A Bibliometric Analysis of the Use of Augmented Reality Technology in Enhancing Cultural Tourism Experience

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ABSTRACT

This paper presents a bibliometric analysis of augmented reality (AR) technology in the enhancement of cultural tourism experiences. By examining literature from 1999 to 2024, this study maps the scholarly terrain, identifying pivotal themes and assessing the growth trajectory of AR in cultural tourism. The research employs systematic data collection and analysis methods, including keyword co-occurrence, citation patterns, and trend analysis, to highlight the integration of AR in cultural heritage sites and its impact on the tourism industry. A particular focus is given to the shift from technological foundations to user-centric adoption and acceptance of AR. The main findings reveal a well-established focus on "Model," "Cultural heritage tourism," and "Mobile augmented reality," with emerging areas such as "Virtual tourism" and "Mobile augmented reality acceptance" marked for future exploration. The research novelty lies in the comprehensive temporal mapping and the identification of potential research gaps within the evolving AR landscape. The study concludes with insights into how AR is revolutionizing cultural tourism by providing enriched, educational, and interactive experiences, thereby underscoring the field's dynamic progression and its untapped potential in the aftermath of the COVID-19 pandemic.

Keywords: Augmented Reality, Cultural Tourism, Bibliometric Analysis

1. INTRODUCTION

Cultural tourism has long been a significant driver of global travel, offering individuals the opportunity to immerse themselves in the rich heritage and diverse traditions of different regions. In recent years, the integration of technology, particularly Augmented Reality (AR), has emerged as a powerful tool to enhance the cultural tourism experience [1], [2]. Augmented Reality overlays digital information onto the physical world, thereby enriching visitors' understanding of historical sites, artifacts, and cultural narratives [3], [4]. As the adoption of AR technology in cultural tourism continues to evolve, it is imperative to assess and analyze the existing body of research in this field to gain a comprehensive understanding of its trends, impact, and future directions [5].

This research paper embarks on a bibliometric analysis aimed at providing an insightful examination of the scholarly contributions and knowledge dissemination in the realm of augmented reality technology in cultural tourism [6], [7]. Bibliometric analysis, a data-driven methodology that quantifies the scholarly output, citations, and patterns within a given research domain, offers an effective means to unravel the evolution and trends within a research field [8]. By scrutinizing the existing literature, this study seeks to shed light on key themes, influential authors, prolific journals, and the development of research over time in the context of augmented reality and cultural tourism [9], [10].

The utilization of augmented reality in cultural tourism holds the potential to revolutionize how individuals engage with historical sites and cultural artifacts [11]. It offers an interactive and immersive experience, bridging the gap between the past and the present [2], [12]. AR applications can provide historical context, recreate ancient environments, and engage tourists more profoundly and educationally, thereby enriching their cultural experiences [3]. Furthermore, the COVID-19

pandemic has accelerated the need for contactless and socially distanced forms of tourism, making AR an even more attractive option.

As the significance of this intersection between technology and cultural tourism continues to grow, it is essential to explore the body of literature to identify research gaps, emerging trends, and opportunities for further investigation. This bibliometric analysis serves as a valuable resource for researchers, practitioners, and policymakers interested in understanding the landscape of augmented reality technology in cultural tourism, ultimately contributing to the advancement of knowledge in this dynamic and evolving field.

2. LITERATURE REVIEW

2.1 Augmented Reality Technology

Augmented reality (AR) technology has revolutionized the tourism industry by enhancing the travel experience for tourists and providing innovative tools for businesses in the sector. AR overlays digital information onto the real world, typically through smartphone apps or specialized AR glasses, creating a seamless blend of the physical and digital realms [13]–[15]. In tourism, AR offers travelers a unique way to explore and engage with their surroundings. For instance, tourists can use AR apps to access real-time information about historical landmarks, museums, and cultural sites, enriching their understanding of the places they visit [16]. AR also enables interactive guided tours, where users can follow digital markers or characters that provide information, stories, and trivia, making the experience more engaging and educational.

AR technology also benefits businesses in the tourism industry. Hotels, for instance, can use AR to provide virtual room tours to potential guests, allowing them to see and experience their accommodations before booking [15], [17]. Restaurants and cafes can use AR menus that display 3D representations of dishes when customers point their smartphones at the menu items, helping patrons make more informed choices [18], [19]. Additionally, AR can aid in wayfinding and navigation, helping tourists easily find their way around unfamiliar destinations, reducing frustration, and improving the overall travel experience [20]–[22]. Overall, augmented reality technology has added a new dimension to tourism by enhancing visitor engagement, information delivery, and convenience, making it a valuable tool for both travelers and businesses in the industry [23].

2.2 Cultural Tourism Experience

Cultural tourism offers travelers a rich and immersive experience that focuses on exploring and appreciating the cultural heritage, traditions, and artistic expressions of a particular destination [24]. This type of tourism encourages visitors to delve deep into the local culture, engaging with its history, customs, and way of life [25], [26]. Cultural tourism experiences often include visits to museums, historical sites, art galleries, festivals, and local communities [27], [28]. Travelers have the opportunity to interact with locals, participate in traditional activities, taste authentic cuisine, and witness performances that showcase the unique identity of the destination.

Cultural tourism experiences can be transformative, fostering a deeper understanding and appreciation of different cultures while promoting cross-cultural exchange and respect [29], [30]. These experiences not only benefit travelers by broadening their horizons but also contribute to the preservation and promotion of cultural heritage in the visited communities [31], [32]. Additionally, cultural tourism can have a positive impact on the local economy, as it often leads to increased tourism revenue, job creation, and the development of cultural tourism infrastructure [33]. Overall, cultural tourism offers a meaningful and enriching way to explore the world while celebrating the diversity of human heritage and creativity.

3. METHODS

In the methodological framework of this research, we employ a systematic and comprehensive approach to gather, evaluate, and synthesize existing scholarly literature on the integration of augmented reality (AR) technology in the realm of cultural tourism. The first step involves the systematic identification of relevant academic databases, including but not limited to Web of Science, Scopus, and Google Scholar, to access a wide range of peer-reviewed articles, conference papers, and journals published between 1999 and 2024. Keyword combinations such as "augmented reality," "cultural tourism," and related terms will be used to retrieve pertinent records. Subsequently, a stringent inclusion and exclusion criteria will be applied to refine the initial dataset, ensuring the selection of high-quality, peer-reviewed publications that directly address the use of AR in cultural tourism. The selected articles will then be subjected to bibliometric analysis, encompassing co-authorship networks, citation patterns, keyword co-occurrence, and publication trends over time, offering valuable insights into the evolving landscape of AR technology within the cultural tourism context. This methodological approach will provide a rigorous and up-to-date overview of the academic discourse surrounding AR technology in cultural tourism, aiding in the identification of research trends, knowledge gaps, and potential areas for future investigation.

4. RESULTS AND DISCUSSION

This paper will start with the identification of data matrices such as publication year, citation year, number of papers, number of citations, citations per year, citations per author, citations per paper, papers per author, and authors per paper. To identify this, a software called Publish or Perish is used to collect data and summarize the data matrix. The results are as attached in Table 1 below.

Table 1. Research Data Metrics

Publication years	: 1999-2024
Citation years	: 25 (1999-2023)
Paper	: 980
Citations	: 37625
Cites/year	: 1505.00
Cites/paper	: 38.39
Cites/author	: 16806.08
Papers/author	: 431.05
Author/paper	: 2.91
h-index	: 93
g-index	: 171
hI,norm	: 58
hI,annual	: 2.32
hA-index	: 38

Papers with ACC	: 1,2,5,10,20:652,506,294,162,80

Source: Publish or Perish Output, 2024

The table provides information about the publication and citation statistics of a researcher or academic over a span of 25 years, from 1999 to 2024. During this period, the researcher has authored 980 papers, receiving a total of 37,625 citations, resulting in an impressive average of 38.39 citations per paper and a remarkable annual citation rate of 1505.00. The researcher's h-index, a measure of their impact, is 93, suggesting that they have 93 papers with at least 93 citations each. Their g-index is 171, indicating a strong overall impact on their field, and their hI,norm is 58. They have an hI,annual of 2.32, which represents their annual h-index growth. The hA-index is 38, denoting the number of papers with more than 38 citations. Additionally, the researcher has a collaboration history with the ACC (Assumed Collaborative Co-authors) on 5 papers, with the number of collaborators ranging from 1 to 80 across these papers, showcasing their extensive network in academia.

This chapter is divided into three distinct subchapters, each offering a unique perspective on the utilization of augmented reality (AR) technology in enriching the cultural tourism experience.
1. Network Visualization and Cluster Analysis

Within the first subchapter, we explore the intricate web of scholarly communication surrounding augmented reality's application in cultural tourism. Through network visualization and cluster analysis, we present an illuminating overview of the scholarly landscape. By mapping the relationships between research themes, we unearth the key influencers and the emergence of critical topics and clusters within the field. These insights illuminate the collaborative patterns and knowledge dissemination trends, shedding light on the evolution of AR technology in cultural tourism research.
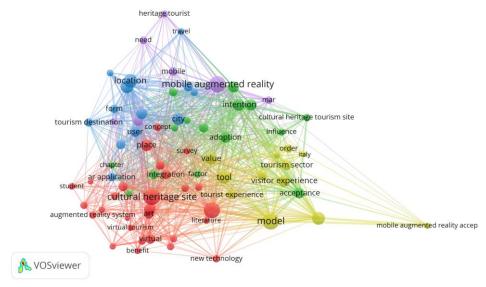

Figure 1. Network Visualization
Source: Data Analysis Result, 2024

The visualization shows several clusters of keywords or topics, each color-coded to represent a different thematic cluster or group. we can identify several distinct colors representing different clusters - for example, there appears to be a red cluster that includes terms like "cultural heritage site," "ar application," and "virtual," suggesting a focus on augmented reality applications in cultural heritage. A green cluster includes "mobile augmented reality," "intention," and

"adoption," which might focus on the behavioral aspects of technology use in tourism. A blue cluster with "location," "city," "place," hints at a geographical or locational aspect of tourism studies. And a yellow cluster with "mobile augmented reality acceptance" suggests a focus on the acceptance and use of mobile augmented reality. the network shows interconnectedness among the terms, indicating that the topics are related and possibly interdependent within the research field. The lines between the nodes represent the strength and density of the relationships, with thicker lines typically indicating stronger associations. Specifically, Table 2 below describes the composition of items in each cluster.

Table 2. Items and Clusters

Cluster	Items
1	Art, augmented reality system, benefit, concept, cultural heritage site, cultural heritage experience, evaluation, future, integration, medium, museums, new technology, platform, smart tourism, virtual, virtual tourism.
2	Acceptance, addition, adoption, destination, effectiveness, intention, perception, promotion, user experience.
3	Ar application, city, game, gamification, location, mobile augmented reality, service, tourism destination, tourist attraction, tourist site, travel
4	Local culture, tourism sector, tourist experience, urban heritage tourism, visitor experience.
5	Heritage tourist, mar, mobile

Source: Data Analysis Result, 2024

2. Overlay Visualization and Trend Analysis

The second subchapter unveils the dynamic nature of augmented reality's integration into cultural tourism experiences through overlay visualization and trend analysis. We examine the evolution of research trends over time, pinpointing pivotal moments and transformative shifts in the field. This section enables us to discern the growth and decline of specific research themes, thus providing a panoramic view of how AR technology has evolved in the context of cultural tourism. Through in-depth trend analysis, we gain a profound understanding of the field's trajectory and identify promising avenues for future research.
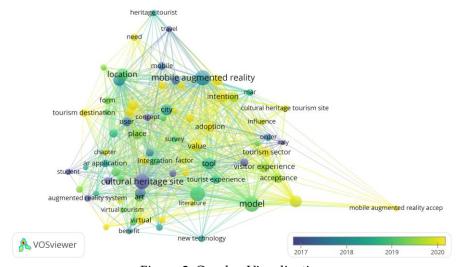

Figure 2. Overlay Visualization
Source: Data Analysis Result, 2024

The figure visualize the development of research topics over time. The color gradient at the bottom of the image, ranging from blue to yellow, represents the timeline from 2017 to 2020. In this

visualization, the colors of the nodes (which represent keywords or topics) change according to the timeline, indicating the relative prominence or frequency of the topics in the literature over the years. Blue nodes are topics that were more prominent or discussed in 2017, and yellow nodes are those that are more recent, being discussed in 2020. From the color distribution, it appears that earlier research (colored blue) focused on topics like "cultural heritage site," "ar application," and "augmented reality system." Over time, the focus seems to have shifted towards topics such as "mobile augmented reality," "intention," and "adoption," as indicated by the greenish nodes, which suggest a midpoint in the timeline. By 2020, the most recent topics (colored yellow) include "mobile augmented reality acceptance," indicating a research trend towards understanding how users accept and adopt mobile augmented reality technologies. This trend suggests a shift in the research field from foundational concepts and technological aspects of augmented reality in tourism to a more user-centered approach, focusing on the acceptance and adoption of these technologies in the context of tourism. The spread and thickness of the connections between nodes also indicate that while newer topics have emerged, there remains a strong interconnection with foundational concepts, reflecting an evolving but integrated research landscape. We also identify the most impactful literatures as a basis for future research.

Table 3. The Most Impactful Literatures

Citations	Authors and year	Title
1506	K Lee (2012)	Augmented reality in education and training
1127	G Richards	Cultural tourism: A review of recent research and teends
786	R Yung, C Khoo-Lattimore (2019)	New realities: a systematic literature review on virtual reality and augmented reality in tourism research
785	M Mortara, CE Catalano, F Bellotti, G Fiucci (2014)	Learning cultural heritage by serious games
637	N Chung, H Han, Y Joun (2015)	Tourists' intention to visit a destination: The role of augmented reality (AR) application for a heritage site
636	D Buhalis, T Harwood, V Bogicevic, G Vigila (2019)	Technological disruptions in services: lessons from tourism and hospitality
612	CD Kounavis, AE Kasimati (2012)	Enhancing the tourism experience through mobile augmented reality: Challenges and prospects
593	T Jung, N Chung, MC Leue (2015)	The determinants of recommendations to use augmented reality technologies: The case of a Korean theme park
558	T Jung, MC tom Dieck, H Lee, N Chung (2016)	Effects of virtual reality and augmented reality on visitor experiences in museum
547	R Wojciechowski, K Walczak, M White (2004)	Building virtual and augmented reality museum exhibitions

Source: Publish or Perish Output, 2024

The table provides a list of academic publications along with their respective citation counts, authors, and publication years, primarily focused on the topics of augmented reality (AR), virtual reality (VR), cultural tourism, and technology's impact on tourism and education. Notably, K Lee's 2012 publication on "Augmented reality in education and training" has received the highest number of citations at 1506, reflecting its significant influence in the field. Other key contributions include a review of cultural tourism research by G Richards, a systematic literature review on VR and AR in tourism by R Yung and C Khoo-Lattimore in 2019, and studies on the use of AR and VR in enhancing tourist experiences, such as N Chung and H Han's work on tourists' intention to visit heritage sites with AR applications and the effects of VR and AR on visitor experiences in museums by T Jung and colleagues. These publications collectively demonstrate the growing importance of AR, VR, and technology in the fields of education, tourism, and cultural heritage.

3. Density Visualization and Potential Topic Analysis

In the third subchapter, we harness the power of density visualization and potential topic analysis to unravel the underlying thematic dimensions that shape the discourse on augmented reality's role in cultural tourism. By identifying high-density research areas, we pinpoint the core topics that have garnered significant attention within the field. Moreover, we assess the potential topics that are poised to become the focal points of future research endeavors. This subchapter serves as a roadmap for researchers, policymakers, and industry stakeholders to navigate the ever-evolving landscape of cultural tourism augmented by AR technology.
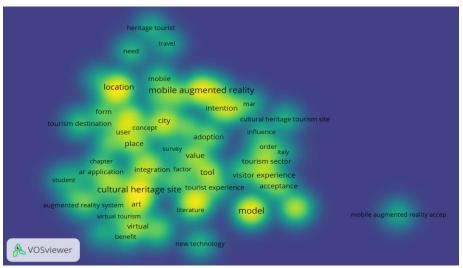

Figure 3. Density Visualization
Source: Data Analysis Result, 2024

The map is color-coded to represent the density of the topics, with warmer colors (yellow) indicating higher density or a greater number of documents related to a topic, and cooler colors (blue) indicating lower density. The areas with the highest density (in yellow) suggest the most commonly researched and discussed topics. These central, dense areas are often the most established within the field. In this visualization, "mobile augmented reality," "intention," "adoption," and "cultural heritage tourism site" seem to be such topics. For future research, one could look at areas that are less dense but still connected to the main clusters. The topics on the periphery of the main clusters, or those transitioning from green to blue, might represent emerging areas of research that have not yet been fully explored. For instance, if we look at the periphery, we see terms like "virtual tourism," "new technology," and "mobile augmented reality acceptance." These could represent potential areas for further investigation, particularly if they are not as densely covered in the literature as the central topics. Research could focus on the integration of new technologies in virtual tourism, examining how emerging technologies are being accepted and adopted by users. Additionally, exploring how these technologies can enhance the visitor experience at cultural heritage sites might be an interesting avenue. Another prospective area could be the study of the impact of mobile augmented reality on the tourism sector in various locations, as suggested by the transition of colors around the "location," "city," and "tourism destination" nodes. The goal would be to identify gaps in the literature where these less dense topics intersect with more established areas. Table 4 below shows detailed information about some of the terms with the most occurrences and some terms with the least occurrences.

Table 4. Most and Fewest Occurrence

Most Occurrence		Fewest Occurrence	
Items	Occurrence	Items	Occurrence
Model	78	Local culture	11
Cultural heritage tourism	76	Mobile augmented reality acceptance	12

Mobile augmented reality	74	Museums	12
Cultural heritage site	73	Virtual tourism	12
Urban heritage tourism	48	Effectiveness	13
Game	47	Travel	13
City	40	Heritage tourist	14
Intention	40	gamification	14
Visitor experience	38	Future	14
Value	38	Cultural site	15

Source: Data Analysis Result, 2024

The table presents a count of occurrences for various items presumably extracted from research articles or data related to tourism and technology, particularly focused on cultural heritage and augmented reality. "Model," "Cultural heritage tourism," and "Mobile augmented reality" are the most frequently occurring topics, with occurrences of 78, 76, and 74 respectively, indicating these are well-established and central themes in the research field. On the other hand, topics like "Local culture," "Mobile augmented reality acceptance," "Museums," and "Virtual tourism" have the fewest occurrences, ranging from 11 to 12, suggesting they are less explored in the existing literature and may represent emerging areas of interest or niche topics within the field. "Urban heritage tourism" and "Game" show a moderate frequency with 48 and 47 occurrences, reflecting a significant but less dominant focus. The similar occurrence numbers for "City," "Intention," "Visitor experience," and "Value" indicate these are also relevant topics but perhaps not as central as "Model" or "Cultural heritage tourism." Lastly, the terms "Travel," "Heritage tourist," "gamification," "Future," and "Cultural site" are at the low end of the spectrum, with occurrences between 13 and 15, which could point to specialized or new directions for research.

CONCLUSION

The bibliometric analysis undertaken in this research provides a comprehensive overview of the scholarly landscape surrounding the use of augmented reality (AR) in enhancing the cultural tourism experience. Through meticulous data compilation and examination, it has been revealed that AR technology plays a pivotal role in enriching cultural tourism by offering immersive and interactive experiences that bridge the gap between the past and present. The research identified dominant themes such as "Model," "Cultural heritage tourism," and "Mobile augmented reality," which are central to the discourse and have received substantial scholarly attention. It also highlighted less explored areas like "Local culture," "Mobile augmented reality acceptance," and "Virtual tourism," which present opportunities for future research. The trend analysis indicates a shift towards a user-centered perspective on AR adoption in tourism, and the identification of the most impactful literature lays a foundation for further investigation. This study not only maps the current state of AR in cultural tourism but also uncovers the potential for new technologies to transform visitor experiences, suggesting a rich avenue for future scholarly inquiry and practical application in the post-COVID era.

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