

Augmented Reality for Urban Cultural Heritage Interpretation

A User-Experience Evaluation of Historic Jeddah

Sema Refae¹ [0000-0001-5515-7126] and Tarek Ragab² [0000-0002-7173-7072] and

Haitham Samir² [0000-0001-8851-0563]

¹ Architecture Department, Dar AlHekma University, Jeddah, Saudi Arabia

² Architecture Department, Effat University, Jeddah, Saudi Arabia

Abstract

Heritage interpretation plays a vital role in understanding and perceiving heritage values. This research investigates the role of Augmented Reality (AR) in the heritage interpretation process through conducting a pilot AR study in historic Jeddah by simulating the old images of existing buildings through an interactive augmentation in an instantaneous mobile. The study measures the users' experience in five aspects: Informative, Interactive & enjoyable, Realistic & intuitive, Convenience, and Memorable, which have been addressed in the literature to describe AR's influence on visitors' experience in cultural heritage sites.

The study verifies the links between heritage sites' interpretation and visitor experience. It also proposes five factors leading to an enhanced visitor experience through the employment of AR in cultural heritage sites. To verify the viability of the AR model in the interpretation of cultural heritage values and the overall visitor experience, a survey was conducted among a group of local visitors and foreign tourists. The survey's analysis helps trace the reactions and responses to using AR interpretation in a specific cultural context like Saudi Arabia. It confirms the acceptance of the visitors and tourists of the AR interpretation model in simulating lost physical urban memory and confirms that implementing AR in cultural heritage interpretation contributes positively to the overall experience and interaction of the heritage site visitors.

Keywords: Urban Heritage, Heritage Interpretation, Augmented Reality, Visitor Experience

1 Introduction

There is a substantial emerging concern for cultural heritage preservation in Saudi Arabia, accompanied by ongoing efforts to enable cultural heritage sites for tourism and visitation. To support these efforts, new techniques are being developed to overcome the hindrances posed by the lack of finance and human resources or even by the extended time needed for traditional heritage preservation techniques. Such techniques shall contribute to the capacity of the concerned stakeholders to manage heritage locations which eventually entices the cultural tourism industry. Within this paradigm, this research argues that incorporating augmented reality (AR) tools and applications shall enhance the physical interaction with historic sites through a quality interpretation of the values associated with cultural sites. This research raises an important question that has been attempted to answer through the research development: "How and to what extent does the utilization of AR contribute to improve the heritage sites visiting experiences through the interpretation of these sites' values?"

To answer this question, and due to the scope of this paper, the research adopts a set of previously defined aspects of visitor-perception interpreted values, which are used as indicators for visitors' experiences and perception quality. These indicators are informativity, interactivity & enjoyability, reality & intuition, Convenience, and, finally, memorability. Then, the research lays a theoretical background that includes revising the literature to review the potential employment of AR in values interpretation and users' perceptions. This was followed by developing a simulation AR model to measure a set of the five indicators of the visitor experience. In building the simulation model interface, the Appypie platform is used to simulate the old images of the existing buildings and locations in the historic Jeddah through interactive augmentation in an instantaneous mobile application. To verify the viability of the model in interpretation the cultural heritage values and the overall visitor experience, a survey was conducted among a group of local visitors and foreign tourists to measure and evaluate its implications on the users' perception, emotions, attachment, and exploration of the concerned cultural heritage sites.

2 The Role of values Interpretation in Cultural Heritage Sites

Interpretation incorporates the various means of representing heritage to people [1]. In 1985, Cohen distinguished between information and interpretation [2]. Beck and Cable (2002) defined interpretation as "an informational and inspirational process designed to enhance the understanding, appreciation, and protection of our cultural and natural legacy." Interpretation refers to different activities that enhance the awareness of heritage sites that drew the principles of the ICOMOS Charter for the Interpretation and Presentation of Cultural Heritage Site [3]. Expert knowledge has indicated that having a proper interpretive plan is necessary to ensure the heritage site's long-term success [4].

3 The Potential of Using AR for Heritage Sites Visiting Experience

The user experience can be improved by new ways of site presentation and interpretation [5]. AR allows for additional cultural heritage interaction, exploration, and interpretation possibilities. AR gives visitors the freedom to explore and personalize their visit [6]

3.1 The information transferred by AR

Aspects related to information are essential variables in the tourists' experience. Tourists use informative features that support their visits. They guide their decisions, shape their gaze, determine their routes, and even influence the interpretation they make of places. Donaire and Galí, 2008 argued that informative features are a central instrument for mapping tourists' itineraries. Therefore, it is not unexpected to find that the relationship between the models of itineraries and the informative variables should be highly significant [7].

3.2 The Immersive Experience of AR as a form of User-Site Interaction

AR can enable novel interaction between visitors and the authentic setting in which the building, site, or urban environment is encountered for heritage sites. AR interaction allows for new experiences with various forms of cultural heritage [8]. On the other hand, the current technology in smartphones and tablets is recommended for improving interactivity with the cultural heritage sites and, in turn, improving how individual visitors navigate these cultural sites [9].

Jung et al. confirmed that the aesthetics of AR have a significant influence on noticing enjoyment. Aesthetic designing of AR implementation is essential to assure positive perception and lead to positive emotion and behavioral intentions [10].

3.3 Active Engagement with the Memory

AR has been identified as one-way visitor memory can be augmented or improved, especially when helping find customized personal experiences. This encourages these visitors to revisit the site. Through more advanced AR, visitors form a new understanding and identity and develop a different perspective or meaning for the heritage site [8].

Table 1: Factors that affect the utilization of AR as a tool to enhance visitors' experience in heritage sites.

Interpretive Principle			
Interpretive	Experience	Factors lead to a good experience	Informative (Awareness)
			Interactive & Enjoyable (Experience)
			Convenience (Acceptance)
			Realistic & Intuitive
			Memorable (Memory & Identity)

4 The Pilot Study

The study investigates visitors' preferences and feedback on using AR and its potential in enhancing the user visitation experience and its implications on their perception, emotions, attachment, and exploration of cultural heritage sites. The investigation was followed by a survey of the visitors' experience quality. The analysis of the results is used to measure the previously mentioned five aspects relevant to visitors' experience and the overall value of the application.

4.1 Model development, limitations, and site selection criteria

Three limitations affected developing the AR application: technical implications, time, and site. There was an evident technical problem in building the AR marker from image reality. The time was also limited in producing a professional 3d model and developing the model to be more convenient to use. The limitation of the site selection options, due to limited data and documents available for the old urban context of the current historical sites, was also evident through the study development.

The researchers investigated the optimum locations (touristic routes) to implement the AR simulation model. Three existing touristic paths designated by the Saudi Commission for Tourism and National Heritage (SCTH), as shown in (Fig. 1), were selected. The three routes are located under the UNESCO protection ordinance. Following a close observation, a particular path was selected that shows valuable urban elements and has always been a vibrant location.

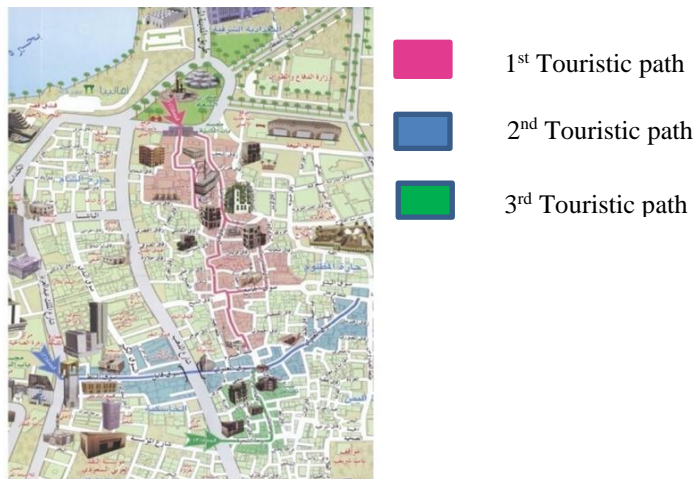


Fig. 1. Jeddah historical touristic path (SCTA, 2012).

4.2 AR simulation tour design and location

The AR simulation tour will pass through nine stops in the second touristic path. The path will allow users to view nine AR views created from nine markers. The views include 2D old photographs and audio videos. (Fig. 2).

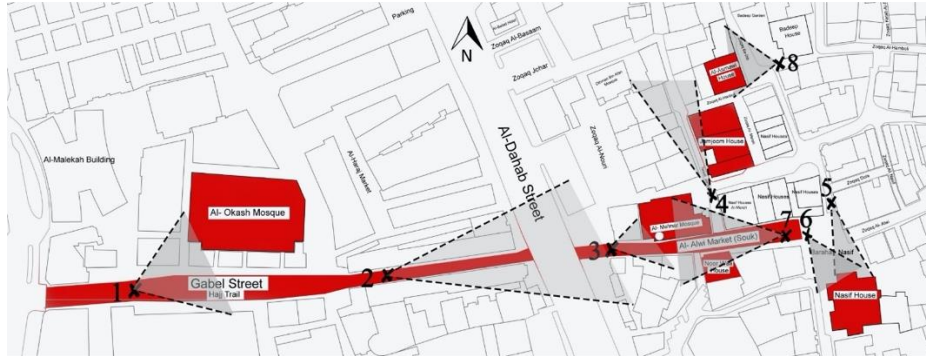


Fig. 2. The AR path simulation (by authors).

4.3 The pilot study methodology and technique

An experimental AR model was developed to measure the five factors that lead to a good visiting experience and evaluate the AR interpretation capacity. The production of the AR model started by selecting a technology platform considering that the application can work with both Android and iOS systems. The app generates two types of AR: old photographs and videos (Fig. 3).

4.3.1 Building the AR Model Interface

The Appyie Builder platform and Vuforia platform are used for building the AR application. It has an AR feature in its beta version. The platform allowed to create a mobile app without utilizing coding skills. Building a demo app began with naming the app "Jeddah historical path" (JHP). The nine features shown in Fig. 4 were added. In addition to a "Survey" feature to the application that includes a designed survey for the visitors to respond to after the tour ends. Fig 4 & Fig 5, and Fig 6 indicate the process of building the images and videos in JHP.

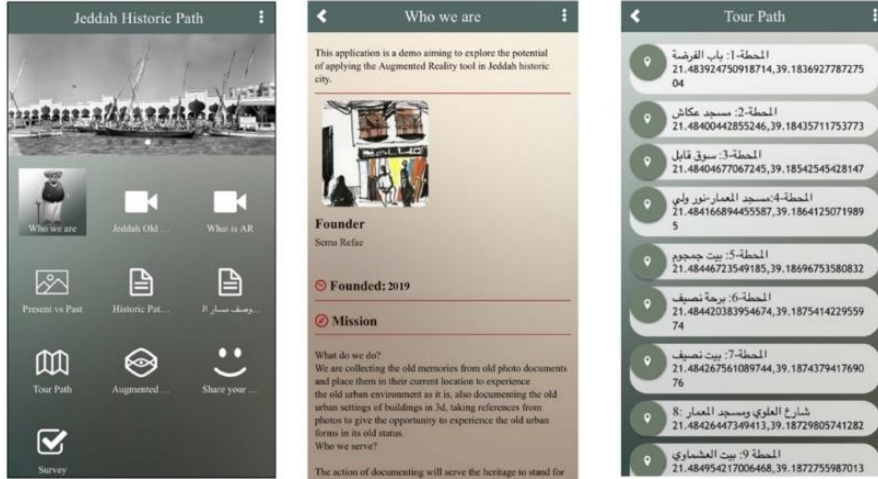


Fig. 3. Mobile app design and features (by authors).

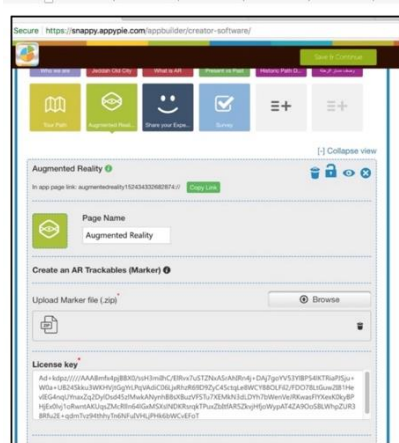


Fig. 4. The app builder face, adding key license and uploading the marker file from Vuforia, (by authors).

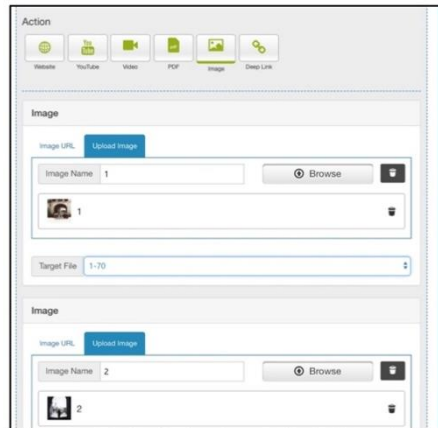


Fig. 5. Selecting a file from the target file database and uploading an image as an AR to attach it with the marker (by authors).

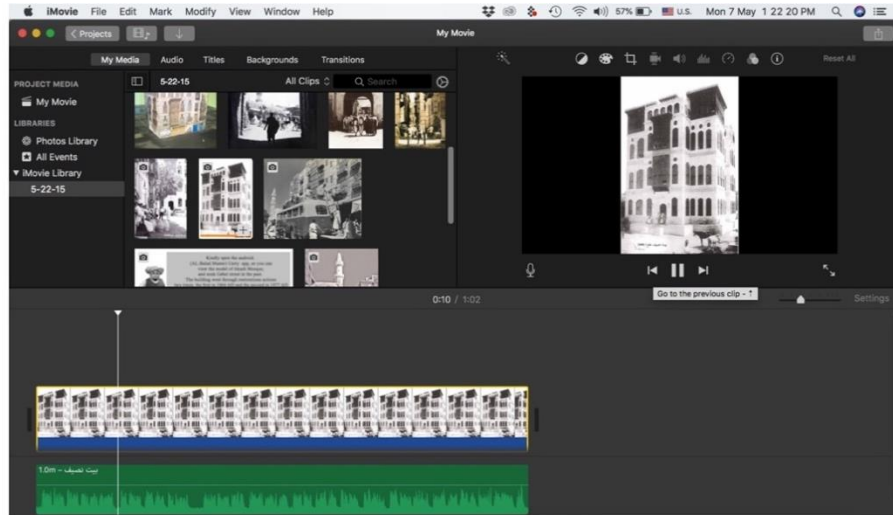


Fig. 6. The process of creating a video by combining the audio with photo (by authors).

4.3.2 Evaluation Methodology

A survey was conducted among groups of local visitors and tourists to investigate the designed AR interpretation viability. Thirty-three participants were able to experience the AR app in different times and days from 23rd to 28th of April 2019 (Fig. 7).



Fig. 7. The image marker was printed on a board throughout the tour to avoid not viewing the AR maker during the experiment tour (by authors).

5 Data Analysis

The first part of the questionnaire explored how the participants are aware of and familiar with AR as a new technology tool. The results show that (64) percent of the participants are aware or have heard about augmented reality. These groups are mostly ranged from 21 to 40 years old. However, (76) percent of them had never experienced AR tools before.

5.1.1 Informative

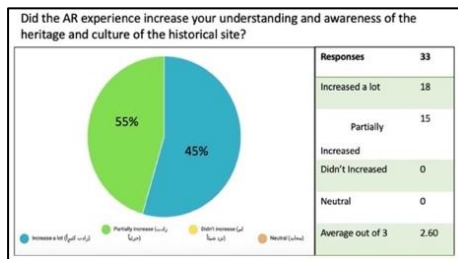


Fig. 8. Survey Result – AR Increased the Awareness of heritage site (the authors).

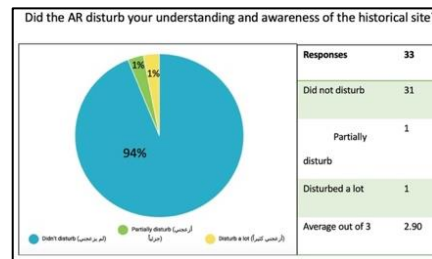


Fig. 9. Survey Result – AR disturb the understanding & awareness (the authors).

The results indicated that (55) percent of the participants had partially increased their awareness regarding the heritage and culture of Jeddah's historic site, and for (45) percent, the experience had increased their awareness a lot. No answers were recorded for negative responses or neutral ones. Also, the results indicated that (94) percent were not disturbed by using the AR experience. Only (3) percent were partially disturbed, and (3) percent were disturbed a lot. It indicates that AR does not disturb awareness. Accordingly, the experience shows a significant role of AR in increasing information and knowledge & expanding visitors' awareness.

5.1.2 Interactive & Enjoyable

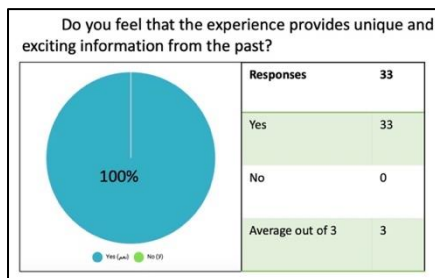


Fig. 10. Experience Survey Results (by authors).

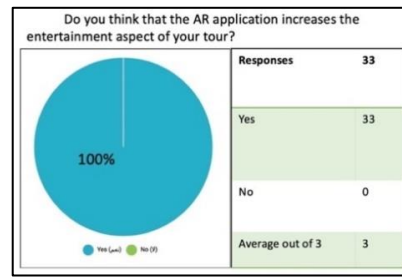


Fig. 11. Entertainment Benefit Survey Results (by authors).

All participants felt that the AR interpretation experience is unique and exciting. The data indicated that (100) percent of participants agreed on the role of AR application in increasing the entertainment and enjoyment of their tour. This result confirms the high impact of AR on the interactive, enjoyable factor added to the visitors of historical sites.

5.1.3 Realistic & Intuitive.

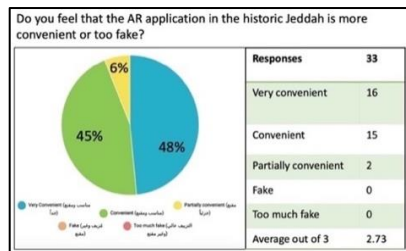


Fig. 12. Acceptance Survey Result (by authors).

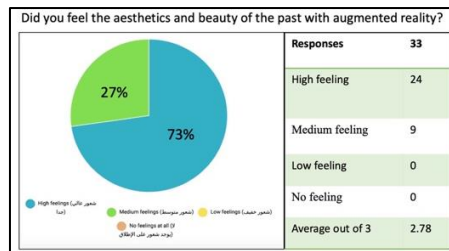


Fig. 13. Memory Survey Result (by authors).

The data indicated that (48) percent of the participants felt that the production of AR in historic Jeddah is very convenient for them, and (45) percent of them felt that it is convenient for them. Only (6) percent of the participants felt that it is partially convenient. None of the participants felt that the augmentation of the application is fake or too fake.

The data also indicated that participants' perception of the aesthetics and beauty of the past from AR recorded (73) percent of the participants had a high level of feelings, and (27) percent had moderate feelings. No participant had low feelings or no feelings at all. It means that the AR enhances the feelings of beauty and aesthetics of the lost memories. These results confirm that the production of AR through the 2D photo is convenient.

5.1.4 Convenience

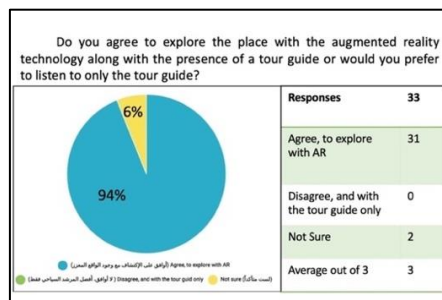


Fig. 14. Acceptance Survey Result–Exploring the heritage site with AR (by authors).

The data indicated that (94) percent of the participants accepted exploring the place with AR technology and a tour guide, and only (6) percent of the participants were unsure. None of the participants disagreed with using the augmented reality tool and preferred only the tour guide for information, which indicates high acceptance of the AR interpretation. The result confirms that the AR interpretation app is convenient to use.

5.1.5 Memorable

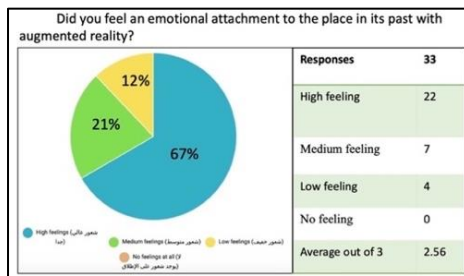


Fig. 15. Memory Survey Result – AR & feeling of emotional attachment to the place in the past (by authors).

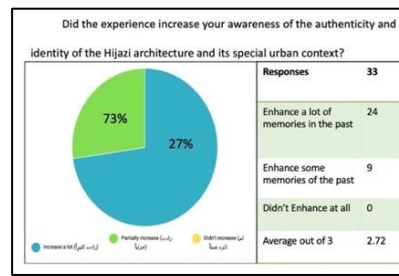


Fig. 16. Identity Survey Result (by authors).

The data indicated (67) percent had simulated feelings of emotional attachment to the place in the past, and (21) percent had moderate simulated feelings of emotional attachment. Moreover, (12) percent presented a low profile of emotional feeling attachment to the past. From the responses, the researcher can assess that the weak feelings could associate with the young and non-Saudi participants who do not have memories or relations to the local culture.

The data indicated that (73) percent of the participants felt that the experience increased their awareness of the authenticity and identity, of the site, and (27) percent of the participants thought it had partially increased their awareness. No participant thought that the experience did not increase their awareness of the authenticity and identity of the Hijazi context. The results confirm that AR has a high potential for increasing the perception of the identity and authenticity of the place. It was concluded from the questionnaire results that AR interpretation had a significant impact on visitors' perception, including old historical memory and identity.

5.2 Results analysis and findings

The table presented below provides the outcome, counting the total average out of 3 from each aspect. The results are all considered positively high from the analysis outcome. It is noted that there are remarkable results from the analysis for the questions

related to the following aspects: Interactive & enjoyable, informative, and Convenience. The findings from the analysis of the results confirmed a general acceptance for utilizing AR in historical sites of KSA.

Table 2: Result Analysis Outcome Measuring the five aspects & sub aspects out of three (by authors)

Main five Aspects	Sub-Aspects	Average out of 3	Total Aspect average out of 3
Informative	Awareness	2.60	2.90
	Understanding	2.90	
Interactive & Enjoyable	Excitement	3	3
	Enjoyable	3	
Realistic & Intuitive	Realistic	2.84	2.79
	Aesthetic	2.73	
Convenience	Convenience	3	2.85
	Easy to use & handy	2.69	
Memorable	Memory	2.56	2.64
	Identity	2.72	

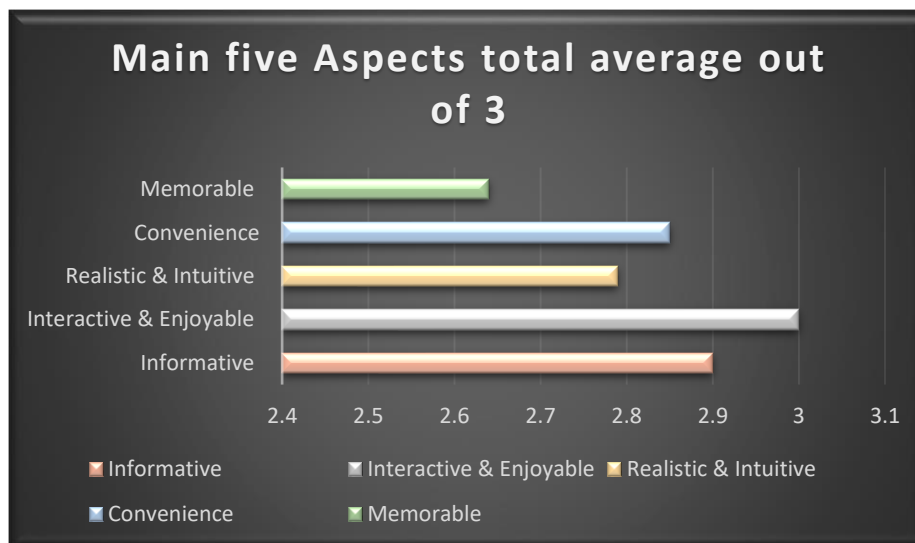


Fig. 17. Main Five aspects total average out of three charts, (by authors)

6 Discussion & Conclusions.

The experimental AR model used in Jeddah's historic site aims to investigate visitors' reactions and responses to the use of AR tool for values interpretation. The study measured five aspects 1) Informativity, 2) Interactivity & enjoyability, 3) Reality & initiative, 4) Convenience, 5) Memorability. These aspects are extracted from the literature

on how AR interpretation affects visitors' experience and interaction and changes cultural heritage perception. The analysis of the survey results and findings is primarily positive and helped trace the reactions and responses to using AR interpretation in a specific culture like Saudi Arabia and confirmed the acceptance of the local visitors and tourists of the AR interpretation model in evoking the lost physical urban memory. The results showed that the impact of the memorable aspect is the lowest, and the less feeling and attachment with the place was from the users who are not familiar with the old urban context or the young generation. However, the researchers observed the positive user's behavior during the tour that endorses high social value and a unique approach to identity aspects through the different reactions to the lost urban memory between the old and young generations.

The study confirms that implementing AR in cultural heritage interpretation will improve the overall experience and the five aspects leading to an excellent experience due to the essential impact of the AR interpretation model in enhancing the user's enjoyment and perception, and understanding of the cultural heritage.

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