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AI tourism: Concepts, practices, challenges and future

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Abstract
Purpose: This paper delves into the concept of AI tourism, examining its foundational principles and essential practices within the industry.
Design/methodology/approach: Based on the literature review, the tourism industry acknowledges the increasing interest in AI tourism from both industry and research viewpoints. AI tourism encompasses activities and services utilizing AI technologies in tourism. Therefore, achieving success in developing and promoting tourism destinations hinges on adhering to AI technology standards and principles across all facets of tourism operations.
Findings: This paper defines AI tourism as encompassing any mode of tourism or activity integrated within the tourism sector, viewed through the lenses of technological advancement and tourism industry evolution. AI tourism facilitates automated execution of services and tasks within practical applications, minimizing the need for human intervention.
Research limitations/implications: Development of specific AI service applications or destinations requires a phased approach. Initially, qualitative research will be conducted to establish foundational insights, followed by quantitative research aimed at formulating criteria for rating AI destinations and classifying and evaluating AI services.
Practical implications: In the travel industry, collaboration between experts and AI systems is envisioned. Here, AI is conceptualized as a suite of technologies poised to enrich the travel experience and optimize outcomes for all involved stakeholders.
Originality/value: The paper offers global exemplars of best practices while also addressing the future trajectory and evolution of AI in tourism practices.

Keywords: Artificial intelligence，Service robots，AI tourism，AI services.

Introduction

As we embark on the fourth industrial revolution, the tourism sector stands poised at a crossroads, facing both opportunities and challenges amidst a wave of technological advancements. Robotics, artificial intelligence (AI), and the Internet of Things (IoT) are shaping the way we create and distribute value, revolutionizing how we live, work, and interact. This shift is particularly evident in the tourism industry, which is increasingly harnessing the power of AI to enhance customer experiences, streamline operations, and create new revenue streams (Parker, 2020; Harris & Cook, 2019). The tourism industry has witnessed a surge in the use of AI, as both practitioners and researchers alike recognize its potential to revolutionize the sector. AI tourism services are now being guided by a fundamental understanding of how

AI technology can be used to drive innovation and efficiency. The global economic, political, and industrial shifts, exacerbated by the Covid-19 pandemic, have accelerated this trend towards AI tourism (Gretzel et al., 2020). At the forefront of this movement is the application of AI and robotics in tourism and hospitality marketing. Marketers are leveraging AI tools to personalize experiences, predict consumer behavior, and optimize pricing strategies (Tussyadiah, 2020). AI-powered chatbots, for instance, can engage with customers in real-time, answering questions, providing recommendations, and managing bookings. Similarly, AI-driven data analytics offer insights into customer preferences and behavioral patterns, enabling targeted marketing campaigns and personalized experiences. Beyond marketing, AI also plays a crucial role in other areas of tourism such as infrastructure development, tour package creation, and activity planning. By understanding the AI tourism concepts and practices, industry players can make informed decisions about the right AI technology and service alternatives to adopt. This knowledge can guide them in creating a competitive edge, enhancing customer satisfaction, and attracting future tourists. However, the rise of AI tourism also presents a series of challenges. Data privacy and security concerns, ethical implications of AI decision-making, and the displacement of jobs by automated systems are among the key issues that need to be addressed (Kraus et al., 2021; Lu, 2022). Policy-makers and regulators must work alongside industry players to ensure that AI tourism is developed in a sustainable and responsible manner, benefitting both consumers and the tourism industry at large. In conclusion, the future of tourism lies in harnessing the power of AI. By understanding and leveraging the opportunities and challenges presented by AI tourism, the sector can embrace change, innovate, and create exceptional experiences for customers. With a focus on responsible development and ethical implementation, AI tourism has the potential to shape a sustainable and inclusive future for the tourism industry.

AI tourism concept

Identifying and clarifying the terminology of AI tourism pose challenges due to its multifaceted nature. Current definitions often lack cohesion and comprehensiveness, tendency to favor a single perspective of industry or academia，or focusing narrowly on computer science or travel management. A comprehensive definition should capture AI's role in enhancing tourism experiences and operations across multiple disciplines.

Industry Perspective

Recent advancements in artificial intelligence (AI) have sparked a wave of technological breakthroughs in the realm of big data. Researchers have identified four key skills that AI is capable of replicating from humans, namely mechanical, analytical, intuitive, and empathic intelligence. Service automation has been touted as a potential replacement for human labor, as AI systems excel in tasks that necessitate these skills, starting from mechanical duties and progressing to empathic responsibilities. Mechanical AI is adept at handling repetitive tasks with precision, relying on observation to replicate actions and reactions consistently. This ensures reliability and stability in responding to its environment. Narrow AI, as highlighted by Bundy (2016), focuses on the potential of AI to perform specialized tasks, reshaping various service sectors and driving innovation, albeit posing a threat to human employment. The distinction between artificial general intelligence (AGI) and artificial narrow intelligence (ANI) has been a focal point in the ongoing discourse surrounding AI development. Categorization into weak narrow-purpose AI, strong general-purpose AI, and super-strong intelligence underscores the evolving capabilities of AI systems, as outlined by researchers such as Fjelland (2020) and Горохова (2020). Analytical AI is capable of executing complex, systematic tasks,

leveraging machine learning and data analysis techniques to process large volumes of data. Intuitive AI, on the other hand, excels in creative, holistic tasks that require intuitive intelligence, such as acting as a personal travel concierge or life coach. This type of AI is deemed "strong" due to its ability to navigate contextually relevant challenges with creativity and finesse. At the pinnacle of AI advancement lies empathic AI, designed to mimic human behavior and interactions, offering psychological comfort to users. As discussed by Goertzel (2017), this form of AI prioritizes the emotional well-being of individuals, striving to provide a human-like touch in its interactions. In light of these advancements, the rapid integration of AI into various industries raises critical questions about the future of work and the ethical considerations surrounding AI deployment. The transformation of legal systems to accommodate the complexities of AI, robotics, and hyperphysical systems underscores the need for a balanced approach to regulatory frameworks. As AI continues to evolve and permeate various facets of society, stakeholders must navigate the dual impact of innovation and potential job displacement, while ensuring ethical and legal standards are upheld in the era of AI integration.

From the perspective of tourist needs, AI tourism offers a range of valuable services. It can predict and understand tourists' preferences, optimizing travel plans and enhancing their overall satisfaction. With the assistance of AI, travelers can easily make informed decisions about destinations, transportation, accommodations, and activities, ensuring a seamless and enjoyable journey. Furthermore, AI can help navigate unfamiliar environments, such as understanding local customs, overcoming language barriers, and exploring new cultures. By providing personalized recommendations and insights, AI enables tourists to have a more enriching and memorable travel experience.

From a business perspective, AI travel service providers encounter challenges in matching customers with travel packages that meet their unique needs. Various studies have explored the application of AI to enhance the travel planning experience. Yue et al. (2017) employed deep learning techniques to identify customers' travel intentions. Liu et al. (2019) introduced an efficient air travel planning approach using APIs provided by airline companies. Wardhani et al. (2019) focused on user experience design in developing a tour guide service application, employing Discovery, Formative, and Evaluative methods. Suparwo et al. (2020) examined the role of direct marketing and customer trust in decision-making for Umrah packages. Ardani (2021) tested the impact of marketing mix and service quality on customer satisfaction and loyalty.The potential customer base for travel service providers is vast, making the task of matching demand with products complex and well-suited for AI capabilities. AI enables businesses to customize travel experiences, meeting the expectations of diverse visitors. While the tourism industry has been a pioneer in adopting advancements, genuine AI applications are still limited. Current implementations primarily involve data processing systems and the development of various products, such as prediction systems, bots, dialogue systems, and speech recognition systems (Addlesee et al., 2020). From a business standpoint, AI can be applied to various aspects of travel management (Buhalis et al., 2019), particularly in marketing and improving operational efficiency (Tussyadiah and Miller, 2019). AI also has the potential to promote sustainable travel by encouraging customers to adopt more socially responsible attitudes (Tussyadiah and Miller, 2019). However, the widespread implementation of AI in the tourism industry remains a challenge, as businesses must navigate ethical, legal, and technological issues while harnessing the power of AI to enhance customer experiences and drive business growth.

Academic Perspective

AI Tourism: A New Research Direction in Tourism Management AI tourism, a nascent research area within tourism management, explores the integration of artificial intelligence into the tourism industry. Encompassing travel agencies, tourism transportation, and accommodation sectors represented by hotels, the tourism industry specializes in attracting and accommodating tourists, providing a range of services including transportation, sightseeing, accommodation, catering, shopping, and cultural entertainment. Unlike other industries, tourism is not monolithic; it consists of various fragmented yet interconnected sectors. These sectors serve not only tourists but also local residents, leading to ambiguity in defining tourism's scope. Within this context, AI tourism emerges as a key innovation. Technology now complements tourism services and fulfills customer needs, minimizing human involvement across multiple services. These transformations manifest in tangible and specific applications, shaping the future of tourism management.

AI is utilized in tourism for fulfilling customer needs and enhancing services. Three primary practices emerge from a service and customer perspective: serving tourists, attractions, and governments/management. These practices cater to the ever-growing material and cultural needs of individuals, fulfilling their desires for rest, relaxation, health improvement, knowledge expansion, and broader horizons. Tourism, thus, acts as a catalyst for personal and societal growth, fostering progress and development.

Artificial Intelligence (AI) tourism has emerged as a revolutionary field that is reshaping the way we travel and experience destinations. It represents a fusion of cutting-edge technology and the travel industry, holding vast potential and a sense of mystique as it continues to evolve. At the core of AI lies data - the lifeblood that fuels its operations. Without data, AI applications are rendered inert, unable to make informed decisions or predictions. Data is transmitted to AI systems through a myriad of channels, including sensors, chips, software frameworks, cloud services, and other technological mediums. For AI tourism to thrive, a robust infrastructure is paramount. Intelligent computer systems must be equipped with the necessary components such as sensors, chips, data, software frameworks, and cloud services to form the Internet of Things (IOT). AI is deeply entrenched in the realm of computer science, encompassing behavior automation and machine learning. The crux of AI lies in its ability to mimic human intelligence by assimilating information and deriving rules for its utilization. Machine learning, a subset of AI, revolves around the integration of algorithms that empower computer systems to learn and enhance their efficiency autonomously. Deep learning, a groundbreaking aspect of AI, leverages layered algorithms to form artificial neural networks that have the capacity to make informed decisions independently. These neural networks, known as "models", are instrumental in processing large volumes of data, commonly referred to as "big data", to facilitate the training process. Unlike traditional machine learning methodologies, deep learning algorithms are adept at handling unstructured data without predefined characteristics, analyzing data based on inherent logical patterns. This mirrors the cognitive process of human reasoning, allowing computers to draw accurate conclusions and solve complex problems with a high degree of autonomy. The amalgamation of data science, computational power, and advanced algorithms enables computers to function autonomously, streamlining processes and enhancing efficiency in various domains. AI, by nature, is intricate and multifaceted, posing challenges in its definition and application. The realm of AI tourism, especially, defies conventional categorization and necessitates a nuanced understanding rooted in practical implementation rather than theoretical abstraction. As AI continues to push boundaries and redefine paradigms in the tourism sector, its transformative impact is palpable. The convergence of technology and travel heralds a new era of exploration, where AI serves as a catalyst for innovation and personalized experiences. In the dynamic landscape of AI tourism,

the possibilities are endless, beckoning travelers and industry stakeholders alike to embrace the future with curiosity and open-mindedness.

The Concept of AI Tourism

AI tourism can be defined as the integration of technology and tourism, where autonomous systems are utilized to enhance and streamline travel experiences. This includes the use of AI-powered vehicles and services that can operate independently without human control. This innovative approach aims to revolutionize the tourism industry by offering efficient and convenient solutions for travelers.

The AI family of technologies in the tourism industry focuses on enhancing the provision of products and services to participants in the main tourism activities. By leveraging AI tools like interpreters, marketing strategies, chatbots, virtual reality, language translation, VR/AR, blockchain for cultural souvenirs, and other cutting-edge applications, travel agencies, transportation services, and the hospitality sector can be significantly improved. These technologies cater to both visitors and service providers, aiming to streamline processes and enhance customer experiences. The definition also emphasizes that AI technologies should be seamlessly integrated into research methods and algorithms to ensure their effectiveness in the tourism sector. Ultimately, AI has the potential to revolutionize the way tourism services are delivered and experienced.

A visual representation of AI in tourism practices is outlined in Figure-1, highlighting key aspects and providing a comprehensive overview.

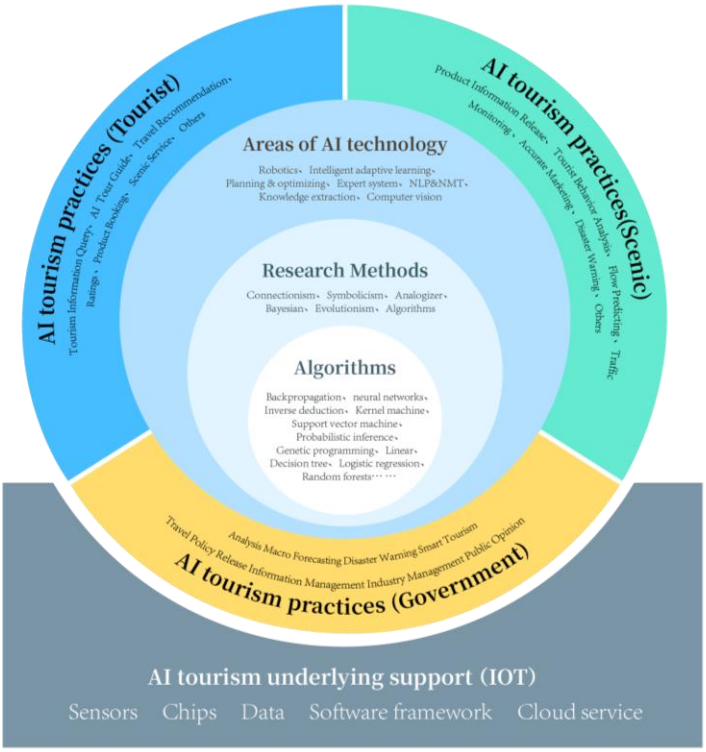

Figure 1: AI Tourism leverages technology to enhance experiences.

Revolutionizing AI in the tourism industry. Enhancing travel experiences with artificial intelligence. Implementing AI technology for personalized adventures.AI transforming tourism for better exploration. Innovative AI solutions for seamless travel. Evolving AI enhancing

tourism experiences.

Artificial Intelligence (AI) is revolutionizing the tourism industry by offering in-depth insights on various aspects of the tourist experience, including natural resources, general infrastructure, tourism facilities, destination attractions, and more. This cutting-edge technology has the capability to surpass human capabilities by quickly providing vast amounts of information on crucial elements. In fact, AI has shown to outperform human services in certain scenarios. Recent data indicates that consumer attitudes towards digital technology are shifting towards a more positive direction, largely influenced by the Covid-19 pandemic. This trend is reflected in the increasing adoption of AI in the tourism sector.

Visitor-facing online services and offline service equipment and facilities

AI technology has revolutionized the way customers' needs are catered to, offering valuable insights on various essential aspects including natural resources, infrastructure, tourism facilities, and destination attractions. It benefits visitors across six major categories: dining, lodging, transportation, sightseeing, shopping, and entertainment. This information can be delivered through interactive platforms, self-service tools, chatbots, audio guides, virtual tours, booking systems, facial recognition, language translation, promotions, and competitive pricing. AI enhances the overall customer experience by simplifying the shopping process and providing a wide range of convenient services and features.

AI tour guide service

The travel industry is experiencing a shift in focus with the new generation of tourists placing a greater emphasis on the overall travel experience and quality of service. Professional tour guide services play a crucial role in enhancing tourist satisfaction and increasing the likelihood of repeat visits. In order to attract and retain tourists, travel companies must now offer personalized and high-quality services tailored to individual preferences. One effective way to meet the evolving demands of tourists is through the utilization of artificial intelligence (AI) technology. AI can analyze and predict the needs and behaviors of tourists, allowing travel companies to provide customized services that enhance the overall travel experience. Smart travel assistants, tour guide robots, and other smart devices are becoming increasingly popular tools in the travel industry, offering tourists a new level of comfort and convenience during their travels. A key aspect of a successful travel experience is the planning of a suitable travel path. Tourists today seek customized travel paths that reflect their preferences and interests. A robust travel path planning system is essential in recommending popular spots to visitors and selecting the best travel route. Moreover, in cases where tourist attractions become overcrowded, this system should be able to adjust the travel path for each individual visitor to ensure a balanced flow of traffic at each location. Despite the growing demand for smart planning systems in the travel industry, many resorts still lack the necessary technology to provide this level of service. However, some progress has been made, with authors introducing smart planning systems at popular tourist destinations such as the Humble Administrator's Garden in Suzhou. Technologies such as interactive tour-guide robots have already been successfully deployed in various settings, showcasing the potential for AI to enhance the overall tourism experience. Researchers continue to explore the capabilities of AI and robotics in the travel industry, with projects aimed at developing intelligent tour guide robots that can adapt to different environments and interact effectively with users. From autonomous mobile robot systems to sophisticated social robots, there is a growing body of work dedicated to enhancing the tourist experience through innovative technology. In conclusion, the integration of AI technology and smart devices is crucial in meeting the changing expectations of modern

tourists. By providing personalized and high-quality services, the travel industry can attract and retain visitors, ultimately leading to a more satisfying and memorable travel experience for all.

Chatbots and voice assistants exemplify conversational technology in digital interfaces, aiding users efficiently.

Conversational systems, such as chatbots and virtual agents, have revolutionized the way customers search for information. These systems use technology like natural language processing and speech recognition to engage in lengthy conversations with users, providing assistance and answers to queries. They have become ubiquitous in our daily lives, found in smartphones and home devices as personal assistants like Apple Siri, Google Assistant, Xiaomi Xiaoai, and Amazon Alexa. Recent research has delved deep into the capabilities and strategies of chatbots. For example, (S et. al., 2020) conducted a critical review of the current practices and innovations in the field. (Abdallah et. al., 2020) developed an open-source solution for building a Smart Assistant Robot specifically designed for managing smart homes for elderly individuals. Meanwhile, (Wellsandta et. al., 2020) introduced a voice-enabled digital assistant to support maintenance activities, and (Zhang et. al., 2020) created an intelligence hotel robot to streamline the check-in process. Further advancements in this field include the implementation of interaction layers between robotic systems and human operators as demonstrated by (Li et. al., 2021). Other notable contributions to the development of conversational systems include research by (Reynolds, 2017), (Deepika et. al., 2020), and (Aghav-Palwe et. al., 2021). These studies highlight the continued growth and potential of chatbots and virtual agents in enhancing customer experiences and improving information search processes.

Customize, suggest, predict user experience effectively.

In recent times, travelers have increasingly relied on photographs in catalogs to make decisions about their upcoming trips. With the vast amount of information available on the internet, including user-generated content (UGC), tourists are better equipped to plan their vacations. However, despite this wealth of information, cost still remains a significant factor in decision-making. The landscape is changing with the advent of artificial intelligence (AI), which allows both travelers and businesses to personalize experiences and optimize choices. Research conducted by Lucas et. al. in 2013 focused on implementing a recommendation methodology within a tourism recommender system using classification based on association. Agarwal et. al., in the same year, proposed three algorithms for recommendation systems, one based on historical data for registered users, one based on cookies for unregistered users, and one based on time scheduling. Al-Hassan et. al. demonstrated in 2015 the effectiveness of utilizing semantic knowledge to enhance the quality of recommendations in tourism. Existing travel planning systems have limitations in how effectively they can adapt to changing user requirements and planning outcomes. To address this issue, Chiang et. al. developed a personalized travel planning system that considers all categories of user preferences simultaneously, providing users with a near-automated travel schedule planning service. Naumov et. al. further implemented this system in both PyTorch and Caffe2 frameworks in 2019, underscoring the importance of adapting to modern technological advancements in travel planning.

Enhancing language translation applications improves accuracy and accessibility. Improved usability benefits international communication.

Travel and tourism often expose individuals to a multitude of different languages, making it crucial for visitors to be able to communicate effectively in order to navigate their way through various destinations and engage in local activities. The advancement of automatic translation tools and simultaneous translation systems, powered by artificial intelligence (AI) technologies such as machine learning and natural language processing (NLP), has revolutionized the way language barriers are overcome in the modern age. A recent study by Mayhew and colleagues (2020) introduces the concept of Simultaneous Translation and Paraphrasing for Language Education (STAPLE), which demonstrated significantly improved performance compared to traditional Korean-English NMT approaches through the implementation of various decoding strategies. This innovative methodology proposed by Park and team (2020) emphasizes the potential for enhancing NMT models without relying on PFA, opening up new possibilities for optimizing machine translation performance. Additionally, Melchor et al. (2020) propose a unique approach using natural language processing techniques and graphic development engines to create avatars capable of displaying information in Mexican Sign Language (MSL), showcasing the potential for technology to bridge communication gaps for individuals with different language needs.

Map App

Modern technology has revolutionized the way we navigate our world, with Artificial Intelligence (AI) playing a key role in enhancing our travel experience. By utilizing GPS technology, AI can provide valuable information on infrastructure like highways, public transportation, and private transportation networks. Today, AI technology integrated into vehicles can offer real-time updates on road accidents, traffic congestion, and suggest the most efficient routes to avoid delays. Furthermore, AI can also provide detailed data on nearby amenities such as stores, hotels, restaurants, and entertainment venues, allowing travelers to make informed decisions on their journey. A groundbreaking development in this field is the Smart-Travel system introduced by Hung et al. (2011), which leverages Social Networking Services (SNS), Internet of Things (IoT), and User-Generated Content (UGC) to create a seamless tourism experience. Specifically, a mobile tourism application has been tailored for Samosir Regency in North Sumatera Province, Indonesia, showcasing the potential of AI to enhance the way we explore new destinations.

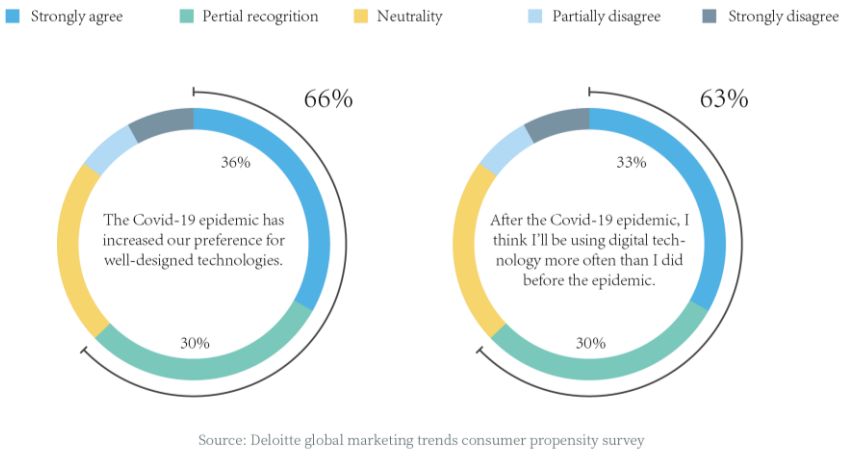

Figure 2: Consumer emotions towards digital technologies during the Covid-19 pandemic have shifted.

The integration of service software and offline facilities is essential for enhancing customer experience in tourist attractions.

Facial Recognition

Facial recognition technology, a subset of artificial intelligence, is increasingly becoming a pivotal tool across various industries for a multitude of purposes. Its prominence is particularly evident in the travel and tourism sector where it streamlines and enhances processes for both travelers and service providers. Traditionally, travelers navigate through a maze of bureaucratic procedures involving the scrutiny of travel documents by customs, immigration, and airport officials. However, recent advancements in facial recognition technology offer a more efficient and user-friendly alternative. Researchers such as Kim et. al. (2019) has put forth innovative approaches like hierarchical deep learning for facial emotion recognition systems that promise to revolutionize user experience in the travel industry. Similarly, González-Rodríguez et. al. (2020) is exploring the potential of AI in capturing tourists' emotions to gauge their satisfaction levels during guided tours at heritage sites. Moreover, Ivasciuc (2020) is delving into the intersection of emerging technologies like augmented reality and facial recognition in AR Media applications to boost the competitiveness of tourism companies amidst the challenges posed by the COVID-19 pandemic. Meanwhile, Widiartha et. al. (2020) is focused on designing state-of-the-art storage systems to support industry 4.0 in the tourism sector. In essence, the integration of facial recognition technology into the travel and tourism industry is shaping a future where seamless, personalized experiences redefine customer satisfaction and operational efficiency.

Robots

Robots, with their advanced capabilities in artificial intelligence and understanding of their surroundings, have become a significant presence in various industries, particularly in the hospitality and tourism sectors. Unlike other AI programs, robots are physical entities capable of making decisions and taking actions independently. Researchers such as Murphy et. al. (2019) has identified eleven key capabilities of robots that influence anthropomorphism and shape human-robot interaction (HRI), as well as explored potential Uncanny Valley marketing outcomes. In the realm of service transactions, Lu et. al. (2019) has developed a multi-dimensional scale to measure consumers' willingness to integrate AI and service robots into their regular interactions. Understanding this willingness is crucial for businesses looking to incorporate automated technologies into their operations. Similarly, Ivanov (2019) has studied the impact of robots, specifically RAISA technologies, on travel, tourism, and hospitality companies, ranging from operations to marketing strategies. During times of crisis, such as health emergencies, technology acceptance becomes even more critical. Kim et. al. (2020) has delved into this topic, offering theoretical and managerial implications for using technology, including robots, in crisis situations. Wan et. al. (2020) has reviewed cutting-edge technologies related to mobile healthcare robots, emphasizing the importance of human-robot interfaces, environmental perception, navigation, communication systems, and artificial intelligence. In the hospitality industry, the use of service robots has been a topic of interest for researchers like Reis et. al. (2020), who are exploring the benefits and challenges of integrating robots into various services. Fuentes-Moraleda et. al. (2020) has focused on human-robot interaction in hotel settings, while Belanche et. al. (2021) provides practical guidance for the implementation of service robots in hospitality and tourism. Understanding the implications of robotization on tourist experiences, as well as customer perceptions towards robots, is crucial for industries embracing automation. Overall, the integration of robots into various service industries

presents both opportunities and challenges. Researchers, such as Tanaka et. al. (1997), have laid the groundwork for understanding the role of robots in enhancing customer experiences. As the field of robotics continues to evolve, further research is needed to explore the full potential of service robots in enhancing operations, customer experiences, and overall industry offerings.

VR/AR/MR

Headsets are widely used in virtual, augmented, and mixed reality technology to immerse users in a simulated environment. This simulated world offers a virtual reality experience, allowing customers to explore a digital 3D world in great detail. The tourism and hospitality industry has embraced various virtual reality applications. From virtual hotel tours to virtual travel experiences and virtual booking interfaces, the possibilities are endless. Virtual hotel tours, for example, showcase the hotel environment and amenities through 3D films, giving customers a realistic preview of their stay. This enables customers to make informed decisions and have a better understanding of the accommodations before arriving at the destination. By providing virtual experiences, businesses can engage customers and spark their interest in visiting a particular tourist site. Virtual reality technology has revolutionized the way customers interact with the tourism and hospitality industry, offering a new level of immersion and engagement.

Revolutionizing cultural creation through blockchain technology. Blockchain revolutionizes digital cultural creativity.

The recent explosion of NFT digital collections globally has sparked a new wave of interest in virtual assets that exist solely in the digital realm. Unlike physical objects, these digital collections are represented by unique serial numbers on blockchain platforms, ensuring their authenticity and preventing duplication or alteration. Each digital collection represents a specific piece of artwork, merchandise, or a digital replica of a limited-edition item, with its ownership rights securely recorded on the blockchain. When a digital collection is purchased, the buyer not only gains ownership of the virtual asset but also receives an unchangeable proof of ownership and access to the digital content. This ownership grants the purchaser certain rights over the digital collection, as determined by the permissions granted by the original rights owner. One notable example is the introduction of the NFT Digital Annual Pass for the Bay Area Light Flyer in Shenzhen, China, allowing holders to access exclusive content and benefits through this innovative digital ownership model.

AI technology impacts government-supported tourism industry sustainability and development.

Prediction System

Forecasting, a method of predicting the future based on historical data and current trends, plays a crucial role in various industries and businesses that rely on foresight for decision-making. Artificial Intelligence (AI) algorithms have proven to be particularly effective in forecasting, with approaches categorized into five main techniques: grey theory, fuzzy time series, rough set methods, support vector machines (SVMs), and artificial neural networks. In the tourism industry, forecasting is essential for understanding tourist demand, designing marketing strategies, managing finances, allocating human resources, and supporting facilities management and maintenance needs. Among the various methods available, Neural Networks have been identified as particularly effective for forecasting visitor arrivals, especially for series without a clear pattern. Additionally, models such as those proposed by (Wang, 2004) offer valuable tools for predicting tourism demand. Researchers have been exploring

increasingly sophisticated models for forecasting tourism demand, aiming to improve accuracy and understanding. For example, (Chou et. al., 2010) propose a fusion model of fuzzy time-series that considers cluster characteristics of observations, defines a more precise universe of discourse, fuzzifiers observations with triangular fuzzy numbers, establishes fuzzy logical relationships through rough set rule induction, and assigns weights based on rule support. Building on previous research, (Folgieri et. al., 2017) applied backpropagation Artificial Neural Networks to forecast tourist arrivals in Croatia, while (Nguyen et. al., 2017) sought to develop more appropriate models for forecasting tourism demand in Vietnam. Other studies, such as that by (Ring et. al., 2019), introduced the concept of vacation dedication to tourism literature to enhance understanding and prediction of tourism demand. Furthermore, researchers have explored innovative approaches to forecast tourist arrivals, such as analyzing web sentiment of online news media coverage to predict actual tourist arrivals in European cities like Berlin, Brussels, Paris, and Vienna as discussed by (Önder et. al., 2019). Additionally, incorporating travelers' web search traffic as external input attributes for tourist arrival prediction has been proposed by (Höpken et. al., 2020) to enhance autoregressive prediction models. Moreover, (Papadopoulos et. al., 2020) present a method for predicting the medical resources needed after disasters to meet demand, while (Demessance et. al., 2021) explore adapting grammatical inference algorithms to big data contexts for more accurate forecasts. These studies collectively highlight the importance of forecasting in various industries and the ongoing efforts to improve prediction models for better decision-making and planning.

Enhancing visitor experience through technology in tourism.

The concept of smart tourism involves utilizing data collected at tourist destinations from various sources such as physical infrastructure, social relationships, government organizations, and even the human body and mind. By leveraging advanced technologies, this data is then transformed into on-site experiences and business opportunities that prioritize efficiency, sustainability, and enhancing the overall visitor experience. Researchers like Gretzel et al. emphasize the importance of AI in driving the development of smart tourism. With AI's capabilities, data can be effectively translated into innovative experiences and valuable offerings for tourists. In essence, AI will serve as a key component in the evolution of smart tourism, enabling destinations to provide tailored and memorable experiences for visitors while maximizing operational efficiency and sustainability.

AI plays a vital role in smart tourism and destinations, creating digital ecosystems. However, for these ecosystems to thrive, diverse social and organizational elements must collaborate effectively. The success of smart destinations hinges on the synergy of AI technology with other components within the ecosystem.

AI tourism faces challenges but promises bright future.

As the industry embraces new technologies for growth, it must also navigate potential challenges and risks. Examining this through the lenses of visitors, industry stakeholders, and government regulations is crucial for ensuring sustainable progress and success.

As technology advances, the tourism industry is facing new challenges and concerns. One of the main issues that tourists are increasingly worried about is the invasion of their privacy through data surveillance. With the ability of AI to extract patterns and information from data, travelers may find themselves exposed to a level of scrutiny that threatens their personal privacy. Additionally, as AI becomes more prevalent in the service industry, visitors may face a dilemma between choosing a fully automated, efficient, and cost-effective service or a more personalized, human touch luxury experience. This shift towards automation may lead to a loss

of control over the service process, forcing tourists to make a choice between convenience and a more authentic travel experience. Furthermore, the rise of algorithmic bias poses a significant risk in the widespread use of AI in the tourism sector. Human biases related to race, gender, age, and economic status can be inadvertently incorporated into AI algorithms, leading to potential discrimination and exacerbating societal inequalities. In light of these developments, it is crucial for stakeholders in the tourism industry to address these concerns and ensure that AI technologies are implemented in a responsible and ethical manner, prioritizing the protection of tourists' privacy and the prevention of algorithmic prejudices. By taking proactive measures, the industry can harness the benefits of AI while mitigating its potential negative impacts.

The travel industry and businesses are confronted with five primary challenges that hinder their progress and success. These challenges include productivity issues, regulatory hurdles, technological innovation barriers, cultural and ethical dilemmas, and financial constraints. To address productivity challenges, businesses and algorithm engineers must comprehend and respond to traveler needs effectively, while also evaluating how AI can be leveraged to improve efficiency. Financial issues like data quality, accuracy, bias prevention, and cost management further complicate matters, alongside technological innovation challenges that arise from implementing new AI technologies. Regulatory issues also pose a significant obstacle, particularly concerning data collection, processing, and the government's role in ensuring the security and privacy of big data in the tourism sector. Additionally, cultural and ethical concerns such as the fear of total dependency on AI, the fear of job displacement, and the fear of unethical use of power need to be carefully considered and addressed in the industry. Overall, overcoming these challenges will require a comprehensive understanding of the multifaceted issues at play and a proactive approach to finding viable solutions.

The use of robotics in the tourism industry poses significant challenges from both a government and regulatory standpoint. One of the key challenges is the potential for human workers to be replaced by machines. Research suggests that robots could potentially replace up to 25% of hotel personnel within the next decade, marking a significant shift in the way the industry operates. This shift not only raises concerns about job loss and unemployment but also about the impact on the sense of belonging and hospitality that human workers bring to the industry. Another challenge is the regulatory capacity needed to oversee and manage the adoption of AI and robotics in the tourism sector. Regulators must be equipped to learn and adapt to the changing landscape of the industry in order to effectively address concerns related to transparency, manipulation, and predictability of AI systems. The ethical implications of using AI in the tourism industry also present a significant challenge. Experts stress the importance of ensuring that AI systems are transparent, robust, and predictable in their decision-making processes to avoid potential harm or bias. Ultimately, the adoption of AI and robotics in the tourism industry will require close attention from regulators to ensure that the industry maintains its sense of hospitality and value for customers while also addressing concerns related to job displacement and ethical considerations. By effectively managing these challenges, the industry can harness the benefits of AI technology while mitigating potential risks and ensuring a positive experience for all stakeholders involved.

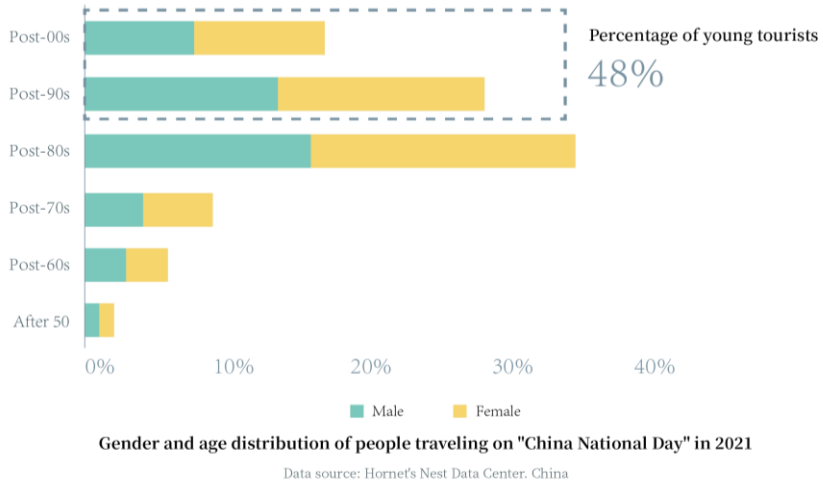

Figure 3: Next generation tourists are the prime consumers, reshaping the tourism industry.

Future Developments

In today's rapidly evolving tourism landscape, the new generation of travelers places a high emphasis on their overall travel experience and the quality of the services provided to them (Wang, 2021). This shift in consumer behavior has significant implications for destination marketers and tour operators, who must adapt to meet the needs and expectations of these next-generation guests. The tourism industry has seen remarkable growth and success in the twenty-first century, with the number of overseas visitors more than doubling from 528 million in 2005 to 1.19 billion in 2015 (www.statista.com, 2019). The expenditures made by people on tourism and travel play a vital role in driving demand and overall performance within the industry. As the market continues to evolve, the integration of artificial intelligence (AI) is poised to provide a competitive advantage for businesses. Looking ahead, the travel sector is expected to become even more competitive, with technological and business innovations driving this evolution. It is clear that advancements in AI will be crucial in unlocking new opportunities and enhancing the overall customer experience within the travel and tourism industry. This underscores the need for continued research and development in various areas to ensure the industry remains at the forefront of innovation.

The interaction between tourists and machines involves aspects like trust, usefulness, privacy protection, and bias correction, influencing visitor experiences.

The intertwined connection between technology and users drives innovative product design, adaptive pricing strategies, and evolving marketing tactics influenced by artificial intelligence in today's changing business landscape.

Machines play a crucial role in industry sustainability, impacting the workplace and potentially replacing human workers. This relationship between AI and sustainability is vital for the future of industries.

Conclusion

The future of artificial intelligence in the tourism industry is filled with exciting possibilities. As we look ahead, we can see a world where the main challenges of AI are successfully overcome. Privacy concerns will be addressed, allowing tourists to feel more comfortable and secure as they take advantage of the convenient, personalized, and cost-effective tour packages that AI can offer. With the help of technology, travelers will be able to navigate unfamiliar environments with ease, alleviating the anxiety and uncertainty that often comes with travel. Language and cultural barriers will no longer hinder exploration, as AI will bridge the gap and

allow for seamless communication. Businesses will benefit greatly from AI, as they will have a deeper understanding of their customers' needs, enabling them to tailor their products, services, and experiences to better suit their clients. Ultimately, the collaboration between travel industry experts and AI systems will revolutionize the travel experience, making it more enriching and enjoyable for all involved.

In the realm of future AI developments, there is a pressing need for the creation of distinct AI service solutions and destinations. The initial step would involve carrying out qualitative investigations, which would then be followed by quantitative analysis, in order to establish effective AI destination rating metrics as well as AI service categorization and assessment standards. The field of AI tourism stands as a burgeoning research domain that requires further exploration into enhancing the utilization of AI technology in catering to both individual tourists and organizations. Delving deeper, one cannot help but contemplate the possibility of AI travel completely supplanting conventional travel practices. To what extent might this transition take place? Furthermore, delving into the perceptions of group travelers towards AI tourism, both in AI integrated and non-AI integrated settings, could potentially unveil an array of invaluable insights.

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