Interaction, Agency and Artefacts

Erik CHAMPION, Bharat DAVE and Ian BISHOP
Faculty of Architecture, Building and Planning, The University of Melbourne

Abstract: This paper argues (i) that understanding of a place (especially in heritage environments) requires a level of cultural engagement and (ii) that virtual environments, in their typical current form, fail to provide such engagement.

A proposed solution to the issue of cultural presence is to apply the interactive mechanisms commonly used in computer games (social agents, levels of interaction constraint, and task-based manipulation of artefacts) to virtual heritage environments. The hypothesis is that the resulting environment will allow for greater engagement and a more culturally immersive learning environment.

Virtual environments also often lack techniques for evaluating the extent to which their design goals are achieved. A proposed secondary outcome is that designers and researchers of virtual environment can also use the above interactive mechanisms for the evaluation of user engagement without simultaneously interrupting the user's feeling of engagement.

1   INTRODUCTION

Many critics have argued that virtual environments have yet to overcome a large number of impediments to their widespread dissemination, distribution, and use. Two fundamental restrictions are a lack of engagement and a lack of presence (as in, a feeling of "being there," of being transported to an actual place).

Virtual environments are often criticised for evoking 'cyberspace' but not 'place'. In other words they lack the richness of the associations and encounters that occur in real space (Benedikt 1991; Johnson 1997; Coyne 1999). Without having to resort to an essentialist definition of architecture, we could also argue that virtual environments with an architectural setting often lack shelter, inscription, a perceived use, and the 'framing' of ceremonial functions.

It may be possible to evoke a sense of shelter through 'dynamic environments' and task related avatar 'health'. We could allow for inscription and personalisation in a virtual environment by having the facility to record user transactions or annotations in either the artefacts of a virtual environment or the environment itself.

We can further 'frame' vistas of virtual environments by creating role-playing tasks where effectiveness in solving tasks is based on the position (and thus view) of the users in the role of virtual actors. This ceremonial (and, in some cases, theatrical) staging is prevalent in such architectural types as the proscenium arch, the balcony, the lookout, the entranceway and the portico. These architectural elements are related to the relative positioning of social actors; such social hierarchies may help embody a notion of a specific cultural environment.

We can attempt to rejoin architectural form with the external environment and a notion of cultural presence (the feeling of place via association, inhabitation, and of shelter); through the use of 'dynamic environments' (which offer affordances and constraints), inscription-capable and contextually appropriate artefacts, personalisation, goal direction, and social agency.

The research described in this paper outlines a specific case study of immediate use to virtual heritage designers. The evaluation methods may also be applied generically to virtual environments and to determining whether potential users will experience a notion of 'cultural presence' and of 'place'.

2 VIRTUAL HERITAGE

We propose that the broad objectives of virtual heritage environments are to impart the significance of a place, and its importance to local cultural values and perspectives. Two major related issues would then be how do we best convey a sense of place, and a sense of cultural presence in the experiencing of virtual environments. Yet surprisingly, they are often not discussed.

The most accurate, realistic and powerful virtual heritage environments do not necessarily produce a corresponding increase in user enjoyment (Mosaker 2000). Such research indicates that lack of engagement with cultural perspectives of the past may have been due to a lack of meaningful content rather than a lack of realism.

Kalay and Marx articulated eight specific notions of place that are missing in virtual environments (Kalay and Marx 2001). However, we argued that these features were important but not comprehensive (Champion and Dave 2002). The Kalay-Marx criteria, being based on modes of reality, do not address virtual environments that offer interpretations of past and present cultures. We instead offered a categorisation of virtual environments (derived from Relph's tripartite notion of place, (Relph 1986)) into the observational (visual), the activity focused (such as games), and the hermeneutic (capable of transmitting cultural perspectives between users, and between past and present inhabitants).

3 DESIGN APPROACH

3.1 Graduation of Place and Presence

Some researchers have defined presence as being in a place that has some present meaning to the viewer (Slater 1999). We employ the term *cultural presence* to identify the feeling in a virtual environment that people with a different cultural perspective occupy the place. We offer this as an addition to the Kalay and Marx classification of virtual environments.

For hermeneutic environments (those requiring cultural associations), we suggest that some notion of social agency (some notion of inhabitation or visitation by others) is required. This may range from voices or ghosts from the pasts, indication of past or present use, some means of inscription be it writing, scrawl or art, to avatars driven by the self, by others, or by a database-driven computer script.

The other major element required would be task-based artefacts (objects that are in some way contextually appropriate to goal-directed behaviour). Dynamic environmental elements (wind, rain, and navigational obstacles) may help evoke the intentions of the environmental designers. Personalisation (either of artefacts, personal record of the journey, or of the wider environment) is also required for a comprehensively participatory notion of social agency.

3.2 Design Elements

We propose to apply the following interactive features (that are common to games) to virtual heritage environments: dynamic environments, artefact-based interaction, avatars and scripted agency, and personalisation.

Dynamic environments affect how people move through virtual environments. Paths, changing light and obstacles aid or impede navigation. Less skilful navigation will adversely affect metaphorical 'health points' (in computer games participants have a certain amount of 'health' points that are adversely or positively affected by their travels and actions in the environment). The dangers and opportunities of the environment will be contextually related to the local cultural perspective.

Social interaction is a powerful mechanism for creating a sense of engagement. However, without artefacts and a shared understanding of tasks, the presence of others only allows social behaviour but not cultural exchange to take place (Schiffer and Miller 1999). Cultural behaviour in an environment without modifiable artefacts is extremely limited, as a great deal of cultural transmission occurs through "people-artefact interactions".

In virtual heritage environments participants could collect and trade artefacts in order to improve the participant's social role. Some artefacts can act as portals to previous times. By relating the use of artefacts to tasks and to setting, it is hoped that the user will understand the original cultural significance of the object. Travellers

can view the effects of their approach to tasks via the artefacts at their disposal and evaluators can record the rate of completion of tasks.

Designers of real and virtual environments need to build on relationships between patterns of inhabitation and usage of spatial artefacts, exemplified by such items as furnishings (Rapoport 1982; Beckmann 1998).

However, artefacts alone constitute only a fragment of the cultural process. To fully understand a cultural environment, one requires both artefacts, and an idea of the task that motivates their use. Computer-scripted agents that users can talk to, gain information from, and that remember them, will give the user information on where artefacts are, and how they can be best be used to solve tasks.

4 PROTOTYPE CONTEXT: PALENQUE, MEXICO

In order to evaluate the various interactive elements as described above, we are currently creating a virtual reconstruction of the Mayan city Palenque, in Mexico.

Palenque was most prominent during the Classical period of Mayan civilization, and three of its temples hold three tablets to three different gods, as recorded in the Popol Vuh, a Mayan story of creation. Palenque was the site where archaeologists made a major advance in understanding the complex Mayan written language, (Schele and Mathews 1998; Foster 2002).

The condition of inscriptions and setting of Palenque, with its mountainous backdrop, wide-span temples, and collection of tablets, tombs and rivers, have made it a popular tourist destination. The early morning fog can be so strong that some archaeologists believe Palenque was created to resemble the Mayan mythical origin of the current world, magical mountains that took form out of the primeval sea.

Mayan tombs also had pipes constructed that linked the dead ruler in his or her tomb to the living world above. The Mayans believed that the rulers had magical umbilical cords that connected them to the gods in the sky, and constructed their buildings so that certain events - such as the equinox - were framed by the outline of specific buildings. For example, from the Temple of the Cross view east twice a year the constellation appears similar to the Mayan depiction of the 'Flowering Tree' that connects sky, the earth, gods, and their ancestors.

As the Palenque rulers suffered a break in paternal lineage, their temples emphasized the rulers' right to lead by recording creation myths of the gods and linking them to divine properties of the rulers. The three tablets of the major temples, plus the sarcophagus found in the tomb of Hanab Pakal the Great, in the Temple of Inscriptions, all stress the relation of heavenly bodies to the ascension of Kings, and to the importance of maize.

As with other Mayan cities, Palenque's buildings were consecrated with human sacrifice (usually war captives), the ball court commemorated both trade and sacrifice, and slaves were found in the burial chambers of the kings. Even today, Mayan Indians consecrate new dwellings by burying sacred artefacts. The Mayans

believed everything had a life force, and that this force accumulates. Hence they built new tombs over older ones; the older and more accumulated the life force, the more powerful they believed it to be.

The Mayans believed in three levels of existence, the sky, the earth and the underworld. Rites involving smoke, sacrificial blood, and offerings of food and artefacts were to thank the Gods for continual existence. Some artefacts were seen as magical aids that could help the spirits of the ruling class travel through portals to the other planes of existence. 'Cenotes' (wells) and rivers were also symbolic links to the underworld, and many items of worship have been found there.

5   EVALUATION OF DESIGN PROTOTYPE

Academic virtual environment evaluation usually involves requesting test users to fill out questionnaires indicating a level of presence against criteria such as a feeling of physical space, negative feelings, social agency, naturalism or realism, and engagement. However, the use of questionnaires is problematic. As noted by Slater, (1999), the best time to ask people to measure a sense of presence is the worst time as well.

To measure a sense of engagement we need evaluation devices but we cannot stop people who are in a virtual environment to evaluate their feelings of engagement, as that will affect their sense of engagement. Further, evaluating people after their experience of the virtual environment may be prone to error, as it relies on memory and on their noticing and communicating exactly what made their sense of engagement seem powerful, weak or non-existent.

Game designers can gather evaluation data by indirect interactive mechanisms (chat logs, health points, completion of tasks as shown on a map and the final state of the inventory of artefacts). Such data can be compared against results from a pre and post-experience user evaluation questionnaire to determine if we can gain user feedback on cultural immersion in virtual heritage environments without their enjoyment being curtailed, and without them being forced to participate in laboratory interviews or complete survey forms.

We could also evaluate virtual environments through specific interactive techniques, such as those demonstrated in specialist Virtual Reality environments such as four and six wall caves. However, this 'testbed' technique does not help us determine which type of virtual environment content is most engaging or useful to a potential visitor. Nor does it aid us in determining which interactive elements most aid hermeneutic worlds, as the very notion of 'world' implies a complex matrix of interactive elements and social agency.

5.1   Design of Evaluation Experiments

In contrast to past evaluations of virtual heritage environments, we intend to initially

conduct cognitive walkthroughs of a reconstruction of Palenque, with experts from web usability, virtual reality, and archaeology backgrounds. After they have suggested improvements to the content, interface, and navigation, we will conduct three separate sessions of user testing. The users will be from the fields of multimedia, architecture, archaeology, and tourism.

The users' age, gender, PC literacy, knowledge of the site and culture, travel experience, exposure to computer games, and three-dimensional design experience, will all be recorded. They will be split into two groups, and over three sessions will undergo three different 'world-modes' of interaction with the environment.

5.1.1   World-Mode 1 - Exploration and Personalisation

In the first test there will be 32 people, split into 2 subgroups. Both groups have the simple task of exploring the site. There is no narrative as such. Interaction consists of clicking on elements to see and hear and audio-visual information on the inscriptions, stelae, rivers, buildings, animals and site.

When viewing the information, there will be an associated timeline so that people can navigate forward and backward to view related information. The further back in time, the outline of the information will be blurrier. For half the users, their footsteps will also be left on the environment so they can see where they have been.

At the end of the evaluation, users will be asked to indicate their feeling of spatial presence, of cultural presence (how much they felt they were interacting with foreign beliefs), to recall certain facts, and to retrace their steps via a map.

5.1.2   World-Mode 2 - Actor and Agent Dialogue

In the second test there will be the same 32 people, again (randomly) split into 2 subgroups. Both groups have the task of asking agents that pop up when users draw near, how to advance to the next stage of the adventure.

The narrative is backwards, users start in a panorama or simple model of part of Tenochtitlan (the last great Mesoamerican city, of the Aztecs, on which Mexico City now sits). They ask a guide for directions; the (computer scripted) guide tells them where to find artefacts that will act as portals to allow them to travel back in time.

There is no narrative as such; users follow the direction of the guides. Interaction consists of clicking on elements to see and hear visual and perhaps audio information on the inscriptions, stelae, rivers, buildings, animals and site. When viewing the information, there will be an associated timeline so that people can navigate forward and backward to view related information. There will be 4 guides, a Mayan descendent, and three Palenque rulers (of the Pakal lineage).

The users will be asked to find certain emblems on the following inscriptions in order to go back in time: the three tablets from The Temple of the Cross, The Temple of the Foliated Cross, and The Temple of the Sun. If they read these successfully they are taken to the Temple of Inscriptions, where they must first find

and select the right emblems. On doing so, a slab in the temple opens and they can descend the stairs to Pakal's tomb. There they are asked to find the World Tree, Sun and Day. On doing so, they are taken to short extracts from the Mayan Creation Myth as described in the Popol Vuh stories.

As users go back in time, more recent buildings will disappear, and the fog will intensify. By the time of the Primal Creation, the terrain will disappear, and there will only be fog and water (as in the Mayan myths). All users will have empty Mayan books that will have places appear as they visit them. Half the users can leave messages for each other to read via the agents who can recall individual attributes and conversations.

Users will be asked when they have completed the session, similar questions to the first session, and will be asked to compare the world-modes in terms of how engaging, memorable and informative they were.

5.1.3   World-Mode 3- Multi-user Social Transactions

In the third test there will be 32 people, split into 4 subgroups of 8 people each. Each subgroup includes a ruler, 2 priests, a farmer, 3 enemy priests, and an enemy ruler.

Before Hanab Pakal, Calakmul briefly overtook Palenque. Pakal's second son, Kan Xul, of Palenque also attacked Tonina in order to gain captives for sacrificing to consecrate Palenque's new Great Palace. But Tonina counter-attacked and controlled Palenque. This environment will re-enact (without bloodshed) such conflict. The goal is to gain points of life force – k'uluh (the Mayans believed everything had psychic energy value) and to lower the points of the enemy.

Half of the group will have their victories recorded in tablets, and can choose the Mayan equivalent of their names. Users will be asked when they have completed the session, similar questions to the first and second sessions. They will also be asked to compare the world-modes in terms of how engaging, memorable and informative they found them to be.

Figure 1 Reconstruction of the Temple of Inscriptions, Palenque

255

5.2 Recording Techniques

Table 1 Interaction Patterns Associated with 'World-Modes'

Test	Goal	Task	Agency	Artefacts	Progress
1a	Explore	Explore site	Personal avatar	Clickable objects	Fog
1b	Explore (with footprints)	Explore site.	Personal avatar	Footprints will be displayed.	Fog, footprint
2a	Question-query agents	Reverse time travel via glyphs	Personal avatar	Zoom-able tablets.	Book, dialogue
2b	Question and messages	Leave messages for future users	Personal avatar	Messages can be displayed.	Agent recalls messages
3a	Multi-user	Collect artefacts - increase points	Personal avatar	Artefacts	Inventory points
3b	Multi-user and tablet	Can record on tablets	Personal avatar	Can add artefact icons to tablets	Tablet of victory
	Task (external)	Task-subtask (internal)	Agency (self, guide, other)	Multimedia, books, tablets	Footprints, messages, annotation

In the above table, 'Goal' is the generic aim of understanding the environment. 'Agency' is the type of social agency (self, agents, other users). 'Artefact' indicates the interaction available with objects. 'Progress' refers to how the user knows they are doing, what they have done, what is still unexplored. This may also act as feedback, which provides task performance data for the evaluators.

For the first world-mode (group 1a and 1b), a database will record task completion, artefacts chosen, route taken, and the time taken between artefact selections. However, only the subgroup 1b will see their footprints in the environment.

For the second world-mode, (group 2a and 2b), a database will record the questions asked by the users, the level of understanding by the computer-scripted agents, the time taken to complete the task, and the route taken. The database will populate the book users carry when they complete each task and will also record messages left with agents by subgroup 2b.

For the third world-mode, (group 3a and 3b), the database will record routes taken, individual and team accumulation and placement of artefacts, and the overall health points per round. It will also store the annotations of the subgroup (3b).

5.3   Scope and Validity of Results

As each group will undergo three sessions of experiencing the environment, they may become so knowledgeable about the content that their engagement wavers. Hence as a second stage of testing, we intend to have a control group of forty-eight people. Each subgroup will undertake one world-mode only. From results gathered from the first three sessions we should be able to determine user preferences, memory recall and relative task performance for social agency, artefacts, progress indicators, and tasks. Hence we should be able to guess the 'engagement' results of the control group.

6   CONCLUSION

Theoretically, we wish to elucidate a framework for designing and evaluating virtual environments in terms of interactive features. In creating this categorisation we hope to be able to turn descriptive hermeneutic theory (with its notion of cultural presence and horizons of understanding) into a prescriptive practical craft for designing virtual environments via useful and applicable categories of classification.

In terms of method we hope to demonstrate that not only can we learn from game design techniques to make more engaging worlds, but also that we can use the indirect monitoring methods of games for feedback. Designers cannot always justify expensive and drawn out questionnaires and lab experiments on user engagement. Could indirect methods such as game-style task performance give results that correspond to data from physiological monitoring of users, and to data from subjective responses via questionnaires?

Practically, it may be that inventories, tasks, dynamic environments, or computer-scripted agents are not always ideal features, but we may be able to provide a framework for evaluating when they are useful.

Specifically, by gaining useful user and expert feedback we can help 'virtual archaeologists' and historians in designing past worlds with underlying cultural and not just material content. Which elements for a specific type of audience are necessary or desirable to gain a feeling of inhabitation, of architectonic change, and of environmental interaction? Can we create both engaging and informative environments?

ACKNOWLEDGEMENTS

REFERENCES

Beckmann, J. 1998. ***The Virtual Dimension: Architecture, Representation, and Crash Culture.*** New York: Architectural Press.

Benedikt, M. 1991. *Cyberspace: First Steps*. Cambridge, MA: MIT Press.

Champion, E., and B. Dave. 2002. Where is This Place? *Proceedings of ACADIA 2002: Thresholds Between Physical and Virtual*, ed. Proctor, G., 87-97. CA: California State Polytechnic University, Pomona.

Coyne, R. 1999. *Technoromanticism: Digital Narrative, Holism, and the Romance of the Real.* Cambridge Massachusetts USA: The MIT Press.

Foster, L.V. 2002. *Handbook to Life in the Ancient Maya World.* New York: Facts on File, Inc.

Johnson, S. 1997. *Interface Culture: How New Technology Transforms the Way We Think and Communicate*. San Francisco: HarperEdge.

Kalay, Y. and J. Marx. 2001. Architecture and the Internet: Designing Places in Cyberspace. *Proceedings of ACADIA 2001: Reinventing the Discourse,* ed. J. Wassim, 230-240. Buffalo, NY: ACADIA.

Mosaker, L. 2000. Visualizing Historical Knowledge Using VR technology. *Digital Creativity S&Z,* 12:1.

Rapoport, R. 1982. ***The Meaning of the Built Environment: a Nonverbal Communication Approach.*** Beverly Hills: Sage Publications.

Relph, E.C. 1986. *Place and Placelessness*. London: Pion Ltd.

Schank, R.C. 1990. *Tell me a Story: a New Look at Real and Artificial Memory*. New York: Scribner.

Schele, L. and P. Mathews. 1998. *The Code of Kings*. New York: Scribner.

Schiffer, M.B. and A.R. Miller. 1999. *The Material Life of Human Beings: Artefacts, Behaviour and Communication*. London: Routledge.

Slater, M. 1999. Measuring Presence: A Response to the Witmer and Singer Presence Questionnaire. *Presence*, vol.8, no.5, 560-565.