

Research Article

# Rising Trends and Springing up Challenges of Augmented Reality – A Comprehensive Study with Special Focus on Tourism Industry

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Received: 03/10/2025;

Revision: 25/10/2025;

Accepted: 20/11/2025;

Published: 28/12/2025

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**Abstract:** A developing field of interactive design is augmented reality which combines displays of real-world scenes with virtual content in a seamless manner. The enormous potential of augmented reality has started to be investigated with the emergence of personal mobile devices that can create engaging Augmented Reality environments. The latest advancements in augmented reality is reviewed in this publication. It outlines the work done in several application sectors and clarifies the current problems that arise when developing augmented reality applications while taking into account the technological and ergonomic constraints of mobile devices. This paper mainly focuses on Augmented reality marketing in tourism industry of India.

**Keywords:** Digital marketing, Augmented reality marketing, Augmented Reality, Virtual Environments, Mobile Technology, AR in tourism.

## INTRODUCTION

Using immersive digital layers augmented reality marketing enables travellers to preview, explore and emotionally connect with destinations in a time when experiences sell more than brochures. Tourism industry is one of the economic sectors in India that is expanding fastest. Every year millions of tourists travel from all over the world to India. India is renowned for its vibrant festivals, varied landscapes, rich culture, and ancient heritage. India offers a variety of travel experiences, from the beaches of Goa to the snow-capped peaks of the Jammu and Kashmir, and from spiritual locations like Varanasi to historic sites like the Taj Mahal. In addition to showcasing the nation's natural beauty, tourism plays a significant role in India's economic development by supporting local communities and generating jobs.

According to a report published by Ministry of Tourism the Domestic Tourist Visits (DTVs) and Foreign Tourist Arrivals (FTAs) and during the calendar year 2024 are as<sup>1</sup>:

Year	Domestic Tourist Visits (DTVs)	Foreign Tourist Arrivals (FTAs)
2024	99.52 lakh	29481.91 lakh

Source: Secondary Data (Press Information Bureau)

The tourism statistics for 2024, which show 99.52 lakh domestic visits and 29,481.91 lakh foreign tourist arrivals demonstrate the size and variety of tourist demand, which offers significant prospects for Augmented Reality (AR)-based marketing in the tourism industry. With such high visitor numbers, Augmented reality (AR) can serve as a strategic engagement tool by improving destination promotion, offering multilingual and interactive

information to foreign visitors, and enhancing domestic traveller's on-site experiences. In order to maximise the economic and experiential value of both domestic and international tourism markets, augmented reality applications such as virtual site previews, AR-guided tours, and interactive cultural storytelling can assist destinations in attracting foreign visitors prior to travel and enhancing satisfaction and retention during visits.

Till August 2025 India had drawn about 56 lakh foreign visitors demonstrating growth in both foreign and domestic tourists travel.<sup>2</sup>

The tourism industry suffered significant losses and nearly came to a standstill as a result of COVID-19 and the restrictions on international travel. However, Augmented Reality based travel gained popularity during the pandemic since it gave people a way to break the monotony and escape loneliness. In the tourism sector technology is essential for drawing travellers and boosting competition between travel destinations and companies Özkul, E., & Kumlu, S. T. (2019). By offering contextual information, interactive maps, and immersive storytelling, augmented reality (AR) has the potential to revolutionise how tourists engage with historical sites, museums, and urban settings. Yagol, P., Ramos, F., Trilles, S., Torres-Sospedra, J., & Perales, F. J. (2018) argued that in the rapidly expanding tourism industry, augmented reality plays a crucial role in redefining traditional tourism through cutting-edge technologies.

According to Azuma, R., Bailiot, Y., Behringer, R., Feiner, S., Julier, S., & MacIntyre, B. (2002). Augmented Reality should have the following properties:

1. Combines real and virtual objects in a real environment;
2. Runs interactively and in real time;
3. Registers (aligns) real and virtual objects with each other.

Augmented reality (AR) is the superimposition of additional digital data on top of what you see in the real world. When you look through a phone or augmented reality device, computer-generated objects such as avatars, 3D objects, or interactive elements appear directly on your

actual surroundings, providing you with useful information based on your location Han, D. I., Jung, T., & Gibson, A. (2014, January). AR is now regarded as “one of the most revolutionary inventions in recent years” due to its rapid rise in popularity and increased industry and scholarly attention over the past five years He, Z., Wu, L., & Li, X. R. (2018). Growing awareness of its special capacity to offer a mediated perception of the real world by fusing it with computer-generated content is one factor contributing to its popularity Han, D. I. D., Tom Dieck, M. C., & Jung, T. (2019).

This review of the literature examines earlier studies on augmented reality (AR), with a special focus on its use in the travel and tourism sector.

S/ no	Title of paper & name of journal	Author name & (Year)	Objective	Findings
01	Augmented reality marketing in hospitality and tourism: a guide for researchers and managers.	Han, D. I. D., & Rauschnabel, P. A. (2024).	This paper aims to provide a holistic understanding of AR marketing for hospitality and tourism industry context, present a number of fundamental premises of AR marketing within it and establish an agenda for future AR research.	The three fundamental premises of AR marketing presented are the need to clearly differentiate between AR and virtual reality within hospitality and tourism; the use of AR for the on-trip experience; and the combined focus on content, context, customer and computing devices for a successful strategic implementation of AR.
2	Using Augmented Reality to Improve Tourism Marketing Effectiveness	Aggag, A., & Kortam, W. (2025)	Investigate the impact of <b>web-based augmented reality (Web AR)</b> on tourist's <i>destination visit intention</i> . Develop and test an <b>integrated framework</b> combining the <b>Stimulus–Organism–Response (SOR) model, Technology Acceptance Model (TAM), and Flow Theory</b> to explain how Web AR affects tourism marketing effectiveness. Examine how two AR attributes <b>interactivity</b> and <b>vividness</b> influence tourists' internal states (perceived ease of use, perceived usefulness, perceived	Both interactivity and vividness of Web AR had significant positive effects on all five organism variables: Perceived ease of use, Perceived usefulness, Perceived certainty, Perceived enjoyment, Perceived immersion all five variables had a positive impact on destination visit intention, with perceived enjoyment and perceived usefulness showing particularly strong effects. Indirect effects: Interactivity and vividness influenced destination visit intention indirectly through the organism variables, highlighting the mediating role of tourists' cognitive and emotional states. The results confirmed that Web AR is an effective tourism marketing tool, increasing tourists' confidence, engagement, and likelihood of visiting a destination. Practical implication: DMOs should enhance AR interactivity and vividness—using high-resolution visuals, multi-sensory features, and user control—to strengthen marketing

			certainty, perceived enjoyment, and perceived immersion). Provide <b>theoretical and practical insights</b> for Destination Management Organizations (DMOs) on leveraging Web AR to enhance sustainable tourism marketing.	outcomes and promote sustainable tourism. Theoretical contribution: The study fills a gap by empirically testing Web AR in tourism using an integrated TAM–SOR–Flow model, offering a framework for future AR tourism research
03	Impact of AI and robotics in the tourism sector: a critical insight	Samala, N., Katkam, B. S., Bellamkonda, R. S., & Rodriguez, R. V. (2022).	Highlight the Role of AI and Robotics: To critically examine how Artificial Intelligence (AI) and robotics are transforming the tourism industry. Explore Technological Integration: To identify various emerging technologies—such as chatbots, virtual reality, facial recognition, and language translators—that are being adopted in the tourism and hospitality sector. Analyze Benefits and Challenges: To understand both the positive impacts (e.g., service personalization, automation) and challenges (e.g., data privacy, cost, human touch limitations) of AI implementation.	Enhanced Customer Experience: AI technologies significantly improve customer engagement and personalization e.g., chatbots for assistance, VR for virtual hotel and destination tours, and AI-powered Google Maps for navigation. AI Cannot Replace Human Touch: While AI enhances service quality, it cannot fully replace the emotional and experiential value delivered through human interaction. Increased Efficiency and Automation: Tasks such as booking, check-in, room service, and multilingual communication are streamlined, reducing human workload and increasing efficiency. Major concerns include data privacy, security, high implementation costs, and technological dependence. AI is still limited in handling complex or emotional customer needs.  AI will play a larger role in creating immersive, smart tourism environments, though careful integration is needed to retain authenticity and human elements.
04	Augmented Reality Applications as a Marketing Tool and Its Impact on Visit	Elsolia, E. M. (2025).	Evaluate the current state of augmented reality (AR) applications in hotels. Develop an AR application for hotels to address identified	All three AR dimensions—usefulness, ease of use, and enjoyment—had a statistically significant positive impact on tourists’ visit intentions to Egyptian hotels. AR applications helped tourists make informed booking decisions, provided

	Intention: Evidence from Egyptian Hotels		problems and act as a marketing tool to enhance tourists' behavioral intentions toward hotels. Measure the benefits of AR applications through a framework assessing their impact on tourists' behavioral intentions. Identify obstacles hindering AR implementation in hotels. Provide recommendations for hotel managers and decision-makers in Egypt on adopting AR to improve tourist visit intentions	engaging and rich information, and enhanced overall travel enjoyment. Tourists expressed strong intentions to visit and book hotels after AR interactions, with an average agreement score of 3.87/5. The study recommends integrating AR into hotel marketing strategies, expanding its development, and promoting its adoption to strengthen Egypt's tourism competitiveness.
05	Innovative marketing technologies in the tourism industry: trends and prospects.	Murodova, N. (2025).	Identify the most prominent innovative marketing technologies currently used in the tourism sector. Examine how these technologies influence customer engagement and decision-making. Explore emerging trends and future prospects for tourism marketing technologies. Provide a comprehensive understanding of how AI, data analytics, VR/AR, chatbot systems, and social media strategies are integrated into tourism marketing.	Personalization through AI & data analytics has become a mainstream marketing strategy, enabling tailored recommendations and dynamic pricing, improving customer loyalty. Immersive technologies (VR & AR) are widely used to offer virtual previews of destinations, increasing emotional engagement and reducing booking uncertainty. AI-powered chatbots now provide 24/7 multilingual customer support, integrate with booking systems, and deliver real-time recommendations, reducing operational costs. Social media and influencer marketing—especially experience-based storytelling by micro-influencers play a critical role in branding and audience engagement.
06	Augmented Reality Marketing : A Systematic Literature Review and an Agenda	Liu et al. (2022)	To examine how augmented reality (AR) marketing affects tourist destination brand experience and tourist inspiration. To analyze the mediating role of destination brand experience in the	<b>AR marketing positively influences tourist inspiration</b> by enhancing destination brand experience.  <b>Destination brand experience mediates</b> the relationship between AR marketing and tourist inspiration, meaning AR strengthens how tourists perceive and connect with the destination brand.

	for Future Inquiry		relationship between AR marketing and tourist inspiration. To investigate the moderating effect of destination familiarity on these relationships.	<b>Destination familiarity moderates the effect</b> AR is more effective in inspiring tourists who are less familiar with the destination. The study highlights AR as a <b>powerful promotional tool</b> for tourism destinations, especially in attracting and inspiring new visitors.
07	Artificial intelligence, virtual and augmented reality, social media, online reviews, and influencers: a review of how service businesses use promotional devices and future research directions	Chu et al. (2025)	To review how artificial intelligence (AI), virtual and augmented reality (VR/AR), social media, online reviews, and influencers are being used as promotional tools in service businesses. To provide a structured overview of the literature in these domains. To identify gaps in existing research and suggest areas for future study. To examine the impact of these promotional tools on consumer behavior, service experience, and business performance. To develop a conceptual framework connecting these emerging technologies with service promotion.	AI is increasingly applied in personalization, chatbots, and recommendation systems, enhancing customer engagement. VR/AR create immersive experiences that improve customer decision-making and service interaction. Social media and influencers have become powerful tools for brand image building and customer trust, especially in services like tourism, hospitality, and retail. Online reviews significantly influence purchase intentions and service evaluations, acting as electronic word-of-mouth (e-WOM). There are still research gaps in understanding long-term impacts, ethical issues, cross-cultural variations, and integration of these technologies. The study highlights the need for interdisciplinary research to bridge marketing, technology, and service management.
08	Understanding augmented reality marketing in world cultural heritage site, the lens of authenticity perspective	Zhu, C., Io, M. U., Ngan, H. F. B., & Peralta, R. L. (2023).	To examine how augmented reality (AR) can be used in marketing at a World Cultural Heritage Site. To analyze the role of authenticity (object-based, existential, and constructive) in shaping tourists' experiences with AR. To understand how AR influences tourist's perceptions, engagement, and behavioral intentions. To provide insights into how cultural	AR can enhance visitor experiences by providing immersive, interactive, and informative content, making cultural heritage sites more engaging. However, AR may challenge authenticity—while it can strengthen constructive and existential authenticity, it may weaken object-based authenticity (since it overlays the original heritage with virtual content). Tourists perceive AR as valuable when it adds meaning and context rather than replacing the real heritage. The balance between technology and authenticity is crucial for sustainable cultural heritage tourism. AR positively influences visitor satisfaction, learning, and intention to revisit, but must be designed carefully

			heritage sites can use AR while maintaining authentic experiences for visitors.	to preserve the heritage site's integrity.
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**Contemporary development in the field of Augmented Reality (AR) marketing within the Tourism Industry of India**

The Gujarat government is establishing an archaeological museum in Vadnagar that incorporates Augmented Reality (AR) and Virtual Reality (VR) technologies to improve cultural understanding. Vadnagar will be used as a model for digital museology because it is a historically layered town with Mauryan-era archeological findings. Visitors will be able to view ancient urban layouts, interact with rebuilt historical environments, and connect with cultural narratives through dynamic, multimodal experiences because of the museum’s augmented reality features. This project is part of a larger movement toward digital heritage initiatives that put an emphasis on intangible cultural values, accessibility, and experiential learning.<sup>3</sup>

The Hindu article covers a Bengaluru tourism technology initiative that uses virtual reality (VR) and augmented reality (AR) to improve the experiences of tourists at cultural sites. The Karnataka Tourism Department started the project, which aimed to digitally reproduce historical settings at famous sites like Bengaluru Fort and Tipu Sultan’s Summer Palace. However, because of bureaucratic obstacles, poor decision-making, and problems with stakeholder cooperation, the project has experienced major delays. Although it has the potential to modernize heritage tourism and draw in tech-savvy tourists, its implementation has been slow, which raises questions about how such ambitious digital efforts should be carried out in public cultural settings.<sup>4</sup>

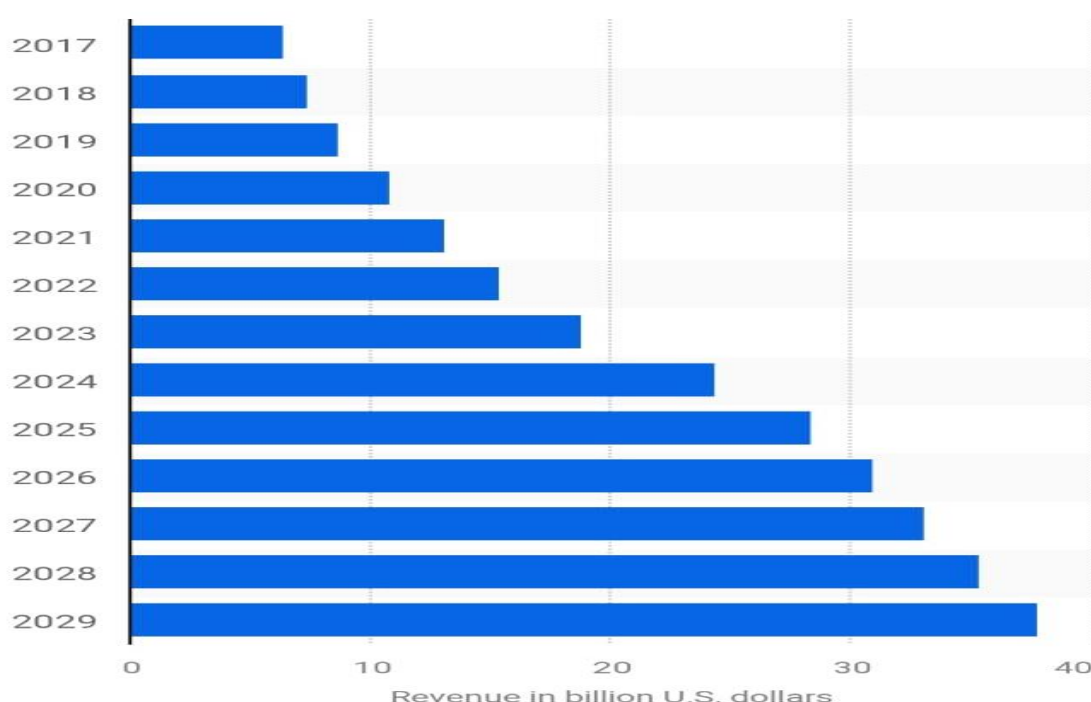
As part of the Keraleeyam festival Kerala Tourism set up a pavilion in Putharikandam Maidanam that uses digital technologies to highlight the state’s tourist attractions.<sup>5</sup>

An Immersive Virtual Reality Lab (IVRL) was opened by the secretary of the Science & Technology Department at the Division of Veterinary Anatomy at the Faculty of Veterinary Sciences & Animal Husbandry Sher-e-Kashmir University of Agricultural Sciences and Technology Kashmir. With cutting-edge augmented reality, virtual reality, and 3D technology, one of the nation’s first in a university setting supports instruction and research in anatomy, physiology, pathology, gynaecology, and clinical disciplines. The “Skills Hub Centre,” which is funded by the National Bank for Agriculture and Rural Development (NABARD), seeks to improve pedagogical usefulness, reduce ethical issues related to traditional practical sessions, and strengthen student experience and researcher capacity through cutting-edge immersive techniques.<sup>6</sup>

**Augmented reality applications in multiple domain**

Tourism, education, healthcare, retail, and marketing are just a few of the industries that use augmented reality (AR) to improve user experience and interaction by superimposing digital content on the real world. Business houses and Organisations are using digital solutions more and more to deepen their relationships with their customers and increase brand and product engagement Barreda, A. A., Bilgihan, A., Nusair, K., & Okumus, F. (2015). Batra, R., & Keller, K. L. (2016) argued that Web 2.0 platforms (such as social media (Facebook, Twitter, Instagram), blogging sites (WordPress, Blogger, Medium), wikis (Wikipedia), video/image sharing (YouTube, Flickr), and collaborative tools (Google Docs) are some of the examples of Web 2.0) are becoming an essential component of the marketing mix for an increasing number of businesses Batra, R., & Keller, K. L. (2016).

Augmented Reality (AR) Business-to-Consumer (B2C) market revenue worldwide from 2017 to 2029. (In Billion United State dollars)



Source: Secondary Data (Statista)

The graph shows the revenue from the global B2C Augmented Reality (AR) market between 2017 and 2029, expressed in billions of US dollars. It clearly indicates an aggressive and ongoing upward trend in AR commercialisation and adoption.

Revenues are comparatively low in the early stages (2017–2019), suggesting AR was still a developing consumer technology with few widespread uses.

The market grows more quickly starting in 2020, which is a result of rising consumer familiarity with immersive technologies, better AR software platforms, and increased smartphone penetration.

With revenues surpassing roughly USD 20 billion by 2024, a notable uptick is evident after 2022, underscoring AR's shift from experimental to widespread B2C use. With revenues projected to reach USD 40 billion by 2029, the forecast period (2025–2029) indicates strong investor confidence and expanding application areas like retail, tourism, education, gaming, and marketing. Overall, the graph shows that AR is developing into a significant consumer-facing technology due to the need for interactive user experiences, experiential marketing, and digital transformation. This growth trajectory highlights AR's strategic significance for sectors like tourism marketing, where destination visualisation and immersive previews can greatly impact consumer choice.

## TOURISM

**Vlahakis, V., Ioannidis, M., Karigiannis, J., Tsotros, M., Gounaris, M., Stricker, D., & Almeida, L. (2002)** put forward that an early outdoor augmented reality system called Archeoguide was created to improve visits to archaeological sites by superimposing contextual data and virtual reconstructions on actual ruin structures. To deliver precise location-based augmented reality experiences the system combines mobile computing, wireless communication, and hybrid tracking techniques. It facilitates interactive customised tours based on visitor preferences. Archeoguide, which was implemented at the ancient Olympia site shows how augmented reality can be used to improve tourism and interpret cultural heritage. Dadwal, S. S., & Hassan, A. (2016) in a chapter argued that in order to improve customer engagement and experience, this paper looks at how augmented reality marketing (ARM) combines interactive AR technology with travel

and hospitality marketing. By superimposing digital content on actual locations, it contends that augmented reality (AR) enhances traditional marketing by enhancing information delivery, customer connection, and perceived value. By producing engaging and fulfilling user experiences, ARM has the ability to revolutionise tourist marketing tactics, boost location appeal, and improve demand. The researchers conclude that using augmented reality (AR) in tourism marketing can give businesses a competitive edge and foster expansion in a market driven by technology. Çalışkan, G., Yayla, İ., & Pamukçu, H. (2025) uses the UTAUT2 (Unified Theory of Acceptance and Use of Technology 2) paradigm to identify the variables influencing AR acceptance and usage among stakeholders in the tourism industry. The study concludes that augmented reality (AR) is a useful and informative tool for improving customer experiences supporting marketing and promotional activities, and offering significant

potential for adoption in tourism industries. In a research paper by **Cabeleira, M., & Vaz de Carvalho, C. (2025)** stated that particularly during the COVID-19 pandemic when personal interaction were few augmented reality has made a substantial contribution to the tourism industry's expansion. The majority of augmented reality applications in the tourism industry use location-based and marker-based technology to improve the visitor experience by offering entertainment and pertinent information.

### Education

**Lampropoulos, G., Keramopoulos, E., Diamantaras, K., & Evangelidis, G. (2022)** stated that augmented reality (AR) integration improves learning outcomes and encourages students to have positive learning attitudes and behaviours. Through immersive and interactive learning environments, augmented reality (AR) enhances traditional educational practices, supports educators, and raises the standard of instruction overall. Self-regulation, self-efficacy, cognitive load management, motivation, embodiment, interest, sense of agency, and perceived presence are all positively impacted by augmented reality (AR).

### RETAIL

A study by **Tan, Y. C., Chandukala, S. R., & Reddy, S. K. (2022)** looks into how augmented reality (AR) affects online retail sales by enabling virtual product evaluation before purchase. Using actual transaction data from a major global cosmetics retailer the authors discover that using augmented reality on the retailer's mobile app dramatically boosts sales, particularly for more expensive, niche, and less well-known brands. Customers who are new to the online channel or product category experience a greater positive sales impact, indicating that AR promotes online adoption and lessens product-related uncertainty. The findings showed that by enhancing product visualisation and lowering purchase risk, augmented reality (AR) can boost consumer decision confidence and increase sales.

### Marketing

Rauschnabel, P. A., Babin, B. J., tom Dieck, M. C., Krey, N., & Jung, T. (2022) highlighted that in order to reach broad marketing objectives (such as brand value, engagement, and loyalty), augmented reality marketing (ARM) is a strategic interdisciplinary sub-discipline of marketing that integrates AR technology beyond basic promotional tools. ARM is a component of an organization's whole strategy not just advertising. Rauschnabel, P. A., Felix, R., & Hinsch, C. (2019) argued that inspiration is essential for converting AR use into favourable brand outcomes, marketers should create mobile AR experiences that inspire customers, such as by producing captivating, immersive, and emotionally attractive content.

### CONCLUSION

Services in the tourism and hospitality sector are constantly being improved by cutting-edge technologies. An emerging technology augmented reality (AR) aids digital marketers in improving customer value and service quality.

Augmented Reality frequently surpasses customer expectations by providing interactive and captivating experiences which boost satisfaction by making experiences more memorable. Since Augmented Reality is a relatively new technology and there hasn't been much research done in the tourism and hospitality sector, more research and innovations in this field could have a big impact on the sector resulting in a lot of revenue in the future.

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