

Cultural Learning in Virtual Heritage: An Overview

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Abstract. The aim of this paper is to present the overview of cultural learning in virtual heritage. In the past, works done on virtual heritage were mostly focused on replicating and visualizing heritage objects for presentation using virtual reality. However, accurate and realistic representation of heritage objects is not enough when it comes to cultural learning in virtual environment. This paper attempts to identify issues that impede cultural learning in virtual environment. In order to develop a virtual environment that is able to facilitate cultural learning, we argue that there is a need to understand what the end users really want to know when it comes to learning culture. We propose a thorough user study to be carried out at the beginning of virtual heritage project development and discuss the outline of our intended approach.

Keywords: Virtual Heritage, Virtual Environment, Cultural Learning, Visual Informatics.

1 Introduction

Cultural heritage, by UNESCO (1972) definition, refers to monuments, architectural structures and sites which are of outstanding universal value from the historical, aesthetic, ethnological and anthropological point of view. Virtual Heritage on the other hand refers to works that involved replicating or visualizing cultural heritage entity using virtual reality [1].

The initial motivation of Virtual Heritage research is to facilitate conservation, historical research, reproduction, representation and display of cultural evidence with the use of virtual reality. However, efforts have been made to shift the direction of virtual heritage research, from creating 3D models of heritage objects merely for display to creating a virtual environment that is able to facilitate the teaching and learning of culture [2]. It is suggested that the accumulation of 3D heritage objects in virtual environment is not supposed to be like a dead museum, but to enable users to feel and understand another culture [3].

This paper intends to identify the issues that impede cultural learning in virtual heritage and proposed an action that would help to improve present condition. The rest of this paper is organized according to the following: Section 2 briefly presents the background study on virtual heritage domain; Section 3 discusses current issues for cultural learning in virtual heritage; Section 4 outlines our proposed approaches and discusses the reasons behind the proposal, and Section 5 presents the conclusion of this paper.

2 Virtual Heritage

2.1 Domains of Virtual Heritage

Virtual Heritage is a term used to define works that deal with cultural heritage and virtual reality [1]. Rahaman and Tan define Virtual Heritage as the instance of cultural heritage properties within a technological domain [4]. Among all the definitions, we feel that the definition suggested by Toast and Champion is the most comprehensive in describing what Virtual Heritage should be: “...*the use of computer-based interactive technologies to record, preserve, or recreate artifacts, sites and actors of historic, artistic, religious, and cultural significance and to deliver the results openly to a global audience in such a way as to provide formative educational experiences through electronic manipulations of time and space.*” [5].

According to Addison [6], there are three major domains in Virtual Heritage as shown in Fig. 1.

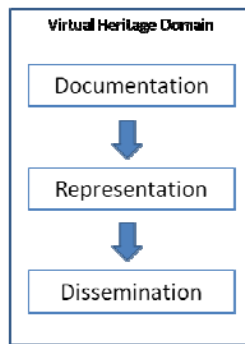


Fig. 1. Virtual Heritage Domain

3D documentation involves gathering data, as accurately as possible, about cultural heritage object under study ranging from site investigation, measurement taking, sketching to epigraphy. There are many techniques available to capture the data for heritage objects. Among them are using 3D laser scanning, laser triangulation, topography, photogrammetry, empirical, stereophotogrammetry and structured light technique [7,8,9]. Each of these techniques requires certain devices and hardware to work with, and also suitable for different types of object and monument. Some of the data collected also comes from sources such as ancient map, photograph, period painting, and written document [10, 11].

3D Representation involves either the 3D replication of heritage object that still exists, or visualization of heritage object that has been badly damaged, lost or does not exist anymore. Research in this domain mostly focused on the technical aspect of heritage object digitization such as effective 3D modeling technique [12, 13], computational lighting, effective texturing, faster rendering and processing of raw data from 3D scanning.

3D dissemination of virtual heritage content refers to how the recreated 3D models being displayed to the users. In most of the projects, virtual reality is used as the

medium to present the 3D content to the users. Some of the researches in this domain focus on securing data validity and preserving its authenticity while transferring the 3D heritage content between computer networks, archive system for the 3D heritage content created [14], and content retrieval [15].

Table 1 presents a short list of the various type of virtual heritage project. As we can see from the table, the type of projects in virtual heritage varies, ranging from the reconstruction of architecture building to the simulation of intangible heritage.

Table 1. Type of Projects in Virtual Heritage

Project Type	Example
Reconstruction of Historical Building	19 th Century of Italian Theatre [16]
	Gassho-zukuri house [17]
Reconstruction of Historical monument, relic or object of cultural value	The Great Buddha Project [18]
	Anyang Xinyu Project [19]
Historical site based on archeological finding	DentroTrento Project [20]
	Roman Cologne Project [21]
Historical site based on existing ancient town	Ancient city of Hue, Vietnam [22]
Simulation of the intangible heritage	Royal Dance of Chu performed in Royal Palace of Zhongshan [10]
	Namaz Prayer performed in the Sergius & Bacchus Mosque [23]

2.2 Research in Cultural Learning

From literature review, we observe that there are five (5) important research areas when it comes to cultural learning in virtual heritage, as summarized by Fig. 2. The five (5) research areas are:

- Navigation or wayfinding.
- Interpretation of cultural heritage content in virtual environment.
- Evaluation of virtual heritage project.
- Cultural Presence in virtual environment.
- Creation of meaningful content expressing cultural value in virtual environment.

Research in navigation or wayfinding within the virtual environment is what we regard as a ‘classic virtual reality problem’ inherited by virtual heritage. Lots of works have been done in this area (with regards to virtual reality) and many suggested solution to the problems can be applied to the design of virtual heritage environment.

Interpreting virtual heritage is another research area that focuses on the method of communicating cultural heritage content to the users to increase their awareness and enhance understanding of cultural heritage site [4]. There is also a need to define suitable evaluation method for virtual heritage environment since there has no satisfactory standard of methodology yet been developed [5].

Cultural presence is another interesting area in virtual heritage research [5] that focuses on defining the elements that constitute cultural presence in virtual heritage environment. The last research area is the study to create meaningful content expressing cultural value.

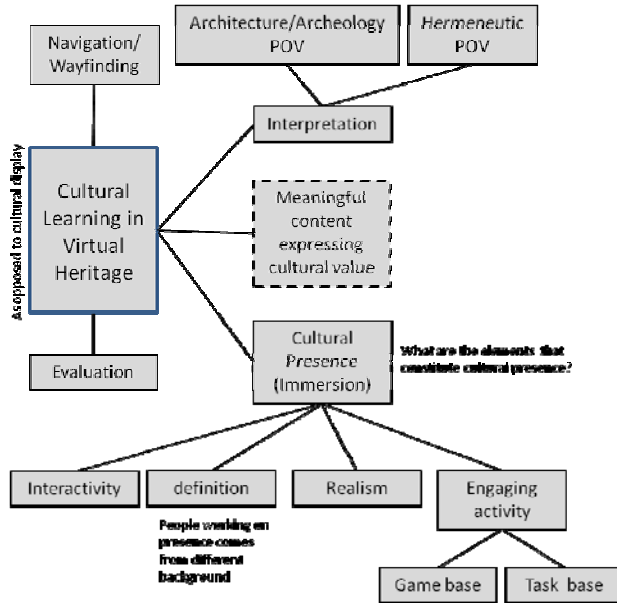


Fig. 2. Research areas for Cultural Learning in Virtual Heritage

3 Issues

Earlier projects in virtual heritage focused more on creating an accurate and realistic representation of heritage objects, which is a vital component for heritage preservation. However, the accumulation of those 3D heritage objects has become nothing more than becoming a collection merely for cultural display. While the main reason for virtual heritage project is to preserve the past by reconstructing or reproducing heritage object, the real goal in virtual heritage study should actually to understand past culture [3]. Designing virtual environment that encourage cultural learning still poses a great challenge for virtual heritage designer.

Some studies have been made to address this challenge. Laycock et al. developed an environment which is capable of displaying the evolution of particular heritage content over time [24]. Jacobson and Holden created an abstraction of Egyptian temple which has three level of interpretation suited for three different types of users [3]. Valtolina et al. introduced the concept of guided tour based on a predefined script and storyboard [16]. Papagiannakis et al. developed character-based virtual heritage, where real time character simulation is used to recreate ceremonies of past culture so that users can see how ceremonies were performed back then [23]. Champian also suggested the use of game and thematic activities to improve user engagement factors in virtual heritage [25], while Rahaman proposed a new heritage interpretation model that incorporates multiplicity viewpoint [4, 26].

Although many studies have been made in this area, we observe some issues that are still quite apparent and hindering the process of cultural learning in virtual environment. These issues are discussed in the following sections.

3.1 Cultural Heritage Learning

In order to understand what is required for cultural learning to take place, we need to understand the motivation for people to learn culture. Why do people go to the museum? Or why do people go to any historical places around the world? The motivation for people to learn culture is different from those learning formal academic subjects done in the classroom. They do not learn culture because they want to earn a degree or to get a passing grade. Most of the time, people learn culture for personal gain, with most of the time to satisfy their personal curiosity.

Learning culture should not be treated in similar fashion as when ones learn other subjects. Cultural Heritage is not a static concept but is defined by the society in question [27]. The meaning of heritage evolves and is updated by subsequent generations [4]. A study conducted by Wedgwood [28] showed that cultural value is not only perceived by what ones can see, but also by what ones retained in the memory (i.e. what they remember about the past).

The aim of cultural learning should be emphasized for historical and cultural awareness, directed to informal learning instead of mentally challenged. Unfortunately, many virtual heritage projects have taken the approach that is more towards pedagogical in nature. The design of the virtual environment is treated like designing a courseware or teaching plan, while the 'learning part' is evaluated as if someone is taking an exam – through memory recall. Example of memory recall are the use of Multiple Choice Question (MCQ) to gauge users understanding about the 'culture' through their visit to the virtual environment, or puzzle game where users need to rearrange the jigsaw puzzle until it forms the correct image. More serious games include finding the answer to the clue given by a game master in order to proceed to the next level, where the answers to the clues is embedded within the environment or even more, from external resource such as books or the internet.

3.2 Content Development Approach

We observed that some virtual heritage projects were initially carried out for preservation purpose. It is only when the recreation of the past has been completed that the developers start to think how the 3D environment could be used for cultural learning. As the result of this approach, users are left out from the development cycle. They only function as the *consumer* of the product, but not part of the development process.

Hence there is an issue that the existing virtual heritage projects are still not able to provide for cultural learning. One of the suggested reasons for this is that the users do not feel as if they are connected to the past. It is recommended that in order for the users to feel the past, the virtual environment should:

- look realistic,
- have engaging activities, and
- utilizes multi-sensory interaction (e.g. visual, haptic, audio).

Could it be possible the reason that the users could not feel connected to the past is because there is not much information for them to comprehend? Or the kind of information that they are looking for is not provided? The analogy of this assumption

is like having someone looking for information over the web. By visiting an exciting looking website but with no relevant information or with not much information will make the users leave feeling that his search is unfulfilled, not matter how interesting the website is constructed.

The same thing goes with the development of virtual heritage project. At the moment, the decision on what the users *should see and know* is based on expert assumption (i.e. archeologist, historian and 3D designer). From the literature review, almost none of the papers actually discussed having asking the actual users of the system (museum visitors or general public interested in ancient history) what they really want to know when it comes to cultural learning. Most works carried out mainly based on *user survey of a completed project*. To our knowledge, no proper user study has been made *prior* to project commencement.

There is however, one interesting work that includes users as part of project development. Rahaman et al. [26, 29] proposed a new non-linear interpretive framework that incorporates multiplicity of viewpoint. An online platform was developed to allow multiple users to share their experience and memories of a recreated historical site. Although users are included as part of the process, the users only get to feed their interpretative view of the historical site only AFTER the historical site has been reconstructed (in this case, it is the 3D view of Sompur Mahavihara, in Bangladesh). This approach is quite different from what we would like to propose where users' view are taken into account at the very beginning of the project.

3.3 Every Culture Is Unique

Since cultural heritage is defined by the society in question, it is important for us to know how that society perceives its own culture. Generalization that every culture is perceived as the same is no longer appropriate here. There are aspects that seem to be important to one culture but it is not to another. Vecco [27] highlighted that western philosophical approach regards '*conservation manifests itself in the preservation of the historic monument*', while the oriental '*tries to use the monuments to preserve the very spirit they present*'. For example, to some culture, conserving heritage means preserving the very remains of the architecture, while to some other, preserving the knowledge and technique link to the creation of the architecture is more important than preserving the architecture itself.

4 Proposed Approach

From the issues discussed above and from the observation made from literature review, we conclude that there is a need for proper user study being carried out for virtual heritage project. In order to develop a virtual heritage project that facilitates cultural learning, we believe that users should not be treated merely as the consumer of the product but as the shareholder of the project development. Their view should be taken into account at the very early stage of any virtual heritage project development. Therefore, we proposed a comprehensive user study to be included as part of the process in virtual heritage project development.

4.1 User Study

The objective of this study is to understand how cultural elements are seen by the users. Our approach is based on the assumption that different users want to know different things when it comes to learning culture, based on their individual interest, prior knowledge and their association with the culture. Hence, in order to determine *what kind of information should be incorporated in the virtual environment*, it is important for us to capture everyone’s view on what they perceive and expect a culture should be made of. In order for us to do that, we would like to identify (as shown by Fig. 3):

1. What kind of information that the end users want to know when it comes to cultural heritage learning?
2. How the society perceives a particular culture?

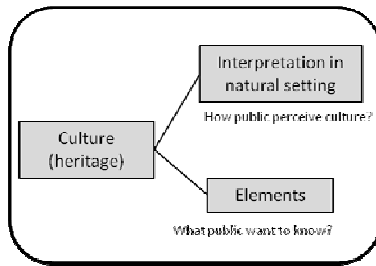


Fig. 3. Culture and Heritage study from end user perspective

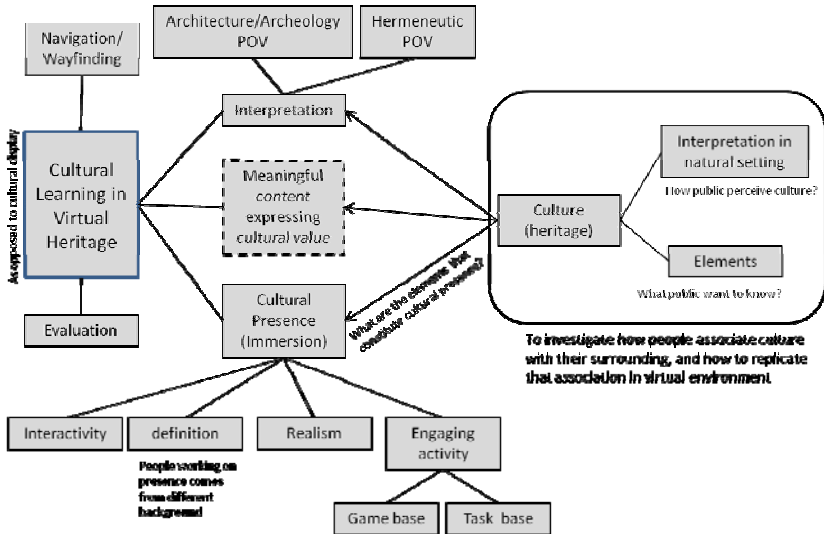


Fig. 4. User study in cultural learning in virtual heritage

Fig. 4 shows how our research fit into current research direction. It is our intention and hope that the result from this study to be used to complement the three important researches areas described in section 2.2: Identifying elements of cultural presence, complementing existing heritage interpretation model and providing guideline for content creation.

For this study, we plan to conduct in depth interview. Interview is chosen as the data gathering method because it gives us the opportunity to probe for more detail and specific answer from the respondents.

Type of questions to be asked to the respondent will be based on the following objectives:

Objective 1: Finding out the respondent knowledge about ...

Objective 2: Finding out what the respondent would like to know more about...

Objective 3: Finding out the elements that the respondent thinks are important, if s/he wants to promote the culture to others.

Each of the questions asked will be based on a specific cultural heritage object, for example, architecture, monument or historical relic.

4.2 User Groups

We have identified 4 user groups as the respondents for this user study, as follows:

1. Expert: someone who have an in-depth knowledge about a particular culture.
2. Ethnic: the ethnic belongs to the culture under study.
3. Non Ethnic: people who live within the community long enough to understand the culture under study.
4. General Public: anybody picked at random.

As for our research, since *Budaya Melayu* or *Malay Culture* is chosen as our case study, the **expert** group will consists of those who have in-depth knowledge in Malay Culture, and also those who work in preserving the heritage with regards to Malay Culture (e.g. museum curator). The **ethnic** group will be the Malays (Bangsa Melayu). The **non ethnic** group will consist of any other races that have been living closely with the Malay community (in our case, we anticipated that the non ethnic group will mostly comes from the Chinese and the Indian races).

The **general public** group is a special group targeted to study people perception about learning another culture that they do not know anything about. In this study, the general public will be represented by two groups of user:

- People living outside Malaysia who have no prior knowledge about the Malay Culture, and
- Malaysian people, whom we will ask about another distant culture that we hope they never have heard of, for example, the Mayan Culture.

The reason why we need to gather data from these four different groups is because each of this group represents different set of user's needs and requirements, and data gathered from each group will complement each other. Expert view might provide guideline of what a particular culture should have. Even though experts have a deeper understanding and knowledge of a specific culture, they might dismiss anything that seems trivial as not important, and hence not including it in their answers. The ethnic

group will recount based on what they remember, what being told to them by their ancestor, and based on how they lived the culture themselves. The non-ethnic will give their answers based on what they assumed the culture has to be based on their observation, and the general users will give their answer based on the universal understanding of what constitute culture.

The finding from this user study will provide us an insight of cultural elements as seen by the users. Fig. 5 summarizes our proposed user study.

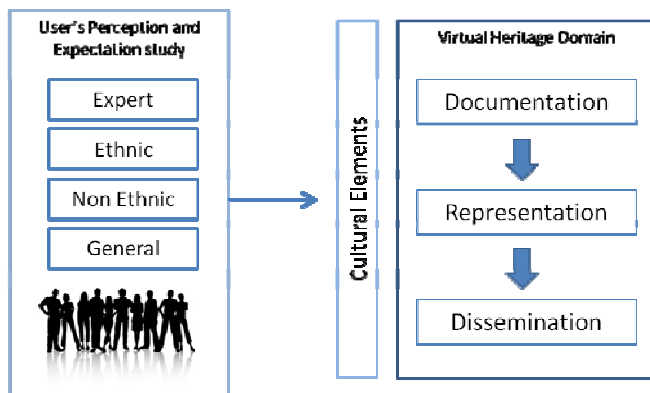


Fig. 5. Proposed user study for cultural learning in virtual heritage

5 Conclusion

In this paper, we have presented an overview of virtual heritage particularly in learning culture. Some issues and challenges have been discussed and the direction of the research has been laid out in a diagram mapping. We argue that in order to encourage cultural learning, we need to understand what the users really want to know when it comes to learning another culture or even understanding culture of their own. We have also discussed three issues that could impede cultural learning in virtual environment. We proposed for a proper user study to be included as part of virtual heritage development process. Our next plan is to carry out the user study as outlined in this paper and to develop a prototype of virtual environment based on the findings of the study.

References

1. Roussou, M.: Virtual Heritage: from the research lab to the broad public. In: Virtual Archeology, pp. 93–100 (2002)
2. Ott, M., Pozzi, F.: ICT and Cultural Heritage Education: Which Added Value? In: Lytras, M.D., Damiani, E., Tennyson, R.D. (eds.) WSKS 2008. LNCS (LNAI), vol. 5288, pp. 131–138. Springer, Heidelberg (2008)
3. Jacobsen, J., Holden, L.: Virtual Heritage: Living in the Past. *J. of the Society for Philosophy and Technology* 10(3) (2007)

4. Rahaman, H., Tan, B.K.: Interpreting Digital Heritage. In: 15th International Conference on Computer-Aided Architectural Design Research in Asia CAADRIA 2010, pp. 93–102 (2010)
5. Tost, L.P., Champion, E.: A Critical Examination of Presence Applied to Cultural Heritage. In: 10th Annual International Workshop on Presence, PRESENCE 2007 (2007)
6. Addison, A.C.: Emerging trends in virtual heritage. *Multimedia*, IEEE 7(2), 22–25 (2000)
7. Pavlidis, G., Koutsoudis, A., Arnaoutoglou, F., Tsioukas, V., Chamzas, C.: Methods for 3D digitization of Cultural Heritage. *Journal of Cultural Heritage* 8, 93–98 (2007)
8. Pieraccini, M., Gabriele, G., Carlo, A.: 3D digitizing of cultural heritage. *Journal of Cultural Heritage* 2(1), 63–70 (2001)
9. Cignoni, P., Roberto, S.: Sampled 3D models for CH applications: A viable and enabling new medium or just a technological exercise? *J. Comput. Cult. Herit.* 1(1), 1–23 (2008)
10. Cheng, Y., Peng, D., Sun, S.: Creating a Virtual Activity for the Intangible Culture Heritage. In: 16th International Conference on Artificial Reality and Telexistence–Workshops, ICAT 2006, pp. 636–641 (2006)
11. Yahedu, E.K.: Preserving cultural heritage through digital media. In: Yehuda, E.K., Kvan, T., Affleck, J. (eds.) *Hew Heritage: New Media and Cultural Heritage*, pp. 1–10. Routledge (2008)
12. Rafi, A., Salleh, A., Paul, A., Noraisah, S., Jun, Y., Hanif, R., Mahadzir, M.: Modeling optimization for real-time virtual heritage visualization content: A research on e- Warisan SENIBINA. In: International Symposium in Information Technology (ITSim), pp. 1–7 (2010)
13. Ibrahim, N., Azmi, K.A., Salleh, F.H.M., Yussof, S.: Cultural Heritage Preservation: 3D Modeling of Traditional Malay House using Hidden Surface Removal Approach. In: *Proceeding of International Conference on Software Engineering and Computer Systems, ICSECS 2009* (2009)
14. Koller, D., Frischer, B., Humphreys, G.: Research challenges for digital archives of 3D cultural heritage models. *Journal on Computing and Cultural Heritage (JOCCH)* 2(3) (2009)
15. Chen, C.-c., Wactlar, H.D., Wang, J.Z., Kiernan, K.: Digital imagery for significant cultural and historical materials. *International Journal on Digital Libraries* 5(4), 275–286 (2005)
16. Valtolina, S., Franzoni, S., Mazzoleni, P., Bertino, E.: Dissemination of Cultural Heritage Content through Virtual Reality and Multimedia Techniques: A Case Study. In: *Multimedia Modelling Conference (MMM 2005)*, pp. 214–221 (2005)
17. Hirayu, H., Ojika, T., Kijima, R.: Constructing the historic villages of Shirakawa-go in virtual reality. *Multimedia*, IEEE 7(2), 61–64 (2000)
18. Ikeuchi, K., Oishi, T., Takamatsu, J., Sagawa, R., Nakazawa, A., Kurazume, R., Nishino, K., Kamakura, M., Okamoto, Y.: The Great Buddha Project: Digitally Archiving, Restoring, and Analyzing Cultural Heritage Objects. *International Journal of Computer Vision* 75(1), 189–208 (2007)
19. Xinyu, D., Baoqing, G., Chuangming, S.: Virtual Exploration Application of Cultural Heritage for Anyang Yinxu. In: *Second Workshop on Digital Media and its Application in Museum & Heritages*, pp. 237–241 (2007)
20. Conti, G., Piffer, S., Girardi, G., De Amicis, R., Ucelli, G.: DentroTrento: a virtual walk across history. In: *Proceedings of the Working Conference on Advanced Visual Interfaces*, pp. 318–321 (2006)

21. Trapp, M., Semmo, A., Pokorski, R., Herrmann, C.-D., Döllner, J., Eichhorn, M., Heinzlmann, M.: Communication of Digital Cultural Heritage in Public Spaces by the Example of Roman Cologne. In: Ioannides, M., Fellner, D., Georgopoulos, A., Hadjimitsis, D.G. (eds.) EuroMed 2010. LNCS, vol. 6436, pp. 262–276. Springer, Heidelberg (2010)
22. Pugnaroni, F., Issini, G., Minh, N.D.: 3D City Model of the Ancient Hue, Vietnam; Reconstruction of the City Environment for the Cultural Heritage Identity Conservation. In: Wyeld, T.G., Kenderdine, S., Docherty, M. (eds.) VSMM 2007. LNCS, vol. 4820, pp. 13–23. Springer, Heidelberg (2008)
23. Papagiannakis, G., Foni, A., Magnenat-Thalmann, N.: Real-Time recreated ceremonies in VR restituted cultural heritage sites. In: CIPA XIXth International Symposium, pp. 235–240 (2003)
24. Laycock, R.G., Drinkwater, D., Day, A.M.: Exploring cultural heritage sites through space and time. *Journal on Computing and Cultural Heritage (JOCCH)* 1(2) (2008)
25. Champion, E.: Heritage Role Playing - History as an Interactive Digital Game. In: Interactive Entertainment Workshop, pp. 47–53 (2004)
26. Rahaman, H.: Interpreting Digital Heritage: Interaction, Dialogue and Multiple Perspectives of the Past. In: SMARTdoc 2010: Heritage Recording and Information Management in the Digital Age, Pennsylvania (2010)
27. Vecco, M.: A definition of cultural heritage: From the tangible to the intangible. *Journal of Cultural Heritage* 11(3), 321–324 (2010)
28. Wedgwood, T.: History in Two Dimensions or Three? Working Class Responses to History. *International Journal of Heritage Studies* 15(4), 277–297 (2009)
29. Rahaman, H., Rashid, M.M., Rahman, M.: Heritage Interpretation – Collective Reconstruction of Sompur Mahavihara, Bangladesh. In: 16th International Conference on Virtual Systems and Multimedia (VSMM), pp. 163–170 (2010)