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# CULTURAL TOURISM IN THE AGE OF EMERGING TECHNOLOGIES

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#### Abstract:

Tourism is a practice that adds to culture, preserves the natural world, and offers peace. It is a human desire to make use of the spare time away from one's home. Regardless of the main reason for travelling, cultural interest related to the destination prevails.

People have always been fascinated by their own past such as different rituals that have contributed substantially to the evolution of civilisation. However, traditional modalities of discovery – books, museums, or documentaries – do not offer any experiential possibilities. It is in such a scenario that Augmented Reality (AR) and Virtual Reality (VR) enter the limelight. These two inventions have the potential to make history come alive, by actually transporting people into the worlds of the past that have been hidden for centuries, or to enable people to engage directly with their cultural heritage and traditions.

A VR or AR app could bring history to life – imagine walking through a mythical world, or in a medieval town where ancient skills can be learnt. This is the reason why these technologies are more than games; they are becoming fantastic learning tools and culture preservers.

#### Keywords:

Cultural Tourism, Technology, Augmented Reality, Virtual Reality, Unity, Unreal Engine.

### INTRODUCTION

There is an increased use of immersive technologies in cultural tourism in current literature. An extensive review of the field by summarizes the AR and VR tourism trends deliver emotional and learning experiences to tourists [1]. Similarly, [2] comparing AR and VR's impact on engagement in the case of heritage sites emphasizes that AR forms contextual enrichment and VR as immersion of depth.

Extended Reality (XR) technology, including Augmented Reality (AR), Virtual Reality (VR), and Mixed Reality (MR), is increasingly gaining momentum in tourism and education. A review depicts XR's educational significance in cultural heritage education in 2024 [3], and a study discusses XR's capacity to involve tourists in intangible cultural heritage [4].

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Recent trends in cultural tourism have seen the integration of innovative technologies beyond the traditional Extended Reality (XR) applications. Artificial Intelligence (AI) plays a pivotal role in enhancing tourist experiences through personalized recommendations and conversational agents, improving cultural interactions and making them more personalized. The Internet of Things (IoT) enables the development of intelligent tourism infrastructures, ensuring real-time collection and analysis of data to enrich visitor management and safety at cultural heritage sites [5]. Geolocation-enabled mobile apps with gamification and Augmented Reality (AR) features have become the norm in interactive storytelling, enabling tourists to experience cultural tales interactively [6]. Besides, blockchain technology is also researched to authenticate and trace digital cultural assets' provenance, ensuring a secure platform to handle and share cultural heritage information [7].

Besides technological innovation, digitization efforts also involve digitizing records, creating interactive software, and devising digital storytelling approaches that recontextualize heritage narratives for international consumption. Platforms such as Google Arts & Culture and Europeana have made museum collections and heritage sites available for everyone to access, which brings more visibility to marginalized cultures [8]. Social media platforms support participatory heritage-making, where users can share and co-author cultural narratives, which in turn creates a shared memory and involvement with cultural heritage [9]. The application of digital twinsdigital replicas of actual cultural sites-has been of especial value in conservation activities and virtual tourism, especially when the travel is physically restricted, such as during the COVID-19 pandemic [10]. Combined, these digital tools not only save endangered cultural heritage but also enhance the tourist experience by making it more interactive, individualized, and accessible.

Panoramic VR content gamified storytelling has been put forth as a strong means in experiential tourism for engaged cultural immersion [11]. Simultaneously, the economic value of immersive tourism grows in visibility. Market research in 2024 anticipates a compound annual growth rate (CAGR) of 38% of VR tourist market through 2028 [12].

These findings warrant the strategic use of immersive technologies for cultural tourism as an educational technology and a tool for sustainable regional growth.

Tourism has changed over decades and centuries due to a variety of external factors – the most important being the evolution of transport and technology. Shorter travel times have resulted in longer durations of stay at destinations and greater engagement with local cultures. In this context, tourism is not only a leisure activity but also an important motivation for travel, serving to meet spiritual needs and support cultural development. It is based on anthropic res ources – including historical, religious, artistic, literary, traditional, architectural or culinary elements – and is expressed in a wide variety of forms.

Cultural tourism continues to attract an increasing number of travellers worldwide — both those who travel specifically for cultural purposes and those who engage with culture more incidentally. A major trend in this sector is the growth of unique experiences and meaningful interactions with local cultures.

Nowadays, we can assert that there is heated competition among tourism destinations, and technology may be a decisive factor that determines tourists' touring activities.

Augmented Reality, or AR for short, refers to an interactive experience of superimposing digital content on the real world. One can experience this type of reality with a smartphone, tablet, or even smart glasses. These devices use their cameras and sensors to recognize the physical environment and add virtual elements in real time. According to Azuma, AR systems must combine real and virtual environments, be interactive in real time, and register content in 3D space [13].

One sector with significant potential that has already begun adopting such solutions is cultural tourism. By scanning points of interest, visitors can discover the history of a location and how it used to look in the past. They may also encounter mythological characters, animations, or interactive guides. A clear example is illustrated in Figure 1 and Figure 2: tourists visiting Casa Batlló in Barcelona have the option to take a tour using tablets equipped with augmented reality features. Paintings, furniture, and many other elements within the museum come to life, revealing stories that cannot be interpreted by the human eye alone.

Traditional villages, with their rich historical heritage, can adopt this method to share their cultural values with visitors. Traditional folk dances, combined with myths and stories, can help create meaningful connections between tourists and the place. As Giaccardi argues, digital heritage experiences such as these enable users to actively participate in the meaning–making process of cultural sites [14]. An example is shown in Figure 3, which demonstrates how Augmented Reality (AR) can be used to digitally reconstruct ancient ruins for archaeological and cultural interpretation [15].



Figure 1. Viewing historic interiors through AR at Casa Batlló



Figure 2. Viewing historic interiors through AR at Casa Batlló



Figure 3. Examples of AR applications for archaeological purposes

According to Mize.tech [16], AR is increasingly used in tourism to deliver layered digital storytelling and enhance real-time visitor experiences. Using Augmented Reality in tourism is a promising approach since most smartphones and tablets support AR and it is relatively easy to integrate with the real world. The drawbacks concern the restrictions of immersion and reliance on the physical context of surroundings. Virtual Reality (VR), on the other hand, is an immersive technology which places the user in a fully digital environment, separated from the real world. This is made possible through specialised VR helmets, which provide a 360–degree visual experience and allow full interaction with virtual environments via controllers or motion sensors. Slater and Wilbur emphasise the importance of "presence" in VR – the feeling of being physically situated within a simulated world [17]. An example of this can be seen in Figure 4, where a soldier uses virtual reality to simulate parachute jumps in a controlled and immersive environment.

In the context of cultural tourism, Virtual Reality (VR) enables the reconstruction of entire locations or historical places. Users can take part in traditional ceremonies and explore historical locations that no longer exist in the present days. These types of applications can be used in museums, in education, or even for personal use.

VR's strengths lie in its high degree of immersion its virtually limitless creative potential. However, challenges remain, such as the high cost of equipment and the need for technical optimisation to ensure smooth performance.

The broader category of Extended Reality (XR) encompasses both Augmented Reality (AR) and Virtual Reality (VR), which operate in distinct ways to fulfil different purposes and contexts. Augmented Reality is well–suited for integration in real–world settings to deliver contextual information which enhances physical reality. On the other hand, Virtual Reality functions as a self–contained virtual universe that provides optimal conditions for complex simulations and immersive storytelling.

The proposed case study illustrates the differences between these two technologies, their development and preparation process, and their application in cultural tourism – using the theme "Magic Meadow". Through AR, tourists are guided through real forests where mythical creatures appear. In VR, users can experience a digital version of the legendary meadow from their actual location.

### 2. CASE STUDY: THE "MAGIC MEADOW" EXPERIENCE AS A DIGITAL HERITAGE MODEL

All countries preserve elements of their folklore and mythology, even if only in fragments.

Throughout Romania, various legends are passed down, including stories of "Sânziene", "lele", fairies, "Baba Dochia", "Ileana Cosânzeana" and beautiful maidens who have turned into waterfalls. Other mythical figures include "Iovan Iorgovan", werewolves, and more. There are also wonderful natural sites, as well as man-made sites – manors, fortresses, and ancient ruins – where one can still feel the echo of tales whispered across centuries.

Some of these places continue to attract tourists, such as Poiana Narciselor (Daffodil Meadow) in Zerveşti, Caraş–Severin Country, a nationally protected area settled in IUCN Category IV, that is chosen as a botanical nature reserve. The reserve spans approximately 40 hectares and lies within the administrative territory of Turnu Ruieni Commune. The road distance from Timişoara to Zerneşti is about 116 km, via Timişoara –Caransebeş–Turnu Ruieni route. From Caransebeş to the village of Zerneşti the distance is only 6 km, with access to the protected area made via an agricultural road.

The Festival of the Daffodils was first held here in 1965 and it usually takes place in May, when the white flowers are in full bloom. Each year, the local authorities organize open–air celebrations to promote regional traditions, including local attire, traditional dance, and specific culinary heritage.



Figure 4. Soldier using VR for parachute jumps simulation

According to local folklore, the Roman poet Ovid is said to have passed through this area on his way to exile. Upon seeing this stunning field of narcissus, he is believed to have exclaimed: "Cara mihi sedes"— "My beloved home."

It is a peaceful glade, bathed in sunlight by day and moonlight by night – a place where one feels as though they are stepping into a fairytale.

The application "Magic Meadow", inspired by Daffodil Meadow in Zerveşti, Caraş–Severin Country, serves as an example of how storytelling can be used to engage tourists with the history of a place, incorporating mythological content and traditional practices. Tourists are transported into a mythological world, where they may encounter fairies as well as legendary stars and talking trees. Every part of this fictional realm is rooted in stories drawn from Romanian folklore, alongside traditional customs and historical spiritual practices. According to Green and Brock (2000), narrative transportation – the feeling of being absorbed in a story – enhances the impact of such experience [18].

The creation of such an application requires multiple development phases. Collaboration with ethnographers and local representatives is essential during the documentation stage. A narrative map of the meadow will be created, identifying key points where stories will be triggered.

The following development stages require the construction of a 3D environment using Unity or Unreal Engine as graphic engines. The environment requires 3D models of trees and flowers and mythical creatures together with special effects including fog and volumetric lighting and magical particles to establish a mythical atmosphere. Users will be able to interact with elements through proximity detection, which will activate audio stories and animations.

The audio component plays a crucial role in enhancing the immersive experience. Spatial sound techniques can be used to simulate natural and magical elements — such as birdsong, wind, or whispers — coming from different directions. Storytellers can narrate the tales in a theatrical style, accompanied by music inspired by local traditions. The application can be developed in both an AR version, accessible via smartphones or tablet, and a VR version, designed for a fully immersive experience using headsets.

### 3. TECHNICAL ARCHITECTURE: PLATFORMS, LANGUAGES, AND DEVELOPMENT TOOLS

The development of immersive cultural tourism applications relies on advanced engines and development frameworks capable of delivering interactive, high-fidelity, and emotionally resonant experiences. The two primary engines in use—Unity and Unreal Engine—offer robust toolsets for building both AR and VR environments and are widely adopted across educational and heritage-focused XR projects.

Unity is favored for mobile AR applications due to its flexibility, large developer community, and support for cross-platform deployment. It integrates seamlessly with AR Foundation, a unified framework supporting both ARKit (iOS) and ARCore (Android), as well as Vuforia for image-based AR experiences. Developers leverage Unity's C# scripting, NavMesh Agents for character movement, Collider systems, i.e. Listing 1, and XR Interaction Toolkit for real-time interactions. Recent research highlights Unity's effectiveness in rapid prototyping of educational XR apps and integrating multimodal user interaction—such as gesture, voice, and proximity-triggered storytelling.

Unreal Engine, on the other hand, provides superior graphical fidelity, making it ideal for large-scale VR environments and photorealistic cultural simulations. Its Blueprints visual scripting system supports fast iteration without deep coding expertise, while the Niagara VFX System enables dynamic particle effects like glowing creatures, fireflies, and magical trails. The Sequencer tool allows complex storytelling scenes to unfold in synchrony with sound, animation, and environmental changes. Unreal Engine is also recognized for its support of MetaHuman characters, making it suitable for simulating virtual docents or mythological figures in high-detail.

```
void OnTriggerEnter(Collider other) {
    if (other.CompareTag("Player")) {
        fairyEffect.Play();
        narratorAudio.Play();
    }
}
```

Listing 1. An example of a OnTriggerEnter() function written in C#

Further enhancements include the use of spatial audio, haptic feedback systems (e.g., for interactive museum exhibits), and AI-driven NPCs using Unity ML-Agents or Unreal's Behavior Trees to simulate interactive folklore characters with autonomous reactions. The OpenXR standard ensures compatibility with a broad range of headsets.

Developers are also incorporating cloud rendering (e.g., NVIDIA CloudXR) to offload heavy visual computation and make rich XR experiences accessible on lightweight mobile devices. Moreover, spatial computing platforms are shaping a new generation of cultural applications rooted in environmental understanding and gesture-based input.

Together, these technologies offer a powerful toolset for building highly immersive, culturally respectful, and technically optimized tourism experiences that are deployable across various devices and environments.

# 3.1. INTERACTION DESIGN: USER EXPERIENCE IN AR AND VR ENVIRONMENTS

The proposed application functions as an extension of real-world locations - such as forests and ethnographic gardens - within the AR version. Users can experience actual environments through their mobile phones or tablets, while the screen displays interactive virtual content: fairies flying through trees, legendary stags running across clearing, ancient symbols floating in the air, and magical story gateways. The system responds to user input through physical object proximity detection, as well as screen touch and voice commands. The physical path guidance users augmented interactive maps which provide direction while voice-over narration and 3D sound effects deliver the stories. The system targets authentic location visitors who want to enhance their experience without compromising their connection to nature or local heritage.

The VR version provides a fully digital recreation of the entire experience which operates independently from the user's location. The virtual environment includes detailed simulations of natural elements – such as trees, plants, and animals – together with magical atmospheric effects such as auroral lights and mythical mist. Users experience a dreamlike meadow through VR headsets while they explore freely and interact with magical characters, trigger narrative events, and collect symbolic objects. VR also facilitates learning through interaction, aligning with constructivist educational theories [19]. The virtual world can include secret places, gateways to another dimension, and seasonal changes that evolve over time. In addition, virtual reality allows for the incorporation of interactive gaming elements – including tasks to complete, mysteries to unravel, or recreations of ancient rituals. This variant is appropriate for individual exploration and learning exhibition settings, here users can engage with a highly creative narrative that meets cultural expectations comprehensively.

#### 3.2. DEPLOYMENT AND PERFORMANCE OPTIMIZATION

The final stage involves enhancing the performance of the application through optimisation. Techniques such as Level of Detail (LOD), light baking, and texture compression are used. Low–level testing guarantees the readiness of the application for publishing on distribution channels such as SideQuest and SteamVR for the virtual reality and Google Play and App Store for the augmented reality version.

# 3.3. ETHICAL AND CULTURAL CONSIDERATIONS IN DIGITAL HERITAGE

The application's design must remain sensitive to the cultural context it represents. The active involvement of local communities is necessary to maintain the authenticity of the content. As noted by UNESCO, safeguarding intangible cultural heritage requires ethical representation and community involvement [20].

The use of stereotypes should be avoided, and the commercialisation of heritage should be restricted. In addition, the application should be made accessible and inclusive, with multilingual options and facilities for disabled users.

## 3.4. BROADER IMPLICATIONS: AR/VR IN CULTURAL TOURISM AND EDUCATION

Implementing an application of this kind – whether it is AR or VR – within the cultural tourism sector is more than a simple recreation of an immersive experience. Such uses are a change in basic assumptions in the way we learn, engage with history, and experience cultural heritage. At a macro level, they can also serve as strategic instruments of regional development, revitalisation of local identity, and activation of creative economies. From a learning perspective, extended reality enables learning through experience; children get to learn about myths and traditions not just through texts but by being part of those experiences. XE becomes a strategic tool for regional identity, creative economies, and sustainable tourism [14].

Technologically, the rapid evolution of graphics processing, artificial intelligence, and 5G will enable ever more realistic, interactive, and immersive experiences. According to Statista, the global extended reality market will surpass USD 100 billion by 2026 [21], a large increase compared to 2023 when it was USD 41.2 billion.

Culturally, digitisation of myths and rituals by interactive media can prevent their disappearance, but it must also be ethically responsible. There needs to be an assurance that digital representations do not simplify or distort original meanings. This calls for collaboration among developers, artists, ethnographers, and local communities.

In tourism, these kinds of applications like the one proposed can help increase the attractiveness in rural areas, offering sustainable options to mass tourism and being attractive to customers seeking different and authentic experiences. Moreover, UNWTO data from the World Tourism Barometer indicates that cultural and interactive experiences remain a priority for a growing number of international travellers [22].

### 4. CONCLUSIONS: EXTENDED REALITY AND THE FUTURE OF CULTURAL HERITAGE ENGAGEMENT

The combination of AR/VR with tourism is not just a technological development – it is a revolutionary new way of preserving, understanding, and experiencing heritage. With virtual reality rooted in local myth and legend, such apps call for a unique coming together of past and present, virtual, and real. Whether through AR, which is augmenting existing environments, or VR which is immersing users in completely new ones, extended reality is yielding enormous tools for education, preservation of cultures, and establishing sustainable tourism.

Developers should take into consideration cultural sensitivity, attentiveness to detail, and ethical responsibility. Respect for traditional knowledge, participatory communal engagement, and authenticity are imperatives in bringing digital heritage from the shallow reproduction making it a profound extension of cultural memory. As technology keeps evolving, it also enhances the potential to shape the future of cultural engagement – a culturally engaged interaction that is interactive, inclusive, and in close resonance with the values of the cultures that it seeks to represent.

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