Virtual Reality: A Technological Tool for Preserving Built Heritage

Hebat Allah Ali Sayed Gaafar

Tourism Studies Department - Faculty of Tourism and Hotels - Sadat City University

Abstract

Due to the natural degradation as well as the overcrowding effect, heritage preservation efforts are becoming very crucial to support the sustainability of heritage sites. In response to the problems, Virtual Reality (VR) can offer useful applications for heritage preservation. However, VR may provide an alternative form of accessing heritage sites that lessen the impacts of visitors' overcrowding effect, while heightening the overall experience. The research was applied five point Likert scale to explore the tourists' acceptance of the usage of VR technology. The study aims to investigate the perception of heritage conservation as well as the acceptance of virtualizing heritage sites for both domestic and international tourists, as heritage attractions need to be sustainable because they have significance value and lack duplication. The study explored the factors that may affect the tourists' acceptance of using VR technology. The sample consisted of two hundred and fifty tourists (domestic tourists = 107; international tourists = 143), questionnaires were distributed in four tourism destinations in Egypt; these destinations contain heritage sites that were designated at the World Heritage list by UNESCO. The results showed a significant difference by demographic characteristics concerning their overall acceptance of virtualizing heritage sites. Frequencies of visitation, VR experience and tourist perception of heritage conservation were influencing the degree of their acceptance.

Keywords: Virtual Reality, Heritage, Virtualizing Heritage, Tourists' acceptance, Perception.

…….

Introduction

In recent years, heritage tourism has gained an increasing attention, and has generated a growing body of literature (Balcar and Pearce, 1996; Garrod and Fyall, 2000; Poria et al., 2001). Heritage, "the 'buzz' word of the 1990s" (Palmer 1999: 315), is regarded as one of the most important and fastest growing components of tourism (Poria et al., 2003).The word "heritage" in its broader meaning is related to the word "inheritance," that is, something transferred from one generation to another (Huh, 2002; Nerngchamnong et al., 2011).

Van loon (2013) classified heritage resources into; Historic and archaeological resources or built resources contain museums, landmarks, bridges, cemeteries, fountains, lighthouses, sculptures, battlefield parks and monuments; Cultural resources include written records and documents, oral histories, traditional music and dance, theatres, galleries, ethnic restaurants, artists, craftspeople, folklorists, festivals, fairs, community traditions, and land uses such as agriculture or mining; natural resources include gardens and recreation areas, unique or rural landscapes, rivers, lakes, canals, beaches, wetlands, wilderness areas and wildlife habitats.

The governance of heritage needs to fulfill the requirements of protection and conservation, as heritage resources are extremely rare and non-renewable (Wang and Bramwell, 2012). Heritage sites may suffer from natural degradation and damages with the passage of time (Paquet and Viktor, 2005). In addition, the popularity of heritage tourism, especially those sites designated by UNESCO, may be particularly threatened due to their world heritage status that attracts significant number of visitors to the heritage sites (Drost, 1996; Li et al., 2008). Subsequently, heritage preservation and restoration efforts are essential to account for human and environmental factors that affected heritage sites (Guttentag, 2010).

The growing development of Information Communication Technologies has greatly improve the successfulness of VR, providing more natural and obvious modes of interaction and motivational elements (Paquet and Viktor, 2005; Cignoni and Scopigno, 2008; Aziz and Siang, 2014). Some of the advantages that VR contributes to build heritage include:

a) Conserving and documenting the international heritage sites all over the world; as 3D virtual models include accurate data and help for heritage preservation (Reffat and Nofal, 2013).

b) Virtual recovery of the destroyed built heritage.
c) Helping in the education process for students, VR can transfer them to another world and make them feel as if they were walking at the site with its details in the past (Burdea and Coiffet, 2003; El-Razaz, 2007).

For this paper, VR is defined as "the use of a computer-generated 3D environment – called a 'Virtual Environment' (VE) – that one can navigate and possibly interact with, resulting in real-time simulation of one or more of the user's five senses". 'Navigate' refers to the ability to move around and explore the VE, and 'interact' refers to the ability to select and move objects within the VE (Gutierrez et al., 2008: 47). This research focuses on the application of VR technology to preserve built heritage sites and examines the possibility of using VR to provide substitute tourism experiences. The application of VR technology was selected to conserve the built heritage sites, as heritage attractions need to be sustainable because they have significance value and non-renewable. The possibility of using VR experiences to serve as substitute heritage tourism experiences is analyzed, through examining many factors that may influence tourists' acceptance of using VR in heritage.

The aims of this paper are to provide an overview of the VR concept, and how can the application of such technology preserve the heritage sites, and explore the acceptability of both domestic and international tourists towards using VR technology in built heritage. It is hoped that understanding the degree of their acceptability, may help heritage managers to provide VR product that simulate visitors to experience, which in return, conserve the heritage sites and support sustainability. This research will be conducted using the quantitative approach; involving questionnaires were distributed in four tourism destinations in Egypt; Cairo, Luxor, Aswan and Saint Catherine. According to the research aims, six hypotheses were derived:

H1: There is a significant difference between domestic and international tourists concerning their perception of heritage conservation.

H2: There is a significant difference between respondents' overall acceptance of virtualizing heritage sites and their demographic characteristics.

H3: There is no association between tourists' overall perception of heritage conservation and their acceptance of using Virtual Heritage.

H4: There is a significant difference between respondents' overall acceptance of heritage virtualization and their purpose of visit.

H5: There is a correlation between respondents' overall acceptance of virtualizing heritage sites and frequencies of visit.

H6: There is a correlation between respondents' overall acceptance of virtualizing heritage sites and their experience of using VR in heritage sites.

Heritage preservation

Many scholars have stated that heritage sites require preservation efforts to maintain their sustainability. For instance, Prideaux (2002: 320) claimed, ''A growing number of travelers threaten to overwhelm many of the sites that visitors currently find popular''. In fact, some of the world's most treasured sites – those listed as UNESCO World Heritage Sites – may be particularly threatened because their world heritage status can attract increased numbers of visitors to these sites (Drost, 1996). According to Li et al. (2008: 311) ''Many researchers believe the very designation of a World Heritage Site is the catalyst to rapid tourism development and the number of visitors is the major threat to the sustainability of the sites''.

The presentation of such sites as virtual 3D models is considered as a valuable tool for heritage preservation, as such virtual models can include detailed and accurate data sets which can be stored forever (Cignoni and Scopigno, 2008; Paquet and Viktor, 2005). While a heritage site may suffer degradation from impacts such as erosion, a VR model can provide detailed information on its earlier form that can be used for monitoring degradation and offering a blueprint for restoration (Paquet & Viktor, 2005).

VR application could be an effective technology to preserve built heritage by providing an alternative form of access to threatened sites. For example, Hobson and Williams (1995: 133) stated ''With VR offering realistic experiences, it could offer a way of visiting sensitive environments that can't cope with demand''; Cheong (1995: 421) stated, ''With more people choosing to partake in vicarious travel experiences via VR, fewer would actually visit a tourist destination,'' which would significantly decrease the negative impacts of visitors; Reidsma et. al.(2001: 326) stated, ''To a greater degree, technology is solving one of the largest problematic issues concerning built heritage assets - nondestructive public access''; Paquet and Viktor (2005: 1) stated that, in order to decrease site degradation, ''a virtual copy of the original can replace the latter''; and Croizier (2012) mentioned that virtual tours can be used to conserve heritage and/or improve opportunity throughout giving visitors access to a simulation, rather than placing the original heritage sites, which at risk of wear and tear. VR offers the potential to create substitute experiences that may be extremely useful for heritage preservation (Guttentag, 2010).

The list of heritage sites that can be accessed virtually is continually expanding and numerous heritage sites around the world already have been digitized as 3D virtual models. Such as, numerous Terra Cotta Warrior statues from China (Zheng & Zhang, 1999), the Hawara pyramid complex from ancient Egypt (Shiode & Grajetzki, 2000), frescoes from the House of the Vettii in Pompeii (Devlin & Chalmers, 2001), the Dutch castle of Huys Hengelo (Reidsma et al., 2001),the Hagia Sophia Mosque of Istanbul (Foni et al., 2002), assorted Angkor temples in Cambodia (Kenderdine, 2004), a 19th century aboriginal chief house in Canada, a chapel in Ottawa (El-Hakim et al., 2006), and various castles in Northern Italy (El- Hakim et al., 2007).

Virtual Reality (VR)

VR is defined as "the use of a computer-generated 3D environment – called a Virtual Environment (VE) – that one can navigate and possibly interact with, resulting in real-time simulation of one or more of the users' five senses" (Guttentag , 2010). The key characteristic of VR is that the users involved an entirely immersive world, which made-up by the computer system, to experience the VE through using different devices. Nowadays, VR applications can offer feedback in the mode of sound or touch to allow the tourists to interact with objects and spaces, which enable simulating real-world experiences in an artificial environment. VR can preserve heritage sites by providing realistic experience without risking or damaging the heritage sites and allow "visitations" to sites with sensitive environment or situation that are not suitable for crowds (Aziz and Siang , 2014).

A VR experience can be described by its capacity to provide physical immersion and psychological presence. 'Immersion' refers to the degree to which a tourist is isolated from the real world. In a 'fully immersive system' the tourist is completely involved by the VE and has no interaction with the real world (Gutierrez et al., 2008). The level of immersion that can be offered by a VR system is vital for influencing a tourist's feelings of 'presence'. The presence can be defined as "the sense of being in a VE rather than the place in which the participant's body is actually located'' (Sanchez-Vives and Slater, 2005: 333). Subsequently, ''A sign of presence is when people behave in a VE in a way that is close to the way they would behave in a similar real life situation'' (Gutierrez et al., 2008: 3). Feelings of 'presence' are influenced by a VR system's ability to present high quality data to the tourist's senses (Dinh et. al., 1999). VR systems' capacity has improved since the occurrence of VR-type technologies in the 1960s as to provide such high quality sensory data (Burdea and Coiffet, 2003; Rizvic et al., 2008).

Modern VR technology

Most of developed countries' governments and tourism industry labs use digital tools and techniques, which offer a new chance to the conversation and preservation of built heritage (Addison, 2000). Every VR system needs input device in order to interpret the user's actions and the VE can respond accordingly. VR systems follow the motion of hand-held objects or a user's head or limbs, and the received data is utilized to determine the user's view, navigation, interaction with objects, and possible movement of a virtual body, known as an 'avatar' (Burdea & Coiffet, 2003; Foxlin, 2002).

There are many kinds of input devices that VR systems use, such as mouse, joystick, or fixed, mechanical arm with a visual display at one end. In addition, more high-tech devices are also used, such as interactive gloves and voice recognition software (Gutierrez et al., 2008). Also, the movement of a user's body can be tracked using body suits with angle measurement devices placed on various joints, or non-contact tracking devices, which may involve the use of optical sensors, ultrasonic sound, infrared emitters, or electromagnetic fields. These noncontact devices may use only a single tracker point that is located in a specific location, such as on top of the user's head, or they may involve numerous tracker points located on primary joints or throughout the body (Burdea & Coiffet, 2003; Foxlin, 2002; Gutierrez et al., 2008; Vince, 2004).

Champion (2011) mentions that the applications of new technologies such as Head Mounted Displays (HMD), Computer Audio Visual Environment (CAVE), Single Wall Projection Displays / Power walls, Work Benches, Fish Tank VRs and Windows, Icons, Menus, Pointing (WIMP) has opened the new possibilities of exploring and displaying heritage sites virtually, as most of these technologies aim to support an immersive environment for the user.

With reference to Addison (2000) and Tan & Rahaman (2009) there are three major areas of virtualizing heritage sites; the first stage is all about finding information, analysis and documenting the authentic data from both cultural and architectural past, it is always concerned about 'authentication' of data. The next stage is for representation which is presented by a different kind of devices and mostly concentrated on the accuracy of visualization. According to Rossou et al. (2003) the advancement of Virtual Reality technologies is considered as one of the most important issues to measure the successfulness of representation for a virtual reconstruction site. The final stage is devoted to distributing these information and knowledge to tourists by means of interactive digital mediums that focus on showing its 'mastery of technology'.

The visual and auditory aspects of VR are very important alike for the creation of realistic VEs (Gutierrez et al., 2008; Tsingos et al., 2004). In VR systems, audio is generally communicated through headphones or specially located speakers. High quality audio is very essential, as it gives spatial qualities to the sound that allows the tourist to perceive an external 'sound stage' from which the sounds are emitted. Giving sound spatial qualities involves giving it directionality whereas it is important to be considered because sounds must be perceived as coming from appropriate features of the VE (Letellier, 2014). Also, the audio properties of the VE are important to be considered because sound is heard quite differently in different environments (e.g. a closed room versus a cave), which may generate sound signals like echoes. Furthermore, sounds originating in different locations will be heard differently by an individual's right and left ears, and how a sound is heard also is influenced by the unique anatomical shape of the individual's body, head, and ears. Because of these influences, VR requires very sophisticated equipment (Burdea & Coiffet, 2003; Guttentag, 2010; Letellier, 2014).

Tangible sensations are more complicated than audio to replicate in VR because the sense of touch involves complex mechanisms of the nervous system. However, researchers have made significant progress in re-creating certain tangible sensations, such as vibrations. Recently, there is a progress in the simulation of thermal cues and pressure that imitates an object's weight (Gutierrez et al., 2008, Vince, 2004). Smell is often regarded as a very important aspect for VR, as olfactory simulation increases the tourist's sense of presence (Dinh et al., 1999). Researchers have developed olfactory displays that can record and reproduce a wide variety of odors, such as citrus smells, by mixing up to 96 different odor components (Somboon et al., 2007a; 2007b).

Methodology

The research methodology adopted for the study is through a structured questionnaire. The purpose of the questionnaire was to gauge the perception of heritage conservation and determine to what extent the tourists accept the virtualization of built heritage, in order to be preserved. The target population was domestic and international tourists, who visited historic Cairo, Luxor, Aswan and Saint Catherine. These places contain heritage sites that were designated at the World Heritage list by UNESCO. Questionnaires were self-administered among domestic visitors. However international visitors were aided by tour guides. The original questionnaire in the Arabic language was translated into the English language to cater for foreign visitors. Respondents were approached and informed about the purpose of the survey in advance before they were given the questionnaire. They were asked if they would participate in the survey.

Stratified random sampling method was selected to draw out samples of international and domestic tourists who visited the studied areas. A total 300 questionnaires were distributed between January and April 2014, in the following destinations (100 Cairo; 70 Luxor; 70 Aswan; and Saint Catherine; 60 questionnaires) but 250 questionnaires were usable. Unusable questionnaires included missing sections in the received questionnaires. Therefore, the data of the 250 respondents were analyzed. After sorting out the invalid questionnaires, data were entered onto the Statistical Package for Social Sciences (SPSS) version 16.0 and were coded, computed, and analyzed. Statistical analyses such as Two-tailed Independent t-test and Analysis of Variance (ANOVA) were applied to identify the differences in respondents' overall acceptance in terms of demographic characteristics data (gender, age, education, nationality and occupation) and purpose of visitation. Chi^2 test was applied to explore the relation between tourist's perception of heritage preservation and their acceptance of using VR technology in heritage sites. While Pearson Correlation test was used to identify the relationship between the overall acceptance of virtualizing heritage sites and two factors: VR experience and frequencies of visit.

Structure of the questionnaire

The questionnaire used in this study consisted of four sections. The first section determined whether the respondents experienced the VR technology. Past experience was measured by asking respondents to indicate their number of virtual visits to heritage sites. The second section explored the surveyed tourists' perception of heritage preservation: - respondents were requested to give a score to each statement using a 5-point Likert-type scale ranging from not at all important (1) to extremely important (5). The third section investigated to what extent the respondents agreed with virtualizing heritage sites, in order to be conserved and kept for the future generations. Respondents were demanded to give a score to each statement using a 5-point Likert-type scale ranging from strongly disagree (1) to strongly agree (5). The forth section explored the respondents' travel characteristics; purpose of visit, source of information, frequency of visit and willingness to visit the heritage sites again. A section of the questionnaire gathered the respondents' demographic data. Educational level ranged from "no high school degree" to "professional degree".

Pretest of the survey instrument

The survey instrument was revised, and to strengthen its validity, the questionnaire was circulated to 8 academic professors in Tourism Studies. Based on the feedback received from the pretested sources, the questionnaire was modified. Then, the questionnaire was tested through convenience samples consisting of tourists (N=30) in the Historic Cairo by on-site interviews. The main purpose of the pretest was to validate the questions of the study.

Reliability and Validity of data

Reliability can be thought of as consistency in measurement. To establish the reliability of the tourists' perception of heritage conservation and their acceptance of heritage sites virtualization which used in the survey instrument, the reliability coefficient (Cronbach alpha) was verified. If the coefficient alpha is > 0.70, there is a strong suggestion of strong item covariance (Struwing and Stead, 2013). Therefore, these results indicate strong item covariance. The Cronbach's Alpha value was 0.884 for tourists' perception of heritage conservation and 0.770 for tourists' acceptance of using virtual heritage. Accordingly, the questionnaires were distributed to the respondents. Meanwhile, validity indicates the degree to which an instrument measures the construct under investigation. Content validity refers to the subjective agreement among professionals that a scale logically appears to reflect accurately what it purports to measure (Zikmund, 2002). Therefore, in this study, content validity was strengthened through an extensive review of the literature.

Results

Demographic characteristics of the respondents

The demographic characteristics of the respondents are shown in Table (1). The gender distribution of the respondents was 62.8% male respondents and 37.2% female respondents. The dominant age group of the respondents was 35 to 44 years (40%), followed by 25 to 34 years (37.6%), and 15-24 years (20.4%), whereas 45 to 54 years made up the smallest group, representing (2%). A larger proportion of the respondents (57.2%)

were international travelers; the majority of the foreign respondents were predominantly from United Kingdom (20%), Malaysia (13.6%), Korea (12%), and Italy (11.6%), while the rest of the sample (42.8%) was Egyptians.

In terms of level of education, a greater proportion of the respondents (65.2%) had a university education level, 27.2% of the respondents had a post graduate education, and 7.6% of the respondents had a high school education. No respondent in the research study was at the primary level or below. The result shows the relatively high educational attainment of the respondents. The occupation identified most frequently by respondents across all study sites was that of entrepreneurs (48.4%), followed by those who were involved in management (34.4%). Student ranked the third with (8.8%).

Table (1): Demographic profile of respondents (N=250)

Description	Frequency	Percentage
Country of origin		
Egypt	107	42.8
United Kingdom	50	20
Italy	29	11.6
Malaysia	34	13.6
Korea	30	12
Age		
15-24	51	20.4
25-34	94	37.6
35-44	100	40
45-54	5	2
Gender		
Male	157	62.8
Female	93	37.2
Education		
High school	19	7.6
University	163	65.2
Post graduate	68	27.2
Occupation		
Management	86	34.4
Entrepreneur	121	48.4
Clerical	21	8.4
Student	22	8.8

Respondents' perception of heritage preservation

Table (2) demonstrates the perception of the respondents on the heritage conservation, as respondents were requested to give a score to each statement using a 5-point Likert-type, scale ranging from not at all important (1) to extremely important (5).

Table (2): Percentages and means of the respondents' perception of heritage conservation

Attributes	Not at all important	Slightly important	Important	Very important	Extremely important	Mean
	%	%	%	%	%	
The conservation of one's heritage sites	0	0	0	22.8	77.2	4.7720
The governmental efforts	0	0	3.2	22	74.8	4.7160

to preserve heritage sites						
Some heritage sites require preservation efforts as a direct result of the sites current popularity as tourist attractions	0	5	9.6	17	68.4	4.4920

The analyses indicate that all respondents assured that "the conservation of one's heritage sites" and "The governmental efforts to preserve heritage sites" is extremely important as these statements' means were (4.7720 and 4.7160). Only 5% of all respondents stated that the statement "Some heritage sites require preservation efforts as a direct result of the sites current popularity as tourist attractions" is slightly important while the others believed in its importance (mean= 4.4920).

Table (3) illustrates that Mann- Whitney test was conducted to investigate whether there are mean differences between Domestic and International tourists concerning perception of the heritage preservation.

Table (3): Differences between international and domestic tourists' perception of heritage conservation

Attributes	International tourists Mean Rank	Domestic tourists Mean Rank	z	sig
The conservation of one's heritage sites	130.40	118.95	1.704	0.088
The governmental efforts to preserve heritage sites	101.193	157.00	7.886	0.000
Some heritage sites require preservation efforts as a direct result of the sites current popularity as tourist attractions	113.81	141.12	3.599	0.000

The analyses show a significant difference (p=0.000) favoring the domestic tourists in the following attributes "The governmental efforts to preserve heritage sites" and "Some heritage sites require preservation efforts as a direct result of the sites current popularity as tourist attractions" as their mean ranks were higher than the international respondents. While there was no a significant difference (p>0.05) concerning their perception on the conservation of one's heritage sites. Thus, the first hypothesis "**There is a significant difference between domestic and international tourists concerning their perception of heritage conservation"** could be rejected only for their perception on "The conservation of one's heritage sites".

The respondents' acceptability of applying VR

The following table demonstrates to what extent the respondents agreed with the utilization of VR technology as a substitute for real travel, as respondents were requested to give a score to each statement using a 5-point Likert-type scale ranging from strongly disagree (1) to strongly agree (5).

Table (4): Percentages and means of the respondents' acceptance of using VR

Statements	Strongly disagree	Disagree	Neither disagree nor agree	Agree	Strongly agree	Mean
	%	%	%	%	%	
Use VR in unavailable places	0	0	6.4	28.4	65.2	4.5880
I like to visit heritage sites virtually	3.2	20	3.2	18.4	55.2	4.0240
I like to visit virtual heritage sites when applying high-tech	3.2	20	3.2	14.8	58.8	4.0600
I prefer to visit far distance	12	33.2	8.4	12	43.4	3.0760

heritage site virtually						
I'll visit the sites virtually when I feel it is a real place "presence"	0	4.4	16.8	21.2	57.6	4.3160
Rending heritage site as virtual 3D models is a valuable tool for heritage preservation	0	4.8	13.6	18	63.6	4.4040

The results show a larger proportion of respondents (65.2%) were strongly agreed with using VR in unavailable places (mean= 4.5880), followed by (63.6%) of all respondents believed that rending heritage site as virtual 3D models is a valuable tool for heritage preservation (mean= 4.4040). Almost half of all respondents were agreed with the following statements "I like to visit virtual heritage sites when applying high-tech"; "I'll visit the sites virtually when I feel it is a real place 'presence' " and "I like to visit heritage sites virtually". On the other hand, the following statement "I prefer to visit far distance heritage site virtually" scored the lowest mean (3.0760) as 45.2% of those queried were strongly disagreed or disagreed with the usage of VR in far distance heritage sites.

Table (5) illustrates that two-tailed independent t-test and one-way ANOVA results of the mean difference of overall acceptance of virtualizing heritage sites by the demographic characteristics of the respondents. The results indicated a significant difference in the overall acceptance of the respondents was found by gender favor females ($p<0.05$). Concerning country of origin, there is a significant difference in the overall acceptance of applying VR technology favoring Egyptians ($p<0.05$). In terms of Education level, the results showed a significant difference in the overall acceptance of applying VR technology favoring postgraduates' respondents ($p<0.05$). Concerning occupation, there was a significant difference favor entrepreneurs ($p<0.05$). Regarding age, there is no a significant difference in the respondents' overall acceptance of virtualizing heritage sites. Thus, the second hypothesis "**There is a significant difference between respondents' overall acceptance of virtualizing heritage sites and their demographic characteristics**" could be rejected only for age.

Table (5) Two-tailed Independent t-test and One-way ANOVA results of the mean difference of overall acceptance by demographic characteristics of the respondents

Variable	Mean	Sig
Gender (t=1.111)		
Male	4.0038	0.001
Female	4.0935	
Age (F= 0.659)		
15-24	4.1118	
25-34	4.0468	0.519
35-44	3.9924	
45-54	4.0562	
Nationality(t= 6.227)		
Egyptians	4.2992	0.000
Foreigners	3.8411	
Education level (F=10.517)		
High school	3.9301	
University	4.1368	0.000
Post graduate	4.2662	
Occupation (F= 16.533)		
Management	3.7140	
Entrepreneur	4.3476	0.000
Clerical	3.9273	
Student	4.2331	

Overall agree mean ranges from 1 (strongly disagree) to 5(strongly agree)

Chi square test was used to discover if there is an association between tourists' overall perception of heritage conservation and their acceptability of using VR technology instead of visiting the real place. Table (6) Chi^2 analyses found a strong relationship between respondents' overall perception of heritage preservation and their overall acceptance of virtualizing heritage. Chi^2 statistic is large, and the value for the contingency coefficient was much closer to 1. Therefore, the third hypothesis "**There is no association between tourists' overall perception of heritage conservation and their acceptance of using Virtual Heritage**" was rejected.

Table (6) Chi^2 tests the association between tourists' overall perception and acceptance

Variables	Chi^2	Contingency Coefficient	Sig
Overall acceptance of applying VR technology Overall perception Of heritage conservation	685.252	0.812	.000

Travel characteristics of the respondents

Table (7) demonstrates the travel characteristics of respondents, as visiting heritage and culture places in Egypt ranked the first (46.4%), followed by recreation and business purposes (33.6% and 11.6%), whereas visiting relatives and friends represented the smallest group (8.4%). Concerning source of information about the destination, a greater proportion of the respondents (51.6%) depended on website, while (17.6%) of respondents knew about the destination from their friends and relatives, and (16.8%) used travel agencies. For the number of visits to the destination, 63.2% of the respondents had visited the destination more than one time, while 36.8% respondents were on their first trip to the destination. The majority of the respondents (86.4%) expressed their willingness to visit the destination again.

Table (7): Travel characteristics

Description	Frequency	Percentage
Purpose of visit		
Heritage and culture	116	46.4
Recreation	83	33.6
Business	29	11.6
Visiting relatives and friends	21	8.4
Source of information		
Friends and relatives	44	17.6
Travel agency	42	16.8
Magazine	35	14
Website	129	51.6
Frequency of visit		
First time	92	36.8
2-3 times	95	38
4 times and more	63	25.2
Willingness to visit again		
Yes definitely	216	`86.4
May be	34	13.6
Never	0	0

Analysis of Variance (ANOVA) was tested in order to identify the mean differences in overall acceptance of virtualizing heritage sites by the respondents' purpose of travel. The results are shown in Table 8.

Table (8) One-way ANOVA results of mean difference of overall acceptance of virtualizing heritage sites by the Respondents' purpose of visit

Variable	Mean	Sig
Purpose of visit (F= 3.903)		
Heritage and culture	4.1336	
Recreation	4.0548	0.009
Business	3.7810	
Other (visiting relatives and friends and adventure)	3.7862	

The results revealed a significant difference in overall acceptance of the respondents by the purpose of travel (F= 3.903, p <0.05), as the respondents who traveled for visiting heritage and culture places were agreed with virtualizing heritage sites more than the other categories. Thus the hypothesis "**There is a significant difference between respondents' overall acceptance of heritage virtualization and their purpose of visit**" was supported.

A correlation coefficient measured the strength of a linear between two variables (Struwig and Stead, 2013). In the study, a correlation coefficient measured the strength of a linear between the respondents' overall acceptance and frequencies of visit. The correlation between overall agree with virtualizing heritage sites and frequencies of visit was 0.590 (p=0.000) at the 0.01 level (2-tailed) as illustrated in table 9. Therefore, the hypothesis "There is a correlation between respondents' overall acceptance of virtualizing heritage sites and frequencies of visit" was supported.

Table (9): Correlation between overall acceptance and frequencies of visit

Variable	frequencies of visit	
Overall acceptance of virtualizing heritage sites	Pearson Correlation	0.590*
	Sig (2-tailed)	0.000
	N	250

Note: * p ≤ 0.01

Tourists' Virtual Reality experience

Regarding the respondents' experience on using VR technology, a greater proportion of the respondents (61.2%) used VR technology, while (38.8%) did not experience it. 53.6% (n=134) of the respondents' experienced VR technology in heritage sites (80 of them experienced virtual heritage for two times while 54 used virtual heritage for three times) but only 56% of the respondents who used VR in heritage sites preferred to repeat this experience again, while the rest (44%) indicated that they do not like to experience VR technology in heritage because of quality of a product and lack of the latest technology application.

Table (10): Frequencies and percentages of respondents' experiences of using VR technology

Description	Frequency		Percentage	
	Yes	No	Yes	No
Did you experience V R technology before (n=250)	153	97	61.2	38.8
Did you experience virtual heritage site (n=250)	134	116	53.6	46.4
Do you prefer to repeat this experience again (n=134)	75	59	56	44

Table (11) illustrates that the correlation between overall acceptance of virtualizing heritage sites and respondents' experience of using VR in heritage sites was 0.359 (p=0.012) at the 0.05 level (2-tailed). Therefore, the hypothesis "**There is a correlation between respondents' overall acceptance of virtualizing heritage sites and their experience of using VR in heritage sites**" was supported

Table (11): Correlation between respondents' overall acceptance and their experience of using VR

Variable	respondents' experience of using VR in heritage sites	
Overall acceptance of virtualizing heritage sites	Pearson Correlation	0.359*
	Sig (2-tailed)	0.012

Note: * $p \leq 0.05$

Conclusion

The study provides an insight into the application of VR technology on built heritage. As virtualization of built heritage has a significant capability in storing and providing detailed and accurate data that are useful to monitor degradation and preserve heritage. The virtualization of heritage is to actualize the heritage contents digitally and to simulate it using computer graphics technology. According to Letellier (2014) the features of virtualizing heritage include facilitating conservation, reproduction, representation, digital reprocessing, and displaying built heritage using the advancements of VR technologies. The application of VR technology can provide innovation capability to conserve heritage resources. VR technology can preserve heritage by providing an alternative form of access to heritage sites as well as providing realistic experiences, it could offer a way of visiting sensitive environments that cannot cope with demand and significantly lessen the trespass of visitor on heritage sites.

The current study investigates both international and domestic tourists' perception of heritage preservation as well as their acceptance of virtualizing built heritage. Findings in this study identified several characteristics of visitors to the studied heritage sites. A higher proportion of the respondents were well educated, which was supported by Kerstetter et al. (2001: 269) "more educated as most heritage tourists have advanced degrees, and interested in learning about community's history and culture". This study shows that there are significant differences between the respondents' profile concerning their overall acceptance of the possibility of using VR in built heritage by gender, education, occupation and nationality. The study reveals that the tourists who visited the destination for heritage and culture purposes were more agreed with the application of VR technologies on built heritage than those who were visited the destination for other purposes.

In regards to heritage preservation perception, the findings show that the domestic tourists had a higher perception of heritage conservation than the international tourists, because they believe that these heritage sites are belonging to them and their future generations, in addition a large proportion of them support the governmental efforts to preserve heritage sites especially with current popularity. Also, there was a strong relationship between the perception of heritage conservation and the possibility of using virtual heritage for both domestic and international tourists.

Findings show that VR experience, frequencies of visitation and perception of heritage conservation will be influencing factors of the tourist's acceptance of virtualizing built heritage. Concerning VR experience, a greater proportion of the surveyed tourists who experienced virtual heritage do not prefer to repeat this experience because of poor product and lack of applying high technology, accordingly, they could not feel "sense of place". So the challenge that faces the heritage managers is how to deliver a quality product with 'fully immersive system' that enables the users to be isolated from the real world. The application of the latest VR technologies is considered as one of the most important issue to stimulate tourists to experience virtual heritage sites.

Finally, this paper contributes as a significant step towards understanding visitors' perception of heritage conservation and their acceptance of experiencing virtual heritage sites as to preserve the Egyptian built heritage that has unique competitive advantages based on valuable, rare resources, which are impossible to imitate or duplicate. It can be concluded that understanding of visitors' opinions on experiencing VR in heritage sites will greatly assist the tourism authorities to apply high tech and develop a VR system that enables interaction possibilities.

References

- Addison, A.C. (2000). "Emerging Trends in Virtual Heritage", *IEEE Multimedia*, 7, pp. 22-25.
- Aziz, K. A. and 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, Vol. 4, No. 5, September 2014 p. 333.*
- Balcar, M. and Pearce, D. G. (1996). "Heritage Tourism on the West Coast of New Zealand", *Tourism Management*, 17(3), pp. 203-212.
- Burdea, G. C. and Coiffet, P. (2003). "Virtual Reality Technology", 2nd ed., Hoboken, NJ: Wiley-Inter science, pp.55-59.
- Champion, E. (2011). "Playing with the Past", Springer-Verlag, pp. 45-56.
- Cheong, R. (1995). "The Virtual Threat to Travel and Tourism". *Tourism Management*, 16(6), pp. 417–422.
- Cignoni, P.and Scopigno, R. (2008). "Sampled 3D Models for CH Applications: A Viable and Enabling New Medium or Just a Technological Exercise?" *ACM Journal on Computing and Cultural Heritage*, vol. 1, no. 1, pp. 2-23.
- Croizier, J. M. (2012). "Innovation at Heritage Tourist Attractions", PhD thesis, University of Tasmania, pp.15-25.
- Devlin, K. and Chalmers, A. (2001). "Realistic Visualization of The Pompeii Frescoes", In Proceedings of Afrigaph, Cape Town, South Africa, pp. 43–48.
- Dinh, H. Q., Walker, N., Song, C., Kobayashi, A. and Hodges, L. F. (1999). "Evaluating the Importance of Multi-Sensory Input on Memory and The Sense of Presence in Virtual Environments". In Proceedings of IEEE virtual reality, pp. 222–224.
- Drost, A. (1996). "Developing Sustainable Tourism for World Heritage Sites", *Annals of Tourism Research*, 23 (2), pp. 479-492.
- El-Hakim, S., Gonzo, I., Voltolini, F., Girardi, S., Rizz, A. and Remondino, F. (2007). "Detailed 3D Modelling of Castles". *International Journal of Architectural Computing*, 5(2), pp.214–220.
- El-Hakim, S., MacDonald, G., Lapointe, J.-F., Gonzo, L., and Jemtrud, M. (2006). "On the Digital Reconstruction and Iinteractive Presentation of Heritage Sites Through Time". The 7th international symposium on virtual reality, archaeology and intelligent cultural heritage, Nicosia, Cyprus, 30 October–4 November, pp. 243–250.
- El-Razaz, Z. (2007). "Virtual Heritage in the Digital Era", *ASCAAD*, pp. 149-154.
- Foni, A. E., Papagiannakis, G. and Magnenat-Thalmann, N. (2002). "Virtual Hagia Sophia: Restitution, Visualization and Virtual Life Simulation", UNESCO World Heritage Congress, p. 56.
- Foxlin, E. (2002). "Motion Tracking Requirements and Technologies", In Stanney, K. (2002). Handbook of virtual environments: Design, implementation, and applications, Mahwah, NJ: Erlbaum, pp. 190–208.
- Garrod, B. and Fyall, A. (2000). "Managing Heritage Tourism", *Annals of Tourism Research*, 27(3): 682-708.
- Gutierrez, M., Vexo, F., and Thalmann, D. (2008)." Stepping Into Virtual Reality". London: Springer, pp. 3, 45-50.
- Guttentag, D. A. (2010). "Virtual Reality: Applications and Implications for Tourism," *Tourism Management*, 31 (5), pp. 637-651.
- Hobson, J. S. P. and Williams, A. P. (1995). "Virtual Reality: a New Horizon for The Tourism Industry", *Journal of Vacation Marketing*, 1(2), 125–136.
- Huh, J. (2002). "Tourist Satisfaction with Cultural / Heritage Sites: The Virginia Historic Triangle", Master of Science, Blacksburg, University of Virginia, pp. 90-98.
- Kenderdine, K. (2004). "Avatars at the Flying Palace: Stereographic Panoramas of Angkor Cambodia", In International Conference on Hypermedia and Interactivity in Museums, Berlin, pp.1–11.
- Kerstetter, D.L., Confer, J.J. and Graefe, A.R. (2001). "An Exploration of The Specialization Concept within The Context of Heritage Tourism", *Journal of Travel Research*, 39, pp. 267-274.
- Letellier, R. (2014). "Virtual Reality A New Tool for Sustainable Tourism and Cultural Heritage Sites Management", Heritage VR Group, http://cipa.icomos.org/fileadmin/template/doc/olinda/99c102.pdf, retrieved on 12-5-2014.

- Li, M., Wu, B. and Cai, L. (2008). "Tourism Development of World Heritage Sites in China: a Geographic Perspective", *Tourism Management*, 29 (2), pp. 308-319.
- Nerngchamnong, K., Kaviya, S., Fujii,Y. and Yupapin,P. P. (2011). "World Heritage City Surveillance System by a Smart CCTV System", 2nd International Science, Social Science, Engineering and Energy Conference 2010: Engineering Science and Management, *Procedia Engineering*, 8, pp.321–327
- Palmer, C. (1999). "Tourism and Symbols of Identity", *Tourism Management*, 20, p.315.
- Paquet E.and Viktor, H. L. (2005). "Long-term Preservation of 3-D Cultural Heritage Data Related to Architectural Sites", Conference on the ISPRS 3D Virtual Reconstruction and Visualization of Complex Architectures, Mestre-Venice, Italy, August, pp.1, 22-24.
- Poira, Y., Richard, B. and David, A. (2001). "Clarifying Heritage Tourism". *Annals of Tourism Research* , 28 (4), pp. 1047-1049.
- Poria, Y., Butler, R. and Airey, D. (2003). "The Core of Heritage Tourism", *Annals of Tourism Research*, 30, pp. 238-254.
- Prideaux, B (2002). "Building Visitor Attractions in Peripheral Areas - Can Uniqueness Overcome Isolation to Produce Viability", *international Journal of Tourism Research*, 4 (5), pp. 320-325.
- Reffat, R. M. and Nofal, E.M. (2013). " Effective Communication with Cultural Heritage Using Virtual Technologies", International CIPA Symposium, 2 – 6 September 2013, Strasbourg, France, International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, 11, pp. 210-220.
- Reidsma, D., Kragtwijk, M. and Nijholt, A. (2001). "Building ''Huys Hengelo'' in VRML", In Proceedings of the International Cultural Heritage informatics Meeting, Milan, Italy, 3–7 September 2001, pp. 325– 330.
- Rizvic, S., Sadzak, A., Buza, E. and Chalmers, A. (2008). "Virtual Reconstruction and Digitalization of Cultural Heritage Sites in Bosnia and Herzegovina", National Centre for Digitization (Nacionalni centar za digitalizaciju) Review Journal, 12, pp. 82–90.
- Roussou, M., Drettakis, G., Reche, A. and Tsingos, N., (2003). " Photorealism and Non-Photorealism in Virtual Heritage Representation", VAST 2003 and First Eurographics Workshop on Graphics and Cultural Heritage, pp. 12-18.
- Sanchez-Vives, M. V. and Slater, M. (2005). "From Presence to Consciousness Through Virtual Reality", *Nature Reviews Neuroscience*, 6(4), pp. 332–339.
- Shiode, N. and Grajetzki, W. (2000). "A Virtual Exploration of The Lost Labyrinth: Developing A Reconstructive Model of Hawara Labyrinth Pyramid Complex", CASA, Paper 29, pp. 1–10.
- Somboon, P., Wyszynski, B. and Nakamoto, T. (2007a). "Realization of Recording a Wide Range of Odor by Utilizing Both of Transient and Steady-State Sensor Responses in Recording Process", *Sensors and Actuators*, 124, pp. 557–563.
- Somboon, P., Wyszynski, B., and Nakamoto, T. (2007b). "Novel Odor Recorder for Extending Range of Recordable Odor", *Sensors and Actuators*, 121, pp.583–589.
- Struwig, F. W., & Stead, G. B. (2013). "*Research: Planning, designing and reporting",* 2nd ed., Pretoria, South Africa: Pearson Education, pp.15-20.
- Tan, B. K. & Rahaman, H. (2009). "Virtual Heritage: Reality and Criticism". In Tidafi, T. and Dorta, T. (2009). "Joining languages, cultures and visions", CAADfutures Montreal, Canada, 17-19 June 2009, pp. 210-228.
- Tsingos, N., Gallo, E., and Drettakis, G. (2004). "Perceptual Audio Rendering of Complex Virtual Environments". *ACM Transactions on Graphics*, 23(3), pp. 249–258.
- Van Loon, R.R. (2013). "Tourism and the Economic Valuation of Cultural Heritage", PhD dissertation, Vrije Universiteit, Amsterdam, pp. 30-38.
- Vince, J. (2004). "Introduction to Virtual Reality". New York: Springer, pp. 89-95.
- Wang, Y. and Bramwell, B. (2012). "Heritage Protection and Tourism Development Priorities in Hangzhou, China:A Political Economy and Governance Perspective", *Tourism Management*, 33, pp 988-998.
- Zheng, J. Y., & Zhang, Z. L. (1999). "Virtual Recovery of Excavated Relics". *IEEE Computer Graphics and Applications*, 19(3), pp. 6–11.
- Zikmund, G.W. (2002) "Business Research Methods",7th ed., New York: Springer, p.25.

الواقع الافتراضي : أداة تكنولوجية للحفاظ على مواقع التراث

هبه الله على سيد محمد جعفر

قسم الدراسات السياحية - كلية السياحة والفنادق - جامعة مدينة السادات

الملخص العربي

ازدادت أهمية جهود الحفاظ على التراث من التدهور نتيجة للعوامل الطبيعية وزيادة عدد الزائرين لضمان استدامة المواقع التراثية. و للتغلب على مثل هذه المشاكل تُقدم تكنولوجيا الواقع الافتراضى عدة تطبيقات تساهم فى الحفاظ على مواقع التراث. حيث توفر تكنولوجيا الواقع الافتراضى امكانية زيارة مواقع التراث افتراضيا مما يؤدى الى تقليل الآثار السلبية الناتجة عن اكتظاظ اعداد الزائرين مع تعظيم تجربة الزائر من الزيارة. وتهدف هذه الدراسة إلى التعرف على مدى ادراك السائحيين المحليين و الدوليين لاهمية المحافظة على مواقع التراث، وكذلك مدى قبولهم لتطبيق تكنولوجيا الواقع الافتراضى على مواقع التراث و زيارة الموقع افتراضيا بدلا من زيارته فعليا. وقد بحثت الدراسة العوامل التي قد تؤثر على مدى قبول السائحين لاستخدام تكنولوجيا الواقع الافتراضى. تكونت عينة الدراسة من مائتين وخمسين سائح (السائحيين المحليين = 107؛ السائحيين الدوليين = 143)، و قد تم توزيع الاستبيانات في أربع مقاصد سياحية فى مصر، حيث تحتوى هذه المقاصد على المواقع التراثية التي تم تحديدها في قائمة التراث العالمي من قبل اليونسكو. وأظهرت النتائج وجود فروق ذات دلالة احصائية بين الخصائص الديموغرافية لعينة الدراسة بخصوص مدى قبولهم لتفعيل تكنولوجيا الواقع الافتراضى لمواقع التراث. و قد افرزت الدراسة عدة عوامل قد تؤثر على درجة موافقتهم على استخدام الواقع الافتراضى حيث تمثلت هذه العوامل فى: عدد مرات الزيارة لموقع التراث، تجربة تكنولوجيا الواقع الافتراضى من قبل، و ادراك السائح لاهمية الحفاظ على مواقع التراث.