rooms.

The hospitality industry is embracing AI in voice-based digital provisioning and support, enabling in-room voice assistants, voice recognition technology, and 24/7 access to travel information. This trend could eliminate the need for staffed customer service desks, as seen in the Henn-na Hotel in Japan (Joshi, 2017). At the reception desk, robots that speak multiple languages welcome and assist customers. Robotic arms handle the storage of guests' luggage, while facial recognition systems equip the rooms.

Figure 5. Dinosaur-shaped robot receptionists checking in clients at Henn-na Hotel in Maihama, Tokyo Bay (Kiss, 2020)

However, this is not the only hotel that employs robots in all of its various positions. Another example is the Hilton Hotel in McLean, Virginia, which employs a robot named Connie as a concierge to assist guests around the hotel and answer common service questions. And perhaps one day robots will be able to translate questions for guests and employees (Higginbotham, 2016). Connie can interact with visitors using voice recognition technology to answer their questions. Additionally, Connie learns from each interaction, enhancing its reactions with increased use.

Table 1 presents a summary of the diverse applications of chatbots, online customer support, and robots in the tourism industry, highlighting their utilization to improve customer service and overall efficiency. The samples provided illustrate real-world implementations of these technologies, demonstrating their effectiveness and potential for further integration into the travel and hospitality sectors.

Table 1. Using chatbots, online customer support, and robots in tourism (Neaw et al., 2022)

Application	Description	AI Models
1. Chatbots and Online Customer Support		
24/7 Customer Support	Chatbots can answer commonly asked queries by clients and deliver information about hotels, attractions, flight bookings, etc., at any time.	Kris the Chatbot at Singapore Airlines (Singapore Business Review, 2018)
Providing personalized travel information	Chatbots can collect information about customers' preferences and offer personalized recommendations on destinations, activities, and hotels.	The Kayak chatbot Search Flights & Hotels | KAYAK (Biesiada, 2023); Virtual Travel Assistant— Sam Sam :] Travel assistant (Voyagesofmine, 2018)
Handling issues during the trip	Chatbots can assist customers in case of flight delays, cancellations, lost baggage, or other issues and help users purchase cheap airline tickets and search for attractive last-minute deals.	Expedia's Virtual Agent: Expedia Travel: Vacation Homes, Hotels, Car Rentals, Flights, & More (McNeely, 2023); CheapOAir's Chatbot (Helen): CheapOair (Fareportal, 2023)
Providing Trip Updates	Chatbots can send notifications to customers about booking status, flight schedules, weather conditions, etc.	The Kayak bot Search Flights & Hotels | KAYAK; Chatbot BB of KLM Royal Dutch Airlines (KLM, 2017);
Booking and Payment Support	Chatbots can help customers book hotels, flights, tours, and redirect them to the website to fill in travel information and make payments.	Virtual Travel Assistant— Sam; Tour Advisory ES for Kolkata, India (Neaw et.al., 2022)
2. Using robots to serve customers directly		
Hotel Guidance and Information	Robots can welcome guests, guide them to their rooms, provide information about hotel amenities, and answer questions.	Robot Connie in Hilton Hotel, McLean, Virginia (Usa, 2016); Robots in Henn-na Hotel (Japan);
Room Service	Robots can deliver food, drinks, towels, and other items to guest rooms.	H2M2 Robot at Hotel Monville in Montreal, Canada (Dupont, 2024); Sem-Fit: An ES;

Luggage Transportation	Robots can help guests carry their luggage to and from their rooms.	Leo, SITA's baggage robot at Geneva Airport, was featured in the International Airport Review in 2017.
Ensuring safety and security	Robots can patrol hotels or tourist areas to ensure safety and security.	Autonomous Security Robot K5v5 used in Westfield Valley Fair shopping mall in San Jose, California and Sacramento (Feitelberg, 2017).

3.1.3 AI Revolutionizing Smart Hotels

AI is actually inducing a variety of head transforming in the hospitality industry primarily all around innovative resortiers. Leading to a seamless and efficient check-in/ checkout process for guests, wherein their experience was facilitated by automated check in/check out processes. There are some hotels such as Marriott and Hilton have incorporated digital key access to a phone check-in, which puts all their guests in by pass of the front desk (Marriott, 2014 and Hilton, 2016). The American Hotel & Lodging Association, for example, employs AI to monitor and anticipate maintenance needs for its Heating, Ventilation, and Air Conditioning (HVAC) systems (Admin, 2023) Furthermore, AI-powered systems provide customized suggestions for dining, entertainment, and other services, thereby improving visitor experiences. As an illustration, consider the Four Seasons app, which leverages AI to provide guests with individualized itineraries and meal suggestions based on their preferences and historical usage patterns, guaranteeing a unique and enjoyable stay (Four Seasons, 2019).

3.1.4 Data processing and data analysis

Understanding that AI applications in the travel and tourism industry extend beyond customer service is crucial. The use of AI in travel and tourism can cater to more than customer service, making data collection & analysis easier for consumer insights, company process betterment, as well as pricing policies. AI has the ability to filter information quickly and accurately, resulting in fewer mistakes compared to humans. For instance, a Dorchester Collection hotel specifically applied AI to instantly sift through online feedback in surveys, reviews, and polls, aiming to provide as close to real-time sentiment analysis as possible (Brant 2019).

3.1.5 AI facial recognition

One of the real-time applications of AI is facial recognition, which uses facial traits to identify individuals. Facial recognition is typically applied in security aspects for the travel and tourism sector, such as identifying potential individuals and calculating a personnel number in a closed space. Facial identification equipment has already been implemented by Marriott hotels in China and Japan Airlines (EyeforTravel, 2019).

3.1.6 Analyzing social media channels

AI in the travel and tourism industry also plays an important role when it comes to social media. Specifically, businesses in the travel industry can use AI to better understand how users interact with their social media channels and what those users are actually saying (Colladon, et al., 2019).

Some social media channels attract a large number of interactions every day, and

it is nearly impossible to check and analyze them manually. AI enables travel companies to identify key trends and understand the most common emotions, thereby improving their understanding of their customer base (Green, 2023).

3.1.7 Dynamic pricing and AI-powered revenue management

Many firms in the travel and tourist industry use flexible pricing strategies depending on current demand and availability. This applies to hotels, airlines, and a variety of other travel-related enterprises. AI in the travel and tourism business may help optimize this approach. AI's capacity to swiftly collect and analyze data greatly simplifies the process of intelligently altering pricing and guaranteeing their appropriateness. Prices typically rise during periods of strong demand compared to those during periods of low demand. However, AI may use more criteria to do intelligent calculations and suggest fair pricing modifications on a regular basis (Varsha, 2024).

Furthermore, revenue management is the process of selling the right product to the right consumer, at the right time, at the best price, and in the most efficient manner. This is a data-driven specialty; thus, AI may assist individuals in the travel and tourist business in optimizing their earnings. AI makes it simpler to arrange all accessible data. This might contain present reservations, the number of rooms or seats available, planned events, and historical demand statistics for the same time of year. AI may then automatically change pricing and distribution tactics to improve financial performance (Tourismanalytics, 2024).

3.1.8 Making a staff management schedule

Barten (2024) claims that AI can help hotels, airlines, and other travel and tourism organizations enhance workforce management and scheduling. In companies with a large workforce, creating a work schedule can be a challenging and time-consuming process due to the numerous factors that need to be taken into account when making decisions. Using all relevant data, including employee hours worked, senior staff required per shift, and total hours worked, AI can automatically generate a work plan that is both realistic and efficient. Each employee receives a written employment contract, a list of authorized vacation days, and the necessary downtime between shifts.

3.1.9 Forecasting prices and demand

On the traveler side, modern customer trends will always focus on finding the best price, but a variety of factors can influence the prices of hotel rooms, airline tickets, and additional products and services in the sector. Customers in the travel and tourism business may benefit from AI-powered software that helps them comprehend pricing variations. For instance, the program could alert customers to the anticipated increase in hotel room costs in a specific location. Simultaneously, software may assist consumers in identifying surges or dips in demand, enabling them to book flights or hotels at the ideal moment (Barten, 2024).

3.1.10 Regional Trends in AI Adaptation in Travel and Hospitality

According to Haenraets (2024), the practice of AI application in tourism and other travel services depends on regions. In Figure 6, hotel policies that prioritize energy management widely use AI to encourage sustainability and environmentally friendly activities, for example in Europe, where adoption rates range from 50-60%. In countries such as China and India, the use of AI is estimated to achieve 60% or 70%, which data management and marketing strategies target to boost its adoption. With the concentration on smart technology to

improve luxury experience, a higher rate of AI application is 70% to 80% predicted in Latin America and Southeast Asia on the purpose of enhancing activities of overcoming cultural and language barriers. To compete on a global scale, African regions serving tourists use AI at a rate ranging from 20% to 30%.

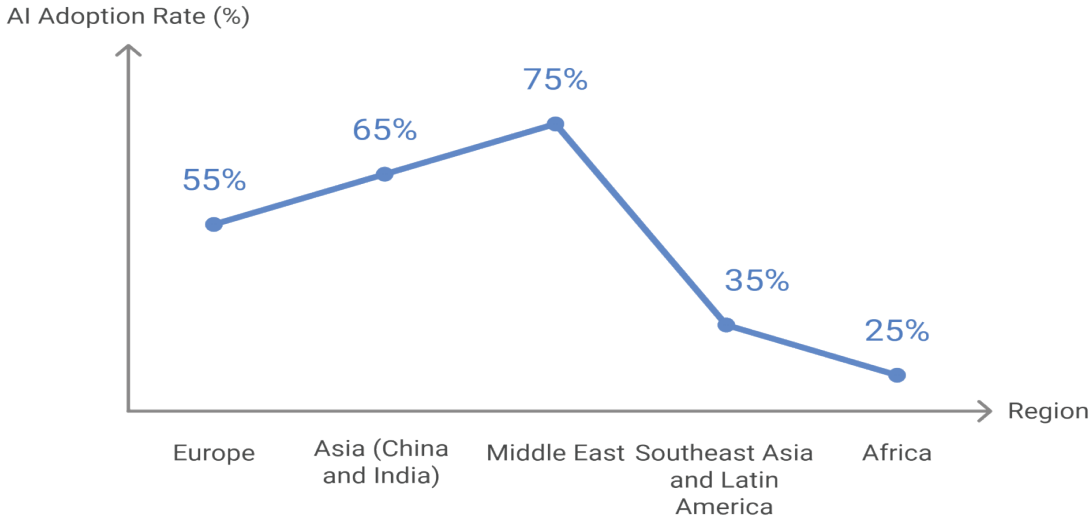

Figure 6. AI Adoption Rates in Hospitality by Region (Haenraets, 2024)

3.2. Trends in AI Applications in Tourism in Vietnam

Artificial Intelligence (AI) in Vietnam Tourism As a rapidly expanding market, Vietnam has recognized the potential of AI to revolutionize travel experiences for both domestic and foreign tourists. The unique socioeconomic and technological environment in Vietnam grants both AI adoption opportunities and challenges, despite being inspired by global trends in AI applications (Vietnam National Administration of Tourism, 2023).

3.2.1 AI-Powered Chatbots and Virtual Assistants

AI-powered chatbots are becoming increasingly popular in Vietnam's tourism and hospitality industry. Leading travel agencies, such as Saigon-tourist and Vietravel, have integrated chatbots into their websites and mobile apps to assist travelers in booking accommodations, planning itineraries, and answering frequently asked questions in multiple languages (VNAT, 2023). For instance, the VNTrip Chatbot caters specifically to Vietnamese travelers by providing personalized recommendations for hotels and flights while addressing real-time queries.

Figure 7 illustrates the interface of My-tour Assistant, a virtual assistant that assists users in scheduling trips, accessing deals, and receiving notifications about travel disruptions. By automating these processes, such tools reduce customer service workloads and enhance user satisfaction (VNTrip, 2023).

Figure 7. Overview of My-tour Assistant mobile app interface

3.2.2 AI-Based personalized travel recommendations

Vietnamese travel platforms like Traveloka Vietnam and Bamboo Airways are using AI to analyze user preferences and behaviors. These platforms employ AI algorithms to suggest destinations, activities, and dining options tailored to individual interests (Traveloka, 2023).

Reliable hotel booking websites such as *booking.muongthanh.com*, *Agoda,* or *Booking.com* often have special offers exclusively for online bookers, giving you the opportunity to experience high-end hotels at attractive prices. With just a computer or smartphone, you can browse through hundreds of different hotel options without having to do too much. The most obvious benefit of booking through the website is that customers can easily compare prices between many different hotels as well as between booking platforms. This helps travelers choose the most suitable hotel at the most affordable price, saving maximum costs for the trip. Reputable hotel booking websites all provide many flexible payment methods, from credit cards and debit cards to e-wallets.

3.2.3 Smart Tourism and Digital Transformation

Vietnam has embraced smart tourism initiatives, particularly in major cities such as Hanoi, Da Nang, and Ho Chi Minh

City. For example, Da Nang's Smart City Initiative integrates AI to manage tourist data, improve traffic systems, and enhance the overall travel experience (VNA, 2024). Interactive AI-powered kiosks at airports and tourist hotspots provide real-time information about attractions, public transportation, and events, making travel more convenient.

In order to meet the growing demand of tourists in the digital age and promote effective connections between tourism management agencies and tourists, Vietnam is currently investing in and developing a smart tourism ecosystem. Promote synchronous smart tourism development in provinces and cities: Hanoi, Da Nang, Ho Chi Minh City, Ha Long City, Hue City, Da Lat City, Ha Giang, Quang Tri, An Giang, and Kien Giang. The Department of Tourism in Ho Chi Minh City has coordinated with relevant units to build the 3D/360 smart interactive tourism map. In parallel, it has taken steps to promote the Tourist Information and Support Station by applying digital technology to attract and make domestic and foreign tourists more interested. The city has also implemented 4.0 technology in its promotional activities, including the construction of a VR tour system to showcase the city's tourist destinations (Lan Trinh, 2024).

3.2.4 AI in Marketing and Social Media Analytics

Vietnamese tourism businesses are utilizing AI to refine their marketing strategies. Tools powered by AI analyze social media trends and customer feedback to identify popular destinations and improve promotional campaigns. For example, the Vietnam National Administration of Tourism (VNAT) uses AI to study global travel trends and target specific markets with personalized advertisements (VNAT, 2023). By understanding trends on platforms like Facebook and Instagram, local businesses can enhance their services and attract more visitors.

3.2.5 AI-Driven Predictive Analytics

Human labor could eventually replace the use of cloud, big data, and AI throughout the aviation industry. We expect Industry 4.0, which encompasses these technologies, to pervade the aerospace industry. By doing this, AI-enabled systems can reduce the number of human resources and overhead costs required by airlines such as Vietnam Airlines and Vietjet to optimize their fleets and operations. Using real-time data, AI can also forecast flight delays, which in turn will help reduce waits and cancellations. It can even optimize flight paths to reduce fuel (Việt Thắng, 2024).

3.2.6 AI enhancing customer experience and operational efficiency

Artificial Intelligence in Tourism: AI for Language Translation— The tourism sectors are being completely overhauled by artificial intelligence (AI) with improved operational efficiency along with better customer experiences. AI can customize a travel itinerary, take stock of consumer demands before they occur, and improve customer service. It can even provide insight into flight delays and booking trends, which can lead to dynamic pricing or targeted marketing. By 2024, a reborn Vietnam will welcome international tourists as its digital infrastructure solidifies and digital literacy grows. The demand for safety certificates at every step, starting from proficient booking to virtual guides, cops as tour guides, and interactive info systems. Artificial intelligence-based chatbots and recommendation systems deliver tailored recommendations and analyze customer feedback for iterations in marketing tactics. Nevertheless, the

industry still has to contend with certain challenges, lack of skilled manpower, for instance. AI addresses these challenges by automating tasks to enhance efficiency and service quality, and enabling personalized learning through process excellence and various methods. Focused investment in AI technology and human capital development is crucial for Vietnam's success in the global tourism market (Ribeiro, 2024).

3.3 AI trends and capability of Vietnam's tourism strengths and limitations compared to global counterpoints

3.3.1 Emerging in Vietnam compared to a diverse global landscape

Vietnam's tourism sector is embracing AI, a trend that is growing in comparison to the global tourism industry. Various aspects of the industry are incorporating AI, such as chatbots, personalized recommendations, and robots for customer service. Vietnam's focus is on specific AI applications, such as chatbots and virtual assistants for booking and itinerary planning. However, the sector is still in its early stages of widespread implementation compared to the global tourism industry's comprehensive and diverse adoption.

3.3.2 Strengths of AI application in Vietnam's tourism sector

Vietnam is applying AI technology in its tourism sector, taking advantage of high market awareness and active embrace by stakeholders like travel agencies. We are implementing AI-enabled chatbots in the customer service and operational processing arena. The Da Nang Smart City program has the potential to facilitate further AI implementation and support governmental initiatives. Vietnam describes the way they will be using AI to target audiences for their strategy in social media analytics, showing higher and increased prediction with future market trends.

3.3.3 Challenges and Opportunities in AI Application in Vietnam's Tourism Sector

Some of the hurdles to overcome with regards to AI in Vietnam's tourism sector are the later adopter stage compared to leading global players, lack of financial and technical resources for smaller businesses, as well as underdeveloped AI infrastructure. In a word, it also stresses digital versus robotics or integrated digital-physical AI solutions. To unleash AI's power in Vietnam's tourism industry, these shortcomings have to be addressed with more investments and development.

Despite its progress, Vietnam faces several challenges in adopting AI in tourism. Many smaller tourism businesses struggle with limited financial resources and technical expertise to implement AI solutions. Additionally, Vietnam's AI infrastructure remains underdeveloped, which constrains scalability. However, the government's commitment to digital transformation through initiatives like the National Digital Transformation Program presents significant opportunities for growth (Samuel, 2021). These efforts aim to improve Vietnam's AI capabilities and make its tourism sector more competitive globally.

4. THE FUTURE OF AI IN TOURISM

Kolesnikov (2024) released a market study in May 2023, projecting that by 2024, tourism companies will allocate 33% of their technology budgets to AI. This is a significant increase from 10% in 2018 and 22% in 2021. The study also forecasts that generative AI in the travel sector will grow at an 18.2% rate, generating an estimated 2.9 billion dollars over the next decade. In 2021, the impact of AI accounted for

21% of the total revenue of global tourism corporations, amounting to more than $1 billion—a sharp increase from just 9% in 2018. Forecasts indicate that AI will impact 32% of revenue by 2024. A global survey predicts a 53% increase in chatbot adoption in the hospitality industry. Another study has shown that 30% of the tourism and hospitality industry is using AI for various purposes, including customer service, marketing, operations, and analytics. Anticipations indicate that AI in the tourism market will generate a global value of approximately $3.58 billion by 2032, a substantial rise from the estimated $632.18 million in 2022.

The integration of AI in the tourism industry offers a revolution that will extend beyond convenience and change for the better the way people travel with sustainability and responsibility. The current data analysis-based ability to make customized recommendations makes it easier for traveling individuals to make ecologically sound decisions, such as selecting environmentally friendly options for accommodation and means of transport, along with carbon footprint reduction. Combining this personalized form of tourism with AI's ability to control tourist flows and reduce resource waste could improve traveler experiences and boost the potential for a greener, more resilient tourism industry. Ultimately, leveraging AI fosters customer satisfaction, which opens up new avenues to sustainable growth and innovation in international tourism.

5. CONCLUSION

5.1 Conclusion

Drawing on a collection of scholarly publications, papers, and internet resources, this research has explored the developing area of artificial intelligence (AI) in the travel sector. Our research shows that the fast development of information and communication technologies, as well as technology, has spurred transformative changes in the hotel and travel industries, creating many new chances for service automation as well as a higher probability of AI implementation applications.

In fact, AI significantly reduces response times and enhances efficiency and consistency in service quality. Although this article mainly describes the positive aspects and implications of using AI in the tourism sector, our review acknowledges the growing concerns over the ethical issues surrounding the deployment of AI, particularly with regards to privacy, security, bias, and transparency of AI algorithms.

Despite some progress in the field, we still need to address some significant research gaps to fully understand and realize the potential of AI in tourism. Firstly, the impact of AI on employment in the tourism industry requires in-depth exploration. Understanding how AI-driven automation will reshape the workforce and devising strategies to mitigate potential job displacement is paramount. Secondly, the barriers to AI application in tourism, particularly in developing countries, require detailed analysis. This includes investigating the technological, financial, infrastructural, and cultural limitations that hinder the adoption of AI solutions in these regions. Furthermore, a deeper understanding of the tourist perspective on AI implementation is essential. This includes surveying tourists' opinions on the use of AI in tourism services to understand comfort levels and preferences. We need to delve deeper into the ethics of AI in the industry and explore the most effective governance practices. Finally, future research should focus on developing strategies to mitigate

the ethical challenges of AI in tourism by focusing on privacy, security, transparency, and the reduction of bias in AI algorithms. To realize the transformative potential of AI in tourism responsibly, inclusively, and ethically, it will be crucial to address these research gaps.

Based on the research and results of the study, the writers believe that the use of artificial intelligence in tourism has enormous growth potential, yet it is not going to arrive without problems. The need for strong data privacy and security policies is one major obstacle. Since artificial intelligence systems primarily rely on large volumes of data, ensuring ethical and safe handling of this material is crucial. Furthermore, relying excessively on technology may lead to a reduction in human connection and a loss of the personal touch that tourists value.

Looking forward, artificial intelligence in travel should concentrate on balancing technological aspects with human factors. This might include creating artificial intelligence technologies that enhance rather than replace human services totally. For instance, we could use AI to handle routine tasks, allowing human employees to focus on more intricate and personalized interactions with clients. Moreover, constant research and development are necessary to address new issues and keep pace with the rapid advancements in artificial intelligence technology.

In conclusion, while the application of AI in tourism presents exciting opportunities for innovation and improvement, it is crucial to approach its implementation with careful consideration of the associated challenges. By striking a balance between technological advancement and human touch, the tourism industry can leverage AI to enhance customer experiences and operational efficiency in a sustainable and ethical manner.

5.2 Recommendations

Advancing data privacy and security safeguards is indispensable for utilizing AI appropriately in the tourist trade. Illegal entities need to leak and access sensitive information content, necessitating robust data protection. Travelers are likely to feel more comfortable sharing their information and engaging with AI-powered services when there are rules in place regarding the use of their data. It would also be prudent to foster investment in AI technology, particularly for smaller tourism companies.

Training programs and resources can assist these enterprises in achieving fairness and effectively implementing AI technologies in their respective fields. Government grants and partnerships with industries can provide support. Another valuable tip is to promote green travel and vacations. Artificial intelligence (AI) is one of those fields that can have a lot of applications to monitor and control environmental impacts, such as optimizing energy consumption or improving waste management systems.

5.3 Suggestions for further research

Future research on the ethical aspects of AI in tourism ought to analyze the concepts of bias, fairness, and transparency. AI's impact on tourism jobs is not an exploration yet; it will need to be studied. This includes determining how tourist workers should reskill and upskill themselves to cope with the changes engendered by AI and whether a certain job will not be eliminated and replaced.

Mocking its role in responding to emergencies such as pandemics or natural disasters may also be used to develop further AI-based tools and tactics for a successful response and recovery. Also, exploring what

roles AI can play with other emerging technologies, such as blockchain and the Internet of Things (IoT), is likely to uncover synergies and develop integrated solutions to enhance tourists' experiences.

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ỨNG DỤNG TRÍ TUỆ NHÂN TẠO TRONG DU LỊCH

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Tóm tắt: *Công nghệ trí tuệ nhân tạo (AI) đã làm thay đổi ngành du lịch và lữ hành. Mục đích của nghiên cứu này là phân tích hệ thống các ứng dụng trí tuệ nhân tạo trong du lịch và cung cấp cái nhìn tổng quan về các xu hướng phát triển hiện tại, thách thức và hướng đi tương lai. Chúng tôi đã xem xét 290 bài báo sau khi đánh giá kỹ lưỡng các tài liệu dưới các từ khóa liên quan. Kết quả cho thấy nhiều ngành công nghiệp du lịch, chẳng hạn như dịch vụ khách hàng, tiếp thị và quản lý hoạt động, đều sử dụng trí tuệ nhân tạo. Các robot, chatbot và hệ thống dựa trên trí tuệ nhân tạo đang trở thành những công cụ hữu ích, cung cấp trải nghiệm được cá nhân hóa, dịch vụ nhanh chóng và giúp đưa ra quyết định tốt hơn. AI nhấn mạnh các lợi ích tiềm năng, nhất là ở châu Âu, Trung Quốc và Ấn Độ, những khu vực cấp tiến nhất trong việc áp dụng AI. Ngành du lịch và lữ hành tại Việt Nam cũng đang chuyển dần sang ứng dụng những tiến bộ của công nghệ này. Tuy nhiên, việc áp dụng nó đòi hỏi phải xem xét cẩn thận các vấn đề như quyền riêng tư của dữ liệu, thay thế việc làm và chênh lệch giữa các vùng trong công tác nâng cấp công nghệ kỹ thuật số. Việc sử dụng công nghệ AI trong ngành du lịch có thể dẫn đến cơ hội phát triển và cạnh tranh, nhưng chúng ta phải giải quyết các tác động của nó đối với đạo đức, pháp lý và xã hội. Một trong những khuyến nghị của nghiên cứu là các bên liên quan trong du lịch nên đầu tư vào nghiên cứu và phát triển AI, đảm bảo sự hợp tác giữa ngành công nghiệp, học thuật và chính phủ, và thúc đẩy các kỹ năng liên quan đến AI trong lực lượng lao động trong lĩnh vực này.*

Từ khóa: *Trí tuệ nhân tạo (AI), du lịch, chatbot, robot, cá nhân hóa, hiệu quả, quyết định, xu hướng khu vực*

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Ghi chú

Các tác giả đã xác nhận không có tranh chấp về lợi ích đối với bài báo này.