Issues and Perspectives in Business and Social Sciences

Virtual reality application for tourism in Saudi Arabia

Hashim Abdulkadir Sharif Ali[1], Azwan Mahmud[2]*,
Azlan Abd Aziz[2], Siva Priya Thiagarajah[1],
[1]*Faculty of Engineering, Multimedia University, Selangor, Malaysia*
[2]*Faculty of Engineering and Technology, Multimedia University, Melaka, Malaysia*
**corresponding: azwan.mahmud@mmu.edu.my*

Abstract

Tourism significantly contributes to global economies and societal development. Virtual tourism has emerged as a crucial alternative during crises like the COVID-19 pandemic, sustaining the tourism sector. This paper explores virtual tourism's potential for Saudi destinations, focusing on its impact and acceptance among 600 participants from Jeddah, Riyadh, Dammam, and Abha. Using a descriptive-analytical approach and an applied experiment with virtual reality tours of Jeddah's historical sites, the results show a positive attitude towards virtual tourism, highlighting its economic viability and support for activation. SEM analysis confirmed that perceived presence significantly influences user satisfaction and engagement, which in turn impact the intention to visit real destinations. These findings underscore virtual tourism's potential as a marketing, tourism promotion, and cultural preservation tool, contributing to the sustainable development of Saudi Arabia's tourism sector amidst global challenges.

Keywords:
Tourism;
Virtual reality;
Saudi Arabia;
Historical sites;
Structural equation.

Received May 24, 2025
Accepted Dec 15, 2024
Published Jun 14, 2025

1. Introduction

Tourism is a linchpin of global economies, attracting significant attention from countries and governments due to its profound impact on economic structure and growth. It serves as a vital revenue source for the tourism sector and associated industries, governmental budgets, and individual livelihoods (Rasool et al., 2021). Tourism is pivotal in shaping national income and fostering economic revolutions, particularly in developing countries. The tourism sector's contribution to national income formation and economic growth has been particularly notable, prompting countries to establish mechanisms for rational investment to achieve societal development and exploit tourism resources for sustainable projects. The significance of tourism sustainability cannot be overstated, as it is seen as a catalyst for sustainable and comprehensive economic growth. With an annual increase in international tourism activities estimated at 4% since 2009, tourism accounts for a considerable portion of global exports, reaching $1,500 billion annually. Tourism represents 10% of the gross domestic product (GDP) and contributes to social integration, poverty reduction, and job creation, especially for women (Zolfani et al., 2015). Despite facing crises such as the Iraq war, the SARS outbreak 2003, and the global financial crisis in 2009, tourism has shown resilience, returning to prosperity in subsequent years. However, the

Issues and Perspectives in Business and Social Sciences (2025) Issue 2:163–177.
doi: https://doi.org/10.33093/ipbss.2025.5.2.6

URL: https://journals.mmupress.com/index.php/ipbss

COVID-19 crisis has emerged as one of the most severe challenges, severely impacting the tourism sector and necessitating alternative approaches, such as virtual tourism, to mitigate the effects of quarantine measures. Zolfani et al. (2015) mentioned the importance of tourism sustainability as a source of sustainable and comprehensive economic growth. The annual increase in international tourism activities has been estimated at 4% since 2009, and tourism constitutes 7% of global exports and services 30% of global exports. It represents the primary export sector for many developing countries, and the employment rate of women in the tourism sector is approximately double its employment rate in other economic sectors and generates capital sufficient to preserve and protect organisms, natural reserves, and the environment (Barkas et al., 2020).

International tourism witnessed increased activity and growth after World War II, but some crises affected this progress. Such as the Iraq war, the "SARS" crisis in 2003 and the global financial crisis in 2009, but they quickly stabilised and returned to prosperity again in the following years. The COVID-19 crisis is considered the most severe, affecting the tourism sector for an extended period due to the cessation of all global transport sectors and their activities, the closing of borders, the cessation of activities, and the imposition of quarantine. These international developments that have affected the tourism industry have opened up alternatives to traditional tourism, including virtual tourism. Virtual tourism enables countries to revitalise tourist sites and destinations, market them, introduce them, and mitigate the effects of travel limitations. Virtual tourism recreates the enjoyment of a tour from the comfort of one's own home and at the lowest cost.

Many past scientific studies have been conducted on virtual reality (VR) technologies and virtual tourism. Oncioiu and Priescu (2022) divided these studies into two axes: First, they examined the role that VR technology plays in attracting tourists and promoting tourist destinations by influencing their tourism decisions, leading to the activation and spread of virtual tourism. Second are studies that used the descriptive approach to define and describe VR and virtual tourism. These studies focus on the applications of information and communications technology to simulate the real world in three-dimensional environments. These studies concluded that VR technology benefits tourists, tourism makers, and the environment. Virtual tourism and VR technologies assist in activating, invigorating and sustaining the tourism industry, creating processes that promote tourist sites, documenting them, and conveying them to the public. The technology enables tourism activities in a contemporary way that creates an almost real experience at the lowest cost.

Conducted in the Kingdom of Saudi Arabia (KSA), the current work emphasises the importance of virtual tourism and VR technology to create tourist attractions and revitalisation. This study also sheds light on the elements of tourist attractions in the KSA, the importance of virtual tourism from the point of view of Saudi society, and the design of virtual tours for several tourist sites in Jeddah. This study also aligns with the goals and vision of the KSA government in the axes of the country's Vision 2030 (Klingmann, 2023). One of the most important goals of KSA's Vision 2030 is to develop the tourism sector and sustainable development (KSA Ministry of Tourism, 2024). KSA's interest was in sustainable tourist development while keeping to its Islamic values and components, societal customs, and the authenticity of its heritage. It sets out to develop the tourism sector, remove the obstacles facing it, try to attract citizens and foreign tourists to KSA and expose the tourism components that the country enjoys, including a diverse and ancient environment and an authentic heritage (General Authority for Tourism and National Heritage, 2014). This study, hence, aims to design and test a VR platform to convey KSA's tourist destinations, highlighting their identity and cultural heritage to activate tourist attraction factors and sustain electronic tourism activity in the country amidst global crises.

This study thus represents the cultural and historical heritage of a KSA city, Jeddah, through virtual environments, exploring the impact of virtual tourism on tourist destinations and its

importance in creating an attraction and activation factor. The study analyses data from human samples and designs virtual tours for sustainable tourism development, focusing on 360-degree virtual tours of Salloum House Museum, Baeshen House Museum, and Matbouli House Museum in Jeddah.

2. Literature review

Several studies have examined the implementation of VR technology to transmit and document artefacts in museums in a virtual environment. For example, Ahmed (2017) used technology to report the details of Egypt's traditional costumes. Majeed (2016) analysed VR technology to document and analyse architectural heritage. Other studies have examined virtual tourism. Madawi and Juruh (2020) reviewed the implementation of virtual tourism in Algeria and found that the elements of virtual tourism are still lacking. According to Hadab and Mekhlef (2017), tourism has been influenced by scientific and technological progress. Marketing of virtual tourist destinations in Jordan through electronic applications using two- or three-dimensional display technology has been found to have enormous potential in Bazazo (2020). In KSA, Al-Najjar (2020) concluded that the applications of virtual tourism are still lacking. On the other hand, according to Falaq et al. (2020), the Emirate of Dubai has used VR technology to activate and promote tourist and entertainment attractions, and many museums, landmarks and shopping centres have launched virtual tour services and have benefited from it.

VR is a computer-generated simulation of an environment that allows users to interact and be immersed in a 3D world. In recent years, VR has gained significant attention in the tourism industry due to its potential to enhance the travel experience, provide virtual tours, and showcase destinations to potential travellers. The application of VR in tourism has been investigated in several studies. In Beck et al. (2019), VR's ability to create immersive experiences, virtual tours, and destination marketing is recognised, emphasising the potential of VR to influence travellers' decision-making and enhance their engagement with different destinations. Similarly, Melo et al. (2022), Nayyar et al. (2018) and Wei (2019) also acknowledge the applications of VR and AR technologies in creating virtual experiences, enhancing destination marketing, and providing interactive travel information. Melo et al. (2022) study specifically examined multisensory VR technology in transforming how tourists perceive and experience different destinations. The application of VR technology is extended by Poux et al. (2020) to include its functionality in preserving and presenting cultural heritage to tourists in an immersive and interactive manner. These studies demonstrate the relevance of VR applications in tourism, especially in enhancing tourists' understanding and appreciation of destinations and cultures.

Despite the growing popularity and applications of VR in tourism, there is limited research on the specific use of VR in Saudi Arabia's tourism industry. As VR technology continues to evolve, there is a need for comprehensive studies that explore the potential applications of VR in showcasing the cultural, historical, and natural attractions of KSA to both domestic and international tourists. Gaps in the existing studies show the need to identify specific VR applications that can enhance the tourism experience in KSA, such as creating virtual tours of historical sites, cultural landmarks, and natural wonders. Considering the KSA's vision, studies must explore the impact of VR on tourists' decision-making processes, satisfaction levels, and overall engagement with the destinations in KSA.

2.1 Tourism trends in Saudi Arabia

In 2021, Saudi Arabia's travel and tourism sector reached a substantial SAR193.125 billion, contributing 6.5% to the country's GDP. The country ranked third globally in tourism investments, with SAR138 billion. Projections suggest the Middle East's tourism sector will grow annually by 7.7% from 2022 to 2034, with Saudi Arabia leading at 11% growth. By 2022, Saudi Arabia climbed to the thirteenth position globally in international tourist arrivals, with 16.6 million visitors and 93.5 million tourists, domestic and foreign combined. Total tourism spending in 2022 amounted to SAR185 billion, marking a 93% increase from 2021 (Saudi Gazette, 2023). According to the KSA Ministry of Tourism (2024), the country experienced a remarkable increase in tourist arrivals, reaching 4.4 million visitors, marking a substantial 455% rise from Q3 2023, with tourist spending totalled SAR35.6 billion. Aseer, Madinah, and Makkah regions were the most visited, with Makkah attracting 6.9 million tourists, followed by Aseer with 3.4 million and Medina with 2.4 million. The primary purpose of trips for domestic tourists revealed that 48% travel for religious purposes, 37% visit friends and relatives, 9% travel for business, 4% for entertainment, and 2% for other reasons.

With its scenic landscapes and unique attractions, the Middle East is poised to become a leading global tourist destination. KSA is spearheading tourism investment to diversify its economy away from oil and gas. While religious travel, particularly the Hajj pilgrimage, dominates tourism in KSA, the country aims to expand into other forms like geo-tourism, cultural tourism, heritage tourism, and ecotourism. Despite efforts, there's a lack of literature on KSA's tourism activities, highlighting the need for further initiatives to fully capitalise on its economic potential.

Understanding the factors driving tourists to KSA is crucial (Madden, 2018). KSA's Vision 2030 outlines plans to transition to a service-oriented economy, reducing reliance on oil revenue. Recently, there has been a shift from solely religious tourism to broader attractions like the Sarawat Mountains and the Red Sea. While access to Mecca and Medina is restricted to non-Muslims, recent tourism initiatives challenge this, which recognises tourism's alignment with Islamic values, promoting cultural unity and societal norms. Despite its cultural significance, KSA faces accessibility and preservation challenges. Strict rules of conduct, including conservative dress codes and severe penalties for offences like drug smuggling, present additional challenges. (Johnson, 2010). Despite their importance, heritage sites face challenges from natural degradation and tourism-related impacts. Thus, concerted efforts are essential to restore and preserve these sites, ensuring their longevity amidst environmental and human pressures.

3. Methodology

The work follows the descriptive analytical approach to identify the tourism components of the KSA's environment, specifically in the city of Jeddah. This study also aims to measure the impact of virtual tourism on the tourist destination and its implications in creating the attraction factor and activation through the analysis of human sample data. Using convenience sampling, questionnaires were distributed electronically using Google Forms, resulting in 600 retrieved responses, comprising individuals from Jeddah, Riyadh, Dammam, and Abha. This work includes a practical framework that involves designing a virtual reality representation of the environment in Saudi Arabia. It focuses on planning and preparing three virtual tours to support the development of sustainable tourism. The framework is based on data and insights gathered through a descriptive-analytical approach and the analysis of questionnaire results.

The work flowchart, as shown in Figure 1, encompasses several vital steps. Initially, data for the VR application is collected from specific locations, such as the Salloum Museum, Baeshen

Museum, and Matbouli House Museum, utilising the Ricoh Theta SC2 camera, resulting in 138 images. The selection of these houses was influenced by their historical significance, availability during the research period, and distinctive location in the oldest district of Historic Jeddah. Additionally, these houses aligned with the Vision 2030 initiative's goal of incorporating historical sites into sustainable tourism areas. Other archaeological houses in historic Jeddah were closed for maintenance and restoration work. The primary objective of this phase was to authentically represent Jeddah's cultural and historical heritage through virtual environments. Closed spaces were selected for photography during non-working hours to ensure privacy and capture of detailed imagery while addressing the time-consuming nature of using the Ricoh Theta S 360 camera.

Each image undergoes a quality check to ensure its suitability for further processing. Accepted photos are then pre-processed using Adobe Photoshop to enhance and refine their quality. Subsequently, the refined images undergo further enhancement using Adobe Topaz Gigapixel AI, known for its advanced image upscaling capabilities. These enhanced images are utilised to design immersive 360-degree virtual tours using the Kuula platform, allowing for interactive and engaging presentations. The created virtual tours are then published on a dedicated web page, providing accessibility to the audience. Concurrently, data is collected from the audience through a survey questionnaire to gather feedback and insights on their experience with the virtual tours. The collected survey data undergoes RStudio analysis to draw conclusions and insights regarding the audience's perception and experience with the 360 virtual tours. Figure 2 shows examples of the collected images.

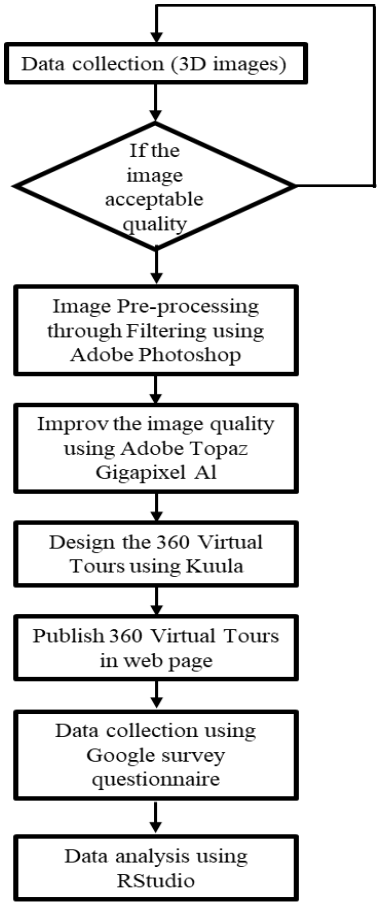

Figure 1. The process flowchart

Figure 2. Samples of 360 images data

Figure 3 outlines the four phases involved in designing virtual tours. Firstly, in the Photography phase, 360-degree pictures were taken using a Ricoh Theta SC2 camera, with a triple camera holder ensuring stability and complete coverage. Specifically, 39 photos were captured of the Salloum House Museum, 30 pictures of the Baeshen House Museum, and 69 photos of the Matbouli House Museum. Subsequently, in the Image Processing phase, Adobe Photoshop was utilised, employing the Spot Healing Brush tool to eliminate remnants of the triple camera holder and other unwanted elements. The final VR using Kuula is shown in Figure 4.

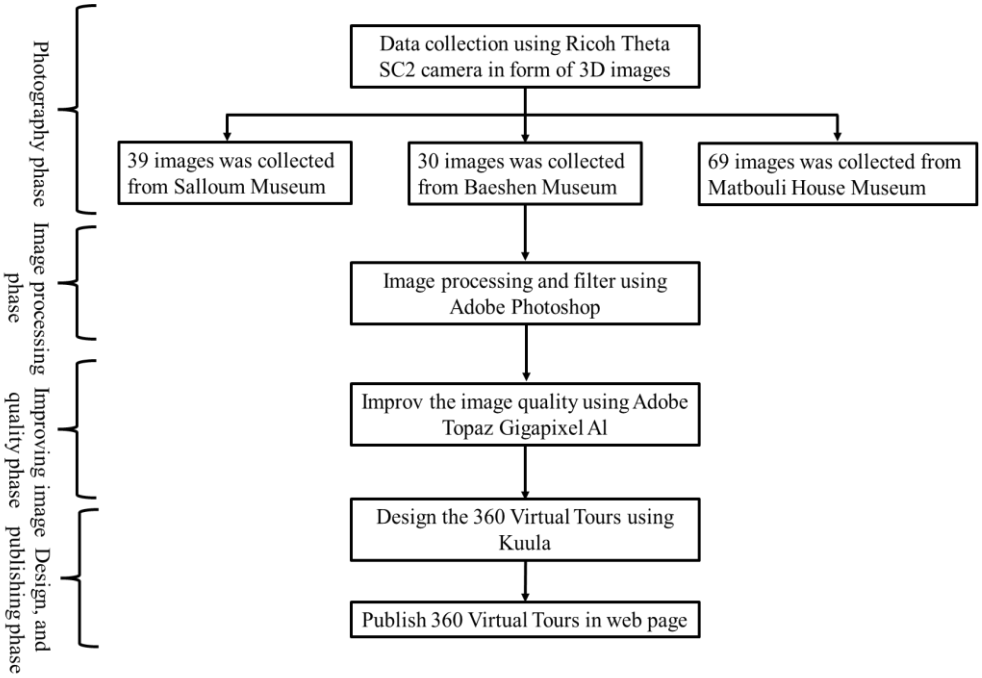

Figure 3. The 360 virtual tours design phases

Figure 4. The Kuula 3D platform environment

4. Data analysis

In this work, data analysis was conducted using the R programming language. R is a powerful and versatile statistical programming language widely employed for its robust data manipulation, statistical modelling, and visualisation capabilities. Leveraging the capabilities of R-Studio, a user-friendly integrated development environment for R, facilitated seamless data exploration and analysis. The application of R allowed for efficient handling and transformation of raw data, enabling the generation of meaningful insights through statistical techniques and graphical representations. This approach ensured the accuracy and reliability of the results and provided transparency in the analytical process. The flexibility and extensive libraries within R supported the implementation of various statistical methods, contributing to the depth and comprehensiveness of the data analysis in this research.

Figure 5 shows the Data Analysis Flowchart. The process begins with importing survey data from Excel to the R environment, a crucial step when handling a dataset of 600 entries. R's robust statistical analysis and visualisation tools make it ideal for processing survey data. Pre-processing involves checking for missing data to ensure data quality, followed by handling missing data by replacing it with the mean of the respective column, a common strategy for large datasets. Analysing participant demographics, including qualification, gender, and age, provides insights into the sample composition. Creating histograms for each of the 18 questions helps visualise response distribution while counting responses quantitatively assesses participant opinions. Principal Component Analysis (PCA) uncovers patterns and correlations within responses to questions 1-18.

Similarly, questions 19-23 are analysed using histograms and response counts to understand virtual tourism experiences. PCA for these questions identifies underlying patterns or correlations essential for gauging sentiment and engagement with virtual tourism. Graphical representation of results through plots enhances comprehension, facilitating trend identification and outlier detection.

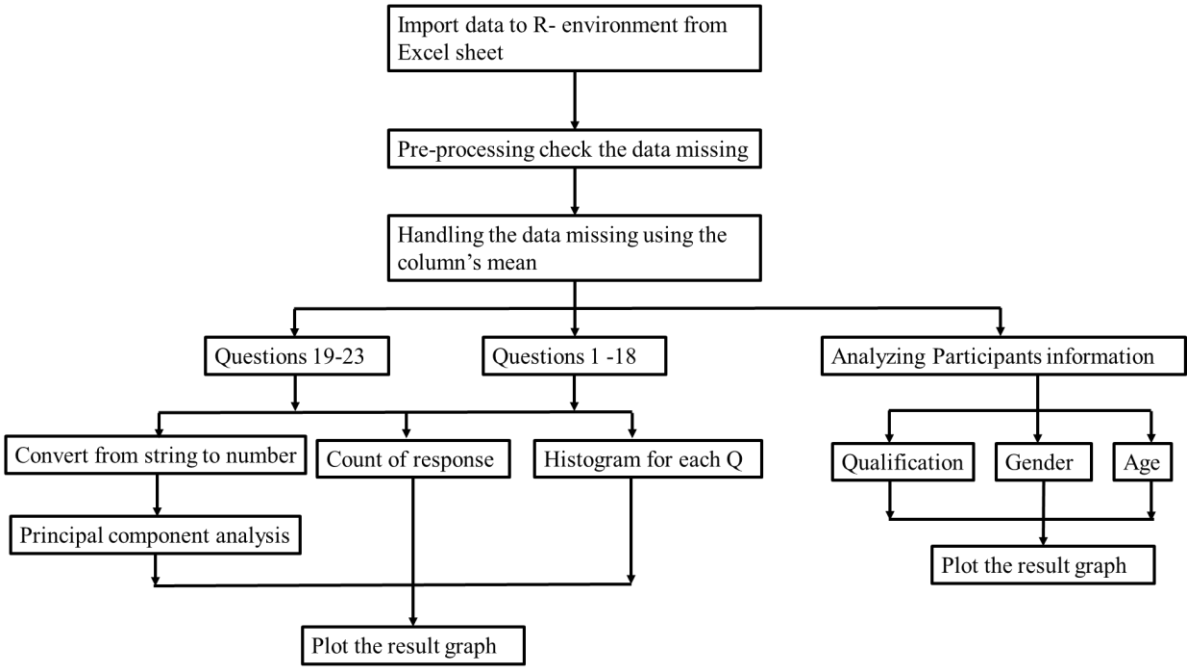

Figure 5: Data analysis flowchart

5. Results discussion

Table 1 provides insightful demographic information on the participants. Regarding gender distribution, the sample comprises 218 males, 36.33%, and 382 females, 63.66% of the total 600 participants. Most participants fall within the 41-50 age group, accounting for 34.16% of the sample, followed by the 31-40 age group with 25.33%. The 19–30 age group represents 17.16%, while those aged 50 and above comprise 22% of the total sample. The academic qualification distribution highlights that 52.33% of participants possess a degree, 19.5% hold a diploma, and 6.33% have attained a master's degree. Participants without a degree make up 18.33%, and those with a PhD constitute 3.5% of the total sample. Collectively, these tables offer a comprehensive overview of the diverse demographics within the work, which is crucial for understanding the representation and characteristics of the participants.

Table1: Respondents' demographics.

Variable		n	Percentage (%)
Gender	Male	218	36.33
	Female	382	63.66
Age Group	18 and less	8	1.33
	19-30	103	17.16
	31-40	152	25.33
	41-50	205	34.16
	50 and more	132	22.00
Academic Qualification	Without a degree	110	18.33
	Degree	314	52.33
	Diploma	117	19.50
	Master	38	6.33
	PhD	21	3.50

5.1 Attitude towards virtual tourism

Table 2 presents survey results indicating the participants' general positive attitude towards virtual tourism. Respondents strongly support virtual tourism, favouring contemporary representations and virtual platforms for decision-making in destination selection. While concerns exist about virtual tourism replacing actual visits, most view it positively, recognising its potential to enhance mood and convey information joyfully. There is widespread agreement on the economic viability of virtual tourism for all segments of society and interest in converting archaeological sites into virtual environments. Arts disciplines are seen as crucial in creating attractive virtual tourism experiences. Overall, the findings highlight the positive potential of virtual tourism in promoting and sustaining Saudi tourist destinations, emphasising the importance of further research and artistic contributions.

Table 2: Attitudes towards VR tourism for Saudi tourist destinations

	Questionnaire items	Strongly agree	Agree	Disagree	Strongly disagree	Mean
1.	Do you think activating virtual tourism for Saudi tourist destinations is essential?	200	203	105	92	2.14
2.	Do you want virtual tourism applications that convey Saudi tourist environments in a contemporary and virtual way?	201	209	111	79	2.11
3.	Does visiting virtual tourism applications to a tourist site before actually visiting it affect your tourism decision-making?	206	203	111	80	2.10
4.	Would you like to try virtual tourism that will help you choose your tourist destination?	209	200	109	82	2.00
5.	Do you think that virtual tourism to a tourist site could achieve its tourist attraction factor?	194	212	107	87	2.10
6.	Do you think that designing a virtual reality site for a tourist site can highlight the features of the tourist site?	280	221	94	5	2.14
7.	Can virtual reality reflect the culture and identity of a tourist site?	216	209	108	67	1.50
8.	Do you think designing and activating virtual Saudi tourist environments might achieve greater dissemination of them and help highlight the tourist site globally?	200	204	109	87	1.70
9.	Would designing a virtual reality for a tourist site increase tourism activity?	199	209	108	84	2.04
10.	Do you think virtual reality designed for a tourist site can convey information about the site to you in an enjoyable, unconventional way?	198	207	109	86	2.12
11.	Do you think virtual tourist environments may replace actual tourism, especially concerning health crises and the imposition of home quarantine?	210	199	110	81	2.10
12.	Can viewing virtual tourist environments improve your mood and bring you joy?	213	191	108	88	2.11
13.	Do you think that experiencing virtual tourist environments allows you to enjoy visiting a tourist site that may be difficult for you to reach or whose circumstances prevent you from visiting it?	199	221	100	80	2.10
14.	Do you think virtual tourism is an economic option that suits all segments of society?	201	208	109	82	2.12
15.	Do you support the idea of converting the archaeological tourist site into a virtual tourist environment to mitigate the side effects of tourists congesting there and preserve it from repeated depreciation factors?	206	203	110	81	2.11

	Questionnaire items	Strongly agree	Agree	Disagree	Strongly disagree	Mean
16.	Do you think providing virtual environments for heritage tourist sites may help sustain the heritage environment?	263	196	45	96	1.95
17.	Do you believe in the importance of studies related to virtual tourism and the tourism sector's need for them, especially in light of technological progress?	199	211	110	80	2.11
18.	Do you believe in the role of art disciplines in creating a virtual tourism environment that reflects Saudi tourist destinations with a contemporary and attractive artistic character?	280	194	61	65	1.85

Principal component analysis (PCA), a valuable tool for assessing response relationships, reveals significant correlations, such as 0.71 between Q2 and Q3. The data shows strong agreement on modern virtual tourism apps (Q2) and their impact on decision-making (Q3), indicating the interconnectedness of opinions. This insight is crucial for understanding participants' perspectives on virtual tourism, as depicted in Figure 6.

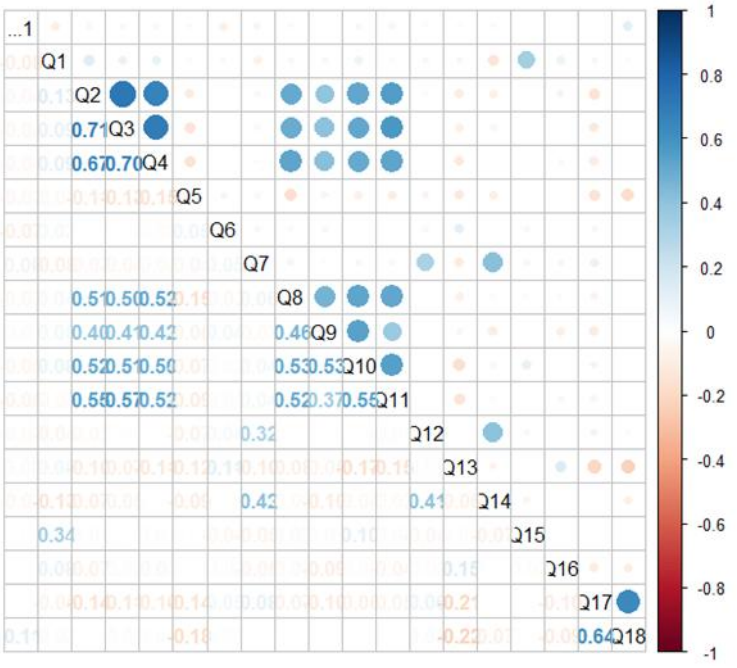

Figure 6: Correlation coefficients

5.2 Virtual reality experiences

Table 3 presents insights into participants' attitudes toward virtual tourism for KSA's destinations, focusing on their virtual reality experiences. The majority of participants (281, 70.2%) have experienced virtual reality environments (Q19), with many feels present (294, 73.5%) and perceiving space completely (299, 74.8%) within these environments (Q20-Q21). Additionally, a vast majority (351, 87.8%) have engaged with virtual tourist environments (Q22), and a significant number (274, 68.5%) felt adequately compensated for their physical absence (Q23). These findings highlight a positive inclination towards virtual tourism, emphasising its immersive nature and perceived value among participants. Figure 10 visually illustrates this compensatory aspect, highlighting the perceived value of virtual tourism experiences.

Table 3: VR experiences

	Questionnaire items	Yes	No	Don't Know
19	Have you experienced any virtual reality environments?	47%	37%	17%
20	Did you feel present inside the virtual environment?	49%	37%	14%
21	Did you perceive the space inside the virtual environment completely?"	50%	38%	13%
22	Have you experienced a virtual tourist environment?	59%	39%	2%
23	Did the virtual tourist environment you experienced compensate for your actual presence at the site?	46%	38%	16%

Figure 7 shows no significant correlation among the selected questions, likely due to the smaller subset and diverse responses. This reflects varied opinions and preferences, emphasising the nuanced nature of individual perceptions within a limited question set.

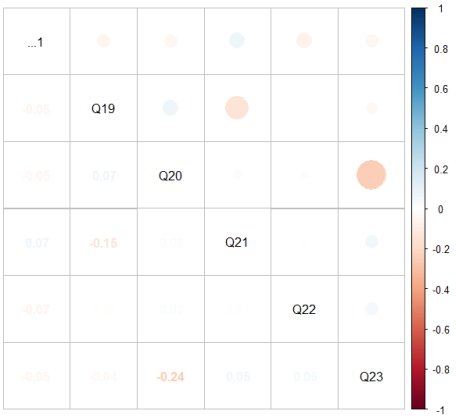

Figure 7: Correlation coefficient for questions

5.3 Structural equation modeling (SEM) results

We have analysed the data using SEM with AMOS 29. The data were analysed via the confirmatory factor analysis (CFA) to confirm the reliability of the measurement model. Four constructs were developed from the responses received from the survey questions. The goodness-of-fit indices for the CFA shows a good fit, with χ^2=250.34, df = 120, p < 0.001; RMSEA = 0.05; CFI = 0.96; and TLI = 0.95. Table 4 shows the constructs, indicators and factor loadings of each indicator. All p-values are well below 0.001, demonstrating strong associations between the indicators and their underlying constructs.

Table 4: CFA results

Constructs	Indicators	Factor Loading	SE	CR	AVE	Composite Reliability
User satisfaction	Satisfaction with the tour [Q1]	0.80	0.032	25.0	0.642	0.843
	Perceived value [Q2]	0.75	0.031	24.19		
	Overall enjoyment [Q3]	0.85	0.035	24.28		
Engagement	Time spent on the tour [Q4]	0.70	0.029	24.13	0.640	0.840
	Level of interaction [Q5]	0.78	0.032	24.37		
	Emotional involvement [Q6]	0.82	0.034	24.11		
Perceived presence	The feeling of being in the place [Q7]	0.83	0.034	24.41	0.674	0.872
	Immersion [Q8]	0.88	0.036	24.44		
	Realism [Q9]	0.80	0.032	25.00		
Intention to visit	Likelihood of visiting the actual site [Q10]	0.90	0.037	24.32	0.741	0.901
	Interest in physical tourism [Q11]	0.85	0.035	24.28		
	Influence on travel plans [Q12]	0.87	0.036	24.16		

Table 5 summarises the SEM results. The structural model showed that perceived presence significantly influences user satisfaction (β = 0.60) and engagement (β = 0.55), suggesting that a higher sense of presence in virtual tours enhances users' overall satisfaction and engagement with the experience. Furthermore, user satisfaction (β = 0.70) and engagement (β = 0.50) significantly impact the intention to visit the actual site, indicating that positive virtual tourism experiences can increase the likelihood of tourists visiting the physical destinations. The goodness-of-fit indices for the measurement and structural models indicated an excellent fit to the data, with RMSEA values below 0.06 and CFI and TLI values above 0.95, suggesting that the proposed model accurately represents the relationships among the constructs.

Table 5 summarises the SEM results.

Tested paths	β	S.E.	C.R.
Perceived Presence (PP) → User Satisfaction (US)	0.60	0.034	17.65
Perceived Presence (PP) → Engagement (EN)	0.55	0.034	16.18
User Satisfaction (US) → Intention to Visit (IV)	0.70	0.033	21.21
Engagement (EN) → Intention to Visit (IV)	0.50	0.032	15.63

* All paths are significant since **C.R. > 1.96** ($p < 0.01$) level.
** Model fit indices: X^2 = 280.45, df = 130, $p < 0.001$; RMSEA = 0.04; CFI = 0.97; TLI = 0.96

6. Discussion and recommendations

The findings of this research have significant theoretical and practical implications for the tourism industry, particularly in Saudi Arabia. Theoretically, the study enhances the understanding of virtual tourism as a viable alternative to traditional tourism, especially during crises like the COVID-19 pandemic. The findings of this research have significant theoretical and practical implications for the tourism industry, particularly in Saudi Arabia. The descriptive analysis revealed that most participants (70.2%) had experienced virtual reality environments, with 73.5% feeling present within them and 74.8% perceiving space completely. Additionally, 87.8% had engaged in virtual tourist environments, and 68.5% felt adequately compensated for their physical absence at a site (Table 3). These findings suggest a widespread positive inclination toward virtual tourism, emphasising its immersive nature and perceived value among users.

The structural equation modeling (SEM) results further confirm these insights, demonstrating strong relationships between key constructs. Perceived presence significantly influenced user satisfaction (β = 0.60) and engagement (β = 0.55), which in turn had a direct impact on participants' intention to visit real destinations (user satisfaction: β = 0.70, engagement: β = 0.50) (Table 5). These relationships indicate that a higher sense of presence in virtual tourism experiences enhances user satisfaction and engagement, ultimately increasing the likelihood of actual site visits.

Moreover, the goodness-of-fit indices for the model confirmed its robustness (χ^2=250.34, df = 120, $p < 0.001$; RMSEA = 0.05; CFI = 0.96; TLI = 0.95), supporting the validity of these conclusions. The strong positive associations between perceived presence, user satisfaction, engagement, and visit intentions highlight the potential of virtual environments to simulate real-world tourism experiences and enhance engagement effectively. These statistical findings reinforce the study's theoretical contribution, demonstrating that virtual tourism is a viable alternative to traditional tourism, particularly during crises like the COVID-19 pandemic. The positive reception of virtual tourism, as shown in descriptive and inferential analyses, underscores its ability to sustain the tourism sector by increasing user engagement and satisfaction through immersive experiences.

The percentage of individuals who experienced virtual reality environments is 34.33% of the 600 individuals. This indicates a limited spread of the technology among society members. The results

also demonstrate that over half of the sample, which tried virtual environments, felt their presence wholly (52.91%) or partially (41.47%). This suggests a high level of user self-presence within virtual environments. Furthermore, 47% of the participants who experienced virtual environments fully perceived the space within the virtual environment, while 44% perceived it somewhat. This indicates users' high visual perception of the designed space inside virtual environments. The percentage of participants who experienced virtual tourism is 26%, suggesting a limited adoption and awareness of virtual tourism among society members. Lastly, 48% of the participants who tried a virtual tourism environment believe it compensated for their real presence at the tourist site. The SEM analysis proves virtual tourism can enhance user satisfaction and engagement, positively influencing tourists' intentions to visit real-world destinations. These findings support the potential of virtual tourism as a valuable tool for promoting cultural heritage and attracting tourists.

Practically, the study offers insights for tourism agencies, governments, and users. Tourism agencies are encouraged to integrate VR technologies into their marketing strategies, offering virtual tours of historical and cultural sites to attract a broader audience, including those unable to visit in person. Governments are advised to invest in VR infrastructure and support virtual tourism platforms, fostering economic growth and cultural preservation through partnerships with technology providers and policies encouraging innovation. For users, virtual tourism offers meaningful experiences replicating physical travel enjoyment, benefiting those with mobility issues or travel restrictions.

Recommendations include tourism agencies developing high-quality virtual tours and engaging with potential tourists, governments investing in VR infrastructure and forming technology partnerships, and users exploring and providing feedback on virtual tourism platforms. By implementing these recommendations, stakeholders can leverage virtual tourism to enhance visitor experiences, promote cultural heritage, and ensure sustainable tourism development amidst global challenges.

7. Conclusions

The results reveal that virtual tourism is a promising technological tool in marketing and promotion. Furthermore, virtual tourism plays a role in strengthening the authenticity of tourist and archaeological sites. It boasts unique and diverse tourist elements across different regions. With its historical significance, the historical site of Jeddah stands out as a global tourist and cultural destination. Moreover, the possibility of designing and preparing a virtual reality for Saudi tourist destinations is seen as a valuable contribution to the sustainable tourism development of the Kingdom. While virtual tourism models do not replace traditional tourism, they serve as a modern and effective means for promoting and revitalising tourist destinations.
Future research should build on these results by exploring different types of tourist attractions, employing more diverse samples, and incorporating advanced statistical techniques to further understand virtual tourism's impact. This study offers valuable insights into virtual tourism but has several limitations. The small and demographically limited sample may not represent the broader population's views. Future research should include a more extensive and more diverse sample. The focus on historical sites in Jeddah may not apply to other destinations, so expanding the scope to various locations and attractions is necessary. Reliance on self-reported data introduces biases.

Future studies should use objective measures like behavioural data or physiological responses for a more robust analysis. The quality of VR technology significantly affects user experience, so

the impact of different VR technologies should be explored. The study also didn't examine the long-term effects of virtual tourism on actual travel behaviour. Investigating whether virtual experiences increase physical visits or influence long-term perceptions could provide deeper insights. Ongoing research is needed to keep up with technological advancements in VR and AR. Addressing these limitations and following the suggested research directions will enhance understanding virtual tourism and its potential to transform the industry. Expanding the research scope, using diverse data sources, and exploring evolving technologies will contribute to the sustainable development of virtual tourism.

Acknowledgement

We want to express our sincere gratitude to Rasha Abdullah Sultan Alshehri, Master's student, Department of Painting and Arts (Design Specialty), College of Art and Design, Jeddah University, Jeddah, Kingdom of Saudi Arabia, for her generous contribution to the 360-degree images essential for this project. Her contribution was invaluable to the successful completion of this work.

REFERENCES

Ahmed, H. I. H. (2017). Digital design of virtual reality technology in light of e-learning quality standards. *Palestinian Journal of Open Learning and e-learning*, 6(11), 65–80.

Al-Najjar, A. K. (2020). Activating virtual tourism as a tool to promote tourist destinations during the COVID-19 pandemic: A case study of Saudi Arabia. *International Journal of Hospitality and Tourism Studies*, 2020. Retrieved from https://scholar.archive.org/work/277w4axoajcqlb7te5wgh46xcy

Barkas, P., Honeck, D., & Rubio Colomer, E. (2020). International trade in travel and tourism services: Economic impact and policy responses during the COVID-19 crisis (Staff Working Paper ERSD-2020-11). *World Trade Organization*. https://www.wto.org/english/res_e/reser_e/ersd202011_e.pdf

Bazazo, I. K. I. (2020). Applications of interactive virtual reality technologies in marketing virtual tourism routes in Jordan. *Arab Universities Association Journal of Tourism and Hospitality*, (1687–1863), 91–98.

Beck, J., Rainoldi, M., & Egger, R. (2019). Virtual reality in tourism: A state-of-the-art review. *Tourism Review*, 74(3), 586-612. https://doi.org/10.1108/TR-03-2017-0049

Falaq, S., Fawqa, S., Fatima, & Sharfi, S. (2020). Virtual tourism as an approach to activating the tourism sector during the COVID-19 pandemic: A case study of Dubai. *Economic Dimensions Journal*. 1140709 (10), 335–351. https://doi.org/10.36539/1427-000-010-017

General Authority for Tourism and National Heritage. Retrieved from https://cdn.mt.gov.sa/mtportal/mt-fe-production/content/policies-regulations/documents/tourism-regulations/Travel-and-Tourism-Services-Regulations-En-V012.pdf

Hadab, S. A. J., & Mekhlef, H. Z. (2017). Virtual tourism and information technology and their role in achieving sustainable tourism development. *Iraqi Journal for Administrative Sciences*, 13(54), 249–273. https://www.iasj.net/iasj/article/154160

Johnson, D. J. (2010). Tourism in Saudi Arabia. In Scott, N. & Jafari, J. (Eds.), In Tourism in the Muslim World: Bridging Tourism Theory and Practice (pp. 91–106). Emerald Books. https://doi.org/10.1108/S2042-1443(2010)2

Klingmann, A. (2023). Rescripting Riyadh: How the capital of Saudi Arabia employs urban megaprojects as catalysts to enhance the quality of life within the city's neighborhoods. *Journal of Place Management and Development*. 16(1), 45-72. https://doi.org/10.1108/JPMD-06-2021-0062

KSA Ministry of Tourism | KSA. (2024). *Domestic Tourism Indicators 2024 Q3 YTD*. Retrieved January 27, 2024, from https://mt.gov.sa/tic/publications

Madawi, A. A. & Juruh, H. B. (2020). Towards activating virtual tourism to promote tourist destinations amid the COVID-19 crisis: A case study of Algeria. *Journal of Management and Economics Research, 2*(2), 50–63. Retrieved from https://www.asjp.cerist.dz/en/article/122036

Madden, D. (2018). Saudi Arabia signals tourism intent with the release of leisure tourist visas. Forbes. Retrieved from https://www.forbes.com/sites/duncanmadden/2018/02/28/saudi-arabia-signals-tourism-intent-with-release-of-leisure-tourist-visas/?sh=255e86992065

Majeed, K. S. S. (2016). Documenting architectural heritage using virtual reality techniques: Opportunities and challenges. *Journal of Engineering Sector at Al-Azhar University*. 11(39), 882–893. https://doi.org/10.21608/auej.2016.19440

Melo, M., Coelho, H., Gonçalves, G., Losada, N., Jorge, F., Teixeira, M. S., & Bessa, M. (2022). Immersive multisensory virtual reality technologies for virtual tourism: A study of the user's sense of presence, satisfaction, emotions, and attitudes. Multimedia Systems, 28, 1027–1037, https://doi.org/10.1007/s00530-022-00898-7

Nayyar, A., Mahapatra, B., Le, D. N., & Suseendran, G. (2018). Virtual reality (VR) & augmented reality (AR) technologies for tourism and hospitality industry. *International Journal of Engineering and Technology (UAE)*, 7(2.21), 156-160.. https://doi.org/10.14419/ijet.v7i2.21.11858

Oncioiu, I., & Priescu, I. (2022). The use of virtual reality in tourism destinations as a tool to develop tourist behaviour perspective. *Sustainability*, 14(7), 419

Poux, F., Valembois, Q., Mattes, C., Kobbelt, L., & Billen, R. (2020). Initial user-centered design of a virtual reality heritage system: Applications for digital tourism. *Remote Sensing*. 12(16), 2583. https://doi.org/10.3390/RS12162583

Rasool, H., Maqbool, S., & Tarique, M. (2021). The relationship between tourism and economic growth among BRICS countries: A panel cointegration analysis. *Future Business Journal*. 7, 1. https://doi.org/10.1186/s43093-020-00048-3

Saudi Gazette. (2023). Saudi Arabia records 93.5 million tourists and total spending of SR185 billion in 2022. Saudi Gazette. Retrieved January 27, 2024, from https://saudigazette.com.sa/article/629890/SAUDI-ARABIA/Saudi-Arabia-records-935-million-tourists-and-total-spending-of-SR185-billion-in-2022

Wei, W. (2019). Research progress on virtual reality (VR) and augmented reality (AR) in tourism and hospitality: A critical review of publications from 2000 to 2018. *Journal of Hospitality and Tourism Technology*, 10 (4), 539-570. https://doi.org/10.1108/JHTT-04-2018-0030

Zolfani, S. H., Sedaghat, M., Maknoon, R., & Zavadskas, E. K. (2015). Sustainable tourism: A comprehensive literature review on frameworks and applications. *Economic Research-Ekonomska Istrazivanja.* 28(1), 1–30. https://doi.org/10.1080/1331677X.2014.995895