THE USE OF IMMERSIVE TECHNOLOGIES IN INTERNATIONAL TOURISM

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The COVID-19 pandemic has catalyzed the digitalization of the global economy, which has resulted in an increase in the number of information technology users around the world. These changes have also affected the international tourism sector. This article is aimed at analyzing the use of immersive technologies (augmented, mixed, and virtual reality) in this industry. The authors explore the incentives and results of the introduction of extended reality technologies, revealing their role in the field of international tourism. For instance, immersive technologies allow the user to familiarize themselves with a tourist destination before purchasing a tourist service, quickly find the desired attraction in an unfamiliar place, or even visit various countries without leaving home. The article highlights the advantages and disadvantages of each of the three extended reality and provides recommendations for their implementation. It is concluded that although immersive technologies are unlikely to completely replace conventional tourism, the effective implementation of extended reality can ensure tourism enterprises’ competitiveness for years to come because the following generations (Y, Z, alpha) are becoming more and more dependent on digital environment.

Keywords: international tourism; immersive technologies; extended reality; virtual reality; augmented reality; digital technologies; COVID-19 pandemic
Introduction

One of the key trends of the COVID-19 era was the acceleration of the digitalization of the world economy. Among other things, it manifested itself through the growing popularity of immersive technologies. Considering that the competitiveness of the global economy actors operating in the field of international tourism depends directly on their creativity and the rapid follow-up of trends, ignoring the extended reality (XR) can negatively affect their profits.

As the main characteristic of XR technologies, immersiveness provides tourism companies with a suitable environment for tourist services promotion. These days some countries are reintroducing coronavirus restrictions (e.g., China), and others are making the entry conditions stricter for some tourist categories (EU against Russian citizens). Moreover, in the present geopolitical uncertainty, there is a worldwide increase in inflation and the cost of living. Thus, the use of virtual tours may well become the only opportunity for the general public to acquire the desired tourist experience in the nearest future if the situation does not change for the better. That is why it is necessary to investigate the most promising directions of using immersive (VR, AR, MR) technologies in international tourism.

The article is aimed at analyzing the use of immersive (XR) technologies in the international tourism. In the context of this study, it is important to: (1) identify the role of XR technologies in international tourism; (2) analyze the technological aspect of the application of AR, VR, MR, advantages and disadvantages of these technologies; (3) give general recommendations on the introduction of immersive technologies in the field of international tourism.

Literature review

This study examined the main modern scientific literature on various aspects of the use of immersive technologies in international tourism in the context of the COVID-19 pandemic and post-COVID recovering.

Weber-Sabil and Han explore XR realms, present a range of Immersive tourism cases and even highlight societal repercussions of extended reality technologies (Weber & Han, 2021).

Kornilov U.V. and Popov A.A. analyze terminology and classifications of immersive technologies in education (Kornilov, Popov, 2020).

Tsai L.-L. investigated the effect of tourist involvement on the three components of holistic image, namely cognitive, affective, and cognitive images. The article states that the enhancement of a sense of presence can strengthen the holistic image of prospective tourists’ virtual tourism (Tsai, 2022).

Rauscher M., Humpe A., Brehm L. analyze whether VR technology can be accepted and adopted as a substitute for a real trip. They used a purely qualitative approach and their research deals with issues of emotional aspect of a trip, the convenience of a VR equipment, social influence. One of their research outcomes shows that VR has some limits and entirely achieve such motivational aspect as social interaction (Rauscher et al., 2020).

Siddiqui et al. explore virtual tourism and digital heritage, discuss VR/AR technologies and applications and conduct a survey to identify the awareness of VT and DH among the users of the Internet. They also admit that these technologies have some limitations and
present pros and cons of VR & digital heritage (Siddiqui et al., 2022).

Zeng Y., Liu L., Xu R. explore how the VR tourism experience affects the tourist's Cultural Dissemination Behavior and extends the theoretical understanding of virtual reality tourism from the emotional perspective (Zeng et al., 2022).

Oncioiu I. and Priescu I. identify the role of virtual reality in choosing a tourist destination, as well as the expectations of potential customers that could rekindle the tourism industry for a post-pandemic world. According to their article, VR can be considered as a decisive factor for strategic planning in the tourism sector (Oncioiu, Priescu, 2022).

Maslova U.A., Belov U.S. analyze the concept of augmented reality, explain how it works and identify the reasons for its popularity (Maslova & Belov, 2022).

Pratisto, E.H., Thompson, N. & Potdar, V. explored the use of immersive technologies in tourism by conducting a systematic review of 88 articles published between 2012 and 2020. The authors highlighted the options of using extended reality technologies (VR, AR in particular) in tourism, as well as explored potential challenges of using immersive technologies (Pratisto et al., 2022).

Syed et al. analyze security concerns of AR use and present an integrity-aware CAR-Tourist (Collaborative Augmented reality for Tourism) framework (Syed et al., 2022).

Shukri A., Arshad H., Abidin Z.-R. identify eleven suggestions for design principles to reduce cognitive overhead of tourist, learn ability and suitable context for providing content whiles their travel in Malaysia (Shukri et al., 2017).

Tsai, H.-Y., Tsai, M.-H., Chiang, T.-H., Chang, C.-C. analyze four VR mechanisms and, as a result of their research, the semi-limited mechanism with visual assistance is considered the one that can increase user's learning efficiency and user experience (Tsai et al., 2022).

Li et al. analyze the influence of two crucial factors (the danger posed by the COVID-19 pandemic that tourists perceive, and the impact of COVID-19 risk perception) on virtual tourism. The safety of virtual tourism appears to be a key to attracting tourists and relieve destination pressure. The authors also consider it necessary to understand how VR can assist the brand sustainability of tourist destinations after the availability of on-site tourism. Simplifying the use of VR applications will increase the effectiveness of virtual tourism in the future (Li et al., 2022).

Tjostheim I. and Waterworth J. examine whether virtual experiences can seem real to the virtual traveler and, if so, under what conditions and on what grounds (Tjostheim & Waterworth, 2022).

Stewart D., Westcott K., Cook A.V. explore the use of digital reality headsets in enterprise and education and make suggestions for further, post-pandemic development of XR. (Stewart et al., 2020).

Thus, the research conducted by the authors of this article is relevant in conditions of increased attention to immersive technology from the world economy subjects.

**Methodology**

The study focuses on the qualitative analysis of the use of immersive technologies in international tourism. It is necessary to immediately determine the conceptual apparatus used in this article. Reality is divided into four components within a framework of Immersive Tourism Reality Continuum (Weber-Sabil & Han, 2021).
According to the Fig. 1, there are Reality itself (it is interpreted to enrich the experience), Augmented reality (supplements the real world), Mixed reality (reimagines the real world) and Virtual reality (reconstructs physical tourist experiences via digital twins).

![Figure 1 – Our reality and immersive technologies]

(Source: made by the authors)

Therefore, VR is a completely virtual environment created through 3D modeling; AR is an actual environment with virtual objects; MR is a real environment with interactive virtual objects. Extended reality is a term that combines these three concepts. In turn, immersive technologies combine XR technologies that emulate the physical world through digital environments, creating a sense of immersion. (Kornilov & Popov, 2020).

In order to achieve the goal of the study, the conclusions of the article are based on previous research of specialists in this field. The sources include analytical reviews, scientific articles for 2017-2022. The relevant statistics are given.

**Results**

Coronavirus-related restrictions have been a catalyst for digitalization worldwide, while increasing the population’s reliance on digital technology.

![Figure 2 – Digital technology users worldwide, 2019-2022 (billion people)]

(Source: Digital 2019, Digital 2020, Digital 2021, Digital 2022, Digital 2022 (July Update))

This is manifested in an increase in the number of Internet users to 5.03 and unique mobile phone users to 5.34 billion people, respectively, by the mid-2022.
Fig. 2 shows the annual growth in the number of people using mobile phones, the Internet and various social networks.

Under these circumstances, the XR industry ecosystem is getting richer. Although the current industry development of the XR is hampered by technological limitations, XR market is approaching a turning point of rapid development as tech giants are expanding deployment in the XR industry aiming for the next generation of computing platforms (Deloitte China 2022). The mobile AR market was estimated to be worth 12.45 billion U.S. dollars in 2021 and is expected to approach over 36 billion U.S. dollars by 2026. The consumer and enterprise VR market amounted to 11.97 billion U.S. dollars in 2022, and it is likely to reach 15.81 billion U.S. dollars by the end of 2023.

Virtual tourism is becoming a solution to the problem of social distancing. Moreover, travel companies will be able to take advantage of immersive technologies even after the COVID-19 pandemic, promoting a positive image of the tourist destination. There are two main reasons for this. Firstly, the extended reality creates a sense of presence that engages the user and can increase trust in the destination and provide a comprehensive understanding of the destination (Tsai, 2022).

Secondly, as a way to pre-survey tourist destinations, XR creates the first impression of a tourist destination, which is partly why some hotels offer preliminary online tours of the hotel and rooms. Based on the first impression, the user makes the final purchase decision.

As a result, immersive technologies are combined successfully with one of the main incentives for consuming tourism services – the desire for a unique experience. After all, VR experiences are much more engaging, memorable, and more persuasive and interactive than traditional social media video content (Oncioiu & Priescu, 2022).

Table 1 – Some examples of XR devices and applications
(Source: as made by the authors)

<table>
<thead>
<tr>
<th>Devices</th>
<th>AR</th>
<th>MR</th>
<th>VR</th>
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<tbody>
<tr>
<td>Devices</td>
<td>Sony Smart Eyeglass; Magic Leap One; Focals by North; Letin AR</td>
<td>Microsoft Holo Lens; Samsung HMD; Odyssey+; Magic Leap</td>
<td>Oculus Rift; Oculus Quest; HTC Vive Flow; VR Valve Index VR Kit; HIPER VR MAX</td>
</tr>
<tr>
<td>Applications</td>
<td>Google Lens; Here City Lens; Skin &amp; Bones; Guides; Civilizations AR; QReal; Questo; Brabant Remembers AR app</td>
<td>Windows Mixed Reality; Dinner In Motion</td>
<td>Street View (Google Maps); National Geographic Explore VR tours to Machu Picchu and Antarctica; The Grand Canyon VR Experience; Patagonia VR; Art Steps; “Moscow that did not exist”</td>
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Immersive technologies also serve the preservation of digital (both cultural and natural) heritage.
First of all, XR applications eliminate the risk of damage to historical monuments due to the negligence of tourists.

Secondly, it becomes possible to avoid the construction of tourist infrastructure and, therefore, to reduce environmental pollution. In addition, immersive technologies provide interactivity, tours to countries of the past and even models of the future and alternative reality. The gaming industry examples (3D content, not immersive VR) include tours to Ancient Greece (“Odyssey”), Ancient Egypt (“Origins”) and Scandinavia (“Valhalla”). These tours are provided in the latest games in the “Assassin’s Creed” series. Although the gaming sector of the world economy is not directly related to tourism, the experience obtained via these tours undoubtedly stimulated the gamers’ interest in the history and these tourist destinations (their modern versions).

As for the virtual tours them, there are such simulators as The VRMuseum of Fine Art (by Finn Sinclair), Realities (byrealities.io), the Blu (by Wevr, Inc). There are much more examples of XR applications as well as XR devices, some of them are presented in the Tab. 1. However, XR tours have certain drawbacks.

Firstly, there may be a discrepancy between the picture in the XR application and the natural scenery in the tourist destination. In order to generate a satisfactory tourism experience, it might not be necessary to reflect the real world in its entirety (Rauscher et al., 2020), but still, the difference should not create cognitive dissonance. Secondly, XR does not provide for the interpersonal communication, which is an integral part of international tourism. It may increase the distance between people from different countries and slow down the implementation of the overall village concept (Siddiqui et al., 2022).

Therefore, tourism companies need to find a balance between the distance inherent in XR-related tourism products and adequate exploration of the culture, worldview and historical experience of the local population. VR developers should emphasize the content with interactive and immersive characteristics by using attractive factors such as story telling to stimulate visitors’ interest and deepen their cultural understanding as pride is proven to mediate the relation between VR experiences and cultural dissemination (Zeng et al., 2022).

It is also proven that authentic experiences of tourism-related VR activities significantly affect the assumptions and beliefs (cognitive response) and feelings and emotions (emotional response) of potential tourists. Nevertheless, there are more factors that affect the intention to visit the tourist destination presented in a VR tour, such as the users’ attachment to such technologies (Oncioiu & Priescu, 2022).

Now let’s focus on the technical component of extended reality technologies and the prospects for the introduction of immersive technologies in tourism related to this aspect.

Let us start with AR technology. There are two approaches to building augmented reality: the first one implies using the user’s location coordinates (which are calculated by mobile devices via GPS receivers, gyroscopes, etc.), and the second uses a marker. The marker is an object from reality, and its location is used for the following projection of the virtual object. (Maslova & Belov, 2022).

There are also two types of devices for AR tour guidance: mobile devices and wearable devices such as smart glasses. Smartphones and tablet PCs equipped with a camera provide powerful computing to run AR-based applications. Moreover, these mobile devices are more approachable for consumers than wearable devices due to lesser prices.

As for the second type of devices, smart glasses are equipped with a processing unit, various sensors and transparent lenses so that the digital information overlays the physical
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environment (Pratisto et al., 2022).

AR has the potential to transform both interior (via applications like ARcore) and outdoor navigation. Tourists may find tourist attractions and suitable lodging via AR-based virtual tours. There is already an example of Hub Hotels by Premier Inn, which uses AR to turn its rooms into city maps that direct the user to the area's top attractions (Mordor Intelligence, 2022).

However, despite all advantages of AR, there is a major issue to be solved. AR apps collect more data than it needs, and vulnerability to cyberattacks leads to the risk of this private data explosion. A buggy or malicious AR app can obscure real-world objects, and simulations serve to protect the system and automatically understand the situation and create policies (Syed et al., 2022).

Pratisto et al. (2022) highlight the following challenges for the further development of augmented reality applications besides user privacy: a lack of interoperability exists across device platforms, a requirement of an Internet connection for some AR applications to retrieve data from the server, physical size of the AR devices, the AR tracking ability when using a camera as a sensor, system responses, the AR application layout, the user’s engagement with the real object or surroundings and, of course, user privacy.

For the successful implementation of a mobile application for tourism with AR, several design principles are proposed (Shukri et al., 2017):

- to create a user-friendly user interface (UI) with a convenient presentation of information;
- to ensure optimal placement of information which facilitates the identification of the points of interest;
- to provide training for the user in order to increase the efficiency of further use of the application;
- to ensure the realism and interactivity of the 3D environment.

Now, let us move on to VR tours. Virtual environment might be accessed through wearable VR headsets. These days, it is not required to have a permanent PC connection to ensure sufficient processing capacity, and there are un tethered headsets such as Oculus Go (Weber-Sabil & Han, 2021).

According to Pratisto et al., (2022), there are the following challenges for the use of virtual reality devices: firstly, device familiarization (which can be time-consuming), secondly, the relationship between physical information from the real tourism destination and the virtual information in the VR environment and, thirdly, data availability. What is more, one of the main barriers to mass adoption of VR lies in facilitating conditions (costs, equipment requirements, and knowledge needed to use this technology) (Oncioiu & Priescu, 2022).

Tsai et al. (2022) proposed four mechanisms of VR technology in tourism: limited (which restricts the user’s ability to move; pre-recorded 360 degree virtual tours), semi-limited (which constrains the user’s range of activity), improved semi-limited (with visual assistance), and not limited (user’s movement is not constrained; the user can even ignore the tour guide).

According to their research, all studied indicators (touring experience, cognitive engagement, and knowledge acquisition) showed the best result for semi-limited mechanism. Besides, the technology acceptance is be based on the standards of the usefulness and ease of use, while the while the autonomy and enjoyment should be considered as ways of
improvement because of tourists’ inherent expectations (Li et al., 2022).

Full-body immersion makes it possible to convey a very rich sense of being in another place. On the other hand, it makes the user vulnerable to any threats, dangers and social antagonism in the actual place the physical body is located (Tjostheim & Waterworth, 2022).

There are some recommendations for creating VR tours:
- in order to evoke a sense of immersion, it is necessary to create an authentic and credible atmosphere;
- it is necessary to provide for every detail of the scenario and to determine interactions (if any) within the virtual environment so that cognitive dissonance does not occur;
- UI elements should adequately fit into the environment and be hidden in a separately called menu;
- audio has an enhanced impact on the user's experience, and therefore VR requires high quality sound;
- it is worth considering that in a virtual environment, phobias (e.g. acrophobia, claustrophobia, nyctophobia) become more intense. Depending on the goals and entourage of the VR tour, it is possible to adjust the user's mood through these elements.

As for the implementation of the mixed reality, MR technology combines the capabilities of the VR headset and external video camera. MR creates a third dimension in which both actual and virtual realities exist, are displayed and are interactive.

One of the MR types provided by HoloLens and Magic Leap works with translucent glasses to allow users to see their immediate environment and create the effect of holograms in the user’s peripheral vision.

Another type (e.g. Windows MR) completely immerses the user in a computer-generated environment and use device cameras to reflect the immediate surrounding (Weber & Han, 2021). The use of holograms is anticipated to be the next innovation trend in teleconferencing. However, holograms are restricted by expensively equipped rooms at both ends. Therefore, flexible digital travel has an advantage over this mixed reality technology (Tjostheim & Waterworth, 2022).

Now that the analysis the introduction of all three components of XR has been provided, it is possible to determine the main characteristics that XR should have in order to maximize its effectiveness: impactful, engaging, flexible and scalable, able to work with change management, easy, physically attractive (Stewart et al., 2020).

In the following years, the basis of consumers of tourist services will be represented by generations Y, Z and alpha. These people cannot imagine their lives without digital technologies.

Therefore, travel companies should start taking advantage of immersive technologies and implement best practices as soon as possible.

Although digital tourism is unlikely to completely replace conventional tourism, with the development of XR technologies, both tourism types can successfully coexist, increasing the value of travel brands and creating unique tourist experiences. AR, MR, AR improve the processes of gathering information about tourist destinations, allow to promote the cultural and natural heritage without causing damage to the historical monuments and our planet, give disabled people the opportunity to explore the world etc.
Conclusion

In conclusion, the article analyzed the use of immersive (XR) technologies in international tourism. One can say that the role of immersive technologies in people’s lives has been growing in recent years.

Extended reality is actively transforming international tourism, and the XR experience often becomes the basis of the decision-making process for the purchase of tourism services. This article considers the advantages received by both travel companies and tourists from the use of AR, VR and MR.

Even though immersive technologies still have certain disadvantages related to the technological aspect, accessibility and facilitating conditions, the scientific community has already provided recommendations to improve the effectiveness of XR implementation. This article contains some relevant proposals too.

References:


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