

Tourist's experience of Augmented Reality Integration in Historical Sites: Case study in Jeddah

Rafeef AlGurashi¹, Alaa Shatwan^{1,*}

¹ Interior Design Department, College of Arts and Design, University of Jeddah,

*Corresponding author E-mail: ashatwan@uj.edu.sa

Abstract. Vernacular architecture has high attention in Saudi Arabia due to efforts aimed at preserving and maintaining cultural heritage. Augmented reality (AR) helps bridge the gap between the rich heritage of vernacular architecture and the expectations of modern tourists. However, there is lack in knowledge regarding the use of technology to contribute for cultural preservation by offering an interactive museum experience. Therefore, this study aim to investigate the intersection of vernacular architecture, AR, and cultural preservation. Study explores how AR can enhance the tourist experience highlighting both the tangible and intangible cultural aspects of the building. Implementation of five feature of old building with AR is achieved. Then, Interviews with 17 tourists is conducted to emphasize how AR can improve cultural tourism by making heritage sites more engaging, and enhancing their overall experience. Study found that AR technology provided a deeper understanding of the heritage site, offering a more immersive experience compared to traditional methods of interpretation. Finding strongly revealed that technology supports the preservation of Albalad's cultural heritage. It also ensure that traditional buildings are not just remembered, but also actively experienced by visitors. Further research could explore how AR could be expanded to other cultural sites, helping to shape a more interactive approach to heritage tourism globally.

Keywords: Culture, Tourism, Augmented Reality, Users experience, Saudi Arabia

1. Introduction

Cultural heritage includes living cultures (such as festivals, rites, education, religion, costumes, legends, behaviors, habits, music, dances and culinary culture), immobile historical monuments (such as parks, gardens, buildings, facilities and archaeological sites), and movable historical monuments (such as paintings, sculptures, artwork, handicrafts, agricultural tools, industrial machines, and documents/objects) (Pan et al., 2018).

As for historic centers, Boussaa (2014) adds that they showcase the rich past and cultural heritage of a city, ranging from its neighborhoods and streets to its plazas. Culture is highly appreciated and valued. It is considered a major asset in the development of the tourism sector. As Mousavi et al. (2016) highlights that both tangible heritage, present in museums and other attractions, and intangible heritage that is present in festivals and events, have the power to strengthen the tourism sector.

2. Literature Review

2.1 A Preservation of cultural heritage through tourism

Please Since vernacular architecture is considered an embodiment of culture, showcasing it through tourism can be a very beneficial, profitable and holistic approach to preserving that built heritage, especially since VA has been considered a motivator for tourists looking to explore different cultures and heritage (Silva et al., 2021). Heritage tourism enhances economic viability, not only that but it positively impacts the tourism experiences tourists have. The efforts and policies placed by governments can be varied; In the case of repurposing buildings into heritage hotels, this opens a window for offering a unique luxurious experience for visitors while simultaneously introducing them to the culture of the region (Lee & Chhabra, 2015). As for efforts In Saudi Arabia, Mazzetto (2023) informs that the primary government organization in charge of advancing the travel and tourism industry in the Kingdom is the Saudi Commission for Tourism and National Heritage (SCTH). The Commission oversees the upkeep and conservation of Saudi cultural heritage in order to boost domestic and foreign tourism.

2.1.2 Popular cultural and historic tourist destinations worldwide

Santa-Cruz and López-Guzmán (2017) confirm that a location's allure to tourists increases when it is named a UNESCO World Heritage Site, which also offers cultural significance and a commitment to preservation. In their study on the demand for tourism in Cordoba, a city recognized as a World Heritage Site; the socio-demographic profile, satisfaction factors, and classification of visitors are examined. The results show that tourists are usually well-educated people with medium-high incomes who were exposed to Cordoba through recommendations. They also show a high degree of destination loyalty. Touristic services are shown to have a substantial influence on visitor satisfaction, and the study highlights three important aspects that affect visitor satisfaction: stay experience, extra services and amenities, and tourist values. This further solidifies the promoting heritage tourism will meet the demands of tourists and increase the level of heritage preservation and management.

Rodzi et al. (2013) discuss the impacts of tourism development on local communities. A paper analysis was presented on the effects of tourism on the residents of Langkawi, finding that while tourism has changed their traditional cultures, it has also improved their quality of life according to the locals. The socio-economic benefits of tourism outweigh the costs, with locals valuing these benefits the most. While George (2010) highlighted the importance of ownership and copyrights in preserving local culture; also warning about the risks of cultural erosion due to commodification and cultural appropriation, citing a case in Lunenburg, Nova Scotia, Canada.

Comparably, the studies by Yang et al. (2009) and Lee (2010) highlight the appeal of cultural heritage sites to tourists in China and Malacca, Malaysia. They found that tourists are more drawn to cultural heritage sites than other tourist spots, with cultural tourism having a significant impact on tourist satisfaction. This indicates the high potential of cultural heritage sites and cultural tourism in attracting tourists and benefiting local communities, as seen in Langkawi. While Ismail (2018) concluded that historical buildings in Malacca are well preserved, there are doubts about the sustainability of tangible cultural heritage without the conscious and equal conservation of intangible heritage. Furthermore, Yuan (2008) aptly noted that the spirit and intangible value of a historic area are crucial, emphasizing the interdependence between tangible and intangible cultural aspects for the preservation and visualization of cultural heritage.

2.2 Overview of Augmented Reality (AR)

AR can be defined as a technology that merges reality with virtual information, while offering a real-time perspective of both. AR enhances said reality by superimposing computer-generated images onto it (Billinghurst, 2020; Chen et al., 2019). While Bec et al. (2021) offer a similar definition, they use the umbrella term (mixed reality) while referring to AR. AR's main objective is to integrate computer-generated images, texts, music and so on onto the real world. It is a way to give people new approaches to perceive, identify and interact with their surroundings (Chen et al., 2019). Another one of its main objectives is to enhance, and not completely change, the real world. There are many types of AR devices, some of which are head-mounted or mobile held AR applications. No matter the type, AR is not restricted to a certain way of generating or presenting information, nor is it restricted to one sense, opposed to popular belief; AR can be used to enhance or substitute all senses, whether it be sight, smell, hearing or touch (Billinghurst, 2020).

An increasing number of globally recognized research institutes, colleges, and businesses have made investments in augmented reality (AR) research lately, moving it from a theoretical stage to a mass-produced one (Chen et al., 2019). Nine out of ten businesses plan to include augmented reality (AR) in their advertising. Mobile augmented reality (AR) is regarded as one of the most significant technologies of the upcoming decade due to the availability of sophisticated mobile devices (Karacan & Akoglu, 2021). These findings solidify the feasibility and innovation of AR innovative as a technique for human-computer interaction (Chen et al., 2019).

2.2.1 Advantages of AR,VR, MR and 3D softwares in preservation

Technologies such as AR, VR, and MR are equally interesting and all hold so much potential within the field of cultural heritage, preservation and history recreation (Buhalis & Karatay, 2022; Lalitha & Rajasekar, 2019). They create a captivating virtual universe that extends well beyond what is seen in a typical museum setting. Using technologies such as AR, provides users with unique interactions with objects and information (Pedersen et al., 2017).

These technologies have garnered global attention and interest, especially for the purpose of tourism and preservation (Bec et al., 2021). In fact, AR is an innovative way to enhance the preservation of history, increase tourist satisfaction, gain positive feedback and offer better learning experiences (tom Dieck & Jung, 2017) but it can still be said that unfortunately a huge gap of literature is present revolving around the use of AR for heritage preservation purposes (Aziz & Siang, 2014).

Results of a thorough study indicate that stakeholders in the context of cultural heritage tourism view augmented reality to have many multifaceted advantages, including economic, experiential, social, epistemic, historical, cultural, and educational value. All of which encourage decision-makers and stakeholders to invest and implement this technology in settings where preservation of history and culture is needed such as museums (tom Dieck & Jung, 2017).

One of the most important advantages of such technologies (VR and AR) is the enjoyable and authentic experience they can offer tourists without the risk of disrupting the heritage sites or causing it any more damage; this is especially beneficial for sites that prohibit or limit tourist interactions (Aziz & Siang, 2014). A great example of this is an interactive virtual tour that was created for the Arvia'juaq National Historic Site in Nunavut, Canada, to showcase locations to people that are otherwise inaccessible and additionally raise their knowledge of cultural heritage (Bec et al., 2021).

Thanks to these technologies, the "passive" tourist transforms into a "active" one allowed to interact, share and view the preserved objects/sites in a novel way that ensures a memorable experience for them (Barrile et al., 2022). Overall, proposing VR-AR technologies as comprehensive applications

for historic preservation not only may offer an innovative preservation/restoration method that is not invasive but they could also strengthen the travel experience. As a result, in the context of Melaka which is a UNESCO World cultural Site, for example, it really is a holistic approach to heritage preservation (Aziz & Siang, 2014).

Buhalis and Karatay (2022) add the importance of utilizing technologies to present culture, heritage and history to new generations such as Gen Z and appeal to their needs. In fact, a staggering 84% of global visitors have shared enthusiasm over using technologies such as VR or AR within their travels, and no less than 42% of them believe that VR and AR are definitely the future of tourism (Han et al., 2018).

2.2.2 Challenges in implementing technology for historic sites and VA preservation

VR can be used in SCT ,or second chance tourism, and although it's a great asset for heritage and historic site preservation and offering authentic/memorable experiences, it could also decrease footfall to the actual sites, given that it could be implemented anywhere even outside of the site (Bec et al., 2021). There are many restrictions on virtual historical reconstruction, and it takes a lot of work to guarantee the accuracy and consistency of the reconstruction of the sites. These restrictions mainly apply to the design of vernacular architecture and user navigation within historic sites. While VR is limitless with seemingly no restrictions on creativity or plot in the creation of video games, historic preservation cannot offer such leniency. Instead, scenes and objects must be developed in accordance with the demands and details of the site or VA (Ferdani et al., 2020).

As fascinating as AR is and contrary to popular belief, it still not being widely used or implemented, that could be for reasons such as the newness of it, regardless it is progressing slower than anticipated (Chung et al., 2015). One assessment aspect is Technology Readiness, which "refers to the propensity for tourists to embrace and use new technology in the context of tourism. It consists of two components: "optimism and innovativeness" (Chung et al., 2015). Thus, it is of grave importance that future studies focuses on analyzing AR users in multiple tourist destinations. Studies found to discuss how AR use affects tourist destinations and tourists' acceptance. This can still be assessed through three main factors: Technology readiness, aesthetic presentation of information, and Facilitating conditions. Technology readiness is a crucial measure to determine AR integration benefits/challenges. The aesthetic presentation of information, this is especially important because it affects the appeal to interact and understand the information presented. Facilitating conditions generally means that individuals are more prone to using technology if the environment around them encourages said use. These conditions can range from the availability of devices that allow for AR use, ease of use with regards to the AR app or device, availability of guides when needing assistance with AR, and overall individual knowledge about the technology at hand (Chung et al., 2015). Since some AR projects consist of using a head-mounted display, this may result in issues including pain, disorientation and poor depth perception. This issue can be circumvented using more current AR systems that are portable, less intrusive and improve a sense of presence and immersion (Wu et al., 2013). In general, it can be safely said that AR is the perfect technology to present historical events and heritage without being invasive to the original architecture and compromising its integrity (Jung, 2016).

2.3 Conservation efforts in Saudi Arabia

The MOC - Ministry Of Culture - in KSA has established 11 different commissions governed by the ministry, two of which are for architecture/design and heritage. It is "eager to give the kingdom's distinctive cultural identity the attention it deserves, nurture cultural heritage, and preserve the cultural heritage and traditions" (MOC, n.d.).

Ibrahim (2018) asserts that KSA has addressed the importance of heritage and identity preservation; therefore, it took so many initiatives to promote conservation like the "initiative to start Center for the

National Built Heritage (CNBH)". In fact, Mazzetto (2023) sheds light on the Saudi initiative referred to as Vision 2030. The vision intends on supporting the growth of the country in many fields, by improving the level of awareness of local traditions, heritage and values, all in a sustainable approach. Another initiative was starting the Saudi Commission for Tourism and Antiquities' (SCTA) which is responsible for "maintaining and developing the architectural heritage, including sites, buildings, historical monuments, antiques in order to employ them for cultural, educational and eventually tourism purposes" (Ibrahim, 2018). Some historical sites that have been on the forefront of conservation efforts are listed by (Ibrahim, 2018):

- *Al-Hijr (Mada'in Salih)*: This was the first world heritage site to be recognized and documented in KSA. It encompasses VA in the form of houses cut directly into stone, decorated tombs dating back to 1st century BC, cave drawings and some inscriptions left by the pre-nabatean kingdom. Studies on this site have been taking place, headed by the Ministry of Antiquities and Museums the Al-Hijr. It prioritizes non-destructive techniques including systematic inventory, aerial photography, geophysical research, and architectural study.
- *At-Turaif District in ad-Dir'iyah*: this was the first capital of the Saudi Dynasty; located in Riyadh; Founded in the 15th century. It was built in the Najdi architectural style. The Antiquities Act has provided protection for the property since 1976.

Another conservation initiative, also part of the 2030 vision, is the Mohammed Bin Salman project for the development and conservation of historical mosques, this project aims to honor Saudi's captivating and rich heritage. The initiative is centered around 130 mosques across Saudi (Vision2030.gov, n.d.). Mazzetto (2023) adds that there have been various conservation projects completed recently as seen below; the goals for these conservation efforts vary and benefit the sites in many ways such as promoting economic growth, strengthening the cultural identity, raising awareness and enhancing the environmental quality of the sites and buildings:

- *Alhanafi mosque*: In Jeddah; completed by the Saudi Commission for Tourism and National Heritage; type: architectural conservation
- *Alduwaihra mosque*: In Riyadh; by Saudi Commission for Tourism and National Heritage; type: architectural conservation
- *Albalad*: type: In Jeddah; by Al-Balad Historical Area Preservation Department; type: urban regeneration
- *Alula*: In Alula; by the Royal Commission for Al Ula; type: archeological conservation and regeneration; repurposing: Old use was residential, now it's a museum and commercial entertainment center

2.3.1 Conservation efforts in Albalad

There have been various projects aimed at reviving Albalad and conserving its heritage, both tangible and intangible (Sacchi, 2013). In the 1970s, the Jeddah municipality started working on historical preservation. The Jeddah ancient Preservation Society (JHPS) was established in 1991 by the Municipality of Jeddah with the goal of conserving Al-Balad's ancient architecture and culture. Another department established was the Historical Area Preservation Department (HAPD); formed in 1990 with the mission of promoting cultural tourism. A famous example of repurposing was turning the famous Nassif house into a museum to revive the building and drive cultural tourism and preservation into such historic buildings (Ibrahim, 2018). However, due to the lack of exploration into the potential benefits of integrating technology, particularly AR, in the vernacular buildings of Albalad for cultural preservation and tourism enhancement, this paper addresses an important gap. As Albalad becomes an

increasingly popular heritage site in the kingdom, there is growing interest in tourism efforts aimed at enhancing and preserving the area. This study aims to investigate the potential of Albalad's vernacular buildings in Jeddah as a cultural tourism asset, with a focus on how AR can aid in heritage preservation and the restoration of historic structures. Additionally, the paper explores tourists' perspectives on the use of AR apps for both preservation and tourism enhancement.

3. Methodology

This study employs a combination of primary and secondary research methods to gather and analyze data on the use of AR for heritage preservation and tourism enhancement. The research is organized into three key phases: a literature review, a case study, implementation, and interviews.

3.1 Research stages

The following stages, materials and tools were utilized:

First stage: AR App Development: The main research tool employed in this project was an augmented reality app development platform. This platform enabled the creation of a digital overlay that could be projected onto the physical environment of the Matbouli House in Al-Balad. By utilizing this technology, users were able to engage with virtual elements that enhanced their understanding of the building's historical and cultural importance. The app was created with the help of a software engineer. The implementation phase was deemed crucial, seeing as the gap of study highlights a lack of real-life implementation of AR apps in historic buildings in AlBalad.

Second stage: Interviews: After using the app, tourists were interviewed to gather their feedback and impressions on the AR technology and its impact on their visit to the house. These interviews provided valuable insights into how effectively the app enhanced their understanding of the historical monument and its significance. Interviews were conducted with tourists during March of 2024 which is considered one of the busiest seasons in Albalad. Interviews were semi-structured and A thematic analysis approach was employed to examine the qualitative data collected. This method helps identify recurring themes in participants' responses and minimizes confirmation bias, aiming to uncover areas of agreement or disagreement with the research objectives. Interviews conducted with 17 tourists, based on a set of questions designed to explore the use of AR apps at historical sites to enhance visitors' exploration and learning. As demonstrated by Buhalis and Karatay (2022) in their study, "Mixed reality (MR) for generation Z in cultural heritage tourism towards Metaverse," saturation was reached after interviewing 15 participants. All interviews took place after the tourists experienced the AR-assisted tour of the Matbouli House. Before using the app, the tourists received guidance on its usage, as shown

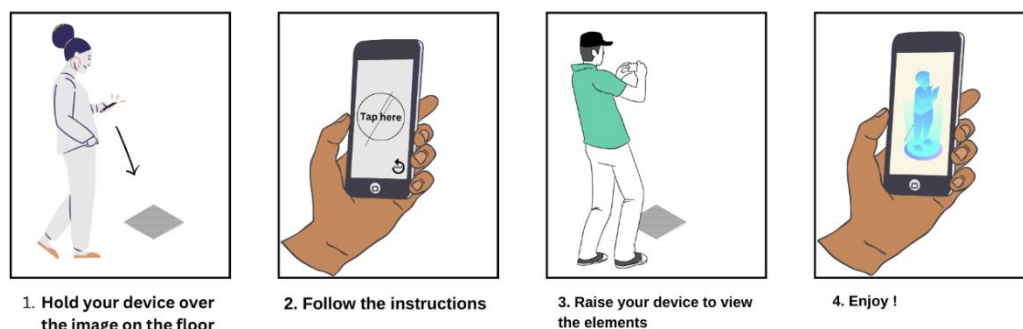


Figure. 1 AR app guide. Source (Al-Gurashi, R & Shatwan, A, 2024)

in (figure. 1).

Third stage: Thematic Analysis: Thematic analysis was employed to systematically examine the qualitative data collected from user interviews and feedback sessions. By identifying recurring themes,

patterns, and insights, a deeper understanding of how the augmented reality app influenced visitors' experiences and perceptions was gained. This analysis revealed key findings and implications for future versions of the app, as well as the broader context of integrating augmented reality technology into heritage preservation and tourism.

3.2 Sample

Interview conducted with 17 tourists varied in age, occupation, nationality and gender. (Figure. 2) below displays the gender, while (figure. 3) displays the nationalities of the sample selected for this study.

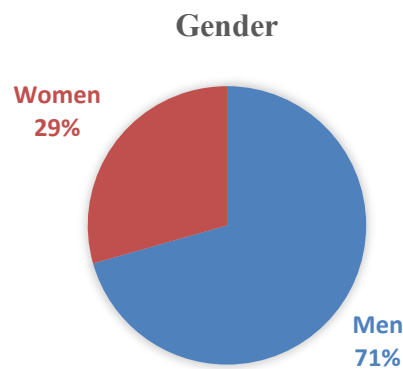


Figure. 2 Sample gender. Source (Al-Gurashi, R & Shatwan, A, 2024)

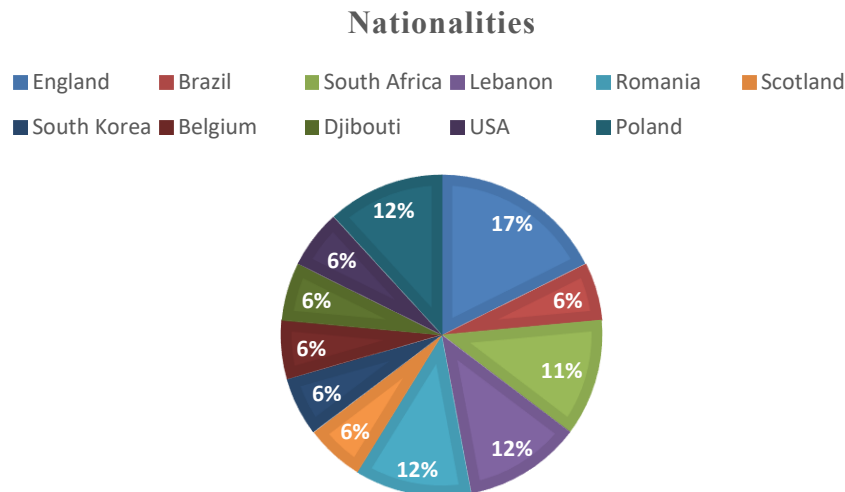


Figure. 3 Sample nationalities. Source (Al-Gurashi, R & Shatwan, A, 2024)

The study used purposive sampling to identify participants who can provide unique insights into the research questions. To guarantee a varied representation of ages, origins, and interests, research participants were selected by the author. The goal of this strategy was to present a thorough picture of how various groups of people used the AR app at the Matbouli House Museum. As seen in (figure. 4), as the study progressed the sample selection became more geared towards participants aged 20-60. This

is mainly due to ease of communication and understanding of technology, as well as availability of participants and their willingness to take part in the study. The diversified sample contributed to the project's overall performance by aiding in the knowledge of the preferences and levels of involvement of different visitor groups. The study adhered to ethical guidelines for research with human subjects. Informed consent was obtained from all participants, and their identities are kept confidential.

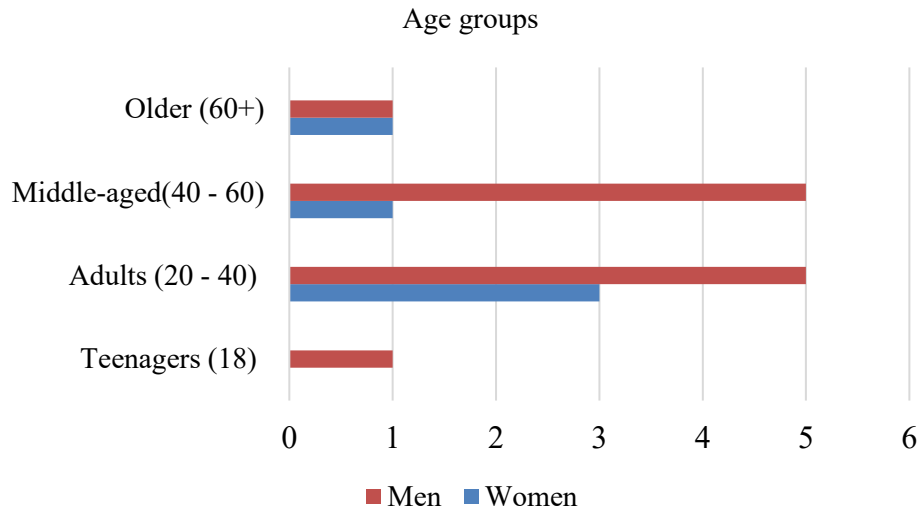


Figure. 4 Age groups. Source (Al-Gurashi, R & Shatwan, A, 2024)

3.4 AR Implementation

The AR app includes 4 main features. It include Arabic and English viewing options. It also has a reset button to move on to other features as shown in (figure. 5). It also contain text that provide extra explanation of the features. This to help tourists learn more about the unique heritage of the house.



Figure. 5 Arabic view Source (Al-Gurashi, R & Shatwan, A, 2024)

First feature is shown in (figure. 6). It shows a man wearing traditional Saudi garments standing at

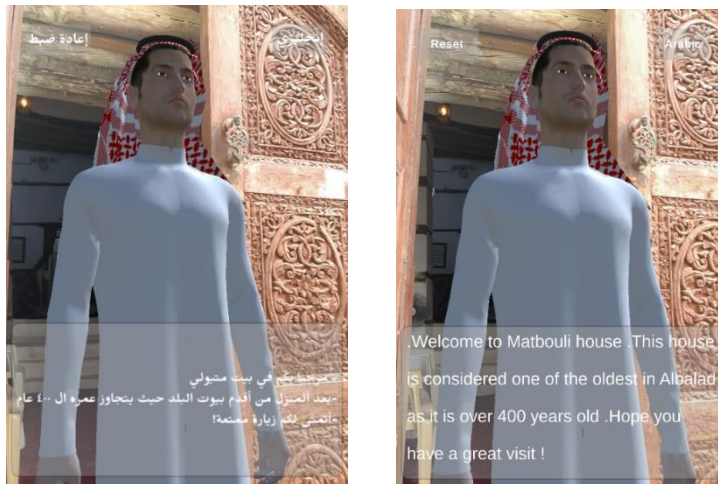


Figure. 6 First feature. Source (Al-Gurashi, R & Shatwan, A, 2024)

the house gate to welcome guest. Then, the two features in (figure. 7) display *Almaqaad* room, which means sitting room. This feature allows participants to see the real built elements that existed in the area before the renovation. It shows a desk that was placed in the room and for an old TV that was crevice at wall. These elements are covered and replaced with sofas. The old elements that are shown in the app help users understand the real function of the room in the past.

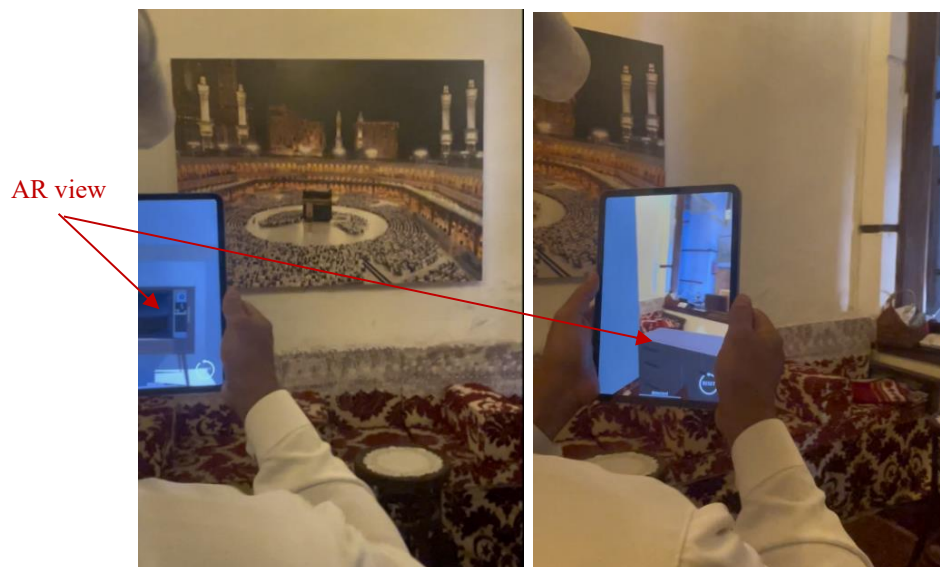


Figure. 7 2nd & 3rd feature. Source (Al-Gurashi, R & Shatwan, A, 2024)

The fourth feature shows a man with pilgrimage garments as shown in (figure. 8). Additionally, the feature contains text to explain the tradition of the Matbouli family where they used to welcome pilgrims to stay in their home; this highlights the intangible heritage of the house. The last feature shows a bride dressed in a traditional bridal gown, which is called “*Masdah Hashimi*” as shown in (figure. 9). The feature also includes information of the culture in the past where weddings stay up to 7 days.



Figure. 8 Fourth feature. Source (Al-Gurashi, R & Shatwan, A, 2024)



Figure. 9 Fifth feature. Source (Al-Gurashi, R & Shatwan, A, 2024)

5. Results

Interviews with visitors who visited the Matbouli House Museum in March 2024 were carried out during what is regarded as a busy season in Al Balad. The AR app created for the museum was presented to the visitors, and their comments and suggestions were gathered. The objective was to ascertain how visitors interacted with augmented reality, how it affected their tour through the house, and whether there were any recommendations for enhancements. Their answers were very helpful and could drive improvements to the tourist experience in Albalad. The following thematic analysis allows the qualitative data to be analyzed based on the recurrent themes, highlighting areas of consensus. The figures are formatted as follows: frequently recurring opinions (Blue) – Suitable title joining the recurring opinions (Green) – The resulting main themes (Grey)

5.1 AR apps enhance the user experience

This recurring theme can be summarized into four main opinions frequently shared by interviewees, as seen in (figure. 10).

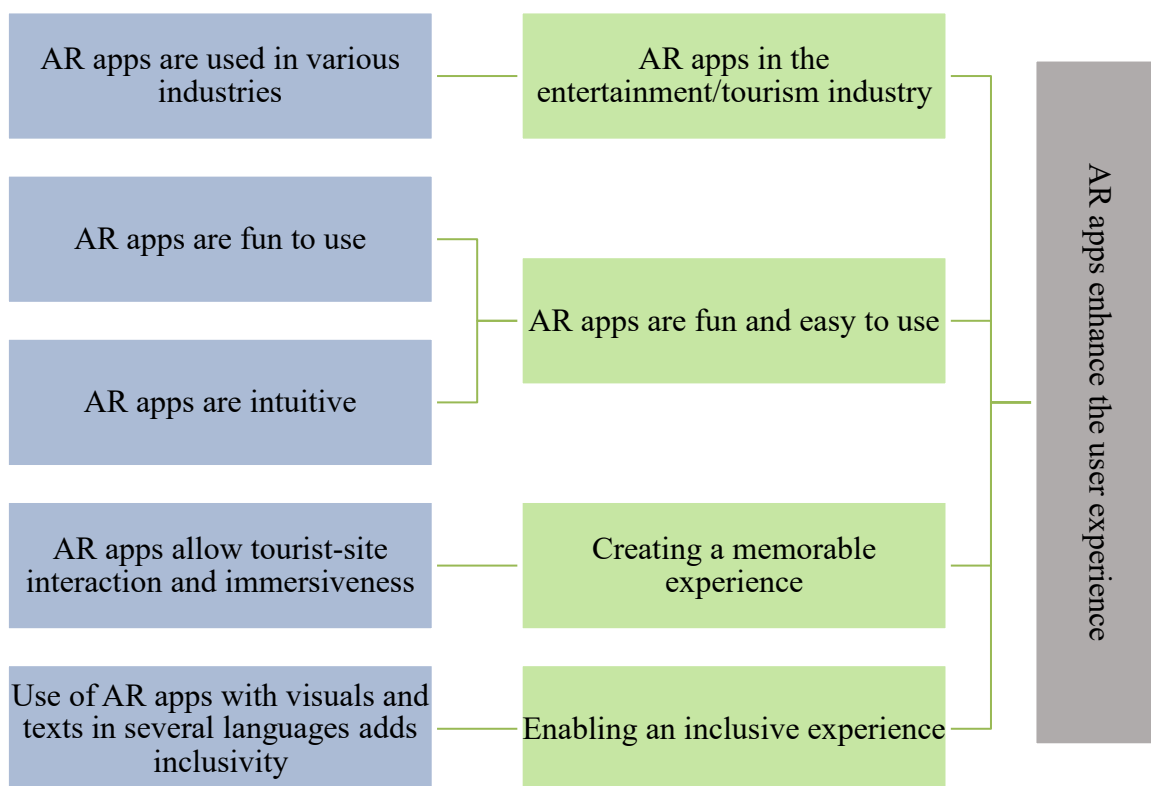


Figure. 10 Thematic analysis (1). Source (Authors, 2024)

5.1.1 AR apps in the entertainment / tourism industry

In this study, only 30% of participants, as seen in (figure. 11), had sufficient knowledge on AR and have extensively used them before. Another 30% have recalled seeing them used in gaming and other industries. These interviewees shared that AR apps are often used in the service sector to enhance user experience in different sorts of events and are even widely used in internationally popular events to enhance user experience. One of them said, *“So, that's even one of the technologies that we used in some major events, some previous ones like Expo 2021 in Dubai and also the World Cup in Doha and Olympics and Islamic Games and all the other, even F1 as well.”*

5.1.2 AR apps are easy and fun to use

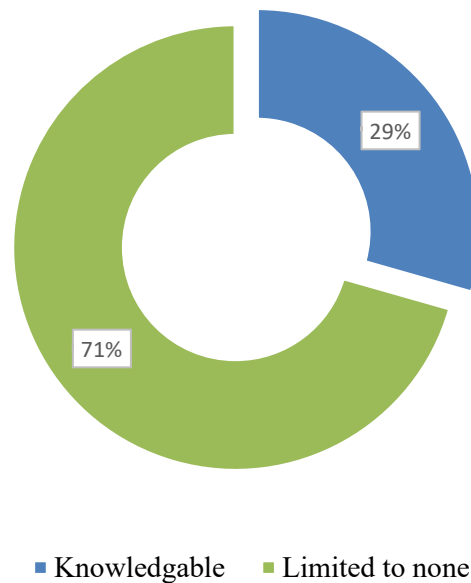


Figure.11 Extent of AR knowledge. Source (Authors, 2024)

The majority of participants, even the older individuals, said AR apps and especially this one are easy and fun to use. Most felt the app was intuitive and they did not face any difficulty while using it. They even found AR apps to be an exciting way to explore historical sites. All of interviewees also believed visuals in AR apps make the experience at historical sites fun for the tourists as one of them said that they think AR adds an element of fun since it not only involves hearing the information, but seeing and interacting with it as well. Some even believed AR apps can aid tour guides in making the experience fun.

AR apps are much more engaging for users who like to read and learn rather than having tour guides as it allows the person to experience the space independently. The app was viewed as fun and interesting for young people and families with children.

5.1.3 Creating a memorable tourist experience

There was a general consensus amongst interviewees regarding the experiences AR generates. They agreed that the visuals and texts in AR apps enhance the experience provided in historical sites. The app was described as liberating, as it allows users to explore the site in a personalized manner based on their own liking and according to their own time. The tourist experience is completely customizable, two people exploring the site together can choose to explore different aspects of the site, like viewing the built elements or viewing the traditions that took place, as per their own liking. Also, as the use of AR in historical sites makes the experience customizable, it also allows the users to spend as much time as they want exploring a certain site or part of it. Almost 30% of users particularly enjoyed the use of the app to provide information specific to rooms. Transitioning between rooms to view different AR features made the experience enjoyable and unique for them.

As for immersivity, visuals in the app make the experience much livelier. AR apps in vernacular buildings enrich the experience as it allows tourists to see past elements of heritage whether architectural or traditional. 88% of interviewees expressed their wish for this app to be applied in more places. AR apps in historical sites can make the experience much more engaging. AR apps in historical sites make the experience much more immersive as it adds interesting historical visuals of people into empty places.

5.1.4 Enabling an inclusive experience

It was found that 95% of participants agree that the app makes the experience at historical sites inclusive for people with disabilities like people with hearing disability can benefit from information provided in visual and text format. Also, 29% of the interviewees added that although this version of the app is considered inclusive, adding audio and more languages would be beneficial. The visuals and texts in several languages makes the experience of historical sites also inclusive for tourists who speak and understand different languages.

5.2 AR apps aid in cultural / historical preservation

This was another commonly shared opinion amongst interviewees, and can be summarized in (Figure. 12).

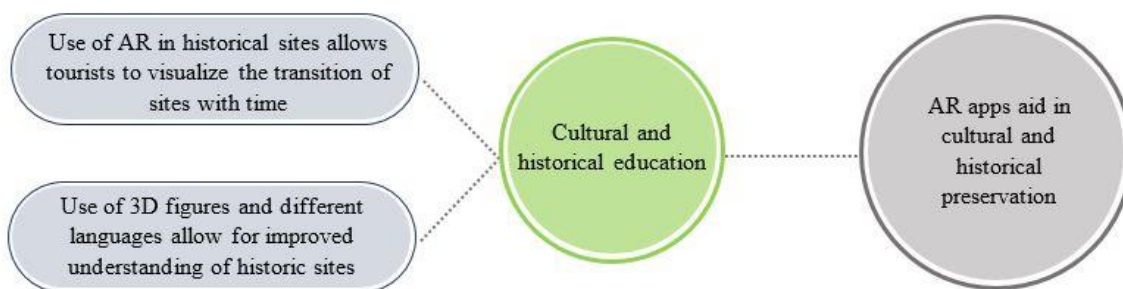


Figure. 12 Thematic analysis (2). Source (Authors, 2024)

5.2.1 Cultural/ historical preservation

Use of AR apps in historical sites is a good way to visualize the history of the site with the help of graphics superimposed into reality, and most participants agree. AR apps are suitable for making the experience at historical sites much more informative. Tourists agreed that the use of AR apps in historical sites makes information about the history of the sites accessible to the tourist, which allows them to learn the significance of each site, and preserves history.

5.2.2 Cultural/historical education

Use of AR apps in historical sites allows tourists to visualize the transition of historical sites with time. There was consensus that use of AR apps in historical sites helps the tourists to learn about history. Use of visuals in the app enriches the experience of learning as it can allow the tourists to visualize the history of the site. Installation of AR apps in historical sites throughout Jeddah can make the travel experience much more insightful. Furthermore, the app allows tourists to gauge the depths of history behind the historical sites. Additionally, 80% of interviewees agreed that AR apps can be beneficial being used in historical sites which are losing their original form to show the tourists what it looked like before. It is easy to understand and interpret the context of historical sites with the help of visuals in AR apps.

5.3 Using other forms of AR technologies

A tourist suggested the use of holograms and different languages to enhance the experience. Although holograms are a separate form of AR than AR apps, it can be put under future consideration.

5.4 AR is preferred over other methods / technologies

Interviewees have expressed their newfound appreciation of AR, as seen in (Fig. 13).

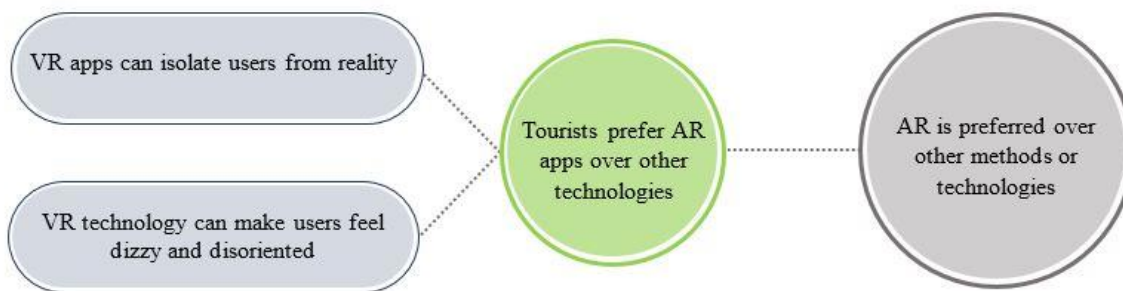


Figure. 13 Thematic analysis (3). Source (Authors, 2024)

The use of AR apps is more convenient and cheaper than traditional methods as it allows tourists to explore historical sites independently and frees them from the cost and need of hiring a tour guide. 60% of participants acknowledge the cost effectiveness of AR apps, while the rest were either unsure or not knowledgeable on the topic. AR apps are easy to use, and it can be convenient and beneficial for users to use AR apps as other options like tour guides are not instantly available and getting historical information becomes difficult.

5.4.1 VR apps can isolate users from reality

Participants were shown a 3D walkthrough done by 3dsmax and most of them agreed it doesn't serve the aim of enhancing their tourism experience as it is completely isolated from the real world and does not add value to their real-world experience at the site, it could be viewed remotely. Regarding VR apps, tourists also agreed that they can isolate the user from reality. One of the interviewees said: *"But then also, you've got a VR headset on, you're not taking it in reality with your own eyes"*. AR apps were preferred by tourists over VR apps in the context of historical sites as the app at hand allowed them to interact with the real world while using it. One of the interviewees said: *"I would rather have an app like this where I can scan things and read it rather than a headset because I don't prefer having that noise, I guess, in a way. I think if I'm in a space like this, I want to talk, I want to engage with the person and oh look, this is what it says so and so rather than hearing someone say it or watching it. So that's my personal preference."* Many of the interviewees also claimed to prefer AR apps in historical sites more than audio recordings as AR apps also contain visuals.

7.4.2 VR causes dizziness and disorientation

It has been widely discussed that VR apps can make people feel dizzy and disoriented, as they have no clue where they are located physically. One of the interviewees confirmed by saying: *"Yeah Joey [her friend] was dizzy all the time when we gamed using VR. There's no clue where you are located basically physically so you can hit stuff while playing the game."*

7.5 AR apps can be inconvenient

Although AR has garnered quite the interest and appreciation, a few interviewees expressed opposing opinions. These can be categorized under two main themes: drawbacks and areas of improvement, as seen in (figure. 14).

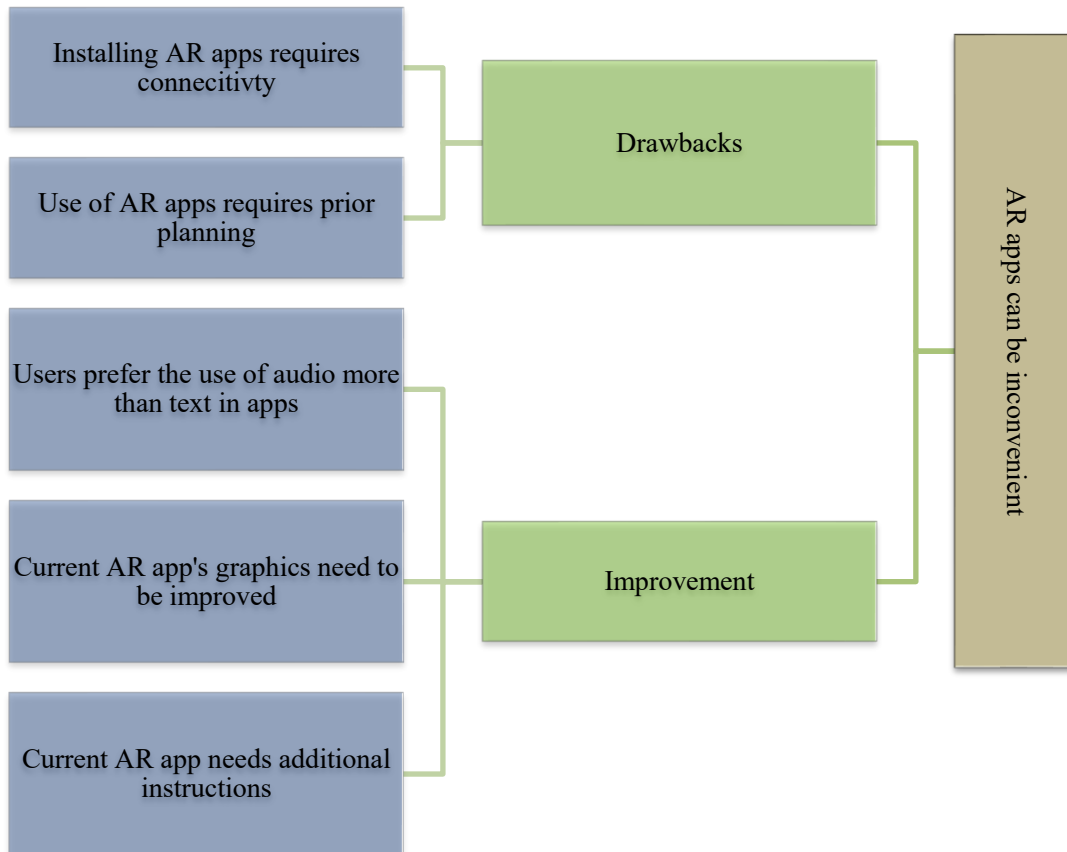


Figure.14 Thematic analysis (4). Source (Authors, 2024)

7.5.1 Drawbacks

Installation of AR apps can be difficult for tourists. Use of AR apps also requires prior planning, as seen in (figure. 15), 3 interviewees were adamant that it requires special prior planning. While the majority held a neutral standpoint, sharing that it's no different than planning for the trip itself, thus it would not be considered an "extra" step. While one of the tourists said: *"somehow I would have to get hold of that piece of software [the app] and that would require prior planning which I'm not very good at."* Use of AR apps in historical sites may also detract users' focus from the actual site. It can be difficult for tourists to use AR apps in historical sites, for example to take pictures while using AR apps in historical sites. Some people do not like virtual reality and prefer tourist guides. Additionally, AR apps are difficult for some old people to use, and they need guidance to help them use it.

Do AR apps require prior planning?

■ Yes ■ No ■ Neutral

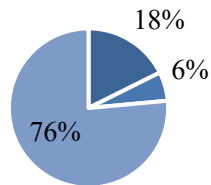


Figure. 15 AR prior planning requirement. Source (Authors, 2024)

7.5.2 Improvement

As seen in (figure 16), all of the interviewees reported enjoying the experience of the app and most of them rated it highly as a concept. The majority also would recommend it to others. Most of them also added suggestions to improve the app to further improve the experience. As for audio, 47% of the interviewees said that they prefer the use of audio over text in the app. This addition can be engaging and further aid the inclusivity aspect of the app. Also, 58% said that the current AR app's graphic design needs to be improved and the visuals can be made more realistic. The interviewees also felt the need for more information and explanation on the historical site. Along with that 11% also suggested the need to have additional instructions. They said that the app can have better instructions to guide users through the app and the process of exploring.

7.6 App effectiveness and feasibility

The app development has proven to be a complex process. Yet, it has also proven to be doable and manageable. The challenges faced during this study can be summarized in the (Table. 1):

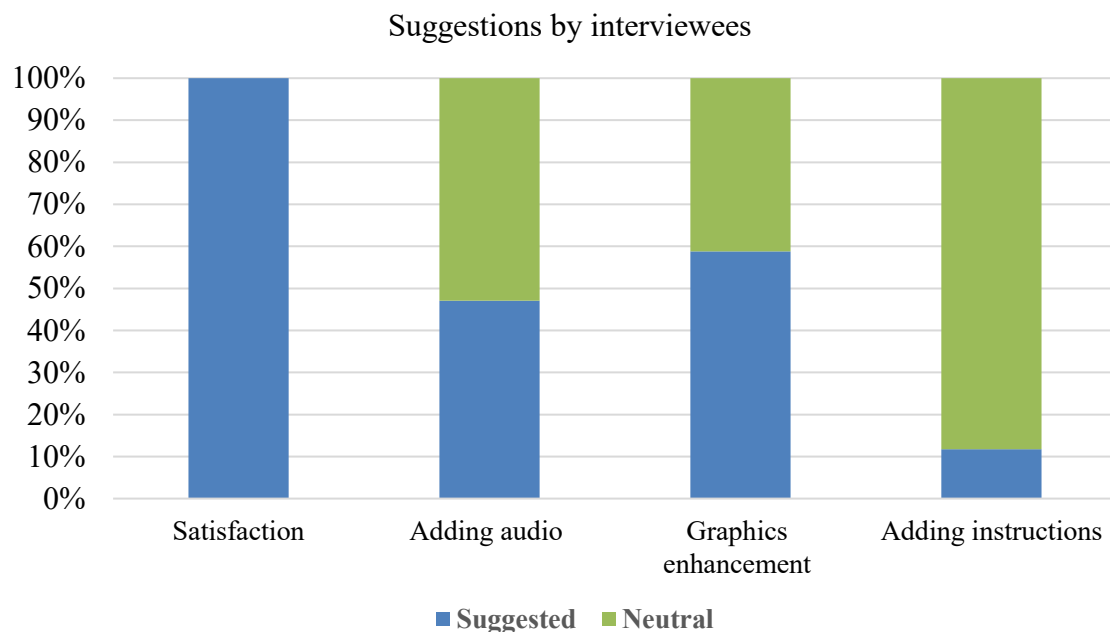


Figure.16 Suggestions by interviewees. Source (Authors, 2024)

Table.1 App effectiveness/feasibility. Source (Authors, 2024)

Factor of app effectiveness/feasibility	HeritageLens
Cost	Costly charges for AR app development
Tools	Missing documents, plans and photographs, especially for pre-renovation or old aspects of the house.
Programming	Rarity of specialized AR app developers in Saudi
Ease of implementation	The app required countless site visits for testing and bug fixes, and given the location of the historic site it has proven to be strenuous at times

8. Discussion

This section discusses the integration of AR for preservation and tourism enhancement into Albalad's vernacular buildings. It presents the conclusions drawn from the results of the thorough approach utilized in this study. The interviews with key stakeholders and tourists, case study, and the review of relevant literature, all aided in realizing this study's objectives and aims. Through tackling the study issue of lack of AR integration in Albalad's vernacular buildings, this section seeks to illuminate the possibilities of AR technology in safeguarding cultural heritage and reviving tourism in the historic site. The discussion is divided as follows:

1. Assessment of current focus on vernacular buildings in Albalad as a tourism resource.
2. Assessment of technology integration in Albalad for conservation and tourism enhancement.
3. AR vs. other technologies
4. Evaluating AR as a viable tool for preservation and tourism Evaluating AR as a tool for preservation and tourism.

8.1 Assessment of current focus on vernacular buildings in Albalad as a tourism resource

Vernacular historic buildings in Albalad have garnered global attention. Saudi Arabia's initiatives and plans to revive and preserve the area are remarkable. From the establishment of the Jeddah ancient Preservation Society (JHPS) and the Historical Area Preservation Department (HAPD) to preserve and promote cultural tourism (Ibrahim, 2018). To the most recent PIF establishment geared towards developing the historic area under the Balad development Company (BDC), and showcasing it as a historic site rich in heritage and culture (BDC, n.d.). Both Mr. Esam Matbouli and Eng. Samir Matbouli acknowledged the importance of VA and praised the attention it has been given by the Saudi Government. With Eng. The engineer also pointed out that the Matbouli family decided on this restoration to fully open the house as a museum, for the purpose of boosting tourism to the house and area.

When discussing VA, not only traditional styles and materials come to mind, but also traditional construction practices. As Olukoya (2021) mentions that VA is the byproduct of individuals sharing a common heritage and creating their own building methods. This point was made clear when restoring the Matbouli house as Eng.Samir mentioned requesting the assistance of an old contractor that is familiar with the Hijazi traditional construction methods in Albalad.

8.2 Assessment of technology integration in Albalad for conservation and tourism enhancement

The study focused on addressing the research problem and analyzing the factors attributing to the problem. The lack of AR integration in historic sites as means of both conservation and tourism

enhancement is not restricted to Albalad only. As discussed in Chapter 4, AR's newness coupled with limited literature investigating its applications contribute to the current lack of use in historic sites worldwide (Aziz & Siang, 2014; Chung et al., 2015). Comprehensive studies examining the usage of augmented reality especially in Al Balad, historic Jeddah, are lacking. For example, about 214 results appear when searching "augmented reality in albalad" on google scholar, dating back to 2014. Only few of the papers analyze AR as an emerging tool, and none of which display real life application of AR on one of Albalad's vernacular buildings. Studies that already exist, frequently concentrate on modern architecture, or broad historical sites without exploring the potential and difficulties of vernacular building and heritage preservation through the implementation of an AR app. Nevertheless, as mentioned in chapter 4 of this thesis, Mazzetto (2023) informs of the initiatives in the smart tourism sector headed by the Saudi Commission for Tourism and National Heritage (SCTH). Fostering technologies and advocating for continued research and integration to boost tourism (spa.gov.sa, 2022).

8.3 AR vs. other technologies

Although all of the tourists interviewed for this study preferred AR over other methods, one tourist suggested the use of holograms as a more interesting form of display. This was addressed by Hussein and El Deen (2020) in their study on using AR holograms, where they proved it possesses more drawbacks pertaining to space limitations mainly and large-scale cost. Other technologies, such as VR, can be great but can also pose some health concerns (Buhalis & Karatay, 2022). Whereas AR, as the majority of interviewees in this study agreed, is a better option.

Seeing as analyzing AR and its advantages, positives and flaws is essential to realize this study's aims and truly test the viability of the app integration. It is imperative to discuss the most prominent results regarding the app, as shown in Chapter 7. One of the features of this app, is that it's marker-based. As Jung et al. (2015) suggested, using marker-based AR is ideal for indoor usage. This was also an advantage when using HeritageLens in Matbouli house museum, as the markers were placed in different areas within the house, and could be moved according to availability. The interviewees especially liked this feature, given that it allowed them to explore different parts of the house with AR, in an easy manner. As far as language options, Heritage Lens in its current state, offers two languages which are English and Arabic. Han et al. (2013) suggested in his study that using several languages increases tourist satisfaction and app viability. This was made clear with around 95% of interviewees praising the app's inclusivity, and with 29% of them wishing more languages to be added to further facilitate inclusivity and enhance the user experience.

As for cost of AR apps, although it proved to be costly during this study. It is important to note it was personally funded, whereas studies such as the one done by Merchán et al. (2021), were covered by a sponsor/government officials. This solution seems to be the best given that it is a cost effective tool, when compared to other forms of preservation/restoration. This was supported by 60% of the interviewees for this study, agreeing on AR apps' cost effectiveness. Cost is also affected by factors such as expert opinions, quality of the app and desired display outcome. Gong et al. (2022) mentioned design and technical difficulties are faced and posed as challenges when creating the AR app.

9. Conclusion

AR can provide immersive teaching experiences that emphasise the historical value and skill of vernacular architecture by superimposing digital information onto physical structures. This method makes sure that the essence of the past is preserved and enhanced by the application of contemporary technologies. By incorporating AR into these structures, a cutting-edge method of conservation is made possible, enabling the digital preservation of cultural narratives and architectural elements. The potential of AR to promote historic and vernacular sustainable tourism is. It takes careful balance to incorporate technology, especially AR, into historically significant buildings and vernacular buildings while also taking cultural and technological factors into consideration. The house's architectural and cultural

features were carefully taken into account during the AR app's creation to make sure the digital overlays enhanced rather than overwhelmed the real building.

Engaging modern tourists is often not possible with traditional techniques of displaying heritage sites. This gap is filled by the AR app created as part of the research, which provides an immersive and engaging experience. With AR, visitors may delve further into the historical tales, architectural details, and cultural value of various rooms within the house, resulting in a more engaging, educational and lasting experience. The positive reactions from visitors, which were disclosed in interviews, emphasize how well the app has helped them comprehend and value Albalad's past.

The extremely favorable response that visitors have given AR shows that it is widely accepted as a tool for promoting cultural assets. While tourists favoured the richer experience and stronger connection to the historical and cultural background of the house, stakeholders appreciated the app's capacity to draw more visitors and stimulate interest in their properties. Key themes that highlight the effective integration of AR into vernacular buildings were identified through the thematic analysis of the interviews. These themes included enhanced engagement/entertainment, educational/historic value, and preservation of cultural identity.

Indeed, incorporating AR into tourist site has proven to be a promising, practical and beneficial strategy for preserving cultural heritage, boosting tourism, and fusing innovation with tradition. This study establishes a standard for further research in this area and adds to the expanding corpus of knowledge regarding the use of AR in cultural heritage.

Future Research: To determine how the AR app will affect travel; economic growth; and cultural preservation, especially in Saudi Arabia, more research and studies on a larger scale should be carried out. Making use of AI in future developments is also a knowledge gap that can be further investigated.

2Investigating other technologies: Investigating further cutting-edge technologies like artificial intelligence (AI) and virtual reality (VR) can improve how cultural material is presented and preserved even more. Assuring that the use of technology into vernacular architecture continues to honor and celebrate its inherent values while embracing the potential of the future will require working in partnership with regional communities, historians, and technologists.

References

- Al-Gurashi, R., & Shatwan, A. Adopting Augmented Reality to Enhance Vernacular Building Preservation and Tourism: Case Study in Matbouli House Museum, Al-Balad.
- Asif, N., Utaberta, N., Sabil, A. B., & Ismail, S. (2018). Reflection of Cultural Practices on Syntactical Values: An Introduction to the Application of Space Syntax to Vernacular Malay Architecture. *Frontiers of Architectural Research*, 7(4), 521-529.
- Azevedo-Salomao, E. M., & Torres-Garibay, L. A. (2016). Vernacular Architecture in Michoacán. Constructive Tradition as a Response to the Natural and Cultural Surroundings. *Athens Journal of Architecture*, 2(4), 313-326.
- Aziz, K. A., & Siang, T. G. (2014). Virtual Reality and Augmented Reality Combination as a Holistic Application for Heritage Preservation in the Unesco World Heritage Site of Melaka. *International Journal of Social Science and Humanity*, 4(5), 333-338.
- Bagader, M. (2014). The Old City of Jeddah: From a Walled City to a Heritage Site. *WIT Transactions on the Built Environment*, 143, 365-374.
- Barrile, V., Bernardo, E., Fotia, A., & Bilotta, G. (2022). A Combined Study of Cultural Heritage in Archaeological Museums: 3D survey and Mixed Reality. *Heritage*, 5(3), 1330-1349.
- Bec, A., Moyle, B., Schaffer, V., & Timms, K. (2021). Virtual Reality and Mixed Reality for Second Chance Tourism. *Tourism Management*, 83, 104256.
- Billingham, M. (2020). Augmented Reality: An Overview. *Geographies of the Internet*, 252-276.
- Boussaa, D. (2014). Cultural Heritage In The Gulf: Blight Or Blessing? A Discussion Of Evidence From Dubai, Jeddah And Doha. *Middle East-Topics & Arguments*, 3, 55-70.

- Buhalis, D., & Karatay, N. (2022). Mixed reality (MR) for generation Z in cultural heritage tourism towards metaverse. *Information and Communication Technologies in Tourism 2022: Proceedings of the ENTER 2022 eTourism Conference*, January 11–14, 2022.
- Chen, Y., Wang, Q., Chen, H., Song, X., Tang, H., & Tian, M. (2019). An overview of augmented reality technology. *Journal of Physics: Conference Series*. DOI:10.1088/1742-6596/1237/2/022082
- Chung, N., Han, H., & Joun, Y. (2015). Tourists' Intention To Visit A Destination: The Role Of Augmented Reality (AR) Application For A Heritage Site. *Computers in Human Behavior*, 50, 588-599.
- Ferdani, D., Fanini, B., Piccioli, M. C., Carboni, F., & Vigliarolo, P. (2020). 3D Reconstruction And Validation Of Historical Background For Immersive VR Applications And Games: The Case Study Of The Forum Of Augustus In Rome. *Journal of Cultural Heritage*, 43, 129-143.
- George, E. W. (2010). Intangible cultural heritage, ownership, copyrights, and tourism. *International Journal of Culture, Tourism and Hospitality Research*, 4, 376-388.
- Gong, Z., Wang, R., & Xia, G. (2022). Augmented reality (AR) as a tool for engaging museum experience: a case study on Chinese art pieces. *Digital*, 2(1), 33-45.
- Han, D.-I., Jung, T., & Gibson, A. (2013). Dublin AR: implementing augmented reality in tourism. *Information and Communication Technologies in Tourism 2014: Proceedings of the International Conference in Dublin, Ireland*, January 21-24, 2014
- Han, D.-I., tom Dieck, M. C., & Jung, T. (2018). User experience model for augmented reality applications in urban heritage tourism. *Journal of Heritage Tourism*, 13(1), 46-61.
- Hussein, F., & El Deen, A. (2020). Using hologram technology in constructing virtual scenes in archaeological sites to support tourism in Egypt. *Journal of architecture and islamic arts*, 5(20), 654-668
- Ibrahim, A. (2018). *The Arab states' UNESCO world heritage sites: the Saudi Arabia experience*. Retrieved from Research Gate.
- Ismail, W. H. (2012). Sustainability of buildings in historic city of Malacca. *Asian Journal of Environment-Behaviour Studies*, 3(10), 57-69.
- Jung, T. (2016). Value of augmented reality to enhance the visitor experience: a case study of Manchester Jewish Museum. *E-Review of Tourism Research*, 7.
- Jung, T., Chung, N., & Leue, M. C. (2015). The determinants of recommendations to use augmented reality technologies: The case of a Korean theme park. *Tourism Management*, 49, 75-86.
- Karacan, C. G., & Akoglu, K. (2021). Educational augmented reality technology for language learning and teaching: A comprehensive review. *Shanlax International Journal of Education*, 9(2), 68-79.
- Lalitha, K., & Rajasekar, A. (2019). Role of technology and hologram in promoting heritage tourism. *J. Inf. Comput. Sci.*, 9(12), 1259-1263.
- Lee, A. (2010). On Tourist Satisfaction with Cultural Heritage Site- A Case study of the Malacca State.
- Lee, W., & Chhabra, D. (2015). Heritage hotels and historic lodging: Perspectives on experiential marketing and sustainable culture. In (Vol. 10, pp. 103-110): Taylor & Francis.
- Mazzetto, S. (2022). Sustainable heritage conservation in the Gulf Regions. *Proceedings of International Structural Engineering and Construction*, 9, 2.
- Mazzetto, S. (2023). Heritage conservation and reuses to promote sustainable growth. *Materials Today: Proceedings*, 85, 100-103.
- MOC. (2024-a). *The National Strategy For Culture*. MOC. <https://www.moc.gov.sa/en/Modules/Pages/About-the-Ministry#aspiration>
- Mousavi, S. S., Doratli, N., Mousavi, S. N., & Moradiahari, F. (2016). Defining cultural tourism. *International Conference on Civil, Architecture and Sustainable Development*.
- Olukoya, O. A. (2021). Framing the values of vernacular architecture for a value-based conservation: A conceptual framework. *Sustainability*, 13(9), 4974.
- Pan, S.-Y., Gao, M., Kim, H., Shah, K. J., Pei, S.-L., & Chiang, P.-C. (2018). Advances and challenges in sustainable tourism toward a green economy. *Science of the total environment*, 635, 452-469.

- Pedersen, I., Gale, N., Mirza-Babaei, P., & Reid, S. (2017). More than meets the eye: The benefits of augmented reality and holographic displays for digital cultural heritage. *Journal on Computing and Cultural Heritage (JOCCCH)*, 10(2), 1-15.
- Rodzi, N. I. M., Zaki, S. A., & Subli, S. M. H. S. (2013). Between tourism and intangible cultural heritage. *Procedia-Social and Behavioral Sciences*, 85, 411-420.
- Sacchi, L. (2013). A critical survey and a design proposal for Al Balad, the historic district of Jeddah, KSA. *Digital Heritage* (2).
- Santa-Cruz, F. G., & López-Guzmán, T. (2017). Culture, tourism and world heritage sites. *Tourism Management Perspectives*, 24, 111-116.
- Silva, J. L., Ruiz, J. S., Ortega, J. O., Tene, M. L., Aguirre, R. R., & López, M. L. D. (2021). Vernacular architecture as a resource for tourism. *Centro Sur*, 5(4).
- Tom Dieck, M. C., & Jung, T. H. (2017). Value of augmented reality at cultural heritage sites: A stakeholder approach. *Journal of destination marketing & management*, 6(2), 110-117.
- Vision 2030. (2024-a). *MOHAMMED BIN SALMAN PROJECT FOR DEVELOPING HISTORIC MOSQUES*. <https://www.vision2030.gov.sa/en/projects/historic-mosques/>
- Wu, H.-K., Lee, S. W.-Y., Chang, H.-Y., & Liang, J.-C. (2013). Current status, opportunities and challenges of augmented reality in education. *Computers & education*, 62, 41-49.
- Yang, C. h., Lin, H.-L., & Han, C.-C. (2009). Analysis of international tourist arrivals in China: The role of World Heritage Sites. *Tourism Management*, 31, 827 - 837.
- Yuan, Wang (2008) The conservation of intangible cultural heritage in historic areas. In: 16th ICOMOS General Assembly and International Symposium: ‘Finding the spirit of place – between the tangible and the intangible’, 29 sept – 4 oct 2008, Quebec, Canada.