ROLE OF AUGMENTED REALITY IN CULTURAL TOURISM Customer reviews

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ABSTRACT

Augmented reality (AR) is an immersive technology that merges virtual data with real-world environments using smart devices. The use of AR in tourism has expanded possibilities for more engaging, informative, and accessible travel experiences. Recent advancements in AR are followed by considerable growth in scientific research, especially in cultural heritage tourism. For primary research, 22 international cultural heritage sites that use some form of AR in their tourist offer, were selected from the TripAdvisor website, which is used as a data source. Qualitative and quantitative data were analyzed to determine users' satisfaction with the AR experience. Overall, this study's findings correspond to previous research by Shin et al. (2021), González Vargas et al. (2020), T. Dieck et al. (2017), highlighting the significant positive impact of augmented reality (AR) on cultural heritage tourism. Users enjoy the interactive aspects of AR when exploring historical sites and cities and find it useful.

Keywords: Augmented Reality, Cultural Tourism, Heritage Tourism, customer reviews

Role of Augmented Reality in Cultural Tourism: Customer Reviews

Augmented reality (AR) is an immersive technology that combines virtual information and real-world settings using smart devices (Cranmer, 2019). This thrilling technology combines real-world items with digital elements like audio, images, video, avatars, 3D motels, text, and other information to provide enhanced user experience.

Virtual reality (VR), on the other hand, gives its user an insight into a completely stimulated, computer-generated reality, using interactive devices such as goggles, headsets, gloves, or body suits (Mavrin et al., 2022).

What differentiates augmented reality (AR) from virtual reality (VR) is the fact that AR enables its user engagement with the real environment by combining physical surroundings with digital information resulting in an immersive experience that combines the real world with the virtual one (Merr, 2019).

Although this technology is still developing, it has already left its mark on different industries including tourism. The emphasis is on having a more connected and informed guest, which allows businesses and destination management organizations (DMOs) to deliver a unique experience that boosts engagement. Because of its interactive nature, AR has shown a big impact on tourism as it provides an innovative approach to discovering new destinations, engaging with local culture, and navigating unfamiliar situations (Loureiro, 2020). AR improves travelers' immersion in the destination by offering sensory stimulation and enhanced information, resulting in more opportunities to improve travelers' experiences.

As AR evolves, its ability to protect, educate, and promote cultural heritage grows, ensuring the safety and accessibility of our heritage for future generations (Kečkeš &Tomičić, 2017). It is mostly used to recreate historical destinations, events, or artifacts in museums and art galleries.

This study aims to identify AR trends in the tourism industry. Furthermore, the research will focus on the value of AR for cultural heritage sites. Primary research consists of Tripadvisor reviews of historical and cultural heritage sites and museums throughout the world that use augmented reality technology. The purpose of this research is to examine Tripadvisor reviews and detect user trends as well as to determine what percentage of people mention it positively or negatively. Additionally, it will compare the ratings given by these visitors to the overall average rating of these sites. Moreover, it will identify the most common challenges or complaints when utilizing AR, as well as the positive sides. This data will provide a better understanding of what individuals and different cultures across the world think about the usage of AR within cultural heritage settings and whether is it worth investing in this technology.
Because of its technical development augmented reality (AR) technology has become a subject of much scientific research in the field of cultural heritage tourism in the past years. Using digital technologies such as smartphones, smart goggles, tablets, and other devices equipped with a camera enables users to visualize 3D digital within the real environment (Cranmer et al., 2020). Those devices are usually divided into mobile-based devices, such as mobile phones and tablets, wearable devices, such as smart goggles, and stationary devices, such as interactive displays in museums (Zanella, 2019).
AR software or apps that are installed on such devices create a unique experience by extending or adjusting the viewer's image of the real environment. Once a camera-equipped device with AR software is pointed towards a desired point of interest (POI) the software will recognize the AR object in the real world. Once the object is recognised the software will augment it in a way that it will mix the real environment with the digital one. The projection is placed in real-time so it will reflect the viewer's changing situation (Porter & Heppelmann, 2017).

Since smartphones combine all necessary technology required to enable AR and are regularly used among all population, they are currently the most used AR device and have a great impact on AR tourism applications (Kečkeš &Tomičić, 2017).

Two main categories of AR can be recognized in the literature: marker-based AR and marker-less AR. González Vargas et al. (2020) define marker-based AR as an image-based technology that uses visual markers such as cones, physical objects, and 3D or 2D images, to augment the physical object. Once the camera identifies the object the software imbeds the visual effects. On the other hand, Saxena (2023) defines marker-less AR as a location-based technology that uses GPS, compass, gyroscope, and accelerator to gather information about the user's location and display the information once the object is approached. It is mostly used to provide information about nearby activities, monuments, navigation, etc.

Another common distinction is between mobile augmented reality (MAR) and spatial augmented reality (SAR). While mobile augmented reality uses mobile (portable) devices, most commonly smartphones (Zanella, 2019), spatial augmented reality is linked to a specific location. It uses light projectors to overlay digital information onto a real surface environment (Cranmer, 2019).

Application of Augmented Reality in Tourism

The use of augmented reality in tourism has increased the potential for more engaging, informative, and accessible travel experiences (Saxena, 2023). It enables its users to engage in virtual city tours and immersive historical site recreations or provides them with navigation assistance and cultural education. It is altering the way people explore and interact with their surroundings. Truyols (2023) states that ''AR should be used to empower users with real-time information and insights about their experiences. It should also provide them with the ability to explore and discover new things on their own''. Studies have also shown that AR can improve education and interpretation (Tom Dieck & Jung, 2017) as well as "tailor information to tourists' specific preferences, increase interactivity, and improve entertainment and engagement" (Cranmer et al., 2020).

The use of AR in tourism in years to come is bright, but it has already left its mark on the industry. It has been used in different businesses such as hotels and accommodations, restaurants, travel, and cultural heritage tourism.

Hotels and Accommodation

The use of AR in hotels and accommodations focuses on providing guests with a better understanding of the accommodation and nearby attractions and destinations by giving true and vivid information about offers before booking (Zanella, 2019). The technology is used to generate 3D visual tours of the accommodation that include all data, including the cost, visual appeal of the rooms, and views from the rooms (Saxena, 2023).

Restaurants

AR smartphone applications provide guests with information on nearby eateries and pubs. Moreover, certain restaurants offer their guest a visual representation of dishes including ingredient lists and serving sizes (Sokhanych, 2023).

Travel

AR is a great tool for navigating through foreign areas. In April 2018, Google Maps unveiled an invention: real-time directions option which uses AR to improve spatial orientation (Saxena, 2023). By using this tool users can navigate an area more easily by seeing virtual trails and arrows displayed on the smart device (Zanella, 2019). Another example is the Nearest Tube application, which provides the user with the subway route based on their present position.

Furthermore, to overcome the language barrier some applications with AR technologies, such as Word Lens, Google Lens, and Intelligent Eye, help travelers with interpreting street signs as well as with translation of written content on menus, train timetables, newspapers, and similar items into the language of their choice (Zanella, 2019).

AR technology also made an impact on the development of guided tours. AR tour guide applications provide travelers with dynamic virtual information, allowing them to discover more about their surroundings with the use of mobile phones (Zanella, 2019). An example of such an application is the Detour app which takes users on engaging sightseeing tours of the city. The app makes use of anecdotes and local tales narrated by important cultural figures serving as guides. Another example is the Tuscany + app, the first AR tour guide application, which provides information about the nearby attractions, accommodations, dining, and nightlife in the Tuscany region.

Use of Augmented Reality in Cultural Heritage Tourism

Augmented reality is transforming how we interact with our cultural heritage (CH), providing an exciting and interactive approach to heritage exhibitions (Sathishkannan, 2024). Ancient artifacts contain significant information about a society's history and civilization, but they are generally poorly preserved or unavailable due to their size and fragility (Boboc et al., 2019). Augmented reality technology is used to tour historical sites, engage with ancient objects, and develop a better understanding of our shared history. Moreover, when it comes to museums and art galleries AR is used to replace classical audio guides in museums. It is immersive and engages users through audio and visual information. It provides navigation, orientation, and interaction with the cultural heritage resources and offers visitors an interactive learning environment. AR technology is utilized in CH for many reasons. The main ones include increasing tourist experience, reconstruction and exploration, conservation and preservation, and bringing previous events to life (Boboc et al., 2019). It is mostly based on digitization, such as 3D reconstruction, which is used to supplement traditional conservation practices while also preserving and promoting CH assets.

“Most AR applications in CH are aimed at exhibition enhancement, followed by reconstruction and exploration” (Bekele et al., 2018, p. 4). Exhibition enhancement uses AR technology to improve users'

experience and knowledge by adding digital audio-visual information. Reconstruction offers the user the ability to visualize the past by reconstructing architectural details or damaged parts of the artifacts while exploration enables users to have individual experiences of learning and exploring (Bekele et al., 2018).

Benefits of Augmented Reality in Cultural Heritage Tourism

By analyzing articles that focus on the use of AR in cultural heritage, González Vargas et al. (2020) identified the advantages as well as disadvantages, challenges, and limitations of incorporating AR in cultural heritage. One of the most important advantages is providing visitors with an engaging experience and enhancing their perception of the physical environment. AR technology also improves learning, develops the user's cognitive process, generates motivation, and helps with learning retention when it comes to cultural heritage resources.

AR technology offers the following benefits for cultural heritage:

Personalization **-** museums, historical sites, and cities can offer specific information that is targeted according to one's past knowledge, age, personal preferences, etc. AR applications with such options can have an impact on providing visitors with a more personalized visit and offer them a memorable experience that meets their needs. Improved customer insights and data collection – Truyols (2023) states that AR can help gather important information regarding users' interaction within the environment and their interests. This information can help businesses adapt their offer and personalize the visit according to users' preferences. Navigation - one of the most effective uses of AR technology is in navigation and location assistance. AR enables placing digital content, such as pictures or graphic directions, over live graphics of actual locations. For this reason, it is widely used in the tourism industry (Tom Dieck & Jung, 2017). Visualization: AR technology allows visitors to see ancient artifacts or historic buildings in their original state.

Challenges of Augmented Reality in Cultural Heritage Tourism

Most challenges in developing and using AR technology revolve around technical issues. Some of the greatest challenges are as follows:

The absence of interoperability between mobile platforms is a key barrier to developing AR technology. Many frameworks and toolkits can't be used in all operating systems (Kečkeš &Tomičić, 2017). Internet connection is required for using almost all AR technology applications in the CH tourism industry. Access to an internet connection remains a significant issue, particularly for younger generation travelers due to the lack of financial resources (Kečkeš &Tomičić, 2017). Technical limitations include "issues with tracking accuracy, device battery life, field of view, and visual quality" (Throssel, 2023). Users may be experiencing problems with precise tracking and registration of 3D models since the outdoor environment is more complex and varied. As a result, AR objects can move slightly or flicker for no reason, information can take longer to load, and objects could be misplaced (Xu, 2018). AR technology uses cameras and locations on smartphone devices, privacy and data security concerns are rising**.** This technology includes collecting and processing personal data and it is important to understand how it will be protected (Throssel, 2023). Thus, having the correct balance between providing a personalized experience and protecting users' privacy must be designed accordingly. Balancing authenticity can become an issue because excessive use of digital enhancement may reduce the authenticity of the real location (Truyols, 2023). In the study of the benefits and challenges of AR in an outdoor tourism experience, Xu (2018) mentions that individuals felt more absorbed when using AR and forgot everything around them. Given that it is an outside setting, there may be dangers of colliding with real-world things. ''Augmented reality is meant to enhance, not replace, the physical location" (Cranmer et al., 2020). AR should focus on providing relevant information about the site to enhance and complement the physical environment without compromising its authenticity.

Motivations to Adopt AR Technology and User Experience with AR

The most frequent constructs used to predict the effects of augmented reality on the behavioral intents of users are perceived ease of use and perceived usefulness (Jingen Liang & Eliot, 2020). In the study on the impacts of AR on behavioral intentions Jingen Liang and Eliot (2020) examined fifteen empirical studies, four of which focused on these two parameters (Haugstvedt & Krogstie, 2012; Chung et al. 2015; Lee et al. 2015; Kalantari & Rauschnabel, 2018). All studies showed that perceived ease of use had a significant impact on perceived usefulness and behavioral intention, but perceived usefulness had a higher effect on behavioral intention, meaning that the perception of the usefulness of certain AR technology has the biggest impact on users' intention to use this technology, recommend it or to revisit the destination. In the meta-analysis based on the previously mentioned statistics, Jingen Liang and Eliot (2020) found the same relationship as previous authors supporting the previous research. Moreover, Shin and Jeong (2021), also concluded that usefulness is the most important factor when it comes to forming a positive attitude towards AR applications. To conclude, the functional benefit of AR application usage is the most important element when it comes to forming favorable future behavioral intentions from travelers.

METHOD

The goal of the primary research is to investigate users' responses to AR applications in cultural heritage tourism by analyzing recent reviews on TripAdvisor. Furthermore, the goal was to identify whether the

users who mentioned AR in their reviews had higher satisfaction with the experience compared to the users who did not mention AR in their reviews.

For primary research, 22 international cultural heritage sites that use some form of AR in their tourist offer, were selected from the TripAdvisor website which is used as a data source. (See Appendix 1.)

For each site, customer reviews were analyzed and the following information was collected:

- Name of the site
- Location
- Type of location it is (e.g. museum, castle)
- Total reviews for the site
- The most recent 30 reviews mentioning AR
- Keywords used for searching on TripAdvisor
- How many reviews out of 30 are positive
- How many are neutral
- How many are negative
- AR reviews average rating for each site
- Overall site rating
- Customer quotes
- Important notes

Quantitative analysis was performed by counting the number of positive, negative, and neutral comments regarding AR, as well as comparing average review ratings (out of 5 stars) overall for each site, with the average review rating given by tourists who mentioned AR.

In addition, through analysis of qualitative data (tourist comments) for each site identify common themes in positive and negative TR reviews. That way giving a better understanding of the type of experience that AR provides.

Results

Out of a total of 460 Trip Advisor reviews that mention AR technology, 365 of them are positive (79.3%), 76 are neutral (16.52%) and 19 are negative (4.13%). This means that AR technology has a very positive effect on users. The result showed that 16 out of 22 destinations have a higher overall rating for reviews that mention AR compared to the overall destination rating on Trip Advisor. This means that 16 destinations benefit from AR technology because users who use AR rate the same destination higher than visitors who do not mention this technology in the same destination. The range of difference for 16 positive destinations is from lowest 0,065 to 0,45 highest. The lowest destination that produced a positive score is Caerlaverock Castle in the UK and the highest positive is Barone Fortress in Croatia.

Looking at the destinations that benefit from AR common themes are (from the most popular to the least):

The most common generally positive comments focused on enjoyment of the AR app. In their reviews, customers used words such as fun, interaction, immersion, engaging, entertainment, useful, and helpful to describe their experiences. ‘’ I'm a tech geek and I loved the use of the iPad to augment the tour. It had a game to find things in the castle. It also allowed you to see how the palace was furnished via the iPad. I was impressed. I can't wait to see more places do something innovative like this.’’ The second most popular theme was regarding the educational features of AR. AR experiences are designed to be informative and educational. In their reviews, customers used words to describe the AR experience as

knowledgeable and instructive. '' The display boards and interactive tour using augmented reality via iPads (which included a little treasure hunt) were absolutely brilliant, an engaging way to learn the history of the castle. I hope other castles can follow a similar approach.'' Followed by the technical category which is very important because of realistic visuals and good quality audio, good internet connection, good navigation, and ease of use, the app responds quickly are some of the key components for having a positive AR experience. I would recommend this to anyone coming to Dubrovnik the app is surprisingly quick and good quality, very easy to use. We had a great time with the interactive objects and listening to the music. Very educational too.'' Lastly, Kids were mentioned a lot in the comments by their parents. They described AR as interesting for kids, they mentioned that they like treasure hunts and other gamified features and are fascinated by special effects. '' The audio guide was incredible with augmented reality showing you how each room would look like back in the day. My teens had great fun playing the game looking for treasures. I also had great fun clicking through all the things for additional information on the screen.''

Looking at 6 destinations that had a lower AR comment rating compared to the overall site rating (these destinations do not benefit from AR) more carefully it is evident that users experienced a variety of problems when they were using AR.

Technical problems were the most popular theme when it came to negative reviews. When users had a bad internet connection, not-user-friendly applications, low-quality visuals, lack of content, app malfunctions, or AR apps drained too much battery life it had an impact on user satisfaction with the experience in the destination they were visiting. Example: '' However, I found that the AR camera is not user-friendly. Sometimes when we stood in front of a place that was for 3D, the AR camera did not show the 3D. And the WiFi connection is not good as well.'', '' In the hour we were there I used the app conservatively and it used more than 50% of my battery life'', '' The augmented reality exhibits require

an app that didn't work properly on my phone. The whole museum is the same three ideas repeated over and over again and by the end, it feels very, very lame.''

The range of difference for the 6 negative destinations is from lowest -0,042 to highest -0,6. The lowest destination that produced a negative score is ''Palais des Papes'' in France and the highest negative score is ''Trick Eye'' in Singapore. Additionally, since AR is considered a novelty and, in some cases, can be difficult to learn how to use, a comparison of AR experiences that used a combination of professional guides with the AR app and ones that didn't was introduced, but it didn't show any major differences in the grading of the overall experience. Gamification emerged as a sub-theme in the TR reviews. Users, particularly younger generations (kids) liked gamified features in AR experiences which helped them be engaged and learn through entertainment.

DISCUSSION

The conducted research aimed to assess users' responses to AR applications in CH tourism by analyzing recent TripAdvisor reviews and to determine if users mentioning AR express higher satisfaction compared to those who don't. The study showed that reviews mentioning AR are mostly positive (79.3%). Moreover, 72.7% of destinations had a higher overall rating in reviews mentioning AR compared to general destination ratings on TripAdvisor, suggesting AR's positive influence. From analyzing common themes among AR-benefiting destinations it is clear that users find AR experiences engaging and entertaining while being a useful tool for effective learning. These experiences are enhanced by high-quality visuals, gamified features, and special effects for a positive learning environment. On the other hand, the study showed that destinations with lower AR comment ratings had technical issues such as poor internet connectivity, user-unfriendly interfaces, low-quality visuals, lack of content, application malfunctions, and excessive battery consumption in some cases, impacting user satisfaction negatively. Additionally, comparisons between AR experiences with professional guides and those without didn't

reveal significant differences. Incorporating gamification in AR experiences was shown to be particularly appealing to younger generations, highlighting the value of interactive and entertaining learning tools. Overall, this study's findings correspond to previous research by Shin et al. (2021), González Vargas et al. (2020), T. Dieck et al. (2017) highlighting the significant positive impact of augmented reality (AR) on cultural heritage tourism. Users enjoy the interactive aspects of AR when exploring historical sites and cities and find it useful. However, it is clear that to maximize the benefits of AR, developers need to focus on creating high-quality and user-friendly apps. Technical issues like poor internet connectivity, poor quality augmented visuals, lack of content, and apps difficult to navigate can ruin the experience and lead to dissatisfaction among users. Therefore, investing in the development of AR applications that are seamless, engaging, functional, and easy to use is crucial for enhancing tourism experiences.

LIMITATIONS AND SUGGESTIONS

This research is limited to only 22 international cultural heritage sites. In the future, it would be better to have more sites participate in order to produce more accurate results. This research explored the 30 most recent reviews in order for the results to be time-relevant and easier to process compared to possible thousands of reviews, but that excludes other valuable reviews. So, in the future analyzing more reviews could produce a better understanding of results. Since the TA site was used as a data source data about customers like gender, age, profession, and nationality was not shown. For the future, it would be better to have an understanding of the users' backgrounds in order to understand their preferences, and what particular cultures or genders like better or less. This study used general AR applications used in destinations, not specific devices or apps. For the future, it would be better to focus on specific apps and devices across all destinations in order to produce uniform results.

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