

# Immersive technologies as a tool for increasing sustainability and environmental friendliness of tourism activities

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**Abstract:** Immersive technologies are rapidly transforming the tourism industry, offering new possibilities for tourists to experience destinations and for tourism businesses to market their products and services. This study examines the current state of immersive technology integration in tourism, with a focus on augmented reality (AR) and virtual reality (VR). The study finds that immersive technologies are being used in a variety of ways not only to enhance the tourist experience (including providing virtual tours of destinations, creating interactive maps and guides, offering augmented reality experiences that overlay digital content on the real world, developing virtual reality simulations of tourist attractions), but also driving innovation and growth, stimulating tourism destination sustainability and environmental friendliness, natural tourist resources safety. The study concludes that immersive technologies are poised to continue to revolutionize the tourism industry in the years to come. As these technologies become more sophisticated and affordable, they will open up new possibilities for tourists and tourism businesses alike.

## 1 Introduction

Modern tourism is a complex and multifaceted product of the socio-economic development of society (Walton, 2018), actively responding, including to the achievements of scientific and technological progress. Traditionally defined as trips made outside of one's place of residence for periods of 24 hours to 6 months per year for any purpose other than earning material benefits (UNWTO, 2019), tourism involves a change in a person's traditional living environment, bringing additional emotions [1-10].

According to its definition as a type of human activity, tourism is, to a greater extent, egocentric, aimed at changing the traveler himself (self-development, self-education, professional growth, health improvement) due to his conscious desire to change his environment. Over the past 40 years, the external motivation of travelers aimed at changing

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the environment of the places they visit has been commercialized (for example, volunteer tourism associated with training local residents, maintaining ecological balance, religious purposes). However, on the one hand, the share of such tourism in the structure of the international tourist flow remains insignificant at the present time. On the other hand, based on the generally accepted definition of tourism, based on the absence of material interest of travelers, it seems extremely difficult to separate tourism focused on improving, maintaining, and preserving the environment of visited destinations from trips for the purpose of various forms of employment, seasonal migration, and so on [11-15].

Consumer egoism, motives for exploiting the specifics of the environment remain a priority in modern tourism and tourism activities, which is quite normal for market relations, the need for tourists to pay and spend their own free time, and emotions on traveling.

Thus, it is the environment, external factors reflecting the specifics of the places visited, their tourist attractiveness, that are the primary condition and driving force for the development of international tourism as a human activity and a type of commercial activity (Pitukhina, 2022; Andreeva & Ushakov, 2016).

It is expected that modern technologies that allow transforming the surrounding reality, the environment that stimulates the emergence of certain emotions, sensations, and, consequently, the source and resource of personal transformation, are capable of exerting (and already exert) a significant impact on both the organization of tourism and the consumer behavior of the travelers themselves.

Immersive technologies offer a new experience of modeling the external environment without the need not only for large-scale and expensive physical modernization, but also for the physical movement itself (Guttentag, 2010; Bekele et al., 2018), in principle. Given the relationship between the state and attractiveness of the external environment and the tourist attractiveness of the tourist destination possessing them, there is no doubt that immersive technologies will have a radical impact on the dynamics of international tourism [16-27].

The purpose of the study is to analyze, based on an assessment of foreign experience, the features of the integration of immersive technologies into tourism production, to analyze their potential impact on the formation and development of sustainable local ecological and tourist systems in the modern dynamics of consumer preferences of travelers.

## **2 Theoretical Basis of the Study**

Advances in fundamental technologies blur the line between the real world and the virtual environment, providing users with a sense of immersion (Lee et al., 2013), allowing to increase tourist satisfaction, their ability to choose and modify the quality of tourist services (Williams & Hobson, 1995). In the context of this study, immersive technology blurs the clear boundary between the real physical and virtual worlds, allowing users to experience a sense of immersion (Slater & Wilbur, 1997). At a certain point in time, the very need for the user to move in physical space disappears, which, in our opinion, should limit tourism. Thus, modern tourism and tourism activities are an object of integration of immersive technologies (augmented reality and augmented virtuality), with only one important limitation - as soon as (at a certain stage of scientific and technological progress or commercialization of technologies) the user's need for direct movement in physical space disappears (while maintaining with this his tourist motivation and even more effective opportunities and prospects for its satisfaction), tourism itself disappears as an object of integration of immersion and virtual reality technologies (Ivanova, 202; Bondarenko et al., 2017; Taranov et al., 2020). Therefore, speaking about the integration of immersive technologies into tourism, we will proceed from the fact that these technologies:

- complement and change the environment surrounding the tourist;
- modernize the tourist product;
- do not contradict the main criteria for classifying a person as a tourist, and his activity - as a tourist. Based on the vision of the prospects for the integration of immersive technologies into tourism, it is possible to specify the spheres and functions of tourism production, sales of a tourist product, in which the implementation of immersive projects seems to be the most promising.

So, they:

- offer opportunities for promoting a tourist destination, convincing potential users to travel (Chung et al., 2018; Flavián et al., 2019; Li & Chen, 2019; Lee & Jung, 2020).
- capable of integrating into navigation systems of their own, user experience distribution systems
- are able to increase the accessibility of a tourist product for user groups with disabilities or special needs
- can be actively implemented in the activities of travel agencies.

In order to characterize the progress of integration of immersive technologies into the practice of tourism, we evaluated the number of publications on this topic and leading international indexing systems (Table 1). Article selection criteria: published between 2012 and 2023 with status “Journal article”, open access, in English and containing keywords (and/or): “augmented reality”, “virtual reality”, “mixed reality”, “AR”, “VR”, “MR”, “360 video”, “360 panoramic”, “touris\*”, “visit\*”)

**Table 1:** Number of papers by keywords “Immersive\*” AND/OR “touris\*” (Source: results of the authors’ survey)

	until 2020	until 2024
EBSCO host	2	175
Sage	26	107
Scopus	245	680
Web of Science	44	193
	347	1155

According to the data in Table 1, there is an obvious growth in scientific interest in the problems of integration of immersive technologies into tourism from 2020 to 2024 (Hereinafter - at the time of the study - March 25, 2024), which is explained, among other things, by the search for scientific justification for the prospects for the development of tourism in the context of the coronavirus pandemic, as well as the active implementation of these technologies in the activities of traditional suppliers of the tourist product during the period of a global decline in international tourist trips (2020-2022).

**Table 2:** Number of published articles containing keywords “Immersive\*” AND/OR “touris\*” by country of publication (Scopus database) (Source: results of the authors’ survey)

Countries of authors’ affiliation	Years of publications	
	2012-2020	2012-2024
China	15	89
USA	34	67
Italy	33	67
UK	24	66
Portugal	20	57
Australia	20	42
India	2	39
Spain	6	32
Greece	4	22

South Korea	10	21
Russia	1	6

It is also possible to single out the trend towards an increase in the activation of scientific research on all key words related to the implementation of immersive technologies in China and India. Table 2 shows the results of a study of publication activity on the key words “Immersive\*” AND/OR “touris\*” in the Scopus database, demonstrating China’s leadership in 2024, despite the fact that it was only in 6th position in terms of the number of specialized publications in Scopus-indexed publications in 2020.

A similar breakthrough is typical for India, as well as Greece and Spain. The results of the general assessment for 4 analyzed databases of scientific works are presented in Table 3. Most of the analyzed articles are devoted to tourist destinations and attractions, and only a few articles are devoted to the use of immersive technologies in tourism support for example, in the hotel business (Bogicevic et al., 2019; Israel et al., Zeng et al., 2020), travel agencies (Bush, 2022) or in transport. It is possible to analyze in more detail the studies devoted to the use of immersive augmented reality technologies in tourism (Isralova et al., 2023; Ushakov et al., 2023; Van et al., 2018)

**Table 3:** Distribution of publications containing keywords “Immersive\*” AND/OR “touris\*” by leading countries (Source: results of the authors’ survey)

	2012-2020		2012-2024	
	countries	%	countries	%
1	USA	13,88	China	13,09
2	Italy	9,47	USA	9,85
3	UK	9,30	Italy	9,85
4	Portugal	8,16	UK	9,71
5	Australia	8,16	Portugal	8,38
6	China	6,12	Australia	6,18
7	South Korea	4,08	India	5,74

Table 4 shows all the devices used in the selected articles related to augmented reality. Mobile devices (smartphone or tablet) were the most frequently used (they are easy to carry when traveling, they are inexpensive compared to other AR devices such as Microsoft HoloLens, OpenAI Glass, or Meta One glasses). Location-aware AR devices (sensors, cameras, location beacons) were examined in 14% of published works. Most of the publications on the integration of immersive virtual (augmented virtual) reality technologies into tourism investigated the potential for using head-mounted devices (HMDs) - more than 65% of publications; synchronized HMDs and personal computers (15%), personal computers (4%), projections and holograms (cave automatic virtual environment - CAVE) - 4.5%.

**Table 4 -** Technical Equipment of Immersive Augmented Reality Technologies in Tourism (Results of a Study of Publications Containing Keywords “Immersive\*” AND/OR “touris\*” AND/OR “AR”) (Source: results of the authors’ survey)

Technical Equipment of Immersive Augmented Reality Technologies in Tourism	% in publications
Mobile device (smartphone or tablet)	62
Location-aware AR devices (sensors, cameras, location beacons)	14
Other (drones, wearable cameras, and haptic feedback devices)	4
Not noted in the studies	20

The most studied virtualization technology for tourism and tourism activities was 360-video (34% of works), 360-picture (16%), 360-picture + video (14%). At the next stage of the study of publications on the use of immersive technologies in tourism, an analysis of keywords was carried out, which, in our opinion, reflects the author's position on the functions and areas of application of immersive technologies in tourism.

The most common related keywords:

-for the search query "Immersive\*" AND/OR "touris\*" AND/OR "AR" were tourist guiding (professional guided tours and сопровождение tourist groups) and as subcategories - tourist guiding with "smart glasses" and using mobile devices; navigation, entertainment, marketing, protection of cultural and natural heritage, education, accessibility;

-for the search query "Immersive\*" AND/OR "touris\*" AND/OR "VR" were marketing and protection of cultural and natural heritage.

### 3 Results

The identified areas allow us to classify the main areas of implementation of immersive technologies in tourism, as well as a set of functions inherent in tourism enterprises, the efficiency of which will be maximized with the use of immersive technologies. First of all, such a function can be attributed to marketing as a function of tourism management, implying a complex set of measures aimed at forming sustainable and effective communication with consumers, stimulating their demand through the dissemination of information, motivation to travel to a specific tourist destination or use the services of a specific tourism supplier (Mai et al., 2019; Ushakov et al., 2022).

Based on an assessment of foreign experience in the use of immersive augmented reality and virtual reality technologies, two patterns can be distinguished:

-if AR technologies are most often used as an advertising tool aimed at personalizing service, stimulating its loyalty, motivating a repeated visit to the destination, then virtual reality technologies are often devoid of personalization, designed for potential visitors;

-both augmented reality and virtual reality technologies, according to numerous public opinion and consumer choice polls, generally have a positive impact on the popularization of a tourist destination, are able to activate tourist flow, influence the process of consumer choice and decision-making both about the direction of the future trip and choosing a specific tourism supplier (hotel, carrier, guide, restaurant, etc.).

Virtual reality as a marketing tool in tourism research was even more prevalent than AR, especially for promoting potential tourist destinations (before the trip, the decision-making process). In the process of choosing a place to visit, future tourists seek and analyze information, while the introduction of virtual reality creates opportunities to maximize the information necessary for a final consumer decision due to the feeling of presence. Through it, the image of the destination is formed (Yung et al., 2019), which, if it meets the expectations and needs of the tourist, leads to the intention to visit (Tussyadiah et al., 2018). The use of virtual reality using an HMD is the best promotion tool, providing sensory stimulation and a more immersive experience (Flavián et al., 2019). As a marketing tool, virtual reality should provide content that reflects the real conditions of the tourist destination. The tourism service provider must ensure that the visual perspective of their proposed destination is authentic and as realistic as possible from the user's point of view (Israel et al., 2019).

However, this does not negate the individualized promotion, taking into account the individual characteristics of a potential tourist (age, gender, nationality, social status, consumer preferences, current search queries on the Internet, membership in social network

groups and other personal information available through a gadget or user accounts) in the context transmitted through virtual reality technologies.

One of the popular areas for using AR and VR systems is the reconstruction of a tourist object or the entire environment through computer-generated objects. AR systems allow the user to experience a three-dimensional virtual object based on a real object of natural or cultural (historical) heritage, which may no longer exist in reality or which is impossible to access. Thus, the user can visualize and understand the form of the object without exploiting it in reality.

The third area of application of immersive technologies in tourism is education, improving the assimilation of knowledge during a visit to a tourist destination.

Immersive technologies, facilitating the overlaying of interactive virtual information on the real world, improve the quality of tourist guiding (professional activities of guides and tour guides). Given the above definition of tourism, it is logical to assume that purely virtual excursions are not tourism, therefore, the work of guides can be considered only as a field of application of augmented reality technologies in order to increase user interaction with the observed object during the visit.

## 4 Conclusions

By and large, the egocentricity of modern tourism as a type of human activity turns the specifics of the environment of a place of short-term visit into the main motivating factor for travelers. This actualizes the technological possibilities of supplementing and virtualizing reality as a driver of transformation of modern (and in the future) tourism and tourism activities. The ability of immersive technologies to transform reality has determined the scale of their integration into tourism, especially during the coronavirus pandemic.

The ability of immersive technologies to completely virtualize reality, and, consequently, over time, technologicalization to reduce the dependence of tourist impressions on the direct physical movement of a person, determined the need to define the boundaries of integration of immersive technologies into tourism, taking into account the characteristics of the latter as a type of human activity (the obligation spatial movement). This part of the study analyzed the experience of implementing immersive technologies in tourism and tourism activities that do not require abandoning direct movement in physical space, acquiring traditional services from tourism suppliers.

As a confirmation of the modern interest of business and the public in the implementation of immersive technologies, the intensity of scientific publications on this topic in journals of world citation and indexing databases was analyzed. The analysis carried out confirmed not only a multiple increase in the number of scientists and practitioners in this topic after 2020 (the number of publications for the period 2020-2024 exceeded the similar indicator for the longer period 2012-2020), but also a change in the geography of the study - a significant increase in research on the problems of immersive technologies, AR and VR technologies in tourism in the Asia-Pacific region and India.

Content analysis of modern publications made it possible to determine the most popular tools and areas of application of immersive technologies in tourism: tour guiding; navigation, entertainment, marketing, protection of cultural and natural heritage, education, accessibility for immersive augmented reality technologies; marketing and protection of cultural and natural heritage - for immersive augmented virtuality technologies. The best foreign experience of integrating immersive technologies in the selected areas and functions of tourism management was also studied.

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