

Reflecting on the Creation of an Authentic Aural Experience in the Digital Songlines Game Engine: part of a contextualised cultural heritage knowledge toolkit.

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Abstract

Digital Songlines is an Australasian Cooperative Research Centre for Interaction Design (ACID) project that is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge. The project explores the areas of effective recording, content management and virtual reality delivery capabilities that are culturally sensitive and involve the indigenous custodians, leaders and communities in remote areas of the Australian 'outback'. It investigates how players in a serious gaming sense can experience Indigenous virtual heritage in a high fidelity fashion with culturally appropriate interface tools. This paper describes the circumstances that gave rise to the concept of a 3D ambient audio quilt, designed and implemented specifically for the Digital Songlines game-engine software. It discusses the importance of a site visit to a remote location in the north-east of the Australian outback, and how this prompted the discovery of a new method for creating an authentic aural experience in a 3DVE. This paper reports on completed and ongoing research in this area.

Categories and Subject Descriptors (according to ACM CCS): K.3.1 Computer Uses in Education

1. Introduction

The Australasian Cooperative Research Centre for Interaction Design (ACID) is a collaborative research organisation formed with a number of universities and industry partners. The Virtual Heritage program is a research program under the auspices of the ACID organisation. The digital Songlines project within the Virtual Heritage program is developing protocols, methodologies and toolkits to facilitate the collection, education and sharing of indigenous cultural heritage knowledge across Australian communities, cultural institutions and commercial businesses [GBW06] [LHB*04] [PW06].

The Australian Aboriginal and their culture are known to be some of the oldest in the world. Aboriginal occupation in Australia has been dated at over sixty thousand years, with recent advances and scientific discoveries continuing to change this time frame.

Before 1788 when English settlement commenced in Australia there were approximately 600 languages spoken throughout Australia, with an estimated Indigenous population of 750,000 people [Hen97]. Today Indigenous people make up 2% of the entire Australian population (about 410,000 people). Most of our knowledge of Aboriginal culture is derived from the diverse cultures recorded of relatively modern Aboriginals, particularly those who survived the impact of European colonisation. Hence, the culture of much earlier Australian inhabitants remains problematic [Bic87] [Coo86] [Elk53] [Mem91] [Rid84].

The project objectives are to protect, preserve and promote Australian Indigenous culture, its practices, myths and legends, expanding and re-vitalizing a culture through the visualization of its most prized asset – the land. The project has developed the Digital Songlines software with a virtual landscape encapsulating cultural information, oral histories and mythological stories, based upon the eternal sense of land and spirituality understood by the Aboriginal people of Australia, where feeling, knowing and touching the country, kin and spirit

investigating how virtual worlds can capture the spirituality, culture and heritage of Indigenous people and impart these in an empathic way so that non-Indigenous people throughout the world can understand the significance and cultural heritage of these areas.

Part of the emphasis on providing a simulated contextually accurate experience of Indigenous knowledge is the need for an authentic aural experience within the virtual environment. This paper reports on the experience and outcomes of a site visit to a remote location in the north-east of the Australian outback that prompted a new way of simulating an authentic soundscape.

2. Background – Indigenous cultural heritage

Aboriginal culture was passed onto others through oral traditions, art, dance and rituals. Aboriginal Legends have served an important purpose in the teaching and learning for Aboriginal people, adding to their understanding, connection and interpretation of the world in which they live.

The stories were the means by which knowledge and understanding were passed from generation to generation for over forty thousand years. These 'yarns' are vivid, dramatic and informative stories that served the purpose of educating the receiver about all the social, environmental and cultural facts that ensured the ongoing survival and prosperity of the clan. Because they lived with such a close connection to the country and seasons, knew it so intimately, the stories, songs and culture are inextricably linked to the land.

Aboriginal culture is still alive today with older people from the country still able to tell their stories. However, many are passing on and the younger people are becoming lost in the struggle between white and traditional cultures. Some want to know and understand their cultural roots, others want to embrace Western values and deny their heritage. Yet others are simply lost in cultural ambiguity.

In the Digital Songlines project we aim to communicate the culture, history, rituals and stories and association with the country through the 3D virtual worlds, presenting these in the context of the originating country. The importance of this work is in the way it demonstrates an appreciation of the natural environment and the Aboriginal affinity to this land. The virtual world seeks to explore the spiritual, mythic, magic and superstitions of the landscape as a traditional hunting ground and hallowed place of worship.

3. Places of Cultural Significance

To-date, the Digital Songlines project has been used to illustrate significant Aboriginal spaces within Australia including the Mt Moffatt and Carnarvon Gorge National Park areas in south-west Queensland. The landscape and surrounding country in these regions is largely undisturbed by modern activities. As such it is a pristine land of gum trees, eucalypts, ironbarks, mulga, caves, granite and sandstone rock formations and fertile, grassy plains. There are innumerable significant places that are marked by a vast array of distinct and special rock art paintings and other cultural artefacts. They contain major meeting places where many different clans descended each year for many months to trade, meet, discuss and follow many practices vital to the survival of the group and the maintenance of their cultural traditions.

4. The ACID toolkit

A core component of the Digital Songlines project is the ongoing development of a digital toolkit. The aim of the toolkit is to be able to effectively communicate meaningful cultural information through a 3D landscape format so the information can be conveyed in context within country. As well as being used for Indigenous heritage, this toolkit can also be used to communicate issues of sustainability, land use, water use, explain development issues and contested narrative issues for a number of different uses.

The toolkit needs to be able to facilitate asset management over a large geographical area. This is done preserving high quality local detail. To-date the toolkit features:

1. 3D landscapes based on satellite imagery (with GPS level accuracy at the macro scale);
2. The ability to set weather, time of day or progressive time etc;
3. User level tools to manipulate the landscape and add finer detail at a micro level;
4. The ability to create scenarios and stories and control these through scripts, control of camera position;
5. The ability to create journey paths through the landscape, control the speed and direction along a path;
6. The ability to add flora, fauna related to the area from a database or catalogue of objects;
7. The ability to add ambient audio (wind in trees, bird calls etc), add audio voice over for significant locations (explaining significance of place to viewer, explaining our presence to the spirits etc), and add oral history (automatic or selected avatars);

8. The ability to link to data attributes for presentation of educational material. For example, select information about flora with botanical data; uses such as medicinal; bush tucker; artefact information such as the making of implements for food gathering, or, use as weapons;
9. The ability to participate in massive multi-user serious gaming strategies.

While the primary use of the tool has been in the area of cultural history, a wide range of potential installations have been identified including: museums, science centres, cultural centres, interpretive centres, community consultation, local councils, forestry, water resources, development organisations, schools, mining, safety training, media and data fusion capabilities.

5. Implementation experiences

A highly resolved proof concept prototype has been developed which includes arrays of 3D objects used to recreate a landscape populated by indigenous flora and fauna. These assets have been imported into the game style application based on the Torque Game Engine. The active features include sound, animations, weather and daylight simulation. An established mechanism to import digital terrain models existed and it was modified for importing satellite based geo-spatial data, or data that is prepared for use in GIS software, for accurately mapping the cultural heritage landscape.

Many issues arise from the creation of virtual spaces of some 400 square kms and its reliance on the computational capacity of real-time hardware and visualization technologies. Some are difficult to resolve in a suitable way to communicate the presence required within the virtual space. Such as, how to convey immersive narratologies like: while in place, indigenous knowing pauses at each rock, knows the cycles of the winds, can track underground water, find food and medicine, and uses of the land to speak its stories and keep its history. The kind of knowledge represented and the 'field' in which it is held by local indigenous peoples is often deep, subtle and most intimate [Lan53].

A 'tiered' model has been developed where 'layers' of content are created, accessed, and linked back to the virtual model of the physical place. With such a model, we are able to conceive of the (virtual) land as an interface through which the more traditional dynamics of software creation can be accessed. This layered model allows us to participate in indigenous knowing and being-with, at the most basic level, as the tool is used.

The content can be layered to support virtual heritage applications and narratives (such as land ownership issues, spiritual knowledge, historical and oral stories)

and as a community content development and archiving tool (re-populate the virtual spaces with indigenous content). These can be used in entertainment, display, community consultation and education, such as museums, cultural centre displays, as an indigenous language walk, or bush tucker walk, or oral history lesson. These are all developed with the notion of land-as-interface where the (virtual) land is layered with information and practices that arise from that very landscape. In this paper we report on the development and implementation of an authentic aural experience in the digital Songlines game engine.

6. The Limitations of Current Ambient Audio Technology

Ambient audio in most current game engines is represented by either a location based looping soundtrack or by placing static 3D audio emitters around specific nodes of interactivity [Finn04] [Lec02] [Mar01] [McC03] [Wil04]. The design of a looping soundtrack needs to be carefully considered so it appears as "dynamic" or randomised sound, and not a loop [Nei05] [NS05] [Roa96] [San04] [Scg94]. For example, when moving through different terrains the user should notice a change in ambient sound levels; a wooded area should sound more alive with wildlife than a sparse terrain. Careful placement of 3D audio objects can significantly enhance the users experience with aural characteristic unique to each area (see figure 1).

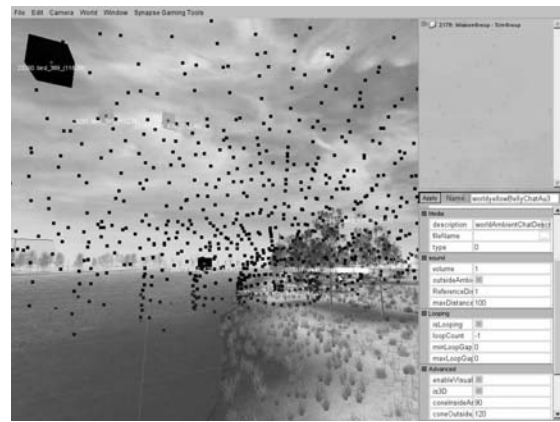


Figure 1: 3D audio emitter in the Digital Songlines Torque Game Engine environment.

7. Collecting Appropriate Audio Assets

By providing the user with multi-sensory awareness information – visual, aural, and tactile (interactive) – a believable landscape simulation experience can be achieved. With the importance of the audio aspect of this virtual landscape experience in mind, the ACID

Indigenous Communities project team embarked upon the collection of a variety of authentic audio ‘assets’ to be used to aurally contextualise a culturally and place-specific 3D virtual environment. A number of locations were identified as suitable. The location reported here is in the remote north-east of Australia. In August of 2005, a field research trip was undertaken to western Carnarvon Gorge in Central Queensland, Australia. The purpose of this trip was to capture the visual and aural environment for incorporation into the Digital Songlines software environment.

7.1 Reflections on the Remote Site Visit: Carnarvon Gorge

As Carnarvon Gorge is a remote area it presented a different aural experience to the urban environment commonly experienced. Most notable was how astoundingly quiet the area is. Such was the extent of this void of sound that quiet sounds, normally obscured through aural masking and filtering, were much more audible. The sound of footsteps on the terrain type being traversed – grasses, leaves, or rocks – could be clearly differentiated with distinct audio differences. These footsteps were capable of dominating the listeners’ audio environment during quiet periods of the day, and could be heard from some distance.

Due to the relative quietness, the acoustic horizon appeared to be much closer than in urban settings. Distant sounds could be heard with greater clarity and definition. For example, the human voice, under certain conditions, could be understood at distances of approximately half a kilometre.

This notion of a closer aural horizon is due to the acoustic properties of the aurally thinner air space in rural environments as there are significantly less audio sources within the listeners’ personal sound field. This reduction in aural density results in distant sounds appearing much closer to the listener, although a perception of distance is still available through the subsequent density of reverberation of the audio source. This raises the question, “how to capture and represent this aural sensation in the Digital Songlines environment?”

7.2 Environment Personality

Prior to the site visit to Carnarvon Gorge the Digital Songlines Engine (DSE) used the more common looping soundtrack to create an aural experience in the virtual environment. However, the very solemnity of the Carnarvon Gorge aural experience prompted us to think about the importance of an authentic aural experience in a new way.

Sitting around the campfire at Carnarvon Gorge, the notion of the environment having a personality emerged. This was triggered by the way the various sounds one could discern in the environment around us at different times of the day seemed to coalesce into what we agreed was an environmental ‘personality’ of sorts. The environment appeared to speak to us through its character. Its character changed as we moved through the environment and at different times of the day. To give this character form we identified specific sounds and isolated them after their recording. In contrast to the quietness of the environment in general, most pronounced was the sheer variety and volume of bird noises. The birds were clearly a large part of the environment’s personality character. At different times of the day particular bird sounds could be heard in the immediate vicinity of our camp. This meant it should be possible (with careful recording and embedment) for our camp environment experience of this personality to be simulated in the DSE 3DVE. The next question was “how to simulate the apparent randomness and dynamism of the changing soundscape?”

7.3 Randomness and Dynamism in a Changing Soundscape

Clearly, as we moved around the camp and into other areas the soundscapes we encountered changed too. The common global, looping, soundtrack would no longer be sufficient. What was needed was a region-specific method for embedding particular sounds that one might encounter in that region, yet dynamically changed to represent different times of the day and to reflect the movement and densities of fauna present.

In its standard format, most game engines do not support algorithmically driven soundtracks. We had to find a method that gave the flexibility and apparent randomness that best reflected the actual environments being simulated. With this in mind the notion of a cellular format was devised.

8. A Dynamic Environmental Soundscape Quilt

By dividing the virtual world space into a series of cells we could recreate the region-specific sounds we encountered from our site visit. These could include sounds embedded in an equally authentic modelled 3D simulation of the environments. The cellular format also allowed specific actions to be performed in relation to an avatar’s movement through the various cells.

The system developed uses a “checkerboard” quilt design methodology with cells monitoring an avatar’s movement throughout the virtual landscape. Upon entering, each cell adjusts the surrounding cells’ audio arrangements – both density and 3D location within

constrained random variables. Audio files are randomly selected from a sound bank and used to aurally populate the surrounding cells. The type of audio assets used to populate surrounding cells is dependant on the time of day and any additional required parameters (see figure 2).

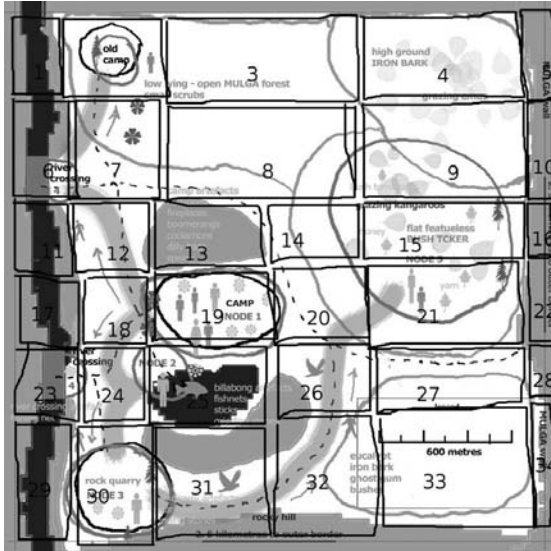


Figure 2: Checkerboard quilt layout of region-specific audio cells.

9. Preliminary Evaluation

The first iteration of this system was evaluated within the project team. Not surprisingly, it proved to be better than what was previously used within the DSE (the looping ambient schema). However, once 3D models and characters were added to the scene, the overhead was too great, resulting in poor performance for both sound and graphical components. Also, difficulty with other animated models within the world, such as birds and non-player characters (such as a human or animal bot in the world that runs on AI and not controlled by a user) through the system triggering these cells. A solution needed to be found that would address these issues.

10. Implementing an Improved 3D Ambient Audio System in the DSE

With the problem of the unacceptably high overhead caused by the first iteration of this system and the triggering action of other objects in the scene, a revised system was developed which leveraged the capacity of the DSE's bitMap code functionality. BitMap codes are usually used for the population of vegetation, specifically grasses, within the DSE world. For example,

a bitMap code is used to analyse a prepared .png overlay on the map to determine what type of grass and level of density is needed to populate a specific region.

10.1 Using Graphics Algorithms to Port Audio

We used this semi-random assignment feature of the bitMap code using audio assets in place of models and textures. By implementing the bitMap code for audio, within a controlled radius of the client machine avatar, the ambient audio quilt could be "generated" in real time from a similarly pre-prepared .png overlay. No actual sound generation was taking effect, as every sound was sourced from the prepared sound bank. What was being generated was an algorithmically generated density, placed in a 3-axes coordinated system with a high level of control achieved.

For example, we could place a group of frogs around a water source. We could control the density of sounds, yet the computer dealt with where to place the objects, which sound file to use (from the given sound bank), and randomly constrain their placement within the x y z axes.

The use of the bitMap code functionality reduced the overall overhead and made the DSE navigable again. With this implementation, the ambient audio system can be used for dealing with populations of large and small birds, crickets and frogs on the map, among other collections.

Moving around the map gives one the illusion of different aural soundscapes. When returning to a region, the density and placement of subsequent audio emitters may have changed due to the random nature of the algorithmic system, generating the desired different aural soundscapes.

The system is extendable to handle any additional audio materials, with unique density and placement logic for the algorithms to process and deal with. Combined with looping area effects (such as wind), DSE's Ambient Audio Quilt provides a more accurate aural representation of the landscape than existed under the standard TGE technology.

10.2 A Simulated Aural Experience

With this system we could capture all the sounds of the environment, rendering them algorithmically in real-time. For example, if one walks into a region of bushland in the DSE 3DVE it generates an ambient audio environment in 3D specific to that region of bushland. One might walk through a cluster of trees and hear birds over there, birds over here, but one doesn't know where they are because the sounds are generated

algorithmically. What this approach also means is that if one leaves the region and comes back later it will have changed.

This approach came about as a direct result of the experiences encountered on site in the Carnarvon Gorge. It satisfies both our desire for an authentic and accurate simulation of the environment and provides a sensitive setting for the stories to be told.

11. Conclusion

The audio quilt described here provides for an authentic aural experience in the DSE. This forms a critical part of a highly contextualised cultural heritage knowledge toolkit. The importance of contextualising the stories gathered from the community elders is paramount in addressing the sensitivity of their telling. A key tenet of the project is to protect, preserve and promote Australian Indigenous culture, its practices, myths and legends, expanding and re-vitalizing its culture through visualization in a 3D virtual environment. As such, the audio quilt project helps contextualise the virtual landscape with an authentic soundscape where feeling, knowing, touching, and hearing the country, kin and spirit can be experienced.

12. Acknowledgements

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