Providing a Digital Voice for Storytellers in Africa

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Abstract

In this paper we examine how digital technology can be used to inspire, record and present oral stories in an African context. In particular we explore how to create technologies that are sympathetic to the cultures of the storytellers, both in the capture of stories and their retelling. Specifically, we look at: inspiring stories in District Six in Cape Town; capturing digital stories from users with low literacy levels and using virtual reality to retell indigenous and personal experience narratives.

Introduction

Technology and storytelling may not seem like an appropriate match, especially in a continent such as Africa where technology penetration is relatively low. However, in our research we have found that interactive digital technology is ideally suited to capture oral stories in a way that is not possible through static media, such as text or video. Beyond simply story capture, we also explore how digital technology can be used to store and curate existing stories, as well as inspire new stories.

In the rest of the paper we will examine each of these issues individually. In terms of inspiring stories, we will discuss an augmented reality system that was used to provide a virtual 'peephole' back in time to see buildings that are no longer standing. We also describe a mobile system that allows non-literate users to plan and record their own digital stories. We look at a virtual reality system that was designed to present indigenous stories to young audiences in an accessible way. Finally, we describe a virtual reality system design aimed at creating virtual storytellers whose style and interactivity is inspired by real life professional storytellers.

Inspiring Stories

Studies in cognitive science have shown that the human brain is much better at recognising than it is at recalling; we can recognise a familiar face more easily than recall that person's name [Preece, 2008]. When collecting oral histories, it is easier to prompt a storyteller with a photograph or artefact than to ask them to recall a non-specific story. With this in mind, we created a virtual version of a now destroyed suburb in Cape Town, in order to elicit stories from it's ex-residents.

District 6 Mobile VR system

Our research group is based in South Africa, a country with a complex and infamous recent history. One of the most shocking acts perpetuated by the Apartheid government was the dismantling of culturally diverse suburbs in order to racially segregate the country. A particularly famous example is the District Six area of Cape Town, where people of different races lived fully

integrated lives. This was an anathema to the government of the time, which forcibly moved the residents into racially segregated townships and levelled the District Six with intentions of turning it into prime real estate for “white” people in the early 1960s. Thanks to activist protest however, the downtown area stands un-developed to this day. Since the establishment of a democratic government, however, there has been a concerted effort to preserve the memories and culture of District Six; the most visible of which is the District Six Museum.

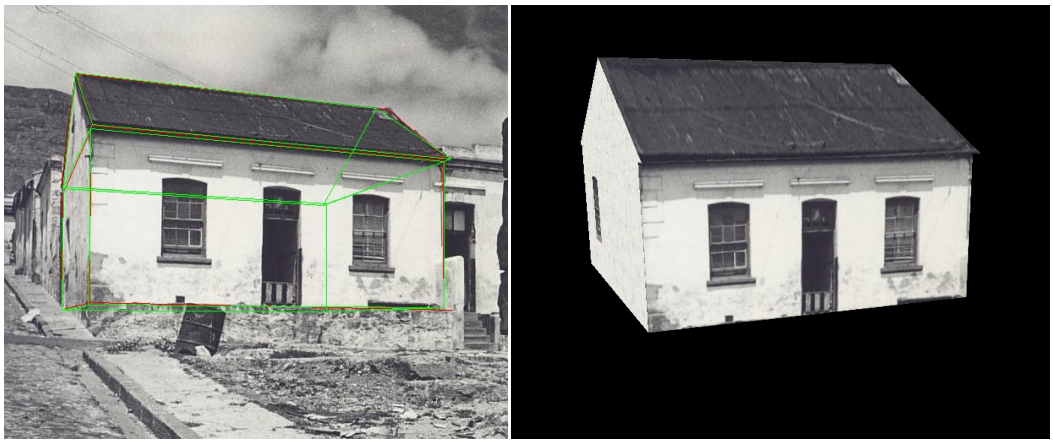

Figure 1: The original photograph is annotated to create a three dimensional virtual building

Our original collaboration with the District Six museum was aimed to rebuild a virtual District Six using photogrammetric techniques to reconstruct three-dimensional models. A sample of this work can be seen in Figure 1. Rather than display the virtual environment on a PC screen in the museum, we became inspired by the ‘Peephole’ work of Yee [Yee, 2003] and explored the possibilities of using PDAs to create a Peephole time-machine, allowing users to virtually view the old District Six whilst standing in the current District Six. The concept can be seen in Figure 2, wherein the system would overlay a destroyed building on the view of the current scene. A user could walk around the (now empty) site where District Six once stood and see the buildings that would have occupied that space before the evictions.

Figure 2: The PDA overlays buildings against the original background

The motivation for embarking on this project was two-fold. Firstly, we wish to reflect the culture of District Six in as interactive a way as possible to show something worth celebrating from apartheid-era South Africa. Secondly, we wish to use the environment to elicit memories from those people who are old enough to remember living there. Using the voice recording function of the PDA, we aimed to record oral histories from former residents. The philosophy behind the District Six museum is that anyone's impression or interpretation of District Six is valid, and they are keen to create this type of evolving archive.

There has been significant research into augmenting physical spaces with mobile computers. The most famous of these is perhaps Lancaster's tourist guide system [Cheverst, 2000]. In terms of systems that project historical information onto physical spaces, there have been two major projects. The first of these is based in a castle in the UK, where a large "Augurscope" [Schnädelbach, 2002], similar in appearance to a television camera, is used to provide a window onto the castle as it would have appeared in Medieval times. However, the device is large, expensive and entirely unsuited to the requirements of the museum. Another approach is that taken by a team in Italy to recreate Pompeii [Scagliarini, 2001]. They use dedicated Tablet PCs with a tilt interface to move the view camera through the virtual environment. Our goal was to extend that work and investigate whether a PDA can give the same levels of interaction.

Interaction

For the project, we had been donated several iPAQ 4150s, which we used as an implementation platform. In earlier work [Marsden, 2005], we had only been able to render a virtual environment in wireframe using PDA hardware. By using the iPAQ 4150 and Open GL ES, we were able to achieve full rendering with acceptable frame rates – summarised in Table 1 below:

Test	Frames Per Second (FPS)
No Ground or Skybox	40
Only Ground	22
Only Skybox	19
Both Ground and Skybox	14

For navigation, the device had to know exactly where it is (GPS) and its orientation. We therefore enhanced the standard PDA with a GPS receiver and a tilt sensor (see Figure 3). In order to evaluate the efficacy of navigating with the GPS and tilt sensor, we built a baseline system that required the users to navigate the environment using only the D-pad control (the D-pad is the button found below the screen on most handsets that allows users to navigate up, down, left and right). We had seven participants use each system and set them a number of navigational tasks.

The main difficulty users had with the GPS and tilt sensor method was familiarising themselves with the tilt sensor control. This took some skill as the system was better at detecting large movements than smaller ones. However, the fact that users were able to see the effect of their movements as they were made meant that they could acquaint themselves with the eccentricities of the system in a reasonable amount of time.

Since users required more time to become comfortable with the tilt sensor, they found the GPS to be more intuitive. They were, however, more critical of inaccuracies from the GPS. This is possibly due to the fact that users have no direct control over the GPS input. Unfortunately, the GPS was not always able to detect the smaller movements made by the user, resulting in users having to move much further than they felt necessary in the real world to affect changes in the virtual one.

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Only Skybox	19
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On average it took users of the GPS and tilt sensor system roughly a minute and a half longer to reach the destination and return. This was mainly due to the fact that users would inadvertently tilt the PDA as they walked around, which would result in the camera turning when the user did not expect it; it would then take time for the user to reorient the camera and continue.

Despite the large difference in time taken to complete the task, users recorded a much higher enjoyment when using the physically based system as opposed to the keypad one. A sentiment that was often expressed by the users when asked what improvements could be made in the system was that a more accurate mechanism for detecting changes in orientation was needed

In summation, users feel that the GPS and tilt sensor input is more interactive and provides a greater sense of being present in the virtual world. This is exactly what we had hoped as the point of the system was to elicit recollections of being in the real environment on which the virtual one is based. This is despite the fact that the time required to perform the tasks is significantly higher compared to using the directional keypad.

Reality Strikes

In this project, we showed that it was possible to create a virtual environment from old photographs and then navigate it intuitively using a location and orientation aware mobile device. However, we were unsuccessful in applying for funding that would allow us to complete the full environment and deploy the mobile system on a large scale. Our hope is that someone else will be able to build on these findings and use this technology to elicit stories from some other community.

Recording Stories

One problem with recording oral stories is that the story collector often comes from a culture different to that of the storyteller. This restriction is imposed by the recording technology which often requires so much training to operate, that it would be impractical to train all potential story tellers in its use. To overcome this barrier, we set about creating a system that could be used by any user to record a story, regardless of their literacy level. As a basis for the project we started with digital stories as they combine the expressive power of visual and audio media without the complex overhead of video editing.

Digital Stories

The late Dana Atchley developed “digital storytelling” in California in the early to mid-1990s with the idea of putting“the universal human delight in narrative and

self-expression into the hands of everyone" [Hartley, 2009]. Atchley developed an exportable workshop in which ordinary people are taught how to produce their own digital stories. Essentially, a digital story is a collection of still images joined and overlaid with a voice narrative. This exportable format has led to the impressive spread of digital storytelling across the world. However, digital storytelling has not spread evenly around the world, for it is practiced less in Asia, Africa, and South America [Hartley, 2009]. This comes to little surprise to us, as "exporting" a technology, method, or approach into Africa has often fallen short or failed [Marsden, 2008]. While it is easy to attribute this uneven spread to the low literacy and computer literacy rates found in Africa, perhaps the more profound reason for digital storytelling's failure in Africa is that the workshop approach is built upon Western storytelling practices and is, thus, insensitive to the rich oral traditions found all over the continent [Finnegan, 2007].

However, we believe that digital storytelling could play a role in rural African communities, as there appears to be a high degree of compatibility between the rich oral storytelling heritage of those communities and the audio narrative of digital stories. In our research we aim to address the imbalance mentioned earlier by not only creating an easy-to-use mobile digital storytelling system but, more importantly, allowing people living in rural African communities to shape their own form of digital storytelling compatible with their ways of doing and saying [Bidwell, 2010].

The mobile phone has had a tremendous impact on the livelihoods and lives of people everywhere, who are using the device for "both productive and personal uses through their daily routine" [Donner, 2009]. From our first hand experiences of living in and visiting rural communities in South Africa and Kenya, we observed the increasing availability and usage of the mobile in rural areas. Because community members are familiar with mobile phones, albeit mostly with basic Nokia 1100 type phones, we targeted it as our storytelling device. The social nature of the mobile along with its communication potential and different media input and output capabilities make it an ideal digital storytelling platform, where people can integrate and playback visual and audio media.

Previous Work

We had previously been involved with a technology-inspired and user-focused project aimed at combining the two technologies of digital storytelling and mobile phones [Reitmaier, 2009]. For the project we iteratively designed and evaluated, with university students, two mobile digital storytelling interfaces. With the story-driven interface users record a narrative first and then add in photos; while, with the photo-driven interface users add photos to a storyline and then annotate these by recording audio. Our usage scenario was one in which a user combines a set of three photos with an audio recording of reading from a pre-scripted story. We iteratively refined these two interfaces by creating and evaluating with university students a paper, a PowerPoint, and two high-fidelity Flash Lite prototypes. To explore a more elaborate interaction scenario, where users construct their own story, rather than read a scripted one, we also developed a further application prototype. In this prototype, which was

informed by usability outcomes from previous prototypes, users could record and select their own audio and photos. However, we decided against evaluating and refining this prototype outside of the urban setting where it was designed, as we noticed vastly different storytelling traditions in the rural communities we visited.

Ethnographic Lens and Design Workshop

Figure 4: A Village Meeting in Lower Ndungunyeni

Our ethnographic perspective on storytelling is informed by data gathered independently of developing initial prototypes and is situated in Lower Ndungunyeni in the Wild Coast of South Africa's Eastern Cape (see Figure 4) [Bidwell, 2009]. Insights on storytelling, oral and digital communication emerged over 18 months as we formed relationships, interpreted priorities, discovered design opportunities in the ad-hoc details of daily life, and undertook socio-technical experiments [Bidwell, 2010]. The insights we gained in-situ, together with our previous experiences on mobile digital storytelling, led us to develop a digital storytelling design workshop in the village Tschani. The aim of our workshop was to allow users to shape the design of a mobile digital storytelling system suited to their community; so, we focused all activities around a pair of phones, where one phone functioned as a voice recorder/player and the other as a camera and photo viewer. We ran the workshop at a local NPO (Non-profit Organisation) and recruited six participants via the NPO. The rudimentary nature of the phone-pair provided participants with enough ambiguity to explore different ways of incorporating visual and audio media in storytelling activities. We asked our participants to form three groups and spread the workshop over two consecutive afternoons, so participants could engage others and gather story ideas and material in a more natural setting. After explaining and practicing the use of the phone-pair's voice recorder, camera, and gallery during the first afternoon, the groups recorded their digital stories on the second afternoon in a variety of different ways. By reviewing the video and notes we took during the workshop, we were able to design a mobile digital storytelling prototype better suited to the needs of rural, oral users.

Current Prototype

Figure 5: The interface to the mobile digital story application

The biggest improvements of our current prototype over our initial prototypes is a flexible and text-free interface, as shown in Figure 5. Its flexibility allows users to create stories in a variety of ways without imposing a constraining storytelling style. Users can record audio first and later annotate it with pictures. Alternatively, they can select pictures first and then record a voice-over; or they can use a hybrid approach. At any time, they can add, move, or remove pictures and append or overwrite audio. All necessary functions can be accessed via a scrollable vertical toolbar of icons, which allows even illiterate users to create digital stories in their mother tongue. With this application we have created a rich means for rural users to tell their stories in a way that is natural to them. By studying its use we can leverage the application as a tool to further situate digital storytelling in rural African communities.

Preserving Stories

Even once stories are collected, presenting them can pose complex problems. Often, the person listening to the story will be in a physical environment completely different to the one in which the story was recorded. Not only that, but the listener may lack the cultural ability to interpret the story.

We looked to virtual reality (VR) to overcome these barriers particularly in relation to oral storytelling. Many African cultures may be described as predominantly oral; knowledge is preserved by telling rather than writing, and storytelling performances are an important social and culture-defining practice. Stories ranging from indigenous folktales to stories about relatively recent historical periods, such Apartheid-era narratives, may be preserved as text or video. However these media lack the original live oral storytelling context of these stories. Virtual reality has been used in cultural heritage work to reconstruct historical sites and artefacts that that no longer exist. We endeavoured to extend this use to recreate storytelling experiences which may no longer possible as well.

San Stories

Cultural heritage preservation work has recently begun to include efforts towards preserving "intangible" cultural heritage (ICH). This definition includes things such as rituals, skills, expressions, which are typically preserved orally. We created two virtual environments aimed at recreating an intangible cultural experience from San culture.

The San (also known as Bushmen) are an indigenous hunter-gatherer people of southern Africa, whose culture dates back over 20 000 years [Parkington, 2002]. Since the start of colonisation in the late 1400's, San populations decreased dramatically and their lifestyle has become almost extinct [Smith, 2000]. Among the most valuable records of San culture are their famous rock art sites [Parkington, 2003]. The San also have a rich oral culture and a tradition of storytelling. Orality is all pervasive and defining of San culture [Guenther, 2006]. Today there are very few San living the traditional hunter-gatherer lifestyle, and none from the Southern San. The Southern San or |Xam[1] culture is no longer alive but in the late nineteenth century the Bleek and Lloyd archive of stories was collected from informants who were imprisoned by the Cape authorities in Cape Town, South Africa.

The Bleek and Lloyd collection at the University Cape Town is one of the most extensive archives of San folklore. Today the original writings are preserved and have been digitised to DVD [Skotnes, 2007[. Wilhelm Bleek, Lucy Lloyd and Dorothea Bleek produced a meticulous archive of |Xam folklore which preserves their content, diction and style [Lewis-Williams, 2000 p.1-41; Parkington, 2002 p.8-13]. Records such as these capture the extensive oral storytelling tradition of the San and give readers invaluable insight into their culture.

We created two virtual environments (VEs) aimed at recreating the experience of San oral storytelling. In the first, we explored how the sounds and visuals used might enhance a user's experience of the story presented. The virtual environment was very simple and featured a cave at night time. Inside the cave there is a fire, surrounded by three figures conceptualised as San hunters setting up camp for the night. One of the hunters tells a traditional folktale to the other two hunters and the user. Initially the user is placed just outside the cave; upon entering they are invited to sit and listen to a story about Kaggen the Mantis, the classical trickster figure of San mythology.

The story told in the VE was taken from a Bleek and Lloyd collection of San folklore which contains two versions of a story about how the Kaggen the mantis created the eland and the moon. [Lloyd, 1923] In addition to being a mischievous trickster, Kaggen is also considered a magical creator. The eland is the most revered of hunted animals to the San, since it is considered to be Kaggen's favourite. The two, slightly differing, versions of the story were combined and adapted to form one story text used in the VE.

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[1] In transcribing San languages the various click consonants are represented by signs such as |. '|' indicates the dental click. It is sounded by pressing the tip of the tongue against the front teeth of the upper jaw, and then suddenly and forcibly withdrawing it. It resembles our interjection of annoyance [Bleek, 1911].

The original sources for the stories were ||Kabbo and his son-in-law |han≠kass'o. ||Kabbo's (whose name means "dream") stories were recorded in the period February 1871 to October 1873. This elder of his community, imprisoned by the colonial authorities, expressed the wish that his stories be known by way of books and he must have been aware that his culture was dying.

Screenshots of this VE are shown in Figure 6. This VE was used in a study to test the effects of adding ambient audio elements and visual elements related to the story on user's experience.

Figure 6: Screenshots from a virtual environment where a user could experience fireside San storytelling among a group of hunters. The figure on the left shows the three hunter avatars sitting around a fire. The figure on the right shows the rock art depicting events from the story told, the addition of these visuals was found to increase presence, story involvement and, when used in combination with ambient audio sounds, story enjoyment.

Ambient audio sounds such as fire crackling and crickets chirping were added along with visuals in the form of San rock paintings depicting story events on the cave wall nearest to the storyteller. Using a retrospective questionnaire we measured study participants' presence, i.e. the extent to which they experienced the VE as a real place and their level of involvement in and enjoyment of the story. In a study run with 77 university students, we found ambient audio significantly increased presence ($F = 138.8$, $p<0.002$) and enjoyment of the story ($F=4.01$, $p<0.05$). The story-related visuals increased involvement in the story ($F=9.49$, $p<0.003$) and the combination of visual and ambient audio significantly enhanced story enjoyment ($F=11.11$, $p<0.002$) [Brown, 2003].

The second investigation of using VR to recreate traditional San storytelling was guided by the difficulty of creating compelling VEs. Creating a good VE requires a great deal of effort and a range of skills such as graphics programming, soundtrack recording and 3D modelling and animation. This, firstly, prompted us to explore whether this investment was worthwhile by critically evaluating VR's effectiveness as a storytelling medium. We decided to compare the VR to text, a more common storytelling medium, particularly for indigenous stories. At present, San folklore is almost exclusively accessible through texts such as the Bleek and Lloyd collection mentioned earlier. While we had previously assumed that reimagining textual stories in a VE would be more engaging than reading, we decided to test this explicitly. We hypothesised that presenting a San story

told by a storyteller avatar in a VE would capture aspects of its original, performative spirit and provide a richer cultural contextualisation.

Secondly, we set out to explore a novel way to boost the effectiveness of using VR for cultural heritage storytelling. In particular, we were concerned that San story content might be too culturally remote to most users and, thus, fail to engage them. To address this we explored the use of priming, a technique where users are exposed to material related to a VE's content *before* experiencing the VE. This is intended to place users in a frame mind that is receptive to the VE's content. [Nunez 2003] Priming material is usually related to the VE content, and we wished to examine whether it would be useful for making potentially culturally remote content more familiar and engaging. We decided to test the use of priming in the form of a culturally familiar introductory VE which foreshadowed the San VE content. This required that we choose a cultural theme that was likely to be familiar to most users of the system. To this end, we chose hip-hop, since it is a well-known contemporary subculture with a distinctive and easily recognisable style. However, any other well-known, contemporary subculture might have been appropriate. We felt that hip-hop fit the bill for our work because it shares some key similarities with San culture. Key aspects of San culture is their storytelling, rock art, music and dance traditions (Bassett, 2001; Parkington, 2003). These may be seen to correspond to the key aspects of hip-hop culture: rapping, graffiti, dj-ing and break dancing, respectively (Ards, 1999). Among these, the link between rapping and oral storytelling particularly struck us. Rapping is a musical style where lyrics are spoken or chanted over music, which is often heavily sampled (Shusterman, 1992). Rap has been described as a hybrid cultural expression which incorporates a great number of expressive systems, including African storytelling and "street-smart moral fables". [Mitchell, 1996; Shusterman, 1992].

To aid us in evaluating the storytelling effectiveness of VR and our introductory VE technique, we carefully considered our measures for storytelling success. We considered what might characterise a successful cultural storytelling experience beyond the presence, story involvement and story enjoyment measures we had used previously. We conceptualised an effective storytelling experience as one where the story is understood and enjoyed; we also felt that it should foster an interest in the culture concerned and make culturally remote stories accessible to most audiences.

The San VE created for this study was much more detailed than our first. We paid particular attention to ensuring that that the story content, avatars and physical environment were authentic. The VE was, again, set in a cave at dusk, with a San gathering sitting around a fire. The cave was modelled on the shallow caves found in the Cederberg mountains, a region once inhabited by the San and one of the richest regions of San rock art [Parkington, 2003]. Digital images of Cederberg caves were used to texture the virtual cave. In accordance with findings in our previous work, we included ambient audio and textured the cave with photographs of rock art which related to the story that would be told in the VE. [Parkington, 2002; Bassett, 2001] The San gathering consisted of an adult man, two children and an elder woman, who acts as the storyteller.

In order to ensure accurate appearance, in terms of clothing and physique, for these avatars we enlisted the help of an artist and an archaeologist expert on the San. Photographs of the San were used by the artist to create detailed reference sketches of the four San characters. Before modelling, these sketches were reviewed by the archaeologist expert. On the first review, significant corrections were made to the sketches and once they were found to be accurate, modelling of the avatars began. Once again, we consulted the archaeologist for guidance with this adaption before recording the narration audio.

In the VE, the user begins some distance from the cave; this view is shown in Figure 7. As they walk toward the gathering, the San man stands up and looks in their direction (see Figure 7). During this time a simple African music track plays in the background along with ambient sounds such as wind blowing and crickets chirping. When the user has almost reached the gathering, the music fades and the San man invites the user to move closer to the gathering. However, if the user takes longer than ten seconds to walk toward the gathering, the San man also offers the following encouragement. Figure 7 shows the San man inviting the user to come closer after which the elder storyteller, shown in Figure ?, says:

> "I was just about to tell a story, the one about how the Mantis made the Eland, please sit down with us and listen."

The storyteller then begins to tell the story, during this time the user is free to explore the cave area and view the fire, rock paintings and other objects typical of a San living area such a grinding stone and a bag and quiver hanging from wooden pegs on the cave wall. These objects were created and placed in accordance with San reference material and the advice of our archaeologist consultant. The San gathering react during the storytelling by exclaiming, gesturing and moving their heads; a screenshot of this is shown in Figure 7. The storyteller avatar, shown in Figure 7, is also animated throughout the story narration. The voice of the storyteller was provided by a local voice-over actress. During this voice recording her movements and hand gestures were video-taped and, subsequently, rotoscoped for the storyteller avatar's animations.

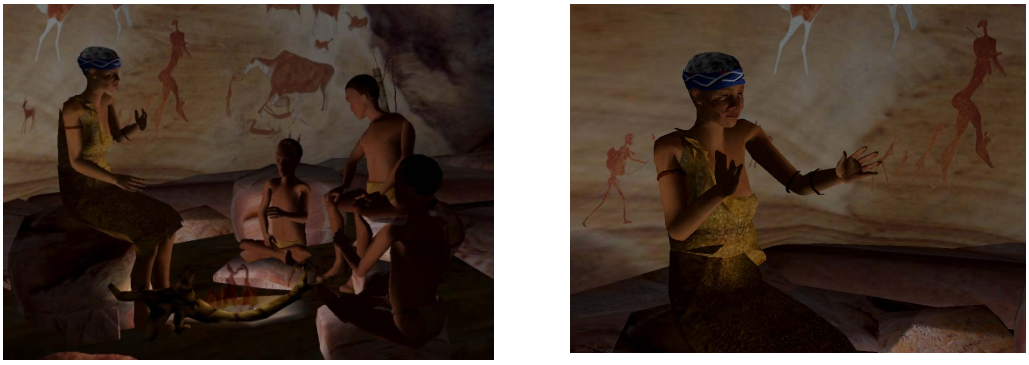

Figure 7: Screenshots from the virtual storytelling environment where an elder women tells the story of how Kaggen the Mantis created the Eland and the Moon to a San group around the fire and the user.

The priming VE presents the user with an urban environment containing a hip-hop avatar with a radio. The avatar is rapping about the San people and the story that will be told in the San VE. Again, the recorded actions of a real-life actor, in this case a hip-hop musician, were rotoscoped to animate the hip-hop actor. Behind the hip-hop actor, in the VE, there are a number of graffiti covered walls and, nearby there is a door with the word "San" in graffiti on it.

As the user walks toward the avatar, he stops rapping and speaks to the user telling about the San and their storytelling tradition:

> "You gotta understand the San, indigenous peeps of da motherland.
> Making rock art, workin' real hard.
> Huntin', yo peeps be frontin'.
> We be jammin', dancin' rhymin'
> Making mad beats now for keeps
> I hopes you like dis story about Him
> Kagg'n da Mantis speaks
> Don't despise this gifted, thrifted, swifted and mighty
> Creator, da maker of da Hartebeest, da moon,
> Soon you gon hear how he made the E-land too
> So listen to me man as I usher you into the world of the San.
> Let's jam!"

This monologue, along with the earlier rap, serves as preparation for the content which the users will encounter in the historical San VE. He then directs the user to the door, which opens to reveal the historical San VE. The user is then able to enter the San VE described above.

Both VEs were implemented using an in-house VE authoring tool called VR Direct, a scripting engine and user interface built on top of Gamebryo, a commercial games engine.

We conducted two studies using these VE's with different samples: (1) 44 high-school children aged 15 to 17 and (2) 98 undergraduate university students. We made two main story experience comparisons. Firstly, between participants experiencing the story in the VE with those reading the story as text and,

secondly, between those who experience the San VE with and without the priming VE. Story experience was measured using retrospective questionnaires for the following dependant variables:

- *Comprehension*: a number of tests drawn from educational research were used to test understanding and recall of the San story.
- *Interest*: interest in and desire to find out about San culture and folklore.
- *Enjoyment* of the story.
- *Boredom* during the story experience.
- *Confusion* about the story content.
- *Presence* in the San VE

For our second study, using the university student sample we added the following additional dependant variables:

- *Attention* paid to the San story.
- *Perceived strangeness* of the San story.

We also measured *Hip-hop Interest,* using a number of questionnaire items in which participant's rated their affinity for hip-hop culture. This was done so that we could factor this into our analysis of the effect of our priming VE.

Story Experience:
The correlations among our dependant variables strongly suggested that our conceptualisation of story experience was sound:

- Comprehension, interest and enjoyment correlated positively.
- Boredom and confusion correlated positively.
- Comprehension correlated negatively with both boredom and confusion.
- Interest and enjoyment both correlated negatively with boredom and confusion.

In Study 2, the following correlations suggested that attention was a positive aspect of story experience while perceiving story content as strange was not:

- Attention correlated positively with comprehension, interest and enjoyment and negatively with boredom and confusion.
- Strangeness correlated negatively with interest and enjoyment and positively with boredom and confusion.

Virtual Reality vs. Text:
Among the high-school students, we found that comprehension was significantly higher for those reading the story ($F=23.54$; $p<0.0001$). However, the results for the other story experience variables pointed strongly towards a more favourable experience for those who experienced the storytelling VE. In the VE participants showed significantly higher enjoyment ($F=17.67$, $p<0.001$), less boredom ($F=7.44$, $p<0.009$), less confusion ($F=15.54$; $p<0.001$) and greater interest in San culture ($F=5.639$; $p<0.02$) [Ladeira, 2004]. However, in the university student sample, the results were slightly different. Comprehension was still significantly higher for the text story ($H=33.07$, $p<0.00001$) while confusion was lower ($F=5.10$, $p<0.026$). Additionally, we found that attention to the story was

significantly lower in the storytelling VE ($F=8.13$, $p<0.005$) while perceived strangeness of the story was significantly lower ($H=6.04$, $p<0.014$).

A puzzling set of outcomes was the lack of differences for enjoyment, boredom or interest. This might have been due to different reading attitudes and skill levels in our two samples. The high-school students who read the story reported strikingly very low levels of engagement with the story, despite scored high on comprehension. This made for a marked difference between text and VR for that sample. Meanwhile the university student sample exhibited similar qualities of engagement in the textual and virtual story. We believe that the university student sample represents a highly selected sample with above average reading skills and a greater likelihood to responding positively to reading. An analysis combining the high-school and university samples showed that, overall, enjoyment ($F=8.47$, $p<0.004$) and interest ($F=4.77$, $p<0.031$) were significantly higher and boredom lower ($F=4.23$, $p<0.042$) for virtual storytelling as opposed to the text story.

Our results suggested that neither text nor VR proved to be the "winning" story medium. In fact, there was an implied trade-off between conveying the story content and providing a fun experience which generates cultural interest. We could classify comprehension as a variable relating to *content* and the interest, enjoyment, confusion and boredom as variables relating to the *experience*. Furthermore, our results suggested that content and experience might not come hand-in-hand, leaving us with a choice: which of these two is the more important goal for cultural storytelling? Say story content is understood and retained, but the experience is not compelling and does not necessarily prompt further exploration of the cultural context. Is there much point in such a once-off story experience? While our VR users did not grasp and retain the story content as fully, they had, what we would term, a more effective story experience. Furthermore, a result we found striking was the apparent disconnection between comprehension and confusion. Those reading the story showed better comprehension and attention to the story but greater confusion (for the high-school sample) and greater perceived strangeness of the story (for the university sample). This suggested that, despite better retention of story content, those reading the story found it confusing or strange. Various elements of the story's style, such as vernacular rhyming and repetition patterns and story events, were likely to be unfamiliar to our sample. However, the marked difference in confusion between the VR and text conditions suggests that placing the story in context and hearing it told out loud in the VE made the story more accessible. We believe these results point towards VR's potential for bringing oral stories to life. This makes it a valuable tool for preserving the stories of the San and other indigenous African people.

The Use of a Priming Virtual Environment:

While the use of the hip-hop themed priming VE didn't have an effect on overall story experience, we did note two interesting effects with each sample. For the high-school sample, we found that *Hip-hop Interest* was a significant predictor of story enjoyment. So those who indicated a high affinity for hip-hop and

experienced the priming VE enjoyed the San story significantly more than those who did not see the priming VE. This suggests that the priming VE only offered a benefit where it tapped in the participants' pre-existing interests.

Among the university student sample, those who identified hip-hop as a favourite music genre and experienced the priming VE (n=6) reported significantly greater presence in the San VE ($F=5.31$, $p<0.029$) than those who chose other genres (n=24). Furthermore, for those who did not experience the priming VE, no effect was noted for those who chose hip-hop as a favourite (n= 5) vs. other genres (n=23). This showed a definite interaction between the priming VE and participant's preference for hip-hop music. While this result is different to that in the high school sample, we were, again, seeing a story experience benefit arise where priming material tapped into pre-existing interests [Ladeira, 2005]. We believe that, for participants with a liking for hip-hop, the introductory VE acted as a hook, piquing their interest at the outset of their virtual experience and increasing their overall engagement in the San storytelling VE. However this is an area that we would like to investigate further.

The VE created for this study was ultimately put on temporary exhibit at the IZIKO South African Museum in Cape Town. The VE was projected onto a wall which visitors could navigate using a joystick.

Virtual Storytellers

In another in-progress preservation project, we are working with personal experience narratives from the Apartheid-era. Personal stories are widely considered a form of cultural heritage which lend unique perspectives on historical events. Digital storytelling aims to capture and present the, often personal, stories of ordinary people. While a story's content can be archived, it is more difficult to preserve the intangible *experience* of hearing a personal experience narrative from the person who experienced it. While some digital storytelling work attempts interactive features, recreating the interactivity of oral storytelling is largely unexplored. We set out to gain a deep understanding of real life oral storytelling and explore which of its aspects could be recreated using VR. We used a multi-disciplinary research approach drawing from human-computer interaction, anthropology and linguistics. For the first part of this project we, again, collaborated with the District Six Museum in Cape Town in order to conduct a thorough ethnographic study of professional storytellers. The museum is self-described as a "community museum" in that District Six ex-residents played an important role in its establishment and much of its content has been donated by ex-residents. Two ex-residents, Joe and Noor (shown in Figure 8), work as resident storytellers whose personal perspectives contextualize visitors' experiences. They give factual historical background but also spend a lot of their interaction with visitors telling stories about their personal experiences of living in and being removed from District Six. These personal experience narratives offer an invaluable insight into the forced removals which is difficult to achieve otherwise. Unfortunately, when Joe and Noor retire, their stories will no longer be told live in the museum space, they

will only be available as texts on the walls and in audio installations. This is something which the museum regards as a real loss to the visitor experience.

Figure 8. District Six Museum storytellers, Joe and Noor

We began this project with the very broad agenda of understanding storytelling for the purposes of using a technology such as VR for preserving the stories told in the museum. Apart from this, there was no predefined research or design direction for the final system as we hoped these would emerge from the storytelling we observed. We conducted an ethnographic study of Joe and Noor over the period of three months. Tours were mostly led by Joe and Noor and to a lesser extent by other museum staff and outside guides. Thirty-nine tours were observed, ten of which were recorded via lapel microphone. Field notes were taken during each tour and recorded tours converted into detailed transcripts. During analysis we paid special attention to Joe and Noor's techniques for conveying personal experience vividly and interacting with audiences.

Initial meetings revealed that Noor focused on telling stories about growing up in District Six and would handle organized groups of young children ("You can tell them stories for hours, they love it!"). Joe told some personal stories but primarily dealt with more "academic" content. The tours of both tended to include only two locations in the museum where they spent a long time talking about a variety of topics. This showed that they were not as concerned with shepherding visitors around the museum as much as providing information and telling stories. Since Joe and Noor told their stories multiple times each day, they were very well rehearsed. Thus, there was noticeable consistency in content and the interactions across tours. Each guide had developed a stable pool of stories. A core repertoire of these were almost always told while other stories would appear when groups had time to hear more or when prompted by audience questions or comments such as "Tell us more about gangs in District Six". A number of interaction types were observed, such as involuntary reactions from audiences, banter, raising hands to signal questions or comments, question-answer sessions and eye contact. [Ladeira, 2007]

Interactions were initiated by both audiences and guides, who would often instigate interactions by posing questions to the audience. With younger groups Noor often used playful guessing games, for example inviting groups to guess the meaning of his name. This is similar to Yamazaki's [Yamazaki, 2009] finding that guides in an art museum used "involvement questions" to engage audiences. The guides aimed to maintain audience engagement in their storytelling by responding to audience reactions and interruptions and actively encouraging

involvement. Thus, their storytelling would be aptly described as a collaborative process.

We conducted a deeper analysis using the story transcripts from a linguistic perspective. We drew from well established theory on personal experience narratives. [Labov, 1972] proposed the following ordered structure for personal experience narratives:

- *Abstract (A)*: states what the story will be about
- *Orientation (O)*: sets up the story context
- *Complicating Action (CA)*: the story's main event
- *Evaluation (E)*: the point of the story (might commonly be referred to as the moral of the story)
- *Coda (C)*: signals the end of the story

In Joe and Noor's stories, we found a definite adherence to this structure but also two interesting differences. Firstly, in complex stories the Orientation might consist of complete narratives which convey back stories. Secondly, often the storytellers told strings of thematically linked short narratives. Another important finding was that verbal storyteller-audience interactions always occurred between the story components, never during. If the storyteller initiated interaction, such as involvement questions, this was done between the end of one component and before the beginning of another. If an audience member wanted to make a comment or ask a question, they would typically wait until the storyteller had finished their current story component.

The results of our ethnographic study have been used to design a virtual storytelling prototype focused on presenting personal experience narratives interactively. The implementation will take the form of a 3D desktop virtual environment developed using Microsoft's XNA Game Studio. The system will embody the following attributes:

Structuring the stories: The design for structuring stories stems from our observations of the storytellers' core and extended repertoires and the A-O-CA-E-C structure described earlier.

User interruptions: Users will be allowed to react to the storytelling at any stage and receive a response from the storytelling agent. Users can strike a keyboard key to get the storyteller's attention; this would be akin to the hand raising behavior observed at the museum. Once the storyteller agent's attention has been acquired, the user may pose a question or comment via typing. Passive interruptions, such as gasps, will be captured using a microphone and will be acknowledged by eye contact or a comment from storyteller agents.

User Involvement: The storyteller agent will seek to involve the user by asking them questions at (1) the same points where Joe and Noor employed involvement questions in the museum transcripts and (2) when users' attention to the storytelling is below a certain threshold. Once again, users may respond to questions via typing.

This prototype is currently being implemented, and thereafter three rounds of user testing, each contributing to the prototype's iterative improvement, are planned. An unstructured pilot test will observe users interacting with the system in order to determine whether users make use of and respond naturally to its interactivity. Further user testing will be more structured, drawing from previous work on measuring user's story experience using retrospective questionnaires.

Conclusion

In all of the research presented, the unifying concept is that of user-centred design [Preece, 2008]. We have not tried to impose a technology from outside Africa into an African situation. Instead, we have worked with individuals, and the cultures they represent, to give them a digital voice and ensure their stories survive in a digital landscape. But the benefit is not only to the communities we work with, by building these systems we have learnt much more about how we ourselves communicate and the value of a good story, regardless of the culture it comes from and the media that is used to convey it.

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