Transforming Cultural Heritage—A Digital Humanity Perspective with Virtual Reality

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Abstract. The study aims to explore a virtual reality (VR) approach representing a local history in the sense of preserving cultural heritage. Two 400-year fort cities, Tamsui and Keelung, located in northern Taiwan, were chosen and transformed into digital fort cities by the researchers from the fields of history, information sciences, and computer science. The researchers invited participants to the VR lab and experience a VR tour. Research tools used for collecting user data include before and after attitude scales and a post-task interview for each participants. The findings of the research revealed that the senses of joy, presence, and control could critically impact VR user experience. The design of the content needed to be more informative and interactive. Affordances in the immersive environment were key for the user to experience a smooth and positive user journey with less pain points. For future work, the next round of data collection will be carried out. Data will be compared and contrasted further to see the differences.

Keywords: Digital cultural heritage · Digital humanities · User experience · User journey · Virtual reality

1 Introduction

Virtual reality (VR) was first predicted in a science fiction novel in the 1930s by writer Stanley G. Weinbaum (Virtual Reality Society 2017). In this study, virtual reality is defined as a computer-generated environment that creates a space where a user can interact with various stimuli (Limniou et al. 2008). The user experiences "scenery, objects, and sound effects" in the virtual space (Lo and Cheng 2020). The sense of immersion and "being there" are expected. The study aims to explore important elements of user experience (UX) when using VR as a tool to relearn and relive local history. As we embrace technology to engage users through various devices, how do users perceive the experience? Could our legacy pass through future generation that meet users' expectations? From the perspective of digital humanities and based on the assumption that VR could bring the past to life, the research team explored users' presumption, perception, attitude, and behavior of VR in the context of a digital collaboration among experts in information sciences and user research. Upon completion of the study in July 2022, researchers will identify current advantages and challenges of VR in preserving culture

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heritage with an emphasis of digital curation. For now, this paper serves an exploratory purpose.

According to UNESCO (2021), heritage is defined as "our legacy from the past, what we live with today, and what we pass on to future generations." For every country there is valuable heritage and should be passed on for future generations to understand their invaluable past. For cultural heritage, it means "those sites, objects and intangible things that have cultural, historical, aesthetic, archaeological, scientific, ethnological or anthropological value to groups and individuals" (UNESCO 2021). In this research, our research team continues its effort in digital humanities by rebuilding local history in northern Taiwan with the combination of artificial intelligence (AI) and VR. A virtual space of the past is set up. This paper focuses on the user aspect and evaluates effects of advanced digital tools. Two 400-year fort cities, Tamsui and Keelung, located in northern Taiwan, were chosen and transformed into digital fort cities by our team researchers from the fields of history, information sciences, and computer science. The research questions are as follows:

Q1: What are the user experience?

(1) How do users perceive before and after reliving history in VR?
(2) How do users feel the sense of presence in the virtual environment?
(3) How do users feel the sense of joy in the virtual environment?

Q2: What are the user journey?

(1) What is the attitude change before and after reliving history in VR?
(2) What are the high points of reliving history in VR?
(3) What are the pain points of reliving history in VR?

2 Related Literature

What is an experience? Before we try to understand how users perceive an object in the digital realm, we first needs to understand what constitutes an experience. According to Li et al. (2001), an experience is "more than simply the passive reception of external sensations or subjective mental interpretation of an event or situation." Mathur (1971) noted that "an experience is the product of an ongoing transaction that gains in quality, intensity, meaning, and value integrating both psychological and emotional conditions."

2.1 User Experience

The term "user experience" is defined in ISO 9241-210. According to the definition, user experience is about "a person's perceptions and responses resulting from the use and/or anticipated use of a product, system or service" (Usability.de 2022). Any of all three aspects of positive user experience means that the product, system of service at least meets or goes beyond users' anticipation and perceptions. According to Norman and Nielsen (2021), the most important requirement for an exemplary UX is to "meet the

exact needs of the customer, without fuss or bother." Other factors are joy to own and joy to use, because of the simplify and elegance that the products bring. User experience also include "the overall workflow and the steps before and after the product is actually in use" (Product Design 2021). To sum up, it is believed UX covers all aspects of the user's interaction with the company, the service, and the product. Based on this discussion, we look at the user's expectations and perceptions, more specifically the sense of presence.

Sense of Presence. In the immersive environment, feeling real is a critical aspect for users to have a positive experience. Erickson-Davis et al. (2021) stated that the "experience of presence implies a felt sense of 'realness'—the being is really over there, within reach." Looking into the literature of user experience, Cruz-cunha et al. (2013), the sense of presence means the user's degree of presence, usually being discussed in augmented reality (AR) and immersive environments, reflecting the degree to which an individual feels present in the environment, and a sense of "being in and belonging in." More specifically, the feeling of "involvement, warmth, and immediacy" while interacting with each other in online environments." With advancement of technology for virtual reality, the promises that the "sense of presence" and "being there" help users of all sorts immerse in the created environment and continue with the task with joy and involvement.

2.2 User Journey

Experts in the field of user study explains that a user journey map is "a visualization of the process that a person goes through in order to accomplish a goal" (Gibbons 2018). The journey described in the form of a map is a common UX tool that comes in all shapes and formats. Since the use of the map could highly depends on the context, the user journey map in this study is used as a way for the participants to describe their own feelings throughout the journey, thus the attitude change borrowed from consumer and marketing are used as a scaling tool to see before and after virtually touring historic sites in an immersive environment how participants anticipate before the touring and perceive the actual experience afterwards.

Attitude Change. Attitude change before and after the virtual experience helps us understands the user's attitude and the associated behavior throughout the journey. Originated from customer behavior, attitude change usually involves measuring before and after going through a certain experience, whether it is well-meaning or manipulative. Levine (2003) pointed out that "a well-meaning persuasion is called education; when it is manipulative, it might be called mind control." In a similar sense, the immersive virtual environment persuade customers that what is being experienced is what could be seen in the real world. When it is positively received, the persuasion is successful; thus brings an attitude change.

In the field of marketing, in addition to ask people directly about their thoughts, such as an interview, scales are one of the tools that are used for attitude change measurement (Epstein, n.d.). Thus, to measure attitude change, participants are asked to draw on a numbering scale with arrows indicating users' attitude towards each statement regarding their VR user journey.

(1) A numbering scale

In order for participants to sufficiently express their feelings, a scale with plus and minus 10 is designed to measure frequency, quality, importance, and likelihood.

(2) Figure drawings

The study uses the technique of figure drawings to assess the attitude change (Mcleod 2009). The technique originates from psychology is used to understand an individual's psychological state and unspoken opinions. This projective diagnostic technique works as an individual is instructed to draw arrows toward a positive or a negative state so that his/her cognitive, interpersonal, or psychological state can be assessed.

3 Research Methods

A VR laboratory was set up and research participants were recruited for a sequence of tasks. The research team designed the research tool for collecting data, which included a brief demographic and VR experience survey, a before and an after attitude scale, and post-task interview questions.

More specifically, the process of data collection included the task of having users wearing a VR device for a virtual tour to the two historic fort cities, think-aloud during the virtual tour, and post-task interviews. The virtual environment is where two 400-year old fort cities are built collaboratively with team experts with expertise in 3D technology. The researchers invited participants to the VR lab and experience a VR tour as shown in Fig. 1. Before the tour started, participants were asked to fill in a questionnaire and a before-task attitude scale, expressing his/her prior experience and/or anticipation for VR. The participants were then asked to wear the VR device and begin the tour. During the tour, participants were asked to think aloud; the entire process was recorded for data analysis. Afterwards, a post-task questionnaire was administered including a post-task

Fig. 1. The virtual environment of historical fort cities, Tamsui and Keelung.

attitude scale. In addition, a short post-task interview were carried out for the researcher to clarify any ambiguities that might occur and served as a follow-up for obtaining insights for attitude change. Figure 2 and 3 below showing participants filling out the before and after questionnaires as well as the lab setting were taken during one of the session for data collection.

Fig. 2. A participant draw on the attitude scale in the lab.

Fig. 3. User explored the historical setting in the VR

3.1 Attitude Statements and Scales

Examining related literature, Besoain et al. (2022) looked into attitude change in their evaluation study on the effects of a virtual museum of cultural heritage. The method used was a factorial design of 2 × 2 × 2 including the (1) direction of thoughts, (2) level of presence, and (3) two test settings, i.e., a virtual museum versus an interactive website. In this study, we designed a scale with positive and negative directions, from 0 to positive 10 and negative 10, which helped participants express their attitude towards 14 descriptions (Table 1) about VR user experiences covering three elements: (1) system, (2) process, and (3) content. The system element covers questions and statements related to behaviors; the process element covers how participants perceive and feel over the course of the experience; the content element covers representations of the local history

in its digital form. For instance, in the system element, the statement "I feel comfortable moving around in the VR" is intended to reveal how the participant feels the actual and perceived comfort in the VR tour. The actual comfort might mean the VR headset and device is easy to wear, but it also could mean moving around in the immersive virtual environment is easy and comfortable, with full control of directions. In this case, the perceived comfort is achieved.

Table 1. Attitude statements grouped by elements of user experience.

Elements of user experience	Item #	Statements
System	4	I feel comfortable moving around in the VR
	8	I feel headaches or dizziness during the process
	10	I think I can perfectly control where I want to go through my own actions
	13	I can't control myself in the VR
Process	1	I felt like I was there
	5	I feel happy in the VR
	7	I would like to stay in the VR scenario
	11	I felt like I was experiencing an exciting moment while interacting with the scene
Content	2	I think the scenes are very informative
	3	I (would) have a different feeling about the events before (after) I revisit the history in the VR
	6	I (would) have different thoughts about the events before (after) reliving the history in the VR
	9	I think the VR scenes are beautiful and impressive
	12	I have a deep understanding of the content presented in the VR
	14	I have full interaction with the scenery during the experience

4 Findings and Discussions

The team was able to recruit 17 participants in a data collection period of approximately 3 weeks (December 20th, 2021 to January 14th, 2022), which included 8 (47%) of the participants had zero VR experience and 9 (52.9%) of the participants had previous VR experienced; 12 of the participants were female (70.5%); 5 of the participants were male (29.4%). The participants were composed of mostly undergraduate students (82.3%) and graduate students (17.6%) from mainly Liberal Arts background of a comprehensive university in northern Taiwan as shown in Table 2.

Table 2. Participant demographics.

		Number of participants	Percentage (%)
Gender	Female	5	29.4
	Male	12	70.6
Education level	Undergraduate	9	75
	Graduate school	3	25
Previous VR experience	Yes	4	33.3
	No	8	66.6

4.1 Sense of Joy, Presence, and Control

Examining user experience from the sense of joy, participants showed greatest attitude changes when comparing the before and after attitudes. The statement "I felt like I was experiencing an exciting moment while interacting with the scene," as seen in Table 3, indicated that there was disappointment on the level of emotion. Participants felt a loss when expectations for interactions and emotional high were not met, according to the analysis of interview data. The attitude changes for the statement "I would like to stay in the VR scenario" as well as the interview results both showed that the scenario in the VR tour was not engaging nor inviting. Participants expressed that they expected there would be objects in the room, and possibly the one could use his controller to interact with some of the objects if there were any. There was one exception, though. Since the tour was rather simple and straightforward, participants were pleasantly surprised when they realized that they could fly to the rooftop of the ancient forts, because in the reality it was an impossible scenario. The statement "I feel happy in the VR" received a negative attitude change as well, compared with the before attitude scale. We could say at its current state, the sense of joy was absent in the design of the immersive environment.

The sense of presence and the sense of "being there" are expected in the VR as one of the core elements and an essential criteria for good user experiences. Research results showed that the statement "I felt like I was there" received a reversed change of attitude when participants were asked to evaluate their expectations and perceptions. On the other hand, because of the slight problem of the VR headset, the statement "I feel headaches or dizziness during the process" received the 3rd highest ranking indicating participants were reminded that they were manipulating a VR.

Participants noted that before experiencing the VR tour, it was expected that they would not be able to have a pleasant and smooth movement in the environment. The scale of attitude changes revealed that the statements concerning "sense of control" reversed the attitude directions afterwards, meaning participants were actually able to move pleasantly and smoothly around in the virtual space, feeling the sense of control over what was seemingly an uncontrollable situation. The statement "I think I can perfectly control where I want to go through my own actions" received the 2nd highest ranking comparing with the before attitude also proved that participants were pleased with the sense of control.

Table 3. Rankings for attitude change directions.

Attitude change		
Negative to positive	Ranked by responses	Statements/Elements
	1	I can't control myself in the VR/System
	2	I think I can perfectly control where I want to go through my own actions/System
	3	I have a deep understanding of the content presented in the VR/Content
	4	I have full interaction with the scenery during the experience/Content
	5	I felt like I was there/Process
Positive to negative	Ranked by responses	Statements/Elements
	1	I felt like I was experiencing an exciting moment while interacting with the scene/Process
	2	I think the scenes are very informative/Content
	3	I feel headaches or dizziness during the process/System
	4	I have different thoughts about the events (after) reliving the history in the VR/Content
	5	I would like to stay in the VR scenario/Process
	6	I think the VR scenes are beautiful and impressive/Content
	7	I feel comfortable moving around in VR/System
	8	I (would) have a different feeling about the events before (after) I revisit the history in the VR/Content
	9	I feel happy in the VR/Process

4.2 The Design of VR Content

Research data showed that the most critical element of VR is interaction. Before experiencing the VR, participants expected that there would be more interaction implemented in the tour; participants' after-task attitude changes revealed there were not enough interaction. On the other hand, the post-task interview data also pointed out that the content of VR needed to be more interactive and informative (see Table 3). Furthermore, examining past literature regarding the design of VR, a number of things need to be considered, especially affordance.

According to Norman (1988), the concepts of affordances could be traced back to Gibson's (1966) which studied human perception. The type of expected interaction between users and products is called affordances. Users bring their experiences, assumptions, and anticipations from the physical world into the virtual environment.

For instance, the buttons, levers, handles of products are affordances that suggest behavioral interaction. Similarly, these designs in the VR also evoke users' anticipations and emotions. Participants revealed that they felt disappointed when there were no persons nor objects to be interacted with when opening the door and entering a room in the VR.

The richness of the design is also a problem participants pointed out. Since the content of the VR is related to a period of local history, the research team is curious to find out whether reliving the history changed the cognitive state. Overall, participants gave positive attitude of the purpose, yet felt disappointed that the historical setting was lacking richness and details. Participants noticed a map was present but were surprised that there was no possible interaction with the map.

Another example is the VR controller. Participants expressed that they assumed the controller would serve as their feet and take them to any directions they wish as they moved the controller to the corresponding angle; but in fact the controller could only move forwards and backwards, taking the participant going forward and backward in the VR. These incidents again showed that when designing the content of the VR, it is critical to meet users' expectations, offer affordances accordingly. Norman (1988) stated that "In the design of objects, real affordances are not nearly so important as perceived ones; it is the perceived affordances that tell the user what actions can be performed on an object and, to some extent, how to do them" (p. 123). Norman also stated that "when affordances are taken advantage of, the user knows what to do just by looking: no picture, label, or instruction needed" (p. 9). The lessons learned here is that the design of content should, if at all possible, very closely meet the expectation of affordances that the user perceives to ensure a positive user experience in terms of learning and receiving the message of the VR design team tries to convey.

5 Conclusions

The study took a qualitative approach and the results so far revealed current perceptions and insights from users. Even though the results represented initial findings from a rather small number of participants, the results could serve as a base for the still ongoing process of data collection. A number of problems of user experience for VR were discussed. The analysis revealed that users experienced not enough interaction during the process of the VR tour, which was the most critical problem. Content per se, users expected a rather rich historical content that is more informative from the learning point of view. For the system aspect, users expressed discomfort such as headaches or dizziness when taking the VR tour. Researchers expected that upon completion of the research in the next couple of months, the researchers would be able to build the framework of user experience and identify key points for VR design and experience, especially in the context of digital preservation of cultural heritage.

VR technology already has significant applications and impacts in various fields such as healthcare, entertainment, education, and marketing. From the viewpoint of marketing digital cultural heritage, the use of VR is highly rated as "Business analysts have suggested that the development of VR is comparable in importance with that of social media" (Morris 2016). Barnes (2017) noted, as technologies continue to advance, VR is very likely to become a key medium for marketing. From the user experience and user journey point of view, incorporating VR to promote local history for creating and

preserving collective memory as well as e-learning, this study identified with its initial research results the key points that needed to be considered when designing VR content related to representing local histories.

The research project is set out to continue collecting research data for another 6 weeks approximately based on the planned schedule. For the current paper, it serves as a progress report. Researchers are curious to find out whether participants from different academic backgrounds would show differences in attitude changes. For the next round of data collection and analysis, it could be compared and contrasted to see the differences academic backgrounds make and a framework would be proposed.

References

Barnes, S.: Understanding virtual reality in marketing: nature, implications and potential (2017). https://ssrn.com/abstract=2909100

Besoain, F., González-Ortega, J., Gallardo, I.: An evaluation of the effects of a virtual museum on users' attitudes towards cultural heritage. Appl. Sci. **12**, 1341 (2022). https://doi.org/10.3390/app12031341

Cruz-cunha, M.M., Miranda, I., Gonçalves, P.: Handbook of Research on ICTs for Human-Centered Healthcare and Social Care Services (2013)

Epstein, L.: Measuring attitude change, the right way. SurveyMonkey (n.d.). https://www.surveymonkey.com/curiosity/measuring-attitude-changes/

Erickson-Davis, C., et al.: The sense of presence: lessons from virtual reality. Relig. Brain Behav. **11**(3), 335–351 (2021)

Gibson, J.J.: The Senses Considered as Perceptual Systems. Houghton Mifflin (1966)

Gibbons, S.: Journey mapping 101 (2018). https://www.nngroup.com/articles/journey-mapping-101/

Levin, R.: The Power of Persuasion: How We're Bought and Sold. Wiley, Hoboken, NJ (2003)

Li, H., Daugherty, T., Biocca, F.: Characteristics of virtual experience in electronic commerce: a protocol analysis. J. Interact. Mark. **15**(3), 13 (2001)

Limniou, M., Roberts, D., Papadopoulos, N.: Full immersive virtual environment CAVE in chemistry education. Comput. Educ. **51**, 584–593 (2008)

Lo, W.H., Cheng, K.L.B.: Does virtual reality attract visitors? The mediating effect of presence on consumer response in virtual reality tourism advertising. Inf. Technol. Tour. **22**(4), 537–562 (2020). https://doi.org/10.1007/s40558-020-00190-2

Mathur, D.C.: Naturalistic Philosophics of Experience. Warren H. Green Inc., St. Louis, MO (1971)

McLeod, S.A.: Attitude measurement. Simply Psychology, 24 October 2018. https://www.simplypsychology.org/attitude-measurement.html

Morris, C.: Virtual reality and the new sales experience. Campaign, 22 April 2016. http://www.campaignlive.co.uk/article/virtual-reality-new-sales-experience/1392253

Norman, D.: The Psychology of Everyday Things. Basic Books, New York (1988)

Norman, D., Nielsen, J.: The definition of user experience (UX) (2021). https://www.nngroup.com/articles/definition-user-experience/

Product Design. User experience (2021). https://www.productplan.com/glossary/user-experience/

UNESCO: Concept of cultural heritage (2021). https://en.unesco.org/themes/information-preservation/digital-heritage/concept-digital-heritage

Usability.de: It is the user who decides on the success of your products (2022). https://www.usability.de/en/usability-user-experience.html

Virtual Reality Society: History of virtual reality (2017). https://www.vrs.org.uk/virtual-reality/history.html