Augmented Reality: Challenges, Opportunities and Implementation in the Tourism Industry

Achmad Solechan [1], Yuli Fitrianto [2], Haryo Kusumo [3]
[1,2,3] Universitas Sains dan Teknologi Komputer

Jl. Majapahit No. 605 Pedurungan, Semarang, Central Java
Email : achmad@stekom.ac.id yuli_f@stekom.ac.id haryo@stekom.ac.id

Abstraction *It is important to carry out this research because the digital tourism theme is a theme that is still relatively little carried out by other researchers. This research uses qualitative methods with literature review techniques with the results discussing 37 research article publications that are relevant to this research. The research results show that the application of digital tourism has a lot of potential that can change the way the tourism industry operates and interacts with tourists, including increased accessibility, enhanced tourism experiences based on AR and VR technology, and effective marketing. The application of Digital Tourism opens up various interesting opportunities in the tourism industry, including: digital marketing, virtual tourist experiences with AR and VR, tour guide applications, online booking, tourism data analysis, environmental conservation, and personalization of tourist experiences.The development or trend of digital tourism in 4 eras has apparently experienced a significant increase. Some of the challenges faced related to Digital Tourism include: lack of a comprehensive framework, limited understanding of technology users, the need to measure the sustainable impact of digital technology, data privacy and security issues, long-term impacts of digital tourism use, collaboration with parties involved in digital tourism, cross-cultural perspectives and implementation of management strategies using intelligent systems.*

Keywords:*Potential, Opportunities, Trends, Challenges; Tourism Digitalization*

1. INTRODUCTION

The use of information technology in the tourism sector (digital tourism) can improve the regional economy and create business opportunities for the community. As a society, keeping up with technological advances can make it easier to access information related to tourist attractions and understand regional cultural values. Information technology integration is carried out as a tourism marketing strategy that will benefit service providers and tourism managers(Saniati et al., 2022).

*Digital tourism*is a concept that is needed and used in information and communication technology to make it more useful in advancing the tourism sector, providing various tourism services to customers in the form of telematics, and making tourism marketing more accessible.(Wilson, 2019).

This research was carried out because the digital tourism theme is a theme that is still relatively little researched by other researchers, this can be seen from the following graph:
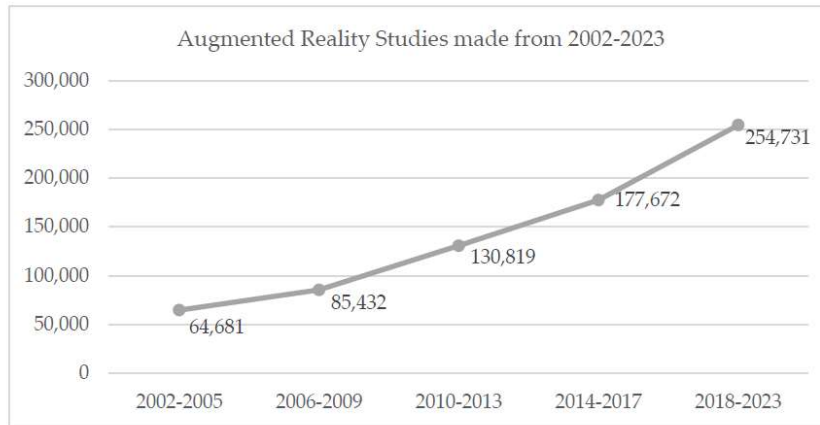
Figure 1.1: Number of Augmented Reality Publications 2002-2023

Source :(Villagran-Vizcarra et al., 2023)

The development of publications related to digital tourism from 2002 to 2022 shows significant development, however the amount of research published is still relatively small. The distribution of publications related to digital tourism in 2003-2012 (early stage) raised the theme of online travel agents, websites (tourism information systems), search engines, tourism e-marketing, online booking systems, and virtual tourism trips. Digital tourism research in 2013-2018 (growth stage) raised the theme of travel mobile applications, social media platforms, review sites (comments), location-based services (GPS), big data, and cloud computing. Meanwhile, in 2019-2022 (hype stage) the theme will be artificial intelligence, augmented reality, virtual reality, IoT, blockchain technology, chatbots and other virtual technologies. Meanwhile, a map of the distribution of research related to digital tourism can be seen in the following image:(El Archi et al., 2023)
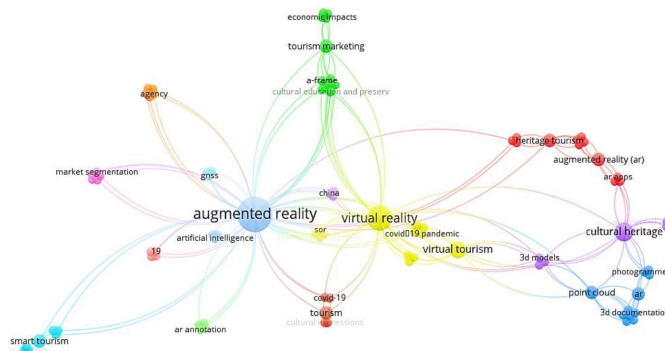

Figure 1.2: Publication Relationship between Augmented Reality

and the Tourism Industry

Source :(Allcca-Alarcón et al., 2023)

2. LITERATURE REVIEW

2.1 Digitalization and Digital Tourism

Digitalization is the application of digital technology and infrastructure in business, the economy and society. Digitalization is also affecting the way we live and work, society is showing increased dependence on technological devices which can result in changes in behavior. With the digital world being replaced by the physical world, daily experiences and interactions between people are reduced, which can result in reduced human connectivity. Digitalization has driven a series of transformations in industry and the economy and is said to be digital transformation in society and the business world(Popescu & Phi, 2019).

Digitalization is a complex concept involving a number of processes that build on each other (integrated), and consist of different steps for (almost) every organization. Digitalization in business is the use of digital technology that will help change business models and create new revenue and value creation opportunities(Happ & Ivancsó-Horváth, 2018).

*Digital tourism*or e-tourism is an integration between ICT (Information and Communication Technology) developments and the tourism industry. The concept of digital tourism in question is the use of information and communication technology to increase usability in the tourism sector, provide various tourism services to customers, and make tourism marketing more easily accessible in the form of telematics.(Yanti, 2019).

According to(Happ & Ivancsó-Horváth, 2018), digital tourism, namely the use of information communication tools, IT solutions that can help meet tourist needs and increase the competitiveness of organizations and businesses in the tourism sector. Meanwhile, according to(Ernawati & Hananto, 2023), digital tourism is defined as the digital support of tourism experiences both before, during and after tourism activities which gives tourists the possibility to re-translate all experiences in traveling in the real world into a digital dimension, and this can blur the boundaries between tourism and gaming. .

*Digital tourism*is a tourism development strategy by massively utilizing digital media. Digital marketing can improve the tourism brand or image(Sufi & Sabri, 2020). According to(Simamora & Sudiarta, 2020), digital tourism or digital tourism is a powerful strategy for promoting various destinations and Indonesia's tourism potential through

attractive online platforms. This means that digital tourism not only exposes the beauty of tourism, but also disseminates it widely to increase the number of tourists.

*Digital tourism*reflects the digitalization of all processes and value chains in the tourism, travel, hospitality and catering industries. Digital tourism is a phenomenon, combining consumers and suppliers of certain tourist services. It can be identified as a service to tourists, providing specialized websites and software that in turn: reduce the time in making travel decisions; providing the right choice of destination and planning the trip itself; facilitate the reservation process and purchase of additional services(Purike et al., 2022).

2.2 Digital Tourism Model in a Business Approach

Tourist visitors will be involved in developing products and services packaged by tourist attractions so that they influence real-time pricing. The main place of sales is the online/virtual space, and online communication ranks first among the activities of establishing contact with consumers. Consumers, consumer behavior and tourist profiles also influence the operation of the model(Happ & Ivancsó-Horváth, 2018).
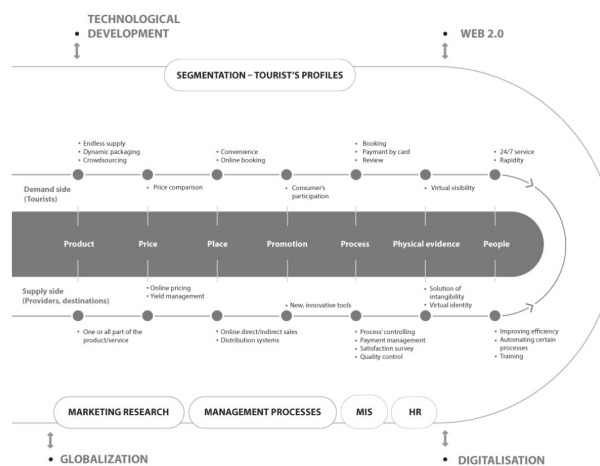

Figure 2.1: Digital Tourism Model in a Business Approach

From the model image above, it shows that digital tourism focuses on tourism as a service, with demand and supply sides. In the system environment, changes conducive to the development of digital tourism are highlighted. The possibility of digitizing other processes in the organization is also important, such as management tasks, marketing research and HR. Marketing tools (product, price, location, promotion, process, physical evidence, and human resources) connect tourists and service providers in tourist destinations. The picture shows that there are digitalization opportunities in

developing digital tourism systems, both from the consumer and service provider side in tourist destinations.

2.3 Digital Tourism Ecosystem

In the ecosystem*digital tourism* So the tourist travel process begins when the service provider provides services that are carried out in a comprehensive and integrated manner. In tourism services, there is a need for social interaction between tourism entities, tour guides, tourist routes, marketing recommendations for tourism services, tourist tickets, and recommendations for alternative tours and activities that support tourist trips and assistance for tourists. There is a need for an application that manages comprehensively and integratedly with regard to information on tourist attractions at a glance, security at tourist attractions, data mining of tourist attractions, tourist management, information on tourist attractions and supporting factors for tourist travel, management of tourist parking lots, statistical analysis of recommendations for tourist attractions, advertising businesses that support tourist activities, tourism e-commerce, and other services(Xia, 2022).
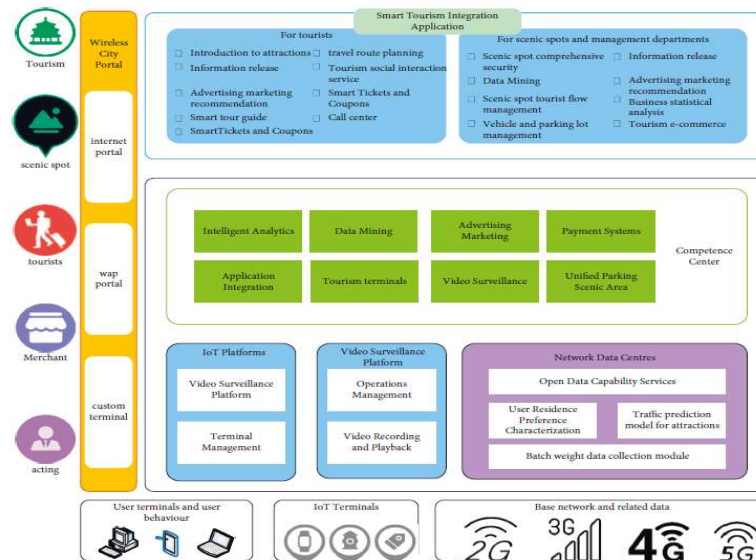

Figure 2.2: Digital Tourism Ecosystem

3. RESEARCH METHODS

This research study uses qualitative methods with literature review techniques, by collecting 37 published research studies or research journals. The data sources obtained include qualitative data through a process of selecting and simplifying the data

which is presented in descriptive narrative form and then conclusions are drawn gradually by considering the type of data obtained.

4. RESEARCH RESULTS AND DISCUSSION

4.1 Literature Summary Results

From previous collecting research carried out, it was found that 37 published articles were relevant to this research theme which can be summarized as follows:

Table 4.1

Summary of Journal Publications Related to the Digital Tourism Theme

No.	Researcher's name and year	Data analysis method	Research Results
1.	(Sangari et al., 2022)	Qualitative analysis uses Research and Development	The implementation of augmented reality for 94% of respondents considers that augmented reality applications are interesting and provide benefits for users to find out tourism potential.
2.	(Mekni & Lemieux, 2014)	*Descriptive Analysis*	The research results illustrate the various tasks that can be completed using augmented reality applications with mobile devices.
3.	(Bağçı et al., 2022)	*Descriptive Analysis*	From the research sample, it was found that there is basic information about augmented reality applications that the use of AR applications in tourism can have both positive and negative impacts on the opinions of prospective tourists in making tourism plans.
4.	(Alnagrat et al., 2021)	*Descriptive Analysis*	The use of virtual laboratories plays a big and effective role for students and universities, because the budget is smaller compared to real laboratories. In this paper, the role of virtual laboratories, using extended reality technology, and their impact on education and the future of virtual training in improving student efficiency will be discussed in this paper.
5.	(Villagran-Vizcarra et al., 2023)	*Literature Review*	The results of the exploration of 60 articles using the PRISMA method found benefits, challenges and problems in implementing augmented reality for future study and development.
6.	(El Kassis et al., 2023)	*Literature Review*	The benefits of using augmented reality are training, visualization and instant information sharing, decision making and intuitive interaction.

			The challenges of using augmented reality include: difficulty in manipulation, unfriendly interface, device discomfort, and bright sunlight. These findings provide valuable guidance for future researchers and practitioners, enabling them to utilize augmented reality for synchronous communication.
7.	(Althewaynee et al., 2022)	*Systematic literature review*	The results of a systematic review of literature on augmented reality in the tourism sector from 60 publications from 2017-2021 show that augmented reality technology has been used in the tourism industry and has various different characteristics in each research.
8.	(Čopič Pucihar & Kljun, 2021)	*Literature Review*	Augmented reality applications are able to support tourist travel activities and there is potential to be offered to tourists regarding augmented reality applications, prototypes and services in the future.
9.	(Cholis & Tjipta, 2023)	Qualitative analysis uses Research and Development	Testing with black box testing found that *augmented reality* and Location Based Services can run and provide results in accordance with research objectives and expectations.
10.	(Lamberti et al., 2014)	*Descriptive Analysis*	Augmented reality-based maintenance and repair procedures are available to end users of consumer electronic devices. New challenges and opportunities of augmented reality technology are being developed in the EASE-R3 project by leveraging reconfigurable augmented reality procedures and remote assistance to overcome some of the limitations of current solutions.
11.	(Horhoruw et al., 2023)	*Literature Review*	The augmented reality development process was carried out through the selection of the MAKAR platform which combines technological innovation with local wisdom. Overall, the MAKAR application has succeeded in providing a charming tourist experience. This research concludes that the development of AR through the MAKAR application has significant potential in preserving culture while providing innovative tourism experiences
12.	(Octaviani, 2023)	Qualitative analysis uses Research and Development	Augmented reality technology in the tourism sector can be used as a provider of various information that can help tourists, especially foreign tourists, to avoid confusion and fraud committed by local residents. Making the "TUK-AR" application using the Spark AR program which says

			rupiah as the target image needs to be adjusted to the criteria, the camera used, and the distance of the camera to the object. The "TUK-AR" application displays information in the form of name, value, exchange rate in USD for all rupiah in Indonesia which can be used anywhere, anytime via Android smartphone
13.	(Mutis & Ambekar, 2020)	*Descriptive Analysis*	Performance features such as motion tracking, localization, error dispersion with respect to lighting, system processing speed, and ambiguity in feature tracking are evaluated. i-Tracker contributes to the growing body of literature and current work on the use of positioning and tracking systems on real construction sites in the context of augmented reality. The research results advance understanding of the rapid implementation and use of augmented reality visualization on the job site, taking advantage of significant advances in mobile and ubiquitous computing with faster central processing units (CPUs) and graphics processing units (GPUs).
14.	(Nirmala et al., 2020)	*Descriptive Analysis*	One technology that can be utilized is augmented reality (AR). Using AR for cultural purposes has its own challenges but is not impossible. The existence of AR will make it easier for the public and tourists to access information about an art object. What's more, this information can be accessed in real time. With the increasing number of cultural works of art that convey meaning, information and facts about the local wisdom values contained therein, tourists will increasingly be aware of respecting, helping to preserve and protect them. This service is carried out in the form of implementing an AR application in the context of introducing tourist attractions in the form of building works of art such as architectural buildings and statues. The AR application implemented is location-based using Global Positioning System (GPS) technology.
15.	(Sya' Dani et al., 2021)	Qualitative analysis uses Research and Development	The Android-based "Tourist Attractions in Bogor" application using Augmented Reality (AR) technology and the Lucas Kanade Algorithm, as well as Marker Based Tracking can make it easier to get the information that tourism wants. By using Augmented Reality (AR) technology, photos, sound and 3D objects can be obtained

			which can bring virtual 3D objects into the real world. The "Tourist Attractions in Bogor" application uses Android Studio, Unity, Sketchup, Vuforia, and Visual Studio to make it easier for tourists to identify data on tourist attractions they want to visit.
16.	(Endarto & Martadi, 2022)	*Descriptive Analysis*	There is an opportunity to apply metaverse technology as educational media along with analysis of the application of Metaverse based on Augmented Reality and Virtual Reality. In terms of design, it has an important role in creating educational media in the Metaverse era, where design principles include layouting, typography, color principles, as well as perception of plane and space. needs to be implemented to build a comfortable virtual world experience for its users.
17.	(Rio et al., 2016)	Qualitative analysis uses Research and Development	Implementation of the Mobile Augmented Reality e-Booklet Model to see the effect of the distance between the smartphone camera and the marker, the distance obtained is ideal for displaying 3D objects, up to 40 cm. ARRiauTouris application testing was able to detect markers at a close distance of 10 cm and a maximum distance of 67 cm, and obtained an average time for the object (mean) between 0.80 seconds to 0.93 seconds.
18.	(ÖzkulL & Kumlu, 2019)	*Descriptive Analysis*	The implementation of augmented reality applications is increasingly being used in the tourism sector, providing extraordinary marketing convenience for businesses and destinations. Augmented reality applications, which play a major role in the traveler's journey, make consumers feel safer while making travel easier. It is estimated that all businesses that want to capture market progress in the coming years and aim to provide a competitive advantage by making a difference in influencing tourists will intensively use augmented reality applications.
19.	(Zholaushievna et al., 2022)	*Literature Review*	The implementation of augmented reality technology is used to develop students' cognitive interest in the learning process of various scientific disciplines.
20.	(Bretos et al., 2023)	*Literature Review*	The implementation of augmented reality in the tourism sector has seen real progress in recent years regarding various things, such as methodology, theories used or variables considered, etc. The future research agenda requires efforts to build a cohesive framework and

			encourage the development of augmented reality and virtual reality research in the field of tourism
21.	(Mohd et al., 2023)	*Descriptive Analysis*	Opportunities, challenges and future prospects of augmented reality technology are widely used in art and design, especially in product design, display design and interactive design taking into account market and industry factors. There is still a lack of attention from the academic community regarding the application of augmented reality and virtual reality technology in the field of art design.
22.	(Kharismajati et al., 2020)	Qualitative analysis uses Research and Development	Augmented Reality and Location Based Service technology can be used to introduce the public to tourist attractions in Purbalingga in an interesting way. It is hoped that the application of Augmented Reality technology and Android-based Location Based Service can invite people to interact while getting to know existing tourist attractions easily and interestingly.
23.	(Nugraha & Purwati, 2023)	*Literature Review*	The development of the Metaverse in the tourism industry provides a sense of satisfaction to tourists, where tourist satisfaction becomes a benchmark for the success of every business actor in the tourism service business. The metaverse business opportunity at museums in Jakarta is very good, with the application of metaverse technology such as Virtual Augmented (VR) and Augmented Reality (AR) expanding museum visitors and profitable market opportunities.
24.	(Latifah et al., 2022)	Qualitative analysis uses Research and Development	-Virtual campus facilities, starting from a description of the security post, parking, front office space, lecture classes, library, laboratory, hall, service room. Users can see the facilities in real life with the help of virtual robots and background music in exploring each location. The results of application satisfaction testing from users show very good acceptance. Future research is expected to add a location search feature and reduce the file size of the resulting application.
25.	(Palagiang & Sofiani, 2021)	Indicative qualitative analysis	Augmented Reality as an interactive promotional media at the Proclamation Manuscript Formulation Museum has a Digital Museum program using an application called Siji. This Siji application can be used by anyone, anytime and anywhere as long as they have good enough internet access. The Siji application works by downloading it to

			each cellphone or mobile phone and then scanning the image which can be scanned using the Siji application. In this case, the Museum for the Formulation of the Proclamation Manuscript has quite a lot of images that can be scanned by the Siji application, both directly at the museum and online via the Museum of the Formulation of the Proclamation Manuscript's social media, such as Instagram, Twitter and other museum social media. The research results showed that when interviewing visitors to provide Augmented Reality technology, the four visitors interviewed gave quite good answers and stated that Augmented Reality technology could indeed be an interactive promotional medium at the Proclamation Manuscript Formulation Museum.
26.	(Zaifri et al., 2023)	*Systematic Literature Review*	The research findings reveal a growing trend in research production, led by Europe and Asia. The main contexts for AR applications in tourism include cultural heritage, mobile AR, and smart tourism, with emerging topics such as artificial intelligence (AI), big data, and COVID 19. Frequently used AR design components consist of mobile devices, markerless tracking systems, outdoor environments, and visual overlays.
27.	(Ocampo & Palaoag, 2024)	*Descriptive Analysis*	Mobile Augmented Reality Applications are one of the most suitable applications to boost tourism activities. However, there are still existing needs and challenges that need to be addressed, these are a. technical requirements of the application, b. user acceptability in utilizing MAR, c. availability of special data regarding this tourist attraction.
28.	(Sugiono, 2021)	*Literature Review*	The level of public acceptance of AR is currently still low. However, this technology has great potential to support marketing communications activities in the future because it provides a pleasant digital experience in interacting with a product. Apart from that, AR technology is also in line with the IMC concept because it not only increases product sales but also shows the competitive advantage of a product or service. Marketing communication strategies using AR technology are currently still targeted at groups of people who are used to the latest technology.

29.	(Ghandour et al., 2021)	*Literature Review*	This research concludes with the opinion that stimulating clients' interest in the historical and cultural context of tourism by providing additional arguments and high-quality information about marketing proposals in a new and unusual way shapes the cultural, epistemic and educational values of augmented reality, necessary in sales, personnel training, and interaction with business partners.
30.	(Bhatt et al., 2020)	*Descriptive Analysis*	The use of augmented reality technology for innovation in everyday life is growing increasingly widespread. This innovation is also additionally applied in the travel industry. Currently, portable mobile application models to enhance the use of technology in the travel industry have been created by utilizing augmented reality innovation. Strategy needs, skills and deficiencies are described. This application expects to provide interactivity to the client when the items are differentiated so that more data can be obtained viewed. Unity 3D software with Vuforia Engine will be used to implement augmented reality technology and also Android application development tools as Android Studio will be used for mobile application development.
31.	(Triantafillidou & Lappas, 2022)	*Literature Review*	Based on the literature review this research develops a conceptual model that considers important antecedents that may influence tourists' intention to adopt mobile gamified augmented reality applications for tourism destinations. In addition, tourists' responses to the use of serious tourism games were also identified. The hypothesized This model shows that tourists' intention to use augmented reality serious games for tourism can be influenced by environmental factors regarding the application design, technical characteristics of the application as well as the features of the user's smart mobile device. Tourist characteristics related to personal and demographic characteristics, perceived benefits (enjoyment, ease of use and usefulness), and motivation (entertainment, knowledge, curiosity, exploration, immersion, escape, physical activity, social interaction) were also found to be factors. important in tourist

			activities. intention towards mobile augmented reality serious tourism games
32.	(Allcca-Alarcón et al., 2023)	*Systematic Literature Review*	The different contributions of AR are systematized, and the most widely used types of AR as well as the main factors influencing the improvement of tourism experiences with the support of AR-oriented applications have been rescued. Finally, a proposed model for building AR-related systems to provide better tourism experiences is presented.
33.	(Thomas, 2024)	*Literature Review*	High investment costs, seasonality of tourism products, lack of specialized staff, corporate culture, high taxes and the need for immediate results from business people strongly influence the desire to invest in the implementation of digital innovation tools. Companies operating in the Tourism sector should reconsider their strategies because implementing Digital Innovation can significantly increase their competitiveness, strengthen their company brand, provide competitive offers, attract more customers as well as foreign investment.
34.	(Keckes & Tomicic, 2017)	*Literature Review*	A comprehensive literature analysis was produced by identifying, compiling and categorizing the key factors that have the most relevant impact on the successful use of additional technology in the tourism sector.
35.	(Khalil, 2014)	*Literature Review*	The current application of augmented reality is not able to attract visitors to destinations or cultural attractions and this needs to be reconsidered. Conclusions and recommendations are presented to provide experts with the opportunity to develop augmented reality technology on a larger scale under certain circumstances
36.	(Jingen Liang & Elliot, 2021)	*Systematic Literature Review*	There are five existing and emerging research groups, with one dominant group focusing on user acceptance of augmented reality, generally applying a technology acceptance model. A meta-analysis of four empirical studies revealed that perceived ease of use had an overall impact of 52.79% on perceived usefulness. Finally, the concept map visually presents those constructs that have been explored across the clusters. Based on our review, future research directions are proposed to advance knowledge in the growing field of gamification, to explore

			the potential negative consequences of augmented reality, and to apply more innovative methods and study designs.

Source: Several research articles, 2024

4.2 Discussion

4.2.1 Potential in Implementing Digital Tourism

The application of Digital Tourism has a lot of potential that can change the way the tourism industry operates and interacts with tourists. Here are some of the main potentials:(Phuong, 2022)

1. Accessibility Improvements:By using digital technology, tourism destinations can become more accessible for everyone, including people with special needs. For example, apps and websites can be designed with accessibility features that allow users with a variety of needs to find information and travel plans more easily.

2. Enhanced Travel Experience: Technologies such as Augmented Reality (AR) and Virtual Reality (VR) can enhance the tourist experience by providing virtual tours of destinations, bringing history and culture to life, and displaying interactive information about tourist attractions.

3. More Effective Marketing: Digital Tourism allows tourism destinations to implement marketing strategies that are more targeted and measurable. Through data analysis and careful targeting, destinations can reach relevant audiences with appropriate messages.

4. Increased Tourist Engagement: Through social media, mobile apps, and other digital platforms, tourism destinations can interact directly with tourists, receive feedback, and promote user-generated content, which can increase user engagement and satisfaction.

5. Operational Optimization: The use of digital technology can help tourism destinations optimize their operations, from inventory and reservation management to queue management and customer service. This can improve efficiency and overall visitor experience.

6. Cultural and Environmental Preservation: Digital Tourism can also be used as a tool to promote cultural and environmental preservation. Through digital education campaigns, tourism destinations can raise awareness about the importance of preserving local cultural and natural heritage.

7. Income Diversification: By harnessing the potential of Digital Tourism, tourism destinations can develop new sources of income, such as online ticket sales, affiliate marketing, and partnerships with local or international brands.

8. Sustainable Innovation: Digital Tourism provides a platform for sustainable innovation in the tourism industry, whether in the use of renewable energy, waste management, or the development of environmentally friendly technologies for transportation and accommodation.

4.2.2 Opportunities in Implementing Digital Tourism

The application of Digital Tourism opens up various interesting opportunities in the tourism industry. Here are some opportunities according to research(Xalxo & Shree, 2019);(Kindzule-Millere & Zeverte-Rivza, 2022);(Thomas, 2024)among others :

1. Digital Marketing: Digital platforms such as websites, social media and mobile applications enable tourism destinations to promote themselves more effectively to a global audience. The right digital marketing campaign can increase the visibility of a tourist destination and attract potential tourists.

2. Virtual Experience: VR (Virtual Reality) and AR (Augmented Reality) technology allows tourists to get a virtual experience of a destination before they actually visit. This could be a virtual tour of the main attractions, hotels, or even city streets. This can help attract tourists and give them a better idea of what they can expect.

3. Tour Guide Application: Development of mobile applications that function as digital tourist guides can help tourists in planning their trips, finding tourist attractions, restaurants, transportation and other important information about the destination. Features such as interactive maps, audio guides, and recommendations based on user preferences can enhance the travel experience.

4. Online Ordering: Online booking platforms for accommodation, attraction tickets, transportation and tours can make it easier for tourists to plan and organize their trips. Smooth and secure booking system integration will increase tourists' comfort and confidence in the destination.

5. Tourism Data Analysis: The use of Big Data technology and data analysis can help tourism destinations understand tourist trends, visitor preferences and travel patterns. With a better understanding of the market, destinations can optimize their marketing strategies and improve the visitor experience.

6. Environmental Conservation: Digital technology can also be used to promote environmental conservation and sustainability in the tourism industry. For example,

apps that provide information about a trip's carbon footprint, recycling locations, or how to contribute to local nature conservation.

7. Personalizing the Traveler Experience: By using data collected from online behavior and user preferences, tourism destinations can provide a more personalized experience for each traveler. This can include recommendations for attractions, restaurants and activities tailored to individual interests and needs.

4.2.3 Trends in Implementing Digital Tourism

The development of digital tourism in 4 eras can be summarized as follows:(Kalandarovna et al., 2022)

Table 4.2

Digital Tourism Development Trends 1.0 to Digital Tourism4.0

Information	Digital Tourism 1.0	Digital Tourism 2.0	Digital Tourism 3.0	Digital Tourism 4.0
1.Technology	Manufacturing industry	Industry	Information technology (web 1.0, web 2.0, web 3.0 and web 4.0	Digital technology or artificial intelligence
2.Digital concept	Tradition, religion views, verbal advice	Television, radio, newspaper, telephone service, special service	Custom websites, interactive platforms, social networks, smartphone devices, custom services	Robots and chatbots, Virtual reality, augmented reality, big data
3. Goals	Make ends meet through trade, visits and treatment	Informing the number of tourists and encouraging tourist travel, developing cultural tourism and skills	Facilitate communication between tourism participants and ensure customer satisfaction and revenue generation	Shaping personal tourism experiences, building smart tourism, travel efficiency, and building a sense of social responsibility among participants
4.Scope of services	Regional	Local and global	Global	Global

Source :(Kalandarovna et al., 2022)

4.2.4 Challenges in Implementing Digital Tourism

Some of the challenges faced related to Digital Tourism include:(El Archi et al., 2023)

1. Lack of a comprehensive framework

   There is a need to develop holistic models that consider the interaction between digital technology, sustainability dimensions and destination-specific factors.

2. Limited Understanding of Technology Users

   There is a need to research and observe tourists' attitudes and perceptions towards digital innovation, their preferences for sustainable options, and the impact of digital interventions on their experiences.

3. Need to Measure the Sustainable Impact of Digital Technology

   Tourism managers need to establish a comprehensive evaluation framework to measure the ecological, socio-cultural and economic aspects of the impact of digital solutions on sustainable tourism development.

4. Data privacy and security issues

   It is necessary to choose the right method to protect the security of tourist data and ensure that their data is used responsibly and ethically.

5. The long-term impact of using digital tourism

   Research studies are needed regarding the long-term sustainability impact of the use of digital tourism technology to ensure its vital role in the world of tourism.

6. Collaboration with Parties Involved in Digital Tourism

   It is necessary to create governance models and strategies to facilitate effective collaboration between government, business, local communities and technology providers.

7. Cross-Cultural Perspectives

   This was done to identify similarities and differences in the adoption and impact of digital technology for sustainable tourism in various destinations and across cultures and across social areas.

8. Implementation of Management Strategy Using Intelligent Systems

   Tourist attraction management needs to implement strategies by utilizing intelligent systems that utilize the latest technology.

9. Implementation of Management Strategy Using Intelligent Systems

   Tourist attraction management needs to implement strategies by utilizing intelligent systems that utilize the latest technology.

5. CONCLUSION

Some conclusions from this literature review research include: (1) the application of digital tourism has a lot of potential that can change the way the tourism industry operates and interacts with tourists, including increased accessibility, enhanced tourism experiences based on AR and VR technology, as well as effective marketing. (2) The application of Digital Tourism opens up various interesting opportunities in the tourism industry, including: digital marketing, virtual tourist experiences with AR and VR, tour guide applications, online bookings, tourism data analysis, environmental conservation, and personalization of tourist experiences. (3) the development or trend of digital tourism in 4 eras has apparently experienced a significant increase and (4) Several challenges faced related to Digital Tourism include: lack of a comprehensive framework, limited understanding of technology users, the need to measure the sustainable impact of digital technology, privacy and data security issues, long-term impacts of using digital tourism, collaboration with parties involved in digital tourism, cross-cultural perspectives and implementation of management strategies using intelligent systems.

6. SUGGESTION

Future research studies need to use interview or survey methods, thereby providing a deeper understanding ofPotential, Opportunities, Trends and Challenges faced by managers of sustainable tourism destinations in adopting digital technology. Future research also needs to test with empirical studies on effective and appropriate digital tourism models.

7. REFERENCE

Allcca-Alarcón, L., Calagua-Montoya, J., Iparraguirre-Villanueva, O., & Cabanillas-Carbonell, M. (2023). Augmented Reality as an Option to Enhance the Tourism Experience - A Review. *International Journal of Engineering Trends and Technology*, *71*(4), 190–202. https://doi.org/10.14445/22315381/IJETT-V71I4P217

Alnagrat, A. J. A., Ismail, R. C., & Idrus, S. Z. S. (2021). Extended Reality (XR) in Virtual Laboratories: A Review of Challenges and Future Training Directions. *Journal of Physics: Conference Series*, *1874*(1), 1–17. https://doi.org/10.1088/1742-6596/1874/1/012031

Althewaynee, H. B., Hamood, M. M., & Hussein, H. A. (2022). a Systematic Review of Using Augmented Reality in Tourism Between 2017 and 2021. *ResearchJet Journal of Analysis and Inventions*, *3*(08), 18–45.

https://doi.org/10.17605/OSF.IO/DF4TZ

Ariza-Colpas, P. P., Piñeres-Melo, M. A., Morales-Ortega, R. C., Rodriguez-Bonilla, A.-F., Butt-Aziz, S., Naz, S., del Carmen Contreras-Chinchilla, L., Romero-Mestre, M., & Ascanio, R. A. V. (2023). Augmented Reality and Tourism: A Bibliometric Analysis of New Technological Bets in the Post-COVID Era. *Sustainability*, *15*(15358), 1–29. https://doi.org/10.3390/su152115358

Bağçı, E., Yeşildağ, G. N. Y., & Taşkın, F. (2022). Potential Tourists' Opinions on Augmented Reality Applications in Tourism Industry. *ROMAYA : Researches on Multidisiplinary Approaches*, *2*(1), 64–75. https://www.researchgate.net/profile/Ebru-Bagci/publication/360247451_Potential_Tourists'_Opinions_on_Augmented_Reality_Applications_in_Tourism_Industry/links/628dc0bcd4e5243d9b9835bb/Potential-Tourists-Opinions-on-Augmented-Reality-Applications-in-Touris

Bhatt, P., Panchal, K., PATEL, H., & Rote, U. (2020). Tourism Application Using Augmented Reality. *SSRN Electronic Journal*, *1*(1), 1–5. https://doi.org/10.2139/ssrn.3568709

Bretos, M. A., Ibáñez-Sánchez, S., & Orús, C. (2023). Applying Virtual Reality and Augmented Reality to The Tourism Experience: A Comparative Literature Review. *Spanish Journal of Marketing - ESIC*, *1*(1), 1–23. https://doi.org/10.1108/SJME-03-2023-0052

Cholis, M. N., & Tjipta, D. S. (2023). Augmented Reality Sebagai Sarana Informasi Wisata Peradaban Candi Menggunakan Local Based Services. *JUTECH : Journal Education and Technology*, *4*(2), 208–221.

Čopič Pucihar, K., & Kljun, M. (2021). *Augmented Reality Systems and Their Future in Tourism: Before, During and After the Journey*. *April*, 49–67. https://doi.org/10.1007/978-3-030-70198-7_3

Demolingo, R. H., & Remilenita, S. (2023). Strategi Penerapan Metaverse Tourism pada Pameran Ruang ImersifA di Museum Nasional Jakarta. *Jurnal Manajemen Perhotelan Dan Pariwisata*, *6*(2), 341–352. https://doi.org/10.23887/jmpp.v6i2.61115

Dwivedi, Y. K., Hughes, L., Baabdullah, A. M., Ribeiro-Navarrete, S., Giannakis, M., Al-Debei, M. M., Dennehy, D., Metri, B., Buhalis, D., Cheung, C. M. K., Conboy, K., Doyle, R., Dubey, R., Dutot, V., Felix, R., Goyal, D. P., Gustafsson, A., Hinsch, C., Jebabli, I., … Wamba, S. F. (2022). Metaverse beyond the hype: Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for research, practice and policy. *International Journal of Information Management*, *66*(1), 1–55. https://doi.org/10.1016/j.ijinfomgt.2022.102542

El Archi, Y., Benbba, B., Kabil, M., & Dávid, L. D. (2023). Digital Technologies for Sustainable Tourism Destinations: State of the Art and Research Agenda. *Administrative Sciences*, *13*(8), 1–21. https://doi.org/10.3390/admsci13080184

El Kassis, R., Ayer, S. K., & El Asmar, M. (2023). Augmented Reality Applications for Synchronized Communication in Construction: A Review of Challenges and

Opportunities. *Applied Sciences (Switzerland)*, *13*(13), 1–15. https://doi.org/10.3390/app13137614

Endarto, I. A., & Martadi. (2022). Analisis Potensi Implementasi Metaverse Pada Media Edukasi Interaktif. *Jurnal Barik*, *4*(1), 37–51. https://ejournal.unesa.ac.id/index.php/JDKV/

Ernawati, H., & Hananto, K. (2023). Pariwisata Digital : Perspektif dan Agenda Riset Masa Depan. *Kepariwisataan: Jurnal Ilmiah*, *17*(2), 144-156.

Ghandour, A., Kintonova, A., Demidchik, N., & Sverdlikova, E. (2021). Solving Tourism Management Challenges by Means of Mobile Augmented Reality Applications. *International Journal of Web-Based Learning and Teaching Technologies*, *16*(6), 1–16. https://doi.org/10.4018/IJWLTT.293280

Habibah, A., Pujiarti, D. A., Widyanti, A., & Soetisna, H. R. (2021). The Potential and Challenges of Virtual Reality in Indonesia. *Proceedings of the Second Asia Pacific International Conference on Industrial Engineering and Operations Management*, *2027*(Lin 2020), 2811–2819.

Happ, E., & Ivancsó-Horváth, Z. (2018). Digital Tourism Is The Challenge Of Future. *Knowledge Horizons - Economics*, *10*(2), 9–16.

Horhoruw, F. L. M., Noviyanti, Mira, & Nadapdap, J. P. (2023). Development of Augmented Reality Technology in Tourism as an Effort to Preserve Local Culture. *Jurnal Info Sains : Informatika Dan Sains*, *13*(03), 882–887.

Jingen Liang, L., & Elliot, S. (2021). A Systematic Review of Augmented Reality Tourism Research: What is now and what is next? *Tourism and Hospitality Research*, *21*(1), 15–30. https://doi.org/10.1177/1467358420941913

Kalandarovna, A. G., Tashtemirovich, O. A., Bakhodirovich, S. G., & Irmatova, A. B. (2022). TOURISM 4.0: OPPORTUNITIES for APPLYING INDUSTRY 4.0 TECHNOLOGIES in TOURISM. *ACM International Conference Proceeding Series*, *1*(1), 33–38. https://doi.org/10.1145/3584202.3584208

Keckes, A., & Tomicic, I. (2017). Augmented Reality in Tourism - Research and Applications Overview. *Interdisciplinary Description of Complex Systems*, *15*(1), 157–167. https://doi.org/10.7906/indecs.15.2.5

Khalil, N. I. (2014). Applications of Augmented Reality in cultural tourism: The case of Bibliotheca Alexandrina. *Journal of Association of Arab Universities for Tourism and Hospitality*, *11*(3), 182–188. https://doi.org/10.21608/jaauth.2014.57571

Kharismajati, G., Umar, R., & Sumardi. (2020). Penerapan Augmented Reality Location Based Service Obyek Wisata Purbalingga Berbasis Android. *Seminar Nasional Dinamika Informatika Universitas PGRI Yogyakarta*, 1–7.

Kindzule-Millere, I., & Zeverte-Rivza, S. (2022). Digital transformation: Opportunities and challenges. *International Conference : Economic Science For Rural Development*, *56*, 33–52. https://doi.org/10.4018/978-1-7998-9117-8.ch003

Lamberti, F., Manuri, F., Sanna, A., Paravati, G., Pezzolla, P., & Montuschi, P. (2014). Challenges, opportunities, and future trends of emerging techniques for augmented reality-based maintenance. *IEEE Transactions on Emerging Topics in Computing*, *2*(4), 411–421. https://doi.org/10.1109/TETC.2014.2368833

Latifah, A., Satria, E., & Hermawan, A. (2022). Penerapan Augmented Reality untuk Informasi Denah Kampus Institut Teknologi Garut. *Jurnal Algoritma*, *19*(2), 770–780. https://doi.org/10.33364/algoritma/v.19-2.1233

Mekni, M., & Lemieux, A. (2014). Augmented Reality : Applications , Challenges and Future Trends. *Applied Computational Science Anywhere, 1*(1), 205–214.

Mohd, C. K. N. C. K., Shahbodin, F., Sedek, M., Zakaria, T. T., Anggrawan, A., & Kasim, H. M. (2023). Unveiling the Potential of Mixed Reality: Opportunities, Challenges and Future Prospects. *Journal of Theoretical and Applied Information Technology*, *101*(20), 6650–6662.

Mutis, I., & Ambekar, A. (2020). Challenges and Enablers of Augmented Reality Technology for In Situ Walkthrough Applications. *Journal of Information Technology in Construction*, *25*(October 2019), 55–71. https://doi.org/10.36680/j.itcon.2020.003

Nirmala, B. P. W., Utama, N. W., & Paramitha, A. A. I. I. (2020). Implementasi Aplikasi Augmented Reality Berbasis Lokasi Untuk Pengenalan Atraksi Wisata di Kota Denpasar. *Jurnal Karya Abdi*, *4*(2), 339–343. https://doi.org/10.22437/jkam.v4i2.11271

Nugraha, R. N., & Purwati, A. S. Y. (2023). Peluang Pasar Metaverse Tourism Pada Objek Wisata Museum Di Jakarta. *Jurnal Ilmiah Wahana Pendidikan*, *9*(11), 486–503.

Ocampo, A. J., & Palaoag, T. (2024). Improving tourism experience in open data environment with mobile augmented reality: Needs and challenges. *IOP Conference Series: Materials Science and Engineering*, *482*(1), 1–7. https://doi.org/10.1088/1757-899X/482/1/012005

Octaviani, A. W. (2023). Pemanfaatan Augmented Reality sebagai Media Pengenalan Mata Uang Indonesia Kepada Turis Asing Berbasis Smartphone. *JIIP - Jurnal Ilmiah Ilmu Pendidikan*, *6*(3), 2138–2145. https://doi.org/10.54371/jiip.v6i3.1911

ÖzkulL, E., & Kumlu, S. T. (2019). Augmented Reality Applications in Tourism. *International Journal of Contemporary Tourism Research*, *3*, 107–122. https://doi.org/10.30625/ijctr.625192

Palagiang, C. L., & Sofiani, S. (2021). Augmented Dan Virtual Reality Sebagai Media Promosi Interaktif Museum Perumusan Naskah Proklamasi. *Destinesia : Jurnal Hospitaliti Dan Pariwisata*, *3*(1), 12–20. https://doi.org/10.31334/jd.v3i1.1801

Phuong, N. M. (2022). Opportunities and Challenges of Digital Transformation of China's Cultural Tourism Industry. *International Journal of Economic, Business and Management Research*, *6*(12), 17–29. https://doi.org/10.54691/bcpbm.v44i.4854

Popescu, E. S., & Phi, G. (2019). The digital transformation of tourism SMEs in the European Union: Challenges, opportunities, and support. ... . *Aau. Dk, Recuperado: Https://Projekter. Aau* .... https://projekter.aau.dk/projekter/files/306181233/European_Tourism_SMEs_in_a_Digital_Context.pdf

Purike, E., Kurniasih, I. W., Wulandari, F. W., & Nirwani, A. (2022). Transaksi Digital dan Perkembangan e-Tourism di Indonesia. *NAWASENA : Jurnal Ilmiah Pariwisata*, *1*(2), 12–19. https://doi.org/10.56910/nawasena.v1i2.157

Rio, U., Erlinda, S., & Haryono, D. (2016). Implementasi Model Mobile Augmented Reality e-Booklet untuk Mempromosikan Object Wisata Unggulan Provinsi Riau dengan Metode 3D Object Tracking. *INOVTEK Polbeng - Seri Informatika*, *1*(2), 177–191. https://doi.org/10.35314/isi.v1i2.137

Sangari, M., Virginia, T., & Rumbayan, M. (2022). Implementation of Augmented Reality Technology in Lalumpe Village to Realize a Digital Tourism Village. *E-Journal UNSRAT*, *11*(2), 109–120. https://ejournal.unsrat.ac.id/v2/index.php/elekdankom/article/download/41058/37496

Saniati, S., Assuja, M. A., Neneng, N., Puspaningrum, A. S., & Sari, D. R. (2022). Implementasi E-Tourism sebagai Upaya Peningkatan Kegiatan Promosi Pariwisata. *International Journal of Community Service Learning*, *6*(2), 203–212. https://doi.org/10.23887/ijcsl.v6i2.45559

Simamora, A. S., & Sudiarta, I. K. (2020). Pengaturan Digital Tourism Dalam Pariwisata Di Kawasan Danau Toba Berdasarkan Permenparekraf Nomor 12 Tahun 2020. *Jurnal Kertha Desa*, *11*(5), 2427–2438.

Sufi, S., & Sabri, J. (2020). Perwujudan Industri Pariwisata 4.0 Melalui Implementasi Digital Tourism Di Kota Lhokseumawe. *Jurnal Ilmu Sosial Dan Ilmu Politik Malikussaleh (JSPM)*, *1*(1), 79. https://doi.org/10.29103/jspm.v1i1.3015

Sugiono, S. (2021). Tantangan dan Peluang Pemanfaatan Augmented Reality di Perangkat Mobile dalam Komunikasi Pemasaran. *Jurnal Komunika: Jurnal Komunikasi, Media Dan Informatika*, *10*(1), 1–12. https://doi.org/10.31504/komunika.v10i1.3715

Sya' Dani, F. A., Wahyuddin, M. I., & Winarsih, W. (2021). Augmented Reality Objek Wisata Bogor Menggunakan Algoritma Lucas Kanade Dengan Metode Marker Based Tracking. *Jurnal Media Informatika Budidarma*, *5*(3), 1179–1186. https://doi.org/10.30865/mib.v5i3.3088

Thomas, G. (2024). Challenges and Trends of Digital Innovation in the Tourism Sector: Contemporary Literature Review. *Open Journal of Business and Management*, *12*(01), 179–190. https://doi.org/10.4236/ojbm.2024.121013

Triantafillidou, A., & Lappas, G. (2022). Virtual and Augmented Reality in Serious Tourism Games: Opportunities, Tourist Motives, and Challenges. *SHS Web of Conferences*, *139*(03021), 1–9. https://doi.org/10.1051/shsconf/202213903021

Villagran-Vizcarra, D. C., Luviano-Cruz, D., Pérez-Domínguez, L. A., Méndez-González, L. C., & Garcia-Luna, F. (2023). Applications Analyses, Challenges and Development of Augmented Reality in Education, Industry, Marketing, Medicine, and Entertainment. *Applied Sciences (Switzerland)*, *13*(5), 1–30. https://doi.org/10.3390/app13052766

Wilson, J. (2019). Potensi Implementasi Digital Tourism/E-Tourism dalam Meningkatkan Tingkat Hunian pada Homestay di Kabupaten Humbahas Desa Bakti Raja. *Jurnal Akademi Pariwisata Medan*, *7*(2), 11–24. https://doi.org/10.36983/japm.v7i2.45

Xalxo, M. M., & Shree, M. V. (2019). A study on Digital Transformation in tourism sector-Challenges and Opportunities. *IJRAR : International Journal of Research and Analytical Reviews*, *6*(1), 203–212. www.ijrar.org

Xia, W. (2022). Digital Transformation of Tourism Industry and Smart Tourism Recommendation Algorithm Based on 5G Background. *Mobile Information Systems*, *1*(1), 1–13. https://doi.org/10.1155/2022/4021706

Yanti, D. (2019). Analisis Strategi Pengembangan Digital Tourism Sebagai Promosi Pariwisata Di Toba Samosir. *Jurnal Darma Agung*, *27*(1), 814. https://doi.org/10.46930/ojsuda.v27i1.137

Zaifri, M., Khalloufi, H., Kaghat, F. Z., Azough, A., & Zidani, K. A. (2023). From Earlier Exploration to Advanced Applications: Bibliometric and Systematic Review of Augmented Reality in the Tourism Industry (2002–2022). *Multimodal Technologies and Interaction*, *7*(64), 1–24. https://doi.org/10.3390/mti7070064

Zholaushievna, N. G., Abdrakhmanov, R., Adylbekova, E., & Danebekkyzy, K. G. (2022). Applying Augmented and Virtual Reality in Online and Offline Educaion. *Journal of Theoretical and Applied Information Technology*, *100*(8), 2528–2541.