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A CONCEPTUAL REVIEW ON THE USABILITY OF AUGMENTED AND VIRTUAL REALITY TECHNOLOGIES IN TOURISM*

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Abstract
Technology renews itself day by day. In this context, the tourism sector should follow these technological innovations within itself. In particular, Augmented Reality technology has the potential to bring revolutionary changes to the tourism industry. Augmented Reality is a technology that enriches user experiences by adding digital content to the physical world. Therefore, people think that the use of augmented reality and virtual reality technologies in the tourism sector will become widespread. Due to the lack of guiding and insightful scientific studies, it is thought that there is a deficiency in the development and application of these technologies in related sectors. The main purpose of this study is to reveal the awareness and applicability of Augmented Reality and Virtual Reality technologies not only in the theoretical fields of tourism but also in practical applications. Specific research on these technologies, which are still in their developmental stages, will provide insights for investments in their practical applications and contribute to their development. For this reason, content analysis method, which is one of the qualitative research methods, was used. In this context, topics and concepts related to the tourism sector were reviewed and related studies in the literature were analyzed. As a result, the possibility of using Virtual Reality and Augmented Reality technologies in tourism is very high. For this reason, academic studies in specific fields such as Museology, Guiding, etc. can be carried out to come up with new ideas for increasing financial support in the field of application.
Keywords: Technology, Tourism, Augmented Reality, Virtual Reality

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Artırılmış ve Sanal Gerçeklik Teknolojilerinin Turizmde Kullanılabilirliği Üzerine Kavramsal Bir İnceleme

Özet
Teknoloji her geçen gün kendini yenilemektedir. Bu bağlamda turizm sektörü de kendi içinde bu teknolojik yenilikleri takip etmelidir. Özellikle Artırılmış Gerçeklik teknolojisi, turizm sektörüne devrim niteliğinde değişiklikler getirme potansiyeline sahiptir. Artırılmış Gerçeklik, fiziksel dünyaya dijital içerik ekleyerek kullanıcı deneyimlerini zenginleştiren bir teknolojidir. Dolayısıyla, insanlar turizm sektöründe artırılmış gerçeklik ve sanal gerçeklik teknolojilerinin kullanımının yaygınlaşacağı düşünmektedir. Yol gösterici ve ufuk açıcı bilimsel çalışmaların eksikliği nedeniyle bu teknolojilerin ilgili sektörlerde geliştirilmesi ve uygulanması konusunda bir eksiklik olduğu düşünülmektedir. Bu çalışmanın temel amacı, Artırılmış Gerçeklik ve Sanal Gerçeklik teknolojilerinin sadece turizmin teorik alanlarında değil, pratik uygulamalarında da bilinirliğini ve uygulanabilirliğini ortaya koymaktır. Henüz gelişim aşamasında olan bu teknolojilere yönelik özel araştırmalar, pratik uygulamalarına yönelik yatırımlar için içgörü sağlayacak ve gelişimlerine katkıda bulunacaktır. Bu nedenle nitel araştırma yöntemlerinden biri olan içerik analizi yöntemi kullanılmıştır. Bu kapsamda turizm sektörü ile ilgili konu ve kavramlar gözden geçirilmiş ve literatürdeki ilgili çalışmalar analiz edilmiştir. Sonuç olarak, Sanal Gerçeklik ve Artırılmış Gerçeklik teknolojilerinin turizmde kullanılabilme olasılığı çok yüksektir. Bu nedenle Müzecilik, Rehberlik vb. gibi spesifik alanlarda akademik çalışmalar yapılarak uygulama alanında finansal desteğin artırılmasına yönelik yeni fikirler ortaya çıkartılabilir.
Anahtar Kelimeler: Teknoloji, Turizm, Arttırılmış Gerçeklik, Sanal Gerçeklik

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Introduction

Contemporary technological advancements are creating new opportunities in the field of tourism, as in many other sectors. In particular, Augmented Reality (AR) technology has the potential to bring revolutionary changes to the tourism industry. AR is a technology that enriches user experiences by adding digital content to the physical world. It incorporates digital information such as pictures, sounds, and texts into the real-world environment in real time. By incorporating computer-generated sensory input, it improves the user's perspective of the physical environment. Graphical and aural overlays are used to enhance or enrich the real-world experience. Unlike Virtual Reality (VR), which produces an entirely fake environment, Augmented Reality (AR) superimposes information over the real world. AR may be experienced on a variety of devices, including smartphones, tablets, and AR glasses. It is employed in different industries, including entertainment, education, retail, and industry, to deliver immersive and engaging experiences (Paulauskas et al., 2023).

The simulation of a realistic virtual world is the definition of virtual reality technology. It may be operated by body motions and is made with interactive hardware and software (Coyne et al., 2018). VR systems come in two varieties: head-mounted gear-based (immersive) and desktop-based (non-immersive). The capacity of virtual reality technology to immerse the user in an interactive virtual world and replicate the feelings of movement and interaction inside that environment is one of its primary advantages. Through multimodal interaction that combines tactile and visual input, user involvement in virtual environments fosters a sense of immersion in which the user and the visible virtual world are separated by no other medium. VR technology is used to provide this feeling of closeness (Sanfilippo et al., 2021).

It is believed that scientific research concerning the application of these technologies is insufficient. Due to the lack of guiding and insightful scientific studies, the development of these technologies and their application in related sectors is thought to be lacking. The primary aim of this study is to highlight the awareness and applicability of AR and VR technologies, not in the theoretical realms of tourism, but in practical applications. While most of the research in the literature remains conceptual, this study aims to raise awareness of the practical applications of these technologies. Specific research on these technologies, which are still in their developmental stages, will provide insights for investments in their practical applications and contribute to their development. Therefore, the content analysis method, one of the qualitative research methods, was employed. In this context, topics and concepts related to the tourism sector were reviewed, and the relevant studies in the literature were analyzed.

1. Applications of Augmented Reality in Tourism

Augmented reality is a technology that merges the virtual and physical worlds. As users scan the physical world through AR devices or mobile applications, digital elements are added to their view. This technology allows for a more detailed exploration of tourist sites, enables visitors to gain more information, and personalizes their experiences (Azuma, 1997).

1.1. Travel Planning and Promotion

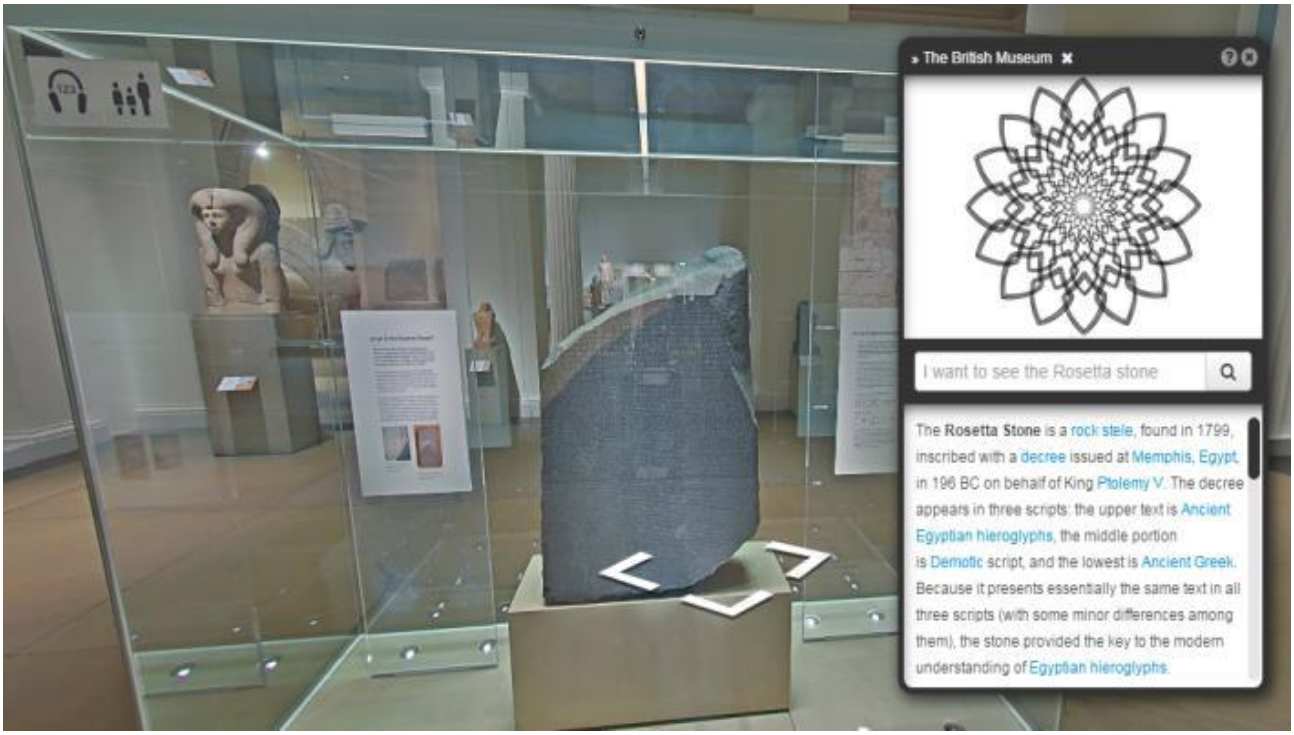
AR is also an effective tool in promoting tourism destinations. Travel agencies and hotels can use augmented reality applications to offer customers the opportunity to experience destinations digitally. This allows tourists to virtually explore the places they plan to visit beforehand, enabling them to make more informed travel decisions (Huang et al., 2013).

1.2. AR Experience in Museums

Museums are among the most common areas where AR technology is utilized. Visitors can gain a deeper understanding of exhibits through information and animations added via augmented reality. Such applications are becoming increasingly popular in major museums like the Louvre. Additionally, AR enables museum visitors to better comprehend the historical context in which the artifacts were created (Dieck & Jung, 2017).

Museums around the world are increasingly incorporating AR into their exhibits. For instance, the British Museum has developed AR tours that allow visitors to view 3D models of artifacts in their original forms or interact with ancient civilizations through digital reconstructions. This technology enables a more dynamic and participatory museum experience, transforming how visitors engage with and learn from collections (Tavčar, Csaba & Butila, 2016).

Figure 1: *A Section from the British Museum*



Source: Tavčar et al. (2016). Recommender system for virtual assistant supported museum tours. *Informatica, 40*(3), 279-284.

AR allows visitors to interact with exhibits in ways that go beyond traditional viewing. For example, scanning a painting with a smartphone can reveal hidden details such as the artist's notes or a 3D model of the painting's creation process. The Louvre Museum in Paris is known to have launched an AR tour that helps guide visitors by overlaying information directly on the objects in the exhibition (Evrard & Krebs, 2018). There are similar examples in Türkiye. For example, in Sakıp Sabancı Museum, some art collections (Figure 2) are shown to guests using AR.

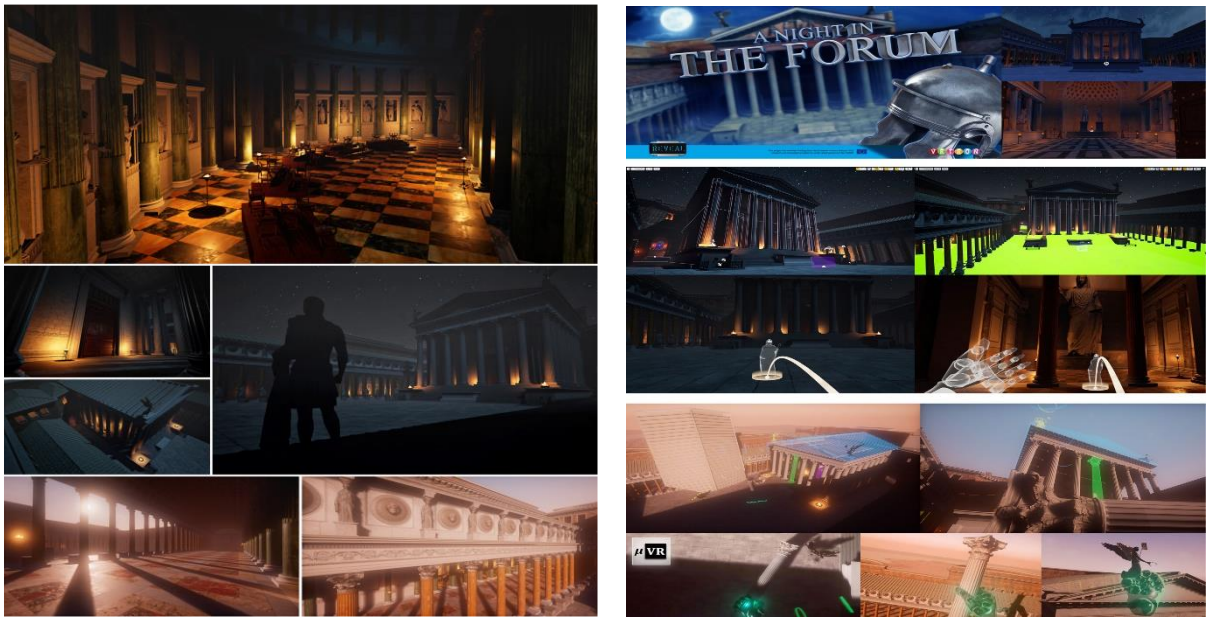
Figure 2: *An Image from the Sakıp Sabancı Museum*

Source: Dağ et al. (2024). The effect of immersive experience, user engagement and perceived authenticity on place satisfaction in the context of augmented reality. *Library Hi Tech, 42*(4), 1331-1346.

1.3. Open Air Historic Sites

AR is particularly valuable in outdoor environments where physical structures may be in ruins or partially destroyed. In places like Pompeii or the Acropolis, AR applications allow users to see reconstructions of ancient buildings and superimpose their original forms over existing ruins. This combination of real-world and digital content helps visitors imagine the splendor of these places in a way that traditional guidebooks or tours cannot. In places like the Acropolis in Greece or the Roman Forum (Figure 3), AR applications allow visitors to see reconstructions of ancient buildings that have deteriorated over time (Ferdani et al., 2020).

Figure 3: *Real-Time Rendering of The Forum of Augustus in Rome in Game Format Using Different Lighting Conditions Using Unreal Engine 4*



1.4. City Tours

In urban environments, AR-based city tours are becoming more popular. City Guide AR is one such application that overlays historical facts, trivia and 3D reconstructions over modern cityscapes. Using these apps, tourists can discover hidden layers of history in cities such as Paris, New York or Tokyo (Paulauskas et al., 2023).

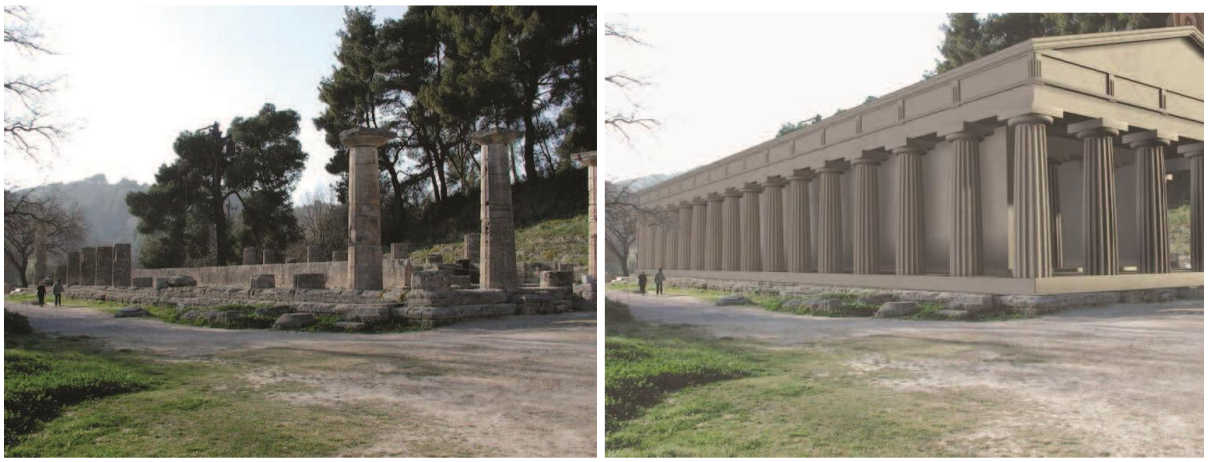
1.5. Guided Tours

Augmented reality combines the real world with the digital world, allowing users to perceive their environment in an enhanced way. AR works mainly through mobile devices, smart glasses and tablets. Supported by visual, audio and even haptic feedback, AR allows users to gain more in-depth information.

Guided tours are trips to museums, historical sites, city tours and similar places, accompanied by a guide. These tours usually aim to convey specific information and provide visitors with more information about the place they are visiting. While traditional guided tours are based on the information transfer of the guide, in the digital age, these tours are made more dynamic with various technologies (Şalk & Köroğlu, 2020).

Augmented reality can guide tourists during their travels. Especially in historical areas, thanks to AR, physical places can be virtually revived in their past state. For example, visitors to the Colosseum in Rome can observe the past splendor of the building thanks to AR applications. Thus, tourists can better see and understand the history of the place by experiencing a time travel experience (Yovcheva et al., 2013). For example, in a study conducted with the ArcheoGuide project, the Temple of Hera in Olympia, Greece was revitalized with AR and brought to tourism (Figure 4).

Figure 4: *View of the Temple of Hera with the Naked Eye and ArcheoGuide*



Source: Vlahakis et al. (2002). Archeoguide: An Augmented Reality Guide for Archaeological Sites. IEEE Computer Graphics and Applications, (5), 52-60.

1.6. Animation of Target Objects

In historical sites, AR can be used to enable visitors to better understand certain events or structures as they were in the past. For example, it becomes possible to see the original state of an ancient ruin (Figure 5) or to re-enact a battle scene. Within a museum, interactive 3D models of exhibits (Figure 6) allow visitors to examine objects from every angle (Bekele & Champion, 2019).

Figure 5: *(a) Real Space-Time, (b) Augmented Reality and Real Space-Time*

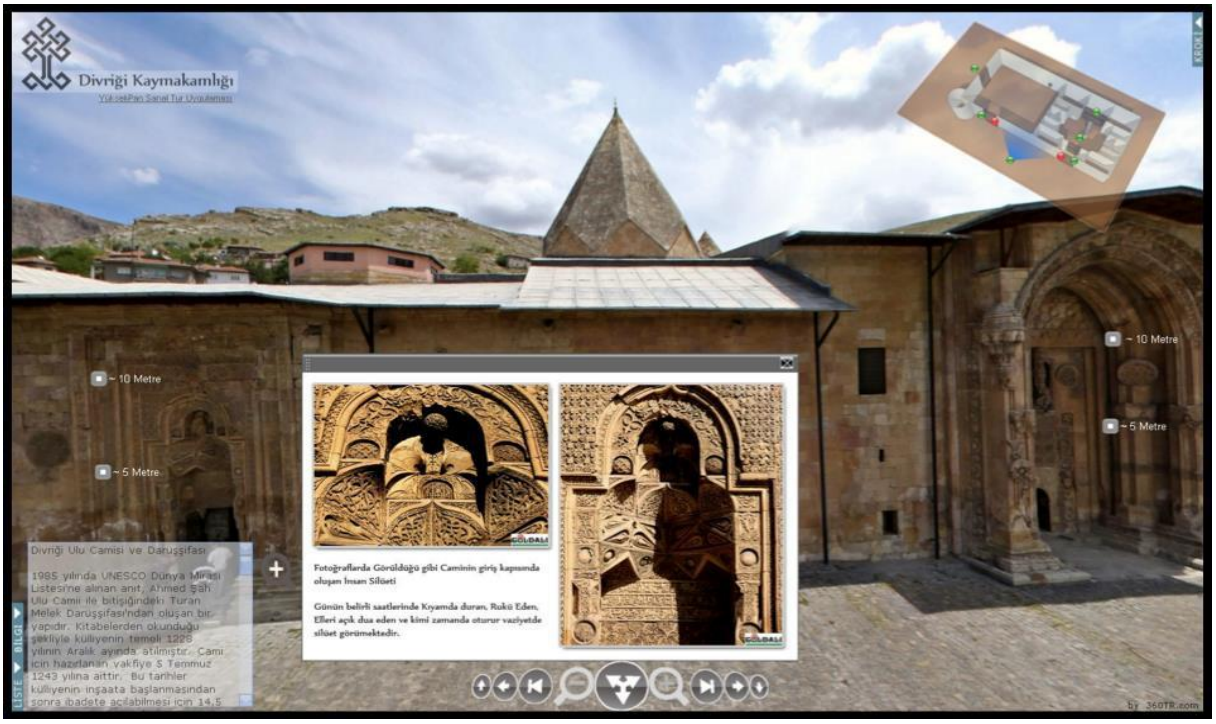
Source: Kysela, J. & Štorková, P. (2015). Using augmented reality as a medium for teaching history and tourism. *Procedia - Social and behavioral sciences, 174*, 926-931.

Figure 6: *The Page with The Vessels and Bowl in The Museum Book of The Museum of Anatolian Civilisations (Left), with The Addition of The AR Marker (Right).*

Source: Sertalp, E. (2017). Müzelerin Tanıtım Kitaplarında Artırılmış Gerçeklik (Ag) Teknolojisi Kullanımı: Ankara Anadolu Medeniyetleri Müzesi Kitabı Örneği. *Sanat Yazıları* Dergisi, *(36),* 107-120.

Virtual reality technologies are also a technology that has started to be used in these areas. It is especially used to revitalize destinations that have been largely destroyed. For example, Divriği Great Mosque and Darusshifa (Figure 7), which are on the UNESCO Permanent Heritage List, can be visited in a virtual environment for visitors.

Figure 7: *Divriği Great Mosque and Darushsifa Educational Virtual Tour Example*



Source: Durmaz et al. (2018), Sanal Gerçekliğin Turizme Entegrasyonu: Samsun'daki 5 Yıldızlı Otellerde Uygulama, *Turkish Journal of Marketing*, *3*(1), 32-49.

2. Advantages of Augmented Reality

2.1. Increased Interaction and Participation

AR prevents users from being merely passive listeners; instead, it makes them active participants. Especially since the younger generation likes to be intertwined with technology, AR offers a great opportunity to attract their attention. It makes the places visited by tourists more meaningful and memorable. It enriches and personalizes touristic experiences by transcending the boundaries of the physical world. This technology also helps to preserve cultural heritage and reach wider audiences (Peters, 2018).

2.2. More Comprehensive and Rich Content

Augmented reality eliminates physical limitations. A museum can offer much more content to its visitors with AR, even if there is no space in the exhibition area. More information than a single book or source can be presented in a digital environment.

2.3. Local and Remote Access

AR can also be used for users who cannot be physically present at the venue. Users can experience the collections of a museum through AR without leaving their homes (Antonioli et al., 2014).

2.4. Training and Information Provision

AR, which allows tourists to have not only a visual but also an educational experience, is used as an educational tool in tourism. For example, when a tourist visits an ancient castle, they can instantly learn about the way of life, war tactics and architecture of that period through AR applications. This allows visitors to establish a deeper connection with the places (Jung & Dieck, 2018).

2.5. Assisting Disabled Tourists

Augmented reality also provides great convenience for disabled tourists. For example, a visitor with hearing impairment can receive text-based guidance through augmented reality technology when visiting a museum. Likewise, audio AR guides for visually impaired tourists make places more accessible (Negruşa et al., 2015).

AR applications can offer multiple language options and adaptive features for visitors with disabilities. A study on the role of AR in promoting inclusive tourism showed that digital avatars, audio guides and on-screen text make cultural sites more accessible to people with visual and hearing impairments (Comes et al., 2020).

3. Research on the Effect of AR on Visitor Loyalty

Research by Graziano & Privitera (2020) shows that AR significantly increases visitor engagement. AR applications in heritage sites provide a bigger comprehension of the historical and cultural background, increasing the level of interaction between visitors and the site. In addition, AR has the ability to attract the attention of younger audiences who are generally more familiar with digital technology.

In a study by Dağ et al. (2024), it was found that AR enhances the learning experience of people visiting historical and cultural sites because it provides interactive learning that allows them to explore the sites at their own pace. The research showed that AR technology encourages active participation by enabling users to interact directly with their environment and increases both enjoyment and knowledge retention.

4. Challenges of these Technologies

Despite their clear advantages, AR or VR applications come with challenges. While these technologies have many advantages, the technology is still in its developmental stage and issues such as device compatibility, internet connectivity and battery life can negatively impact the experience. Furthermore, the costs of developing AR/VR applications are high (Höllerer & Feiner, 2004). It will also require expertise in many areas such as digital skills. Therefore, it will also bring problems such as generation conflicts (Silvestru et al., 2021).

The implementation of AR in historical spaces carries the risk of destroying the authenticity and atmosphere of the environment. The areas where digital content is placed can sometimes contradict the

historical and cultural integrity of the shape. And, some researchers argue that focusing too much on AR/VR technology can reduce the authenticity of visiting historical sites or natural landscapes, as users may become more immersed in their devices than in the physical world around them (Damala et al., 2008).

5. Literature Review

Previous scientific studies were examined and some of these studies were summarized. Şalk & Köroğlu (2020) conducted a research on determining the perception levels of tourist guides towards augmented reality applications. As a result, it was determined that the satisfaction levels and recommendation rates of guides towards augmented reality applications are low due to the fact that tourist guides cannot experience these applications at a sufficient level.

Demirezen (2019) aims to assess the benefits of AR and VR technology and the relevance of its usage in tourism. As a result, he determined that these technologies provide 17 important benefits to the sector.

Siddiqui et al. (2022) did a literature assessment on the most recent technology and applications that may assist the virtual tourism and digital heritage industries. In terms of effect, they recognized the advantages and disadvantages of virtual experiences that can aid the research community in the present scope of virtual tourism and digital heritage, as well as the influence on user experience, awareness, and interest.

Grammatikopoulou & Grammalidis (2023) aimed to test the hypothesis that the educational use of AR technology in the context of a Self-Guided Tour Application for Cultural Purposes can help museums become more democratizing, inclusive and polyphonic spaces by improving attitudes towards sharing of knowledge, collaborative learning, perception, and assessment. As a result, a small-scale preliminary experiment carried out in an art exhibition showed that its use can be efficient as positive feedback was obtained.

Kaźmierczak et al. (2021) conducted a study to analyze the use of AR technology in maritime tourism. As a consequence, a prototype Android app integrating e-navigation and knowledge base was created. The produced solutions demonstrate how the mix of the actual world with a computer-generated environment contributes to the expansion of tourism.

Timur & Köz (2022) aimed to comprehensively analyze the research on AR and VR usage in Türkiye, identify gaps, and propose models for future studies in specific areas and using specific methods. As a result, they found that most of the researches encountered in the literature focused on tourism marketing and museology, mostly qualitative methods were used and most of them consisted of conceptual studies.

Chen et al. (2023) did an extensive literature evaluation to appropriately assess the development and trends in research on Virtual Technology in the Hospitality and Tourism Industries. As a

consequence of this review, researchers were able to comprehend several connected concepts given in prior works.

Praničević (2021) aimed to examine the impact of applying augmented reality (AR) and virtual reality (VR) technologies in cultural tourism. As a result, the application of AR/VR technologies in cultural tourism is encouraged due to the benefits of AR and VR technologies in terms of 'providing visitors with highly relevant content from anywhere at any time', 'reducing the negative impact of tourism on cultural heritage' and 'developing relevant strategies based on more sustainable principles and concepts.

Conclusions and Recommendations

AR/VR technologies are becoming increasingly important in the tourism sector. It is expected that this technology will develop further and be used more widely in the coming years. Especially with 5G technology, AR/VR applications will work faster and more effectively, which will further enrich the experiences of tourists (Tussyadiah et al., 2018). These technologies have great potential for the future of tourism. It can enrich visitors' experiences by increasing interaction and engagement. However, problems such as technological challenges and user adaptability should not be ignored. The development and dissemination of these technologies will play an important role in bringing cultural and historical places to a wider audience.

Scientific research on the application of these technologies is quite insufficient. Due to the lack of guiding and suggestive scientific researches, it is thought that the development of these technologies and their use in the relevant sector areas are incomplete. AR/VR technologies can be used especially in the revitalization of historical places that have been destroyed or are about to be destroyed. For example, with the applications to be made in the ruins of the historical Hippodrome in Istanbul, tourists can be told in a more detailed and entertaining way how this Hippodrome looked in the past and for what purpose it was built. In this way, diversity in the field of tourism can be increased and the number of touristic visitors can be increased.

If historical places in regions that are impossible or difficult to visit are reorganized in virtual environment, tourists will use these technologies to see these historical places that they could not see before due to reasons such as transportation, time, financial, etc. For example, while a tourist who wants to see Mount Nemrut cannot go there due to distance and cost reasons, thanks to VR technologies, he/she will be able to visit these places in a virtual environment from places such as home and office. Thanks to the fictional universe called Metaverse, this VR technology can become a reality. Currently, this technology is still in the incubation stage, but in the future, these technologies will be seen more in daily life (Figure 8). For this reason, this study supports theoretical literature in explaining these concepts and providing certainty. It also provides theoretical insight into the areas in which it can be used and developed. In practical terms, this study shows the applicable areas in the tourism sector and reveals how these areas are formed and can be formed.

Figure 8: *Examples of Applicability in Tourism*

Source: Made by Artificial Intelligence Powered Websites. (https://www.basedlabs.ai/) (https://chatgpt.com/)

It is recommended to provide incentives and trainings for investment in these technologies in the sector. If necessary information is provided especially in the field of guidance, agencies and guides will make a great contribution in transferring and realizing these tours to tourists. Subsequently, it will have an impact on the income from tourism.

Scientifically, it is recommended that research on AR and VR technologies should be increased and directed more towards specific areas. For example, if specific researches are carried out in areas such as Guidance and Archaeology in the tourism sector, these researches will encourage investors to these technologies and provide investors with a specific idea design to develop them.

Declaration

Authors' contributions to the study are equal. There is no author conflict of interest in the study.

In addition, ethics committee permission is not required within the scope of the research.

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