Interactive Cultural Experiences using Virtual Identities

Mardé Greeff [*] *and Vali Lalioti* [#]

[*] CSIR: *i*comtek, Scientia, Pretoria, South Africa
E-mail: mgreef@csir.co.za
[#] University of Pretoria, Department of Computer Science, Pretoria, South Africa
E-mail: vlalioti@cs.up.ac.za

ABSTRACT
People create meaning through stories. Stories are an integral part of every culture. Interactive stories enable the user to actively explore the story world. Museums traditionally provide an area to display artefacts and information about them to the public and they act as centres of knowledge about a particular subject. Museums perform an important role, but they do have limitations. We introduce the concept of using virtual identities for interactive storytelling in virtual environments to create interactive cultural experiences. We discuss how our approach can overcome some of the limitations and problems that museums face. We present how we used the AVANGO framework to develop an interactive storytelling tool for our approach. We also report on the results that we have achieved when we tested the approach with a Cultural Heritage application.

KEYWORDS: interactive storytelling, virtual environments, virtual identities, authoring tools, cultural experiences, museums

INTRODUCTION

People create meaning through narratives or stories. Every culture has stories that are passed along from generation to generation. Culture influences our perspectives, values and behaviour.

The story metaphor has been used in Multimedia and Virtual Environments to create interactive stories [2][3]. Interactive stories enable users to interactively explore the story world and to be actively involved in the outcome of the story. Virtual environments are much richer in terms of freedom of navigation and ease of interaction. Projection-based systems in particular, don't bind the user to a predefined path and enables the user to have a hands-on experience through immersion and interaction with the virtual world.

Our approach for authoring interactive stories in virtual cultural environments allows the creation of several virtual identities, through whose eyes the user perceives the virtual world. Each identity is empowered with knowledge about itself and its perception about and embodiment in the virtual world. This approach allows free interaction and navigation that is appropriate for the specific virtual identity in the culture that is being experienced. This enables the user to experience the culture from many different angles and to get a true reflection and cultural experience.

BACKGROUND

Museums are institutions that have traditionally performed two major roles:

They provide an area for displaying artefacts and information about them to the general public, by putting the artefacts into glass cases with accompanying information panels.

They act as centres for knowledge about a particular subject area – keepers of collections and research staff build up information about these artefacts, such as when and where they were recovered from.

Museums carry out a range of activities and produce a variety of resources whose purpose is to make visitors aware of what is available in the museum, to guide visitors physically through the collections in numerous ways and to increase their understanding and enjoyment of these collections.

Museums are about cultural artefacts that are chosen and displayed in such a way that they incorporate the narratives about history, nature, technology, culture and science. One of the most important visible statements that museums make is the selection, labelling and physical arrangement of individual items and whole collections.

The traditional museum guides provide the visitors with many interesting information about the different cultural artefacts and help the visitors to gain a better understanding of the cultural value of these artefacts. They provide visitors with a personal experience where they are free to ask questions to gain more insight into the different exhibitions. However, they do have a few limitations, such as:

- The random composition and heterogeneous nature of the groups that they deal with
- The limited duration of the tours or other educational programs for which they are responsible
- Frequent repetition of the commentary can lead to mechanical and boring representation
- Physical restrictions of access to museum collections – only a selected number of items can be included in the tour due to time restrictions

Many applications, such as culture, are dynamic and therefore static representations are not efficient for portraying them. Virtual environments can solve this problem by allowing people to experience the virtual world interactively and dynamically. The combination of interaction, immersion and the digital computer makes virtual environments an exciting medium for cultural productions. Mitchell said that virtual environments can play a crucial part in museum work [7].

A virtual tour is a tour of a museum that is represented in a virtual environment. Virtual tours can be either prearranged (the virtual equivalent of the tours that are conducted by a tour guide in a real museum) or individualised and tailored to particular needs and interests, which is rarely possible in a real museum.

The prearranged tours are designed to respond to recognized general interests and to reflect the museum's own viewpoint of what is important, most distinctive and valuable in its collections. They are inflexible, since once a visitor has joined the tour; s/he has to follow it through. This option can be useful for special groups such as school children where they need to view what the teacher specifies. The tours can be made more flexible by allowing a

visitor to depart from what is prescribed at any point to follow a particular idea or interest and then to return to the group.

A virtual tour lacks the personal touch of a traditional guide. The visitors don't experience the personal contact that traditional tours with a guide provide. However, a virtual tour does have advantages, such as:

- The restricted or transitory access to collections can be overcome
- Visitors are not limited by opening hours of the museum to view the artefacts
- Artefacts can be inspected at a level of detail that are usually not possible in a real museum where the artefacts are in locked cabinets, have to be looked at from a distance or are arranged in such a way that only one view is possible
- The visitor can interact with the artefacts without fear of breakage or loss
- The artefacts that are displayed on a particular tour are not constrained to a specific physical location. Therefore a tour can be constructed that consists out of artefacts that are ordered by a logical arrangement or that reflect a special interest, but are located in many different rooms in the real museum
- Abstract data can be transformed into a virtual artefact
- Artefacts from different museums can be combined in tours, assuming that the problems of metadata, permissions and copyright are resolved
- Special exhibitions and their tours can be preserved in the virtual environment even after their constituent artefacts are dispersed to their regular locations in different galleries of the museum, to storage or back to other museums or lenders

Methods used by museums

Museums worldwide are becoming aware of the power of using virtual environments to interpret and demonstrate cultural heritage. Some of the VE applications are the Tomb of Menna [7], Tomb of Menna for educational purposes [7], Kahun project [7] and the ancient city of Miletus [4].

The purpose of the Tomb of Menna project was to investigate the process of creating a virtual artefact from existing information resources and to provide alternative ways for visitors to access the virtual artefact. The Tomb of Menna is located at Sheikh Abd el-Quarna, the most central area of the Theban necropolis. This project was aimed at the general user and did not aim to meet specific educational outcomes. It was primarily a means of displaying information. However, it did not allow the user any real interaction aside from the ability to walk through the tomb and click for more information.

The decision was made to focus on the educational potential of the Tomb of Menna and in particular its application to children of primary schools. The original version of the Tomb of Menna provided a limited range of interaction. Therefore, three interactive tasks were incorporated into the walkthrough experience. However, the children experienced some problems interacting with the system:

- The children had to be too precise

in lining the symbols up in the hieroglyph writing task – a more sensitive mechanism for having symbols snap into place would have been useful

- Some children clicked on symbols instead of dragging them
- Very young children had trouble selecting symbols, because the mouse is physically too large for them to move and hold down a button at the same time
- Granularity of the presented information – it was not always immediately apparent to children that they needed to scroll down a page to see more information
- Some children found it quite disorientating being able to go through the walls of the tomb into darkness – the model lacked collision detection

The aim of the *Kahun* project was to investigate how virtual environments can be used as and educational resource to support the work of Manchester Museum. The three main goals were to teach children about everyday life in Egypt, to provide children with a context for the objects in the museum's collection and to show how objects were used in various activities.

Most of the cultural applications in virtual environments are only walk-throughs or fly-throughs with minimal interaction. However, the virtual experience is limited to only one perspective.

Mitchell said that there is a distinct lack of methodologies that can be readily applied to the development of virtual environments for museums [7].

Our virtual identity authoring approach can provide solutions to these problems.

VIRTUAL IDENTITY AUTHORING APPROACH

In [5] we proposed the *virtual identity authoring approach* to interactive storytelling. With this approach the participant experiences the interactive story through the eyes of the virtual identity. Each virtual identity is defined by knowledge about itself, its perception about the environment and its virtual embodiment. This approach allows for multiple identities to be created and for users to engage with different cultures through many different perspectives. This enables a rich and realistic cultural experience.

Each virtual identity is empowered with knowledge about itself, for example its cultural background, age and gender, which it uses to perceive and interact with the virtual world. The story unfolds as the user explores and interacts with the virtual world, through the embodiment of a virtual identity.

We extended this approach by providing a taxonomy (framework) that can be used to define a virtual identity, with the following main features:

- Characteristics that a virtual identity is born with and that s/he cannot change, e.g. age and gender
- Characteristics concerning the virtual identity's background, e.g. native language and cultural background
- Characteristics concerning the virtual identity's values, e.g. religion and politcal affiliation
- Behavioural characteristics of the virtual identity, e.g. emotion and

motion

- Characteristics concerning the virtual embodiment of the virtual identity, e.g. width, height and attractiveness (the embodiment of the virtual identity can be audio or visual)

According to the identity's characteristics, the participant is allowed to do appropriate interactions and experiences the culture through the eyes of the identity. For example, in certain cultures, according to the identit's age or gender or both, s/he is allowed to do certain things. With our approach this can be reflected in a realistic and true manner.

INTERACTIVE STORYTELLING TOOL

We developed an interactive storytelling tool that enables the user to create many different cultural experiences with the use of a single virtual model. Certain interactions are allowed within the virtual environment according to the characteristics of the virtual identity.

We developed the interactive storytelling tool with the AVANGO [10] framework that has been under development at GMD since 1996. AVANGO is a programming framework for developing distributed interactive virtual environments and is built on top of IRIS Performer. It uses C++ nodes that are represented in an object-oriented scene-graph API. Its interface to the real world and its interaction devices are provided through sensors. The AVANGO object is a collection of fields, where each field can be connected to build a data-flow graph orthogonal to the scene graph, which specifies behaviour and allows for interactive applications. AVANGO also features a complete binding to the interpreted language Scheme [7] and therefore allows rapid prototype development through scripting.

The system consists of C++ nodes and scheme scripts. The C++ nodes are used to define critical functionality. The Scheme scripts instantiate the required nodes, call methods on these nodes, set their field values and define relationships between them.

We used the AVANGO SoundServer to add sound to our application. To play the soundfiles we used the AVANGO node *fpSoundSource* and had to define the following fields:

- *Earnode* that identifies the location from where the sound comes from
- *PlayMode* that identifies whether the sound is played only ones or continously
- *SpatMode* that identifies whether the sound is ambient, statically spatialised or dynamically spatialised
- *SoundName* that identifies the sound file that is played

We developed a *fpVirtualIdentity* node that contains fields that

- relate to the virtual identity's characteristics
- relate to the way that the virtual identity perceives the environment
- relate to the movement of the virtual identity
- trigger a specific event

The fields that relate to the virtual

identity's characteristics are the characteristics that were discussed in the previous section, namely the characteristics that the virtual identity is born with and characteristics that describe the virtual identity's background, value, embodiment and behaviour.

The fields that relate to the way that the virtual identity perceives the environment are fields that influence the viewpoint of the virtual identity.

The fields that relate to the movement of the virtual identity influence the way that the virtual identity moves within the virtual environment, such as the speed with which the identity moves and the speed with which the identity changes direction while moving.

The fields that trigger an event will depend on the application being developed, e.g. if a certain object is selected it can trigger a sound to be played.

We tested our idea in a Cultural Heritage example that is discussed in the next section. The storyworld is a shebeen (township tavern) in Cato Manor [6]. We enhanced and imported to AVANGO a 3-dimensional model of a shebeen in Cato Manor developed by the CSIR[1] under the CultureWare project.

INTERACTIVE STORY: CATO MANOR SHEBEEN

History of Cato Manor

Cato Manor [6] was once a vibrant South African community that was torn down during apartheid, to enforce racial segregation and to open up a prime piece of real estate for white occupation.

In 1845 Durban's first mayor, George Cato, was granted land in Cato Manor in compensation for a beachfront property that had been expropriated for military purposes. Cato and his descendants farmed on this land until the turn of the century, after which the land was subdivided into a number of smaller farms. During the next thirty years the landowners hired out or sold plots of land to Indian market gardeners. Isolated clusters of shacks that were occupied by Africans began to appear along the banks of the Umkhumbane River. At that time Africans were prohibited from owning land or building homes in an urban area and were regarded as temporary sojourners. In 1932 Cato Manor was incorporated into the municipality of Durban and therefore the shack settlements became illegal. The authorities turned a blind eye and people continued to come to the area. In 1943 the squatter population had swelled to 17 000.

In 1949 the "Durban Riots" broke out after an Indian man near Durban's Indian market allegedly assaulted a 14-year-old African boy. This lead to two days of anti-Indian violence, spreading to Cato Manor, where Indian-owned shops and houses were razed and most of the Indian residents fled the area. By 1950 there were 6 000 shacks in the Cato Manor area, housing between 45 000 and 50 000 people.

[1] CSIR is the South African Council for Scientific and Industrial Research. The CultureWare project is fully funded under DACTS (National Department of Arts, Culture, Science and Technology of South Africa) through the Innovation Fund Programme.
http://www.cultureware.net

Figure 1: The Cato Manor shack settlement in 1950 (taken with permission from [6])

Figure 2: A Cato Manor shack settlement prior to the establishment of a Controlled Emergency Camp (taken with permission from [6])

In 1957 the government instructed the municipality to begin developing a new housing scheme for Africans at KwaMashu and to set up a temporary transit camp in Cato Manor. In 1959 attempts to move people to KwaMashu were met with resistance and tensions began to rise in Cato Manor. In 1960 nine policemen were killed by a mob in the Emergency Camp. This incident created negativity towards Cato Manor and rapid clearance of the area began.

In 1968 Cato Manor was left largely vacant and only a few scattered houses, shops, the beer hall and several Hindu temples remained. In 1979 the few remaining residents formed the Cato Manor Residents' Association to resist further removals and racially based housing developments. During the mid 1980's major portions of Cato Manor were officially identified for development for Indian people and some formal houses were built at Wiggins.

Interactive story

We used a model of the Cato Manor shebeen (township tavern) as the storyworld and created three virtual identities, namely the shebeen owner, a Zulu man and a Zulu boy.

The story develops through exploration of the shebeen by the user. The user experiences the shebeen through the eyes of the specific virtual identity. According to the chosen identity, the user is allowed only certain interactions that are appropriate for the specific identity. This enables the user to view the shebeen from different perspectives and angles and to get a true reflection of the culture.

The virtual environment is a shebeen within Cato Manor and contains a radio that plays music of that time, photo's of a soccer match, a boxing match and a jazz singer, mugs for drinking beer, chairs and crates to sit down and extra beds and crates that can be used when more place to sit are required.

The photo's in the shebeen resembles the culture of the people at that time. The soccer photo portrays their love for soccer and attending soccer matches. The boxing photo reflects their love for boxing and the photo of the jazz singer reflects the music that the people liked to listen to during those days. This is illustrated in figure 3.

Figure 3: Illustration of the shebeen

When the user perceives the virtual environment through the eyes of the Zulu boy, the viewpoint is lowered. The user is not allowed to enter the shebeen, but if s/he clicks on the shebeen's front wall, the virtual identity is transformed into a Zulu man and is then allowed to enter the shebeen and to do the interactions that are allowed for a Zulu man.

When the user perceives the environment through the eyes of the Zulu man, the viewpoint is higher than that of the boy. The user is allowed to enter the shebeen and can do the following interactions within the shebeen:

- Click on a photo that will trigger a sound file to be played
- Click on a cup in the shebeen that will cause the identity to sway when he is moving, indicating that he is drunk and had too much to drink
- Move crates around to position them where he wants to sit down

When the user perceives the virtual environment through the eyes of the shebeen owner, the viewpoint is higher than that of the boy. The user is allowed to enter the shebeen and can do the following interactions within the shebeen:

- Switch on the radio that will then play a sound file representing a radio station of that time
- Move the tables around in the shebeen
- Move the spare crates around in the shebeen
- Move the beds around in the shebeen

We demonstrated our application on a monitor and in GMD's CyberStage. The results are discussed in the next section.

RESULTS

Although the Zulu boy is not allowed to enter the shebeen, for testing purposes he was allowed to enter to enable the results to indicate the lowering in viewpoint. The difference in viewpoint between that of the Zulu boy and the Zulu man is illustrated in figures 4 and 5.

The virtual identity's v iewpoint is changed according to its age characteristic that is part of the characteristics that the virtual identity is born with (refer to the section on the virtual identity authoring approach).

When an interactive story is authored with our approach, any number and combination of the characteristics can be used for the specific application. The chosen characteristics can then be used

to define the different interactions within the virtual environment and the events and transitions that take place within the virtual environment.

(a) Viewpoint of Zulu boy

(b) Viewpoint of Zulu man

Figure 4: Illustration of the difference in viewpoint as the virtual identity approaches the table

(a) Viewpoint of Zulu boy

(b) Viewpoint of Zulu man

Figure 5: Illustration of the difference in viewpoint as the virtual identity approaches the radio

With this approach, the user experiences the culture in a realistic way and experiences the culture from many different perspectives. This leads to a rich and more realistic cultural experience.

CONCLUSIONS

In this paper we presented an approach and an interactive storytelling tool for interactive storytelling in virtual environments with the virtual identities approach. With this approach the user can have a realistic and multiple rich experiences through the eyes of different identities. We have implemented one application in the area of cultural heritage and demonstrated it on the monitor and in CyberStage – GMD's surround-screen projection-based stereoscopic display system. We are currently improving the user interface and further extending the virtual identity approach and framework.

ACKNOWLEDGEMENTS

We would like to thank C. Jackson from the CSIR for her valuable input on social psychology, gender and culture and the CSIR for allowing us to use the shebeen model. Special thanks to all the members of the GMD's Virtual Environments group. With their support and valuable help this work was made possible.

REFERENCES

1. Clinger W, Rees J. *Revised report on the algorithmic language Scheme*. November 1991.

2. Johnson A, Moher T, Ohlsson S, and Gillingham M. The Round Earth project - collaborative VR for conceptual learning. *IEEE Computer Graphics and Applications*, 19(6):60-69, November/December 1999.

3. Johnson A, Roussos M, Leigh J, Vasilakis C, Barnes C, and Moher T. The NICE project: learning together in a virtual world. *Proceedings of VRAIS '98*, 1998 IEEE Virtual Reality Annual International Symposium, Sheraton Colony Square, Atlanta, GA, USA, May 14-18, 1998.

4. FHH, Foundation of the Hellenic World. *3D Modeling and animation projects: Miletus. http://www.fhw.gr/fhw/en/projects/3dvr/miletus/index.html*

5. Jackson C, Lalioti V. Virtual Cultural Identities. *CHI-SA 2000*, South African Human Computer Interaction Conference 2000, University of Pretoria Conference Centre, Hatfield, South Africa, May 8-10, 2000.

6. Lynch B. *Cato Manor Development Project. http://www.cmda.org.za*

7. Mitchell WL. *Moving the museum onto the Internet: The use of virtual environments in education about ancient Egypt*. In Virtual Worlds on the Internet, eds. Vince JA and Earnshaw RA, IEEE Computer Society Press, 1999, 263-278. Online chapter available at: *http://www.doc.mmu.ac.uk/RESEARCH/virtualmuseum/Pubs/brad97/brad97pap.html*

8. Norman SJ. Culture and the New Media Technologies. *The Intergovernmental Conference on Cultural Policies for Development*, Stockholm, Sweden, March 30-April 2, 1998.

9. Rayward WB, Twidale MB. From Docent to Cyberdocent: Education

and Guidance in the Virtual Museum. *Archives and Museum Informatics*, 13: 23-53, 1999.

10. Tramberend H. AVANGO: A Distributed Virtual Reality Framework. In *Proceedings of the IEEE Virtual Reality '99*, JW Marriott Hotel, Houston, Texas, USA, March 13-17, 1999.

ABOUT THE AUTHORS

Mardé Greeff is a Computer Scientist as the South African Council for Scientific and Industrial Research (CSIR) since 2000. Previous positions include Assistant at the Mathematical Department at the University of Pretoria. Her research work focuses on Interactive Storytelling in Virtual Environments.
E-mail: *mgreef@csir.co.za*

Vali Lalioti is an Associate Professor at the Computer Science Department of University of Pretoria, since 1999. Previous positions include Research Scientist at the German National Research Centre (GMD), Research Associate at University of Manchester (UMIST), Marie Curie Fellow and Intern at the Systems Research Centre of Digital Equipment Corporation, USA.
Her research work focuses on Collaborative Distributed Virtual Environments, Immersive Telepresence and Interactive Storytelling.
E-mail: *vlalioti@cs.up.ac.za*