

Wheel of Time

The Buddhist Kalachakra Mandala Ceremony in a Three-Dimensional Real Time Virtual Environment

Using Virtual Ritual Representation as a Pedagogical Tool

Melissa Paige Taylor

Thesis Project Design Document

MS : Information Design & Technology

Spring 2006

Thesis Committee:

Michael Nitsche - chair

Eugene Thacker

Mirtha Ferrer

Table of Contents

4	Abstract
5	Introduction
9	Virtual Environments in Pedagogy
11	Ritual Context <ul style="list-style-type: none">- <i>Conducting Rituals in Virtual Spaces</i>- <i>Significance of the Kalachakra Mandala Ritual</i>- <i>Significance of the Mahabodhi Temple</i>
15	Project Problem Space <ul style="list-style-type: none">- <i>Creating a Sacred Space within a Virtual World</i>- <i>Addressing Multi-Sensory Aspects of the Ritual within a Virtual Space</i>- <i>The Mapping of Time Within the Virtual Ritual Environment</i>- <i>The Integration of Additional Descriptive Information Within the 3DRTVE</i>
19	Educational Value of “Wheel of Time” <ul style="list-style-type: none">- <i>Ritual Art Creation Within the Context of Religious and Cultural Studies</i>- <i>Virtual Heritage and Travel</i>- <i>Virtual Galleries</i>
21	Design Methodology
24	Application Introduction
25	Environment 01: <i>Pathway to Mahabodhi Temple & Tree of Enlightenment</i>
27	Environment 02 - Main: <i>Mandala Creation Room</i>
29	Environment 02.1 - Sub-Location of Main: <i>Mandala Creation Process</i>
31	Environment 02.2 - Sub-Location of Main: <i>3D Mandala Extrusion</i>

Table of Contents *(continued)*

33	Evaluation Results
35	Future Development
36	Conclusion
37	Related Works
42	Appendix
50	Bibliography
53	Acknowledgements

Abstract

The goal of this project is to create a screen-based, three-dimensional real time virtual environment (3DRTVE) that can be used as a pedagogical tool. Within this 3DRTVE, a user is able to gain knowledge about and participate in a simulation of the Buddhist Kalachakra mandala ritual within the context of virtual historic and sacred Buddhist sites. As s/he does so, the user gets a sense of the ceremonial process, as well as engages in an event that is simultaneously informative and meditative. This virtual environment serves three purposes within its educational focus.

- 1 It acts as a guide to a user throughout the virtual enactment of a mandala ritual, offering the student an immersive method of learning about an unfamiliar ceremony.
- 2 It serves as a virtual heritage simulation, providing a record of both a Buddhist sacred space and ritual performance.
- 3 It provides a virtual gallery setting, where users can activate and view descriptive images that depict important aspects of Kalachakra, the initiation, and mandala building.

Introduction

In December 2004, WIRED magazine published an article about a man, Yitzhaq Hayut-Man, who had devised a plan to use technology in order to fulfill a Jewish prophecy that would bring about the coming of the Messiah. Currently, the Muslim holy site the Dome of the Rock occupies a 35-acre patch of land, one where Jewish doctrine states that a temple must be built to call the Messiah back to earth and propel the world into a time of peace. Hayut-Man's idea involves creating:

"...a hovering holographic temple. Hayutman (sic) wants to set up an array of high-powered, water-cooled lasers and fire them into a transparent cube suspended beneath a blimp. The ephemeral, flickering image, he says, would fulfill an ancient, widely revered Jewish prophecy that the temple will descend from the heavens as a manifestation of light." [1]

After reading this, one might consider the manner in which new digital technologies that have never before existed are being gradually integrated into people's religious and spiritual lives, allowing them to engage with other members of their religious community and

further the aims of the teachings in new, more globally reaching ways. But beyond the communal aspects of the Internet's influence on religion and spirituality, it is worth examining how visual representations have consistently played a large role as spiritual teaching aids throughout history, and how dynamic, digital representations of symbols and icons might provide new ways of teaching about these subjects.

In order to present this project's subject matter, certain humanistic conventions were considered. It has been regarded within a long artistic tradition that viewing a piece of art in a significant, meaningful way can induce a transcendent experience within a receptive viewer (the romantic ideal of the Sublime). Kant's view of the Sublime is especially relevant here, where the viewer experiences an internal contradiction of feelings. McCormack and Dorin express the idea of sublimity as:

"...the tension created between pleasure and fear – the pleasure of knowing that we can be aware of what we can-

(continued)

Introduction

not experience and the fear that there exist things that are too vast or powerful for us to experience.” [2]

Likewise, a willing person pursuing some sort of religious/spiritual practice possesses similar receptivity and feelings of awe when contemplating their religion’s supreme being(s). Therefore, creating an aesthetically pleasing, immersive experience based on the icons and rituals of a religion, both of which are a remediation of an abstract concept, object, or previous event, affords the possibility of facilitating a user’s spiritual growth, or in the case of this project, offering up a sensorially rich, educational interaction, one which will increase the user’s retention of the subject matter.

Within certain religions, the viewing of the representations is significant, but the creation of the artistic pieces also holds spiritual value. Within Buddhism, the building of a mandala, which is an intricate symbolic design, is a form of ritual art where those creating it meditate on the symbolic significance of its individual components as it is being constructed. Artists creating a non-sacred piece of art also sometimes experience a transcendent or “trance-like” state of being, where the passage of time seems relatively slowed down or sped up. In the realm of game play, a similar experience

can happen; this phenomenon is called into play within Csikszentmihalyi’s Flow Theory, where “...sense of duration of time is altered.” [3] These parallels lead to a design problem of how to create a virtual environment that expresses such a flow on both the creative and game-world levels.

In the areas of Religion and Cultural Studies, historical and conceptual ideas about religious beliefs and practices must be taught, and utilizing pictorial representations has historically been a means of presenting these teachings, especially since many of the ideas expressed are concepts that can be seen only symbolically. VEs have a tradition of serving as educational tools, but they have often been used to teach concepts based on concrete real-world facts and phenomena, particularly in the area of science. Astronomy [4], chemistry [5] and anatomy [6] are just some of the areas which have taken advantage of virtual representative technology as a teaching tool. Some VE developers (such as IDT’s former students Grace Ou and Jeff Weese) design imaginary environments to teach these scientific facts. A strength of virtual environments allows designer/developers to make simulations that creatively portray the abstract (or even invisible, as in the case of molecules and chemical compounds),

(continued)

Introduction

making the subject matter more appealing for its learners.

This possibility for both abstract and concrete representation within virtual environments is particularly germane when dealing with the teachings in the areas of Religion and Cultural Studies, since the higher concepts of a religious belief may be portrayed symbolically. Additionally, depictions of actual locations and artifacts of historical relevance may be incorporated into the world, so that a combination of real world references appear as a contextually relevant backdrop for the presentation of esoteric religious concepts.

In the “Wheel of Time” virtual environment, the before-mentioned aspects have been integrated into virtual worlds that juxtapose impressionistic depictions of real environments next to information that clarifies an abstract Buddhist ritual by adding visual, textural, textual, and auditory sensory information, all of which introduces new material by addressing different arenas of the user’s attention. The subject matter is presented in a way that introduces factual information to the user as s/he explores the space, while allowing for the possibility of a meditative experience for those who subscribe to the Buddhist ideology. This essay

will address conceptual and practical facets of this project, such as virtual environments in pedagogy, ritual context, the problem space in which this application operates, and its educational value.

Notes on the Application’s Use:

In Religion and Cultural Studies, a challenge faced by those presenting information about different religions, particularly ones which are in the minority, is that of teaching about the religion without encouraging students to convert. The concepts presented within this application relate to spiritual practices, but are not presented as recommendations towards a particular religious ideology, in the sense that intentional editorializing is not included. The information presented is related to the historical and symbolic significance of the Kalachakra initiation and its components, and while the virtual mandala creation is intended to be calm and meditative, it is not a venue for conversion in any sense. This application would be used within the context of a college Cultural or Religious Studies classroom situation, where users would be aware and accepting of the fact that they will be exposed to the ideas of spiritual practices, even those that are outside of their own circle of experience. However, this

(continued)

Introduction

simulation may also be used in the case that an individual is considering his/her own participation in the Kalachakra initiation, and wishes to gain more knowledge about the ceremonies.

Virtual Environments in Pedagogy

Within the realm of virtual environments exists extensive opportunities for developing different types of action-oriented and exploratory teaching aids. This has been seen in well-known examples such as flight simulators, virtual surgery applications, and military games such as "America's Army", where the environment, storylines (if applicable), and interactions act as training mechanisms for the user.

While not as immersive as true virtual reality environments, graphically descriptive 3DRTVEs offer opportunities of constructivist learning to users, where the user learns through the manipulation of objects. This pedagogical theory of constructivism "...assumes there are multiple perspectives through which individuals may view the world. Individuals construct these perspectives by building mental models and new mental models are more easily built when they are linked to individuals' existing mental representations." [7] Constructivism is a prominent theory often cited within research on VEs used as teaching tools. According to Dewey, "...a situation represents the experiences of the environment affecting the learner, and interaction takes place between the learner and his or her environment. So, knowledge is based on

active experience." [8] This project engages students in a constructivist manner by allowing them to virtually interact with the mandala-building objects within the ritual space.

Researchers Bricken and Byrne also stated that when users interact with virtual objects in a VE, they seem to gain a more conceptual understanding of the subject matter. [9] This was attributed to the transparent interface, where "...knowledge representation... allows learners to approach some concepts as first-person non-symbolic experiences, whereas too often information is codified and represented as 'third-person symbolic experiences'." [10] It is because of this, as well as the personal nature of ritual interaction, that a first-person point of view is utilized within the virtual ritual.

While pedagogical VEs have been well documented in the domain of the sciences, using these environments to teach about rituals has occurred less frequently. Still, some researchers have realized the teaching potential, and have created virtual rituals, such as in Cruz-Neira and Sanford's "Virtual Hindu Ritual" (see *Related Works*). Because rituals are procedural by nature, and are often carried out in a linear

(continued)

Virtual Environments in Pedagogy

fashion, they lend themselves to the type of virtual recreation offered in this project.

Another realm where VE's serve as pedagogical tools involves that of virtual heritage, a movement that has developed within the past twenty years, alongside the increased capabilities of video game and virtual reality graphics. Proponents of the virtual heritage movement stated in 2000:

"Virtual heritage has become increasingly important in the conservation, preservation, and interpretation of our cultural and natural history. Many of the world's treasures are in danger of being lost or destroyed, causing irreparable damage to human understanding and extinction of our natural wonders.... technology is solving one of the largest problematic issues concerning cultural heritage assets – non-destructive public access."[11]

There are some individuals who insist that this focus on the virtual causes society to lose sight of the importance of maintenance of the real [12]; however, a large community of researchers in the fields of graphics, anthropology, and cultural studies maintain that there is value in designing representational environments of historical sites. An added benefit of this project's environment is that it also preserves a very specific cultural practice. This VE allows a user insight into a ceremony which, until the current

Dalai Lama came into his role, was a closely guarded secret. While more information about the initiation is available than before, the actual action of creating this mandala during the initiation is reserved only for very learned monks who have practiced the execution and learned the significance of each mandala component. In this VE, users are offered a glimpse into a very exclusive ritual practice.

The "Wheel of Time" 3DRTVE utilizes both the constructivist "learning by doing" principle of simulated enacting to teach about the mandala ritual, and uses the spatial, architectural, and historic aspects of virtual heritage applications to provide an effective educational experience by contextualizing the ritual's performance.

Ritual Context

Conducting Rituals in Virtual Spaces

While certainly representations of religious figures, events, and ideas have played a significant role in religious ritual throughout history, one can deduce the complexity of integrating religious practice within the fused dichotomy of representation and experience of virtual environments. Within virtual reality is the representation of artifacts, but these virtual objects seem to have a sense of place, taking up virtual space. Once a person is interacting within this virtual space, he/she has "...the opportunity to conduct almost any ritual, regardless of time, place, or one's hierarchical status (e.g., not being officially consecrated as clergy)." [13] When in a virtual reality environment, a person may also try out different religious practices, without potential uncomfortable social consequences, or choose various rituals as a method of creating his/her personal traditions. In the beginning of virtual reality interactions, it may require a period of acclimation, but once this threshold has been crossed, a user acts within multiple liminal times and spaces: existing between real and virtual world, as well as between pre-ritual and post-ritual existence. Victor Turner defines "liminal" as "being-on-a-threshold",

and states, "Since liminal time is not controlled by the clock it is a time of enchantment when anything might, or even should, happen." [14] The development of a virtual ritual space builds upon his notion of unlimited expressive potential.

Michael Heim compares the entering of cyberspace to the notion of participating in a Zen tea ceremony. He proposes that as researchers move forward in their design for the Internet and other computer-related interactions, the totality of people's engagement needs to be addressed, including not only the conventional human factors aspects, but also the psychic ontological experience of moving through virtual spaces. "As an intercultural testing ground, though, the Internet with its 3D spatial metaphors offers opportunities for translating aesthetic spatial experiences, like the tea ceremony." He further asserts that actually translating the tea ceremony to cyberspace would be an impetus that challenges us to think of interface design differently. [15]

Another researcher interested in the integration of spirituality and technology, Wertheim looks at how we view virtual reality today and

(continued)

Ritual Context

compares this perception to that of how art and religion was viewed in medieval times. She traces through history the emphasis on spiritual spaces in the middle ages to the focus on physical space imparted by modern-day physics. She hypothesizes that cyberspace offers an immaterial world where people can commune, much in the same way the theology of medieval times offered heaven as an ideal place where the non-physical souls could congregate. [16]

These examples lay a philosophical groundwork in creating virtual ritual spaces, while bringing the multiple layers of action within which a user engages into focus. When a person is interacting within a 3DRTVE, s/he is participating in (at least) two levels of interaction: interaction with the controller (video game controller, joystick, keyboard) and the simulated action which is being enacted within the virtual space. The interactivity is the means through which users become engaged within a participatory context. When introducing ritual engagement into a virtual environment, there is yet another level of remediation where the ritual is an act symbolizing some other level of meaning, whether historical, spiritual, or personal. The representation of a representation adds layers to the multiple symbols portrayed.

An example of this can be seen in Laurel and Strickland's virtual reality piece *Placeholder*, where real and virtual elements are integrated in order to form an interactive narrative about indigenous cultures in Canada. While their simulations involve multiple participants, spiritual myths and iconography are revealed, and users see through the eyes of the spirit creature which they may virtually inhabit. In their VE, the users' participation allows them to become immersed in this culture's mythological narrative. [17] Again, the virtual environment's ability to creatively express that which can not be seen is of value here, as well as the users' ability to interact with these aspects and see through another's eyes.

In this project, it is through this participatory agency that users are afforded the ability to learn about the practical aspects of mandala execution, as well as experience the remediated aspects of its symbology. Beyond this, a user takes on the role of a learned monk so that s/he may create the virtual mandala.

Significance of the Kalachakra Mandala Ritual

"Mandala" is Sanskrit for "circle, community or connection". There exist many different man-

(continued)

Ritual Context

dalas within Buddhism, each with a specific symbolic significance. There are commonalities across all mandalas, however, in that each one is a representation of a palace where a specific deity (representing a specific quality, such as bliss or compassion) resides. The deity is depicted within its center, and the mansion itself is contained within a circle. These designs, although 2D in actuality, represent a 3D spatial configuration. Traditional Tibetan mandala ceremonies generally include the use of colored sand as the medium for creating the design, where, at the end, the mandala is “dismantled”, or destroyed, at a closing ceremony. This destruction of such a painstakingly-crafted image connotes the Buddhist idea of impermanence.

The Kalachakra Mandala was, up until recently, a closely guarded ritual held within the ranks of the initiates of Buddhist monks. However, the current Dalai Lama (His Holiness the XIV Dalai Lama) felt that it would be worthwhile to provide it as a cultural offering to the world in order to facilitate understanding of Buddhism, as well as to circulate its symbolic message of peace. Even with its more public performances, it is still regarded to be a very meaningful and important mandala ritual. “Kalachakra” translates into Sanskrit as “Wheel of Time”. It represents in Tibetan (or Tantric) Buddhism concepts

of physical balance and peace for both the individual and the world at large. [18] When the mandala is dismantled, half of the sand is usually given to the attendees of the ceremony, while the other half is poured into a nearby river, both methods of dispersion symbolically spreading the Kalachakra’s peaceful energy throughout the world.

Significance of the Mahabodhi Temple

The Mahabodhi Temple is one of the most prominent pilgrimage sites for Buddhism. This temple is located at Bodhgaya in India, and is believed to be the location where Siddhartha Gautama sat underneath a bodhi tree and achieved Enlightenment; it was at this point that he became the Buddha. What is believed to be a descendant of the actual bodhi tree where this event took place sits behind the Mahabodhi Temple. Mahabodhi Temple was built approximately 250 years after Buddha achieved his Enlightenment, around 250 BC. The Buddhist emperor Ashoka is credited with its construction.

The Kalachakra initiation has been held at this location on four separate occasions, although the 2002 initiation needed to be postponed because of the Dalai Lama’s illness. Because the Kalachakra initiation has been held here more

(continued)

Ritual Context

than in any other place during the XIV Dalai Lama's reign, Bodhgaya's temple landmark was used as a marker in this VE to establish a real geographical sense of place, although elements have been designed as impressionistic representations.

Project Problem Space

Core Conceptual Goals

These are the four topics which I address in this project's design and implementation.

Creating a Sacred Space within a Virtual World

Virtual environments have been called "liminal spaces, sacred places of social and personal transformation..., neither imaginary nor real, ...[they are] a subjunctive realm of externalized imagination where events happen in effect but not [in actuality]." [19] While this is certainly a subjective viewpoint, it touches on the idea of how a designer might consider re-creating a sacred space of the real world within a VE. These notions of the sacred are also quite subjective, in that what constitutes "sacred" varies from person to person. According to the Bachelard, it is the individual's changing of place which creates the meaning:

"By changing space, by leaving the space of one's usual sensibilities, one enters into communication that is physically innovating. For we do not change place, we change our nature."[20]

Within this viewpoint, the user can move virtually through the space, and even change it through his/her actions, and it is through these spatial explorations that one might experience a personal change, whether it be mental or spiritual.

Other designers and researchers have offered their own opinions on how to merge the sacred with virtual spaces. One such paper describes Michael Heim's usage of the Taoist concept of feng shui in his analysis for creating flow within virtual environments. He highlights four areas of flow within 3D avatar worlds used for online teaching and communications: atmospheric flow, the flow of words with visual images, the flow of group dynamics, and flow between virtual and physical architecture [21]. The atmospheric flow and the flow of words with visual images are relevant to my design as it acts as a navigable learning environment. Interaction, environment and information design takes these items into consideration in order to facilitate a smooth interaction within the ritual space. This "smoothness" is essential for keeping the user's attention focused on the experience and information being presented, rather than the technical difficulties caused by

(continued)

Problem Space

poor interaction schemes or glitches within the program.

Along these lines, trouble-shooting for bugs or other software difficulties well in advance of any demonstration has been integral to this VE providing an engaging and immersive experience; it is the depth of this engagement and immersion that offer a better chance of a user feeling as if s/he has experienced a sacred space. In addition, user testing has given a good indication of where the interactions brought hindrances into the forefront, rather than the subject matter presented.

This project's approach is to closely follow the actualities of the ritual by basing my VE on the sequence that monks use in building the mandala; this defines what colors appear at what point in the ritual, as well as the order that the details are laid down. As the ritual and the Mahabodhi Temple are considered by many to be sacred, it is essential that they are represented in as authentic and detailed a manner as possible as a measure of proper respect. The Kalachakra mandala ceremony and Mahabodhi Temple are both deemed to be sacred, or at the very least, culturally and historically significant. By using researched representations of these spaces and temporal events, as well

as by offering simple interactions mapped to appropriate gestures, a virtual environment has been constructed that affords possibilities for both educational and spiritual edification.

Addressing Multi-Sensory Aspects of the Ritual within a Virtual Space

Educators claim that the presentation of multiple relevant sensory inputs in a learning environment aid in the memorization of the information being presented.

"Results strongly indicate that increasing the modalities of sensory input in a virtual environment can increase both the sense of presence and memory for objects in the environment. In particular, the addition of tactile, olfactory and auditory cues to a virtual environment increased the user's sense of presence and memory of the environment. Surprisingly, increasing the level of visual detail did not result in an increase in the user's sense of presence or memory of the environment." [22]

Because screen-based virtual environments typically engage the user only through visual and auditory senses, it is necessary to make the ritual experience as vivid as possible through these two avenues. Unless one is participating in a ritual within an actual virtual reality space, or using specially designed physical controllers, avenues for movement-based and haptic inter-

(continued)

Problem Space

action schemes are limited within the realm of screen-based VEs.

The mapping of gestures within this VE has been particularly important, since the creators of the mandala use a tool called a chakpu (the metal sticks that monks use to lay down the sand). Future iterations of this project could potentially include the creation of a physical “chakpu” controller. For the purposes of this phase of the project, the development of such controllers has not been considered, although a 3D model of the chakpu has been used in the VE as a pointing device.

One method used to increase the level of immersion, since tactile features have not been integrated, is the integration of sound within the VE. These sounds are linked to specific actions, locales, and milestones within the ritual event, and act as markers within the spatial-temporal constructs of the space. Chants, Buddhist music, and bells are some of the auditory cues which are utilized.

The Mapping of Time Within the Virtual Ritual Environment

This virtual ceremony gives a student a detailed overview of its execution and meaning, but it

is limited by the parameters of time and experiential knowledge. Because the Kalachakra mandala ceremony typically takes twelve days, there is an obvious need to condense this ritual into a more manageable time frame. For a teaching tool, it needed to be condensed. As stated previously, this project begins by offering interaction instructions and background information on the significance of the VE’s subject matter; this instruction must be read by the user before s/he can proceed with the interactions.

The mandala ritual has prominent ceremonial markers in the beginning and the end of the process, involving monks in full regalia, with chanting and playing of instruments. These portions of the ritual are shown in the gallery space in photographic form. The actual creation is more of a meditative process, during which the creators (usually monks) focus their attention on the task at hand and the symbolism of the mandala which is being constructed. It is this contemplative segment of the ritual in which the user participates, within a significantly condensed time frame. The granularity of detail within the mandala’s construction determines the time it takes to complete it.

(continued)

Problem Space

The Integration of Additional Descriptive Information Within the 3DRTVE

The three gallery spaces show supplementary visual and textual layers of information. Users must view a record of these represented places and rituals as they exist in the real world, and must reveal a certain number of these images in order to proceed with the mandala creation sequence. This constitutes a method of virtually initiating him/herself in a shorter and broader, but still descriptive and relevant, manner. Through the users interaction, s/he is granted access to deeper layers of instruction.

The audio is particularly useful in offering additional ambiance. The auditory modality is engaged as users move throughout the space; as the user triggers the images' revelation, sounds used in Buddhist meditation are played. These sounds, such as Tibetan singing bowls and chants from Buddhist monks offer users audio information that provides additional contextualization within the Kalachakra rituals. This auditory information, although not explicitly described as being tied to these Buddhist ceremonies, create a mental perception of the musical and tonal particularities that correspond with these rituals.

Educational Value of “Wheel of Time”

This application is a logical extension of VE's remediation abilities. Within this screen-based simulation exist three significant educational foci.

Ritual Art Creation Within the Context of Religious and Cultural Studies

This VE affords the means for a user to virtually enact portions of the Kalachakra mandala ritual. This simulation gives users an idea of the repetitive and meditative elements which are part of meticulously creating a piece of ritual art. Even though this simulation uses pixels instead of sand grains, the process is still one that requires extreme patience. Since this virtual mandala does not require the technical and aesthetic expertise, text and images are displayed throughout the application which call attention to this inherent difference. The users are, however, required to learn a simple sequence of mouse movements and keystrokes, which requires a certain amount of basic memorization and manual dexterity.

Each of the created mandala layers has a corresponding symbolic meaning which the mandala's creators must learn; as they lay down

the sand designs, they meditate and visualize the components which are symbolized in the mandala. This application gives Religious and Cultural Studies students, as well as those interested in Buddhism and the Kalachakra rituals, a broad yet thorough overview of relevant historical, symbolic, ideological, and logistical information. In terms of constructivist learning theory, during the mandala creation sequence, users are afforded access to contextualization information which is unavailable in both the real-world mandala enactment and book descriptions of the ritual: users are afforded simultaneous access to both the mandala layer and its symbolic meaning via textual explanation.

Virtual Heritage and Travel

Placing the ceremony within the context of the Mahabodhi Temple adds a virtual heritage and travel component, in addition to that of the primary Kalachakra exposition of this project. The Kalachakra initiation has been held around the Mahabodhi Temple numerous times, because of its great significance within the Buddhist belief system. Contextualizing the ceremony within a true historic locale, one which individuals could actually visit in the real world, is one way cho-

(continued)

3 Educational Foci in "Wheel of Time"

sen to make the ceremony seem more concrete, since the ceremony is somewhat abstract and esoteric in and of itself.

Because of Tibetan Buddhism's past history, especially with respect to China's invasion of Tibet on 26 October 1950 and the consequential loss of Buddhist life and many of their artifacts, cultural preservation has become a strong cause within the Buddhist community. Projects such as "Buddhist Basics & Kalachakra Animated" and websites such as Buddhanet.net and Kalachakranet.org serve as resources and repositories for information on Kalachakra and Buddhism in general. This project can be considered valuable in this regard.

Virtual Galleries

An added benefit of this prototype's spatiality involves the development of three different virtual galleries. Instead of browsing images in an online fashion, the user browses images in a simulated spatial manner. The user can move leisurely through the space, much as one might explore a museum or gallery in the real world, but his/her motion will trigger the revelation of germane images and text.

The gallery image reveals are accomplished in three different ways: a fade in from complete transparency, a fade in from a black plane, and a vertical animation positioning the image at the virtual eye-level of the user. Each one of these methods was chosen to correspond with the purpose and mood of its respective surrounding environment. Experimentation with different expository methods enliven the exploratory experience of the individual spaces.

Design Methodology

Kaur offers suggestions for a design methodology for virtual environments, which were used in the development of this project. In this section, the five step VE design methodology is listed, and is described in detail. [23]

Requirements specification

In developing this project, the prominent goal is to offer a learning tool that can be utilized by the largest number of educators possible, while delivering content to a receptive group of students. When determining the requirements, definition of the audience was key. Since the content of the Kalachakra ritual is somewhat esoteric for those who are unfamiliar with it, a more mature audience was chosen as potential students who might benefit from this application. College-level Religion or Cultural Studies students was specified as the target audience.

In order to make the application more accessible to a broader number of people, it has been designed as a screen-based virtual environment. While the project certainly lends itself to a virtual reality application scenario, VR technology is extremely specialized, and the number of institutions having access to it are

few compared to those with computers and internet access. Additionally, the implementation schedule called for screen-based development, since VR capabilities could be added at a later time.

Virtools has a web player, to which the application can be exported. While the application is somewhat large in file size, and therefore might require significant download time depending on the facility's internet connection speed, the fact that it can be downloaded onto anyone's computer that is outfitted with the appropriate Virtools viewer allows for a large population of potential educators and students to have access to it.

A first-person narrative viewpoint was chosen as an additional constructivist consideration, in order to present the exploratory experience and ritual enactment as the user's own. It is through this personal virtual experience that the user's knowledge retention can be enforced.

(continued)
Design Methodology

Gathering of reference material from real world objects

Since traveling to India was not a viable option during the course of this project, finding visual references in other ways was important in developing the virtual ritual and its situating environment. Reading about where the Kalachakra initiation has been held served as a starting point, but it was necessary to find images of the ritual and its performance. Having both filmic and photographic records of the Kalachakra initiation aided tremendously in the mapping and design of the ritual space, as well as the methods and locations of contextual information presentation. It is worthwhile to note that this project would have been almost impossible to create thirty years ago; apart from the obvious technological developments, the information on this ritual, both visual and textual, was not available until the Dalai Lama made details about the ritual available to the general population.

Bryant's book on the Kalachakra mandala was essential in designing the mandala creation ritual. It details the mandala building, step by step, elaborating on each part's symbolic meaning. Since this reference provided the core content for the mandala sequence, the application could possibly serve as a corresponding interactive supplement to the book.

While many photographs of the Mahabodhi Temple are available on the internet and in books, lack of spatial exploration of the real-world space made it difficult to construct an accurately detailed representation of Mahabodhi and its surrounding grounds. More impressionistic modes of representation were utilized to visually signify the temple environment.

Structuring the graphical model and, sometimes, dividing it between designers

After the research of the ritual and its placement, a list of objects was made which outlined exactly what would need to be constructed. Once the list was made, 2D aerial views were drawn in Adobe Illustrator to serve as a map for object placement in the worlds. Since I was the only designer on this project, there was no division of labor in developing the models.

Building objects and positioning them in the VE

Beginning with the core elements of the mandala room, each piece of the room was constructed in Autodesk's 3DS Max, exported as an .NMO, and then imported and assembled again in Virtools. The mandala room, with its gallery planes, the thekpu (mandala table), mandala layers, chakpu sticks, and the 3D

(continued)

Design Methodology

extrusion of the mandala were the most crucial elements to the support of the application's aims. Following their construction, the Mahabodhi environment was developed and assembled, and finally the summary planes for the 3D mandala temple extrusion were developed and imported.

Enhancing the environment with texture, lighting, sound and interaction, and optimizing the environment

Textures were based on photographic reference material, but were altered to be stylistically slightly less photo-realistic. The images and textures were filtered to appear rough-edged, and therefore, more organic. These stylistic treatments were implemented in order to create a more impressionistic view of the ritual and its creation, since the virtual version presented is also itself only an impression of the actual Kalachakra mandala ritual.

Interaction schemes were at first detailed in written steps, and then carried out in the Virtools assembly environment. Unforeseen flaws in the interaction schemes were discovered as the prototype was being developed and tested, and were subsequently corrected. Since part of this project involved learning Virtools as the project was in development,

many of the interactions, especially that of the mandala creation, were created by repeated experimentation with the assembly of the Virtools building block scripts.

Sound was one of the last elements to be added, after the objects were placed correctly and interactions were working properly. The sounds were pulled from the Buddhnet.net website's repository of Buddhist chants, sounds, and music MP3s. The sounds' placement in the environment was determined by the user executing specific steps or reaching specific points in the virtual world.

Lights were not utilized, since slow frame rate was an issue within this application.

Optimization of the environment is still in progress, since the prototype can be improved by continued testing and the addition of new features and environmental details.

Application Introduction

Within this application prototype, the user has the opportunity to explore an orienting space which offers insight into the Kalachakra initiation and basic tenets of Buddhism. The user may also choose to jump to a mandala building room, which introduces more specific information about the Kalachakra mandala and the technique, process, and history of the mandala creation. In both of these spaces, the user must explore in order to activate them, revealing pertinent information. It is only after the user has seen a specific number of informational panels that s/he may proceed to the mandala building.

While this forcing function would not be suitable in all applications, in this prototype it serves a necessary purpose. Within the Kalachakra initiation rites, a participant is only allowed to see the mandala after the conferring Lama has bestowed his teachings upon the students. It is in keeping with this tradition that this simulated enactment of the mandala creation requires the user to familiarize him/herself with certain basic facts about the significance of the virtual enactment in which s/he is about to engage. Because this ceremony holds such a high level of spiritual significance for partici-

pants and Buddhists all over the world, it was necessary to convey a sense of respect and magnitude for the process before the user is presented with the ability to create the (virtual) ritual art.

During the mandala creation, the user's viewpoint is situated at the Eastern side of the mandala. With mouse movements and keystrokes, the individual layers of sand are laid down and textual descriptions are displayed. During the process of creating each layer, the camera zooms in to offer a closer vantage point.

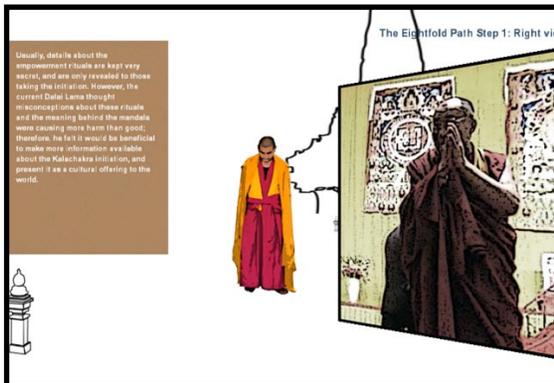
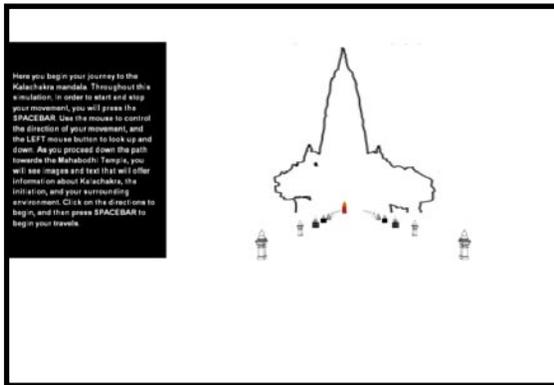
In the end, if the user is unable to finish the mandala (which, with a single user and the large number of mandala layers, this seems likely), the user may click on a button which allows him/her to finish the mandala. At this point, the full mandala is revealed, as well as a 3D extrusion of the mandala temple that the user may navigate spatially. During this exploration, summary text and images are discovered, and the user then has agency to click on a "Finish" button, which concludes the exercise.

The following offers detailed descriptions of the four active spaces.

Environment 01:

Pathway to Mahabodhi Temple & Tree of Enlightenment

Orientation



The orientation environment begins by offering the user instructions on navigation and what to expect as s/he moves through the space. The space is initially very spare; the surrounding space is completely white with only outlines of architectural references showing. These architectural planes present outlined sketches of the Mahabodhi Temple and some small pillars that lead to the western face of it.

Details are minimal at the start, for three reasons.

1. The revelation aspect applies here, where the user's activation of the space brings more color and detail to the environment. Once the user moves past certain triggers, illustrative images fade in, much like a developing photograph, creating a smooth and somewhat soothing reveal. If the user looks behind him/herself at any point, s/he can see how the world has been impacted by his/her movement.

2. As s/he moves through the virtual space,

colored explanatory textual planes show themselves, and the white background adds to the text's legibility. If, because of the user's camera angle, the text appears on top of the image and makes the text difficult to read, the user can readjust his/her view to create a better reading background.

3. Having not been to Bodh Gaya, India, it is quite difficult to create an accurate account of the environment, as well as to determine where the user should begin his/her journey towards the temple. Without the means to make well-informed decisions about proper locations, positions, and details of the large amount of objects within the real environment, I felt it was better to keep environment detail to a minimum. Because this location is extremely detailed, ornate, and spiritually significant to those who visit it, an obligation was felt to include the two most important pieces of the environment, the temple and the Tree of Enlightenment, and nothing else. In order to make proper decisions about Mahabodhi's

3D Model of Temple and Tree of Enlightenment



ALONG WAY STYLIZED GRAPHICAL DIRECTIONS OF MONKS AND BNY OUTLINE DRAWINGS OF STUPES AND TEMPLE APPEAR AS USER WALKS TOWARD 3D MODEL OF TEMPLE/BOODHI TREE AT STEP 12, BILLBOARDS FADE OUT, REVEALING FULL-COLOR 3d MODELLED TEMPLE ENVIRONMENT WHERE USERS CAN EXPLORE BEFORE BEGINNING THE MANDALA SECTION (PART 02)

12	Final Directions The Eightfold Path Step 8: Right concentration	^
11	Mahabodhi and Tree of Enlightenment The Eightfold Path Step 7: Right mindfulness	^
10	Defining Mandala -2 The Eightfold Path Step 6: Right effort	^
9	Defining Mandala - 1 The Eightfold Path Step 5: Right livelihood	^
8	Kalachakra Schedule/ Overview - 2 The Eightfold Path Step 4: Right action	^
7	Kalachakra Schedule/ Overview - 1 The Eightfold Path Step 3: Right speech	^
6	Dalai Lama presiding over Kalachakra ceremony The Eightfold Path Step 2: Right thought	^
5	Secrecy of Ritual / Cultural Offering The Eightfold Path Step 1: Right view	^
4	Kalachakra Tantra & World Peace Four Noble Truths: 4- Maggah: The way to the end of dissatisfaction is the path.	^
3	Receiving the Empowerment Four Noble Truths: 3- Nirvana: There's an end to all dissatisfaction.	^
2	Kalachakra Tantra Four Noble Truths: 2- Trishna: Dissatisfaction is a result of craving.	^
1	Kalachakra the Deity Four Noble Truths: 1 - Duhka: Life entails dissatisfaction.	^

START

Environment 01: (continued)

Pathway to Mahabodhi Temple & Tree of Enlightenment

recreation, an actual visit to the site might be in order, where extensive photography, video, and sketches could be made to facilitate the design of an accurate depiction of a Buddhist holy site.

The spatiality of this introductory environment is focused through a one-point perspective orientation. The temple outline appears in the distance, and the small pillars are placed along a path that leads to the temple; their illusionary convergence in the distance creates a focal point that cues the user to move towards it. While the user could theoretically move in any of the other directions (if not hindered by the environment's invisible walls), it is the provocation that something of interest is in the distance, and investigation might bring about new developments in this sparse world that drives the user in the right direction.

An added spatial reference is a dot of color that appears on the horizon at the start of the scene. As the user moves closer to the temple plane, the user becomes aware that this colored object is moving along the path towards him/her from the opposite direction. Eventually this object is close enough to be seen, and the user realizes that it is a Buddhist monk. Not only does this monk offer another directional guide, it also reminds the user of the context of

the initiation, and the fact that it is a social ritual involving others. In the future, more virtual participants should be added to create more of a populated and social atmosphere.

The user's progression connotes the journey that participants take to attend this initiation. It is often a long pilgrimage for those who decide to partake of it, and the journey requires not only commitment to the oaths that one takes during the ceremonies, but also a mental, physical, or even material commitment exacted by the travels.

At the end of the path, once the user has revealed eleven panels, the temple outline fades out so that it is completely invisible; this reveals a three-dimensional replica of the Tree of Enlightenment and the Mahabodhi Temple. This revelation is a reward for the user's progression along the path, and creates a transitional space that both contextualizes the Kalachakra mandala creation environment and allows the user to go there. Ideally, the user would be able to explore this space in detail and activate it as well; however, for this project, the mandala creation is the primary focus.

Environment 02 - Main:

Mandala Creation Room

Introduction to Mandala Creation



The user may get to the mandala creation room by either successfully navigating Environment 01, or by clicking on “Go to Mandala Environment” on the initial navigation screen. Once the user is in the mandala room, s/he has the ability to move through the room, setting off fades of various descriptive images and text about mandalas, their symbolism, and creation.

The mandala creation room’s exploration is guided by the positions of the image planes, as well as by the constraints of the room walls. This creates an intimate interior space within which the user can mentally prepare to create the virtual mandala.

In this room, there is the possibility for eight different images to be revealed. The revelation process is somewhat different than that of Environment 01. In this section, the user immediately sees unilluminated image planes suspended in mid-air. Because the navigation is less linear within this room, it seemed necessary to offer cues to the user about the loca-

tions of the planes, instead of having him/her wander around trying to activate them, and possibly causing frustration if all of them could not be found. Once the eight planes have been found, a button appears, allowing the user to move on to the mandala creation scenario.

This room’s design was based on the mandala building space shown in Werner Herzog’s documentary “Wheel of Time.” Because this environment’s depiction is derived from an actual historical event’s place, it adds a component of virtual heritage to this room. In Herzog’s film, the viewer is offered an inside view of the ritual space, even before those initiates outside have been shown the inner sanctum. This environment attempts to do the same thing, but with the added immersive element of the user being able to investigate the space and become more informed about the practice of mandala building before s/he sets out to enact a virtual version of the same.

Environment 02: (continued)

Mandala Creation Room



As this is an interior space, and the sanctified space of the ritual, more detail, color, and structure are offered. This also has a symbolic significance, in that if the user has participated in the journey of Part 01, s/he will notice this development of the environment's character, in contrast to the minimalist design of the introductory world. This signifies an ability on the part of the user to see more, because s/he has gained more knowledge about the subject matter.



From Werner Herzog's "Wheel of Time"

While this room is based on the mandala creation room from the 2002 Kalachakra initiation in Bodh Gaya, India, certain room objects have purposefully been left out, particularly in the areas of altars and wall tapestries. Simplicity is a key element in this room with respect to frame rate and smooth motion. Since the mandala creation section has close to one hundred layers hidden on the mandala table, waiting to be displayed, the speed of the screen redraw is adversely affected, even though the layers are invisible. Future iterations of this project would explore alternatives to solve this issue.

Allusions to the social/communal aspects of this ceremony are made using the text and images. Even outside the windows the user can see hundreds of people waiting expectantly for

the mandala to be completed and revealed. Because this ceremony operates on both an individual and communal level for the participants, it seemed viable that in this first prototype, the user could engage in this process singularly, in quiet contemplation. However, it would be desirable to include additional visual and auditory indicators of other individuals, as well as possibilities for group collaboration, in order to further the perception of the initiation community.

Environment 02.1 - Sub-Location of Main:

Mandala Creation Process

Virtual Mandala Execution



By the time the user reaches this point of mandala execution, s/he has been given necessary information to ground him/her in the basic significance, history, and procedures governing it. Because monks at the Namgyal Monastery must learn and practice mandala creation for three years before being allowed to work on the Kalachakra mandala, it was important for users of this to go through their own sort of initiation before being allowed to partake in this simulation. The creation of such ritual art holds high significance for the practitioners, and I felt it was necessary to convey that sense in such a way that users would begin the process informed and mentally prepared, especially since it is at this point that the user officially takes on the role of a learned monk within the simulation.

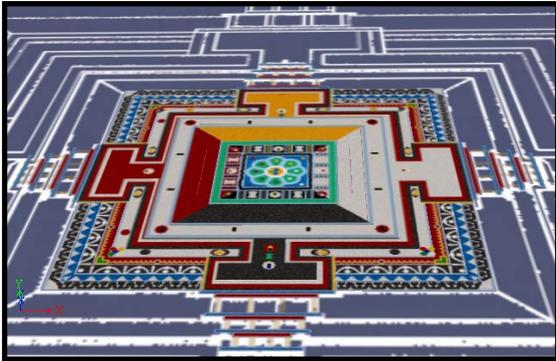
The mandala creation process begins with instructional text. Once the user clicks the instructions to hide them, s/he will notice the first blinking bowl of sand. As instructed by the initial directions, the user is afforded the

ability to use the mouse to move the chakpu sticks, which distribute the sand, over to the blinking bowl as a method of “picking the sand up.” When the sticks come into proximity of the blinking bowl of sand, the proper layer is shown, and blinks, calling attention to itself. At this same time, a light blue text box is shown which describes the symbolic meaning of the illuminated layer. Once the chakpu sticks are moved back over to the mandala’s blinking layer, the text plane disappears, and the user can press the SHIFT key to lay down the sand and move on to the next layer. The animation can only happen, however, when the sticks are located over the layer; this prevents the user from ignoring the important gestural component of the creation process. It is at this point that the next bowl begins its blinking, and the cycle is repeated.

While ideally this 3DRTVE would be exhibited within a true VR simulation, and would utilize physical controllers to control the onscreen chakpu funnels, the mouse was the best and

Environment 02.1: (continued)

Mandala Creation Process



closest corresponding physical controller that would work with a desktop-based application. With the mouse, the user is able to make sweeping gestures, adding a much-needed physicality to the procedure. The correspondence of mouse control to chakpu control is intended as a means of the mouse control being in the Heideggerian state of being “ready-to-hand”, inasmuch as the mouse can move freely across a flat, unencumbered surface. It remains a distal form of control, but possesses similar corresponding gestural attributes.

Once the user initiates the chakpu animated sequence, a sweeping view of the camera simulates the motion of a monk leaning in to the layer, creating a close-up of the small details being laid in. Once the layer is fully displayed, the camera zooms back out to its original orientation, where the user has a full view of the table and the next blinking sand bowl in the sequence.

This back and forth view and the mouse - chakpu controlling mechanism, while not as physically immersive as a VR simulation’s direct manipulation interface, does create a rhythmic pattern which can be somewhat meditative in and of itself, and also provides constraints while engaging the user gesturally and spatially.

One issue encountered while working on this project was within the area of granularity of detail within the domain of the mandala creation. Knowing that the mandala includes symbols of 722 different deities, as well as architectural and offering elements makes it obvious that there is an enormous amount of detail in the design, and each dot, symbol, and color has a cultural significance within Buddhism. One can conclude that if it takes eight-to-sixteen monks to create this intricate design accurately, it will take a single individual a large amount of time to create the same thing, even if s/he is using pre-made pixel-generated layers instead of ones comprised of sand.

At the beginning of this project, there was no real way to anticipate how long it would take to not only create all of these layers, but also for a user to go through the entire process. This raises two temporary measures which were implemented into this version of the project.

A user can press “Finish Mandala” at any time, and an image of the full mandala will fade in. This is a temporary measure, because the full mandala with its hundreds of layers was not completed during this phase of the project, and as of this demo, users can not save their progress in the mandala building sequence.

Environment 02.2 - Sub-Location of Main:

3D Mandala Extrusion

Summary Environment



A sculptural version of the Kalachakra mandala

Once a user either has come to the end of the mandala creation process (which, at this juncture, does not include the complete number of mandala layers and so is incomplete) or chooses to click on the “Finish Mandala” button, three things occur.

1. The mandala fades in on the table. In the application’s fully completed form, all of the mandala layers would fade in, revealing the mandala in its layered form; in this demo version, a bitmapped image of the complete mandala fades into full view;
2. A virtual 3D architectural extrusion of the mandala rises up through the 2D mandala shown on the mandala table;
3. The camera zooms down to the Eastern temple entrance.

Because sand mandalas are 2D representations of an imagined symbolic 3D space, it seems like a natural extension to create it as

a 3D object, and Buddhist practitioners have created 3D mandala sculptures in their own meditations. With the development of CAD/3D modeling technology, other researchers and designers have utilized these tools to depict the Kalachakra mandala, as well as others (see “Related Works”).

In the final Summary scene, the users are afforded the ability to explore the bottom level of the extruded Kalachakra temple, which serves as a virtual gallery environment. As users move through the space, they trigger images to rise up through the table in the same manner as the temple space does at the beginning of the scene.

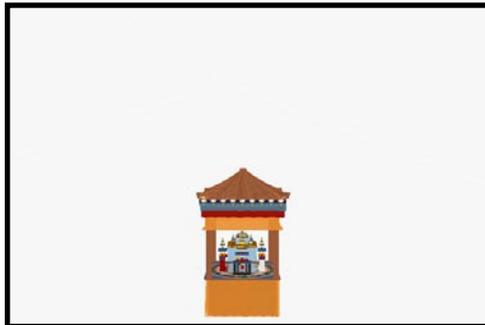
Once these images have all been triggered, a “Finish” button appears, where the user can end the simulation. The user is then transported up to the top tier of the temple, where the deity Kalachakra and his consort Vishvamata are revealed. The camera then flies out from the temple, to a distance where the full manda-

Environment 02.2: (continued)

3D Mandala Extrusion



la, its 3D component and the thekpu (mandala house) can be seen in their entirety. In order to symbolize the dismantling of the mandala, where all of the sand is swept away, the background turns gray, and the colorful mandala building elements fade out, leaving an empty gray screen. This “dismantling” representation alludes to the Buddhist concept of impermanence, which the sweeping away of the mandala signifies.



Evaluation Results

For my evaluations, I was able to get feedback from three different individuals. Changes that I was able to make in the second iteration phase are marked accordingly.

Evaluator A:

Evaluator A assessed the application from the viewpoint of a user. She has an Educational Technologies background, and has had little experience in the domain of computer games. She mainly utilizes computers for research, word processing, and internet browsing. Evaluator A is a librarian at an elementary school. The suggestions she offered were as follows:

1. Make the font size larger *
2. Explanation of interaction needs to be more clearly explained. *
3. Constrain camera so it is only forward and backward motion
4. Fix the proximity of the chakpu sticks to sand bowls and active mandala layer. *

5. Outline at beginning letting user what is coming next.

6. Add ever-present HELP menu

With regard to suggestion 3, because I am using a prescribed camera from Virtools resources, the camera speed can be modified. However, with the variances in my frame rate redraws, I do not wish to slow it down any further. Additionally, my other two evaluators, both of whom have experiences playing games, stated they would get bored easily if the camera speed was too slow.

Suggestion 5 could be added in a future iteration, but because of the nature of this project, I feel that offering too much information up front detracts from the exploratory and discovery aspects. Individuals new to a ritual are learning as they go, and I wanted to keep this quality within the project.

Suggestion 6 may be added in a future iteration, but was not implemented during this design phase.

(continued)
Evaluation Results

Evaluators B and C:

Evaluator B and C assessed the application from the viewpoint of interface and interaction designers. They are both graduate students at Georgia Tech, and participated in a simultaneous evaluation. During this evaluation, at first, I navigated through the environment while they watched. Evaluator B went on to interact with it, while Evaluator C observed. They both are extremely computer literate, and have had 3D game play experience. Their evaluation suggestions were as follows:

1. Make font size larger *
2. Make buttons look more like clickable buttons
*"I was not even aware those were clickable."
"I didn't know that was a button."*
3. Make buttons larger. *
"I didn't even see that [button] there."
4. Make it impossible for user to continue with interactions unless s/he clicks, and thus hides, the instructions. *
5. Add sounds *
6. Make sticks move in with camera movement so they aren't lost. *

7. Adjust camera position at beginning of mandala temple sequence.

8. Add more details to tree and temple 3D objects. *

Positive Feedback:

The evaluators overall felt this application provided an innovative exposition of concepts related to Buddhism and the Kalachakra initiation. While Evaluator A experienced difficulty in navigating the space based on her lack of spatial navigation in games, Evaluator B expressed his enjoyment of the spatial exploration and activation. The gradual reveal of images was also considered to be aesthetically pleasing, and in keeping with the initiation aspects of this simulation. The overall visual design of the interface and its spatial elements were considered to be attractive, and enhanced the user experience. The camera movements were thought to be a positive narrative aid, although suggestions were made about their positioning by B and C.

The two evaluators who actually interacted with the application both spent approximately 8-10 minutes exploring the environment(s).

Future Development

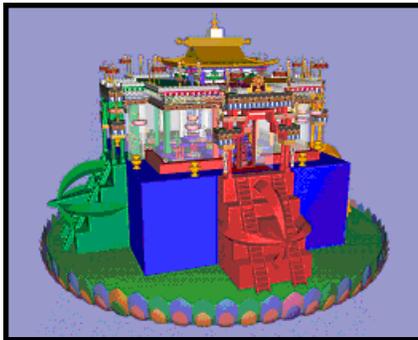
Future iterations of this project would benefit from the following additional features:

1. VR capabilities, utilizing physical controllers for the mandala creation process;
2. Localized sound;
3. Simultaneous multi-user capabilities, so that multiple users can collaborate on the mandala creation;
4. A "Save" function for the mandala creation process, so that user(s) may save their progress;
5. More accurate textures/models of
 - the Mahabodhi Temple
 - the 3D extruded mandala temple
 - the Tree of Enlightenment;
6. Additional lights and shadows to add to the environment's ambiance and realism;
7. Additional characters (not necessarily interactive), to act as indicators of social/ communal nature of Kalachakra initiation;
8. Ubiquitous "Help" functions.

Conclusion

There are multiple conclusions that can be derived from developing this project which support the use of virtual environments as teaching tools for Religion and Cultural Studies at a college level. Additionally, outside of academic learning environments, individuals interested in participating in the real Kalachakra initiation can learn more about it before taking real-world action. In using 3DRTVEs developed for these purposes, these students can view and participate in new or foreign rituals in a related contextual environment, adding to the depth of meaning behind the simulations. By providing multiple avenues of information presentation and virtual action, VEs have the potential to engage students through constructivist learning. Students can interact and experience places and rituals virtually without actually having to do so; in participating in these simulations, there is less personal risk and no need for actual travel. If designed correctly, virtual rituals have the added benefit of providing a meditative experience for receptive individuals. By utilizing visual, textual, spatial, and auditory modes of information presentation as well as the interactive capabilities of 3D real-time virtual environments, expressive and effective teaching tools can be developed that familiarize students with the subject of ritual performance.

Related Works



Exploring the Mandala

<http://www.graphics.cornell.edu/online/mandala/>

Between 1989-1990, a model of the Vajrabhairava mandala was created by Pema Losang Chogyen with his associates and students at Cornell University's Program of Computer Graphics. This model shows the mandala depicted in great detail in its 3D form. My project differs from this 3D mandala in a number of ways. First, the mandala in my VE will be created by users over a period of time. Also, the mandala in my project's space is a different mandala altogether, representing different deities and symbols. Finally, the Kalachakra mandala that is created within my VE will not be extruded to represent its 3D form; however, it will be created within a simulation of a 3D space, comparable to a real world mandala ceremony.



VR Ceremony for the Exchange of Information

http://www.templum.com/virtual_rite.htm

This ceremony's documentation can be found on a site that teaches Kabbalah and Magick to interested parties. Created in the Active World's environment in 1998, this ritual was designed by two individuals as a creative undertaking. While the designers did not create the VE themselves, they used it as a world where they could enact a script which they wrote. This ritual involves interactions and communication between two avatars within the online community space. My VE is based on an actual ritual, and does not include the imaginative conceptualization that this environment uses. The virtual mandala creation will only engage a single user at a time. Additionally, I will be creating my own world and objects instead of using a pre-existing VE such as Active Worlds.

(continued)

Related Works

Virtual Heritage Network

<http://www.virtualheritage.net/>

Formed in 2000, the Virtual Heritage Network is an organization dedicated to building a community of researchers who wish to “promote the utilisation of technology for the education, interpretation, conservation and preservation of Natural, Cultural and World Heritage.” On the website is a catalog of virtual heritage project papers, divided into categories of UNESCO World Heritage, Cultural Heritage, Natural Heritage, and Heritage Objects. I see my project as a valuable addition to this archive, in that I will be preserving both a physical historical environment, as well as a ritual practice that not everyone has the opportunity to experience for themselves.



Virtual Hindu Ritual

Carolina Cruz-Neira, Whitney Sanford

<http://www.vrac.iastate.edu/research/sites/h temple/>

At Iowa State University, Sanford and Cruz-Neira worked on creating a virtual simulation of a Hindu ritual performed in the Radharaman Temple in Vrindavan, India. With the immersive environment, intended as a pedagogical aid for Sanford’s students, Sanford feels that she can teach them about ritual as performance, use of space, sacred architecture and iconography. The website offers a strong argument for using VEs as a pedagogical tool in this manner: “When studying the world’s religious traditions, we investigate not only the beliefs and philosophies, but also the musical traditions, notions of sacred space and sacred images. Using an immersive digital storytelling approach opens up new areas of inquiry that reflect new research and teaching methods in the field of Religious Studies.” While not an actual virtual reality simulation, my project will leverage off of these types of narrative teaching methods within this field, while providing the user first hand experiences of the ritual performance.

(continued)

Related Works

Virtual Reality Vedi

<http://vedavid.org/VRML/vrmlintro.html>

This is a VR altar which is based on the agnihotra ritual. It was created in Virtual Reality Markup Language. Unfortunately, I was unable to make the demos work, but descriptions of the ritual's components seem to be thorough. The level of detail contained within the documentation of the vedic ritual provides a useful reference for my own documentation and instruction for the user's experience of the mandala ceremony.

Virtual Visits

http://www.pearsonpublishing.co.uk/virtual_visits/

The Virtual Visits series is a product put out by Pearson Publishing. Educational institutions can buy a CD-ROM designed as instructional aids for teaching about specified religious, historical, and geographical topics. These applications are set up more within the framework of a web interface; however, in the case of the "Temples" section, a user may click points shown on a floor plan, revealing a photo taken from the particular point within the temple. This method of describing 3D spaces within a 2D interface, while not as immersive as VEs or Quicktime VR, offers the user a better idea of how a space is defined than simply by showing a map, since it shows both an overhead view and the photographed view from the specified location within the room. My proposed VE will take this sense of locality even further by situating the user within a simulated 3D space that has both historical and religious importance. This more participatory interaction will aid in the students' mental retention of the information presented.

(continued)

Related Works



Cathedral of Santiago de Compostela

http://www.cvrlab.org/projects/real_time/santiago_compostela/santiago_compostela.html



UCLA's Cultural Virtual Reality Lab has created numerous VR spaces of historical and architectural significance in the name of virtual heritage. Santiago de Compostela was a medieval pilgrimage site in northwestern Spain, but not much of its original structure remains. The UCLA Virtual Reality Lab created a simulation of this cathedral, complete with songs and sounds thought to be typical of this thirteenth century pilgrimage site. Another such project is that of the Santa Maria Maggiore, an Early Christian basilica situated in Rome. [16] These projects focus on the realistic representation of a sacred space, and the space is not activated in any way. A user simply moves through the space, exploring it, and possibly getting a sense of what pilgrims might have felt when they arrived at the actual church. The mandala VE I am creating offers an architectural representation of Mahabodhi, but since it is not the primary focus of the environment, it is only being partially constructed. My space will give an overview of the temple's immediate grounds and architecture, but then will provide cues that will guide the user into the temple where the significant interaction scenario will take place. It is the activation of this space that is most important, although the sense of place is part of the ritual experience.

Meditation Chamber

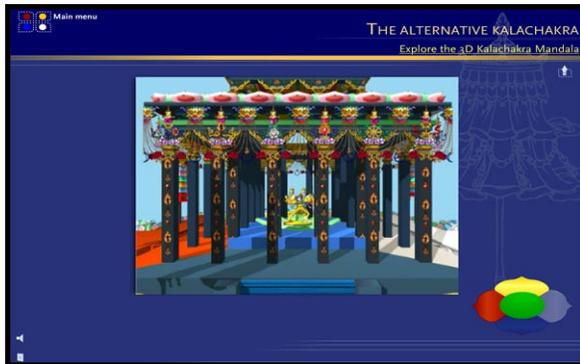
Larry Hodges, Diane Gromala, Jay David Bolter, Christopher Shaw

http://www.gvu.gatech.edu/gvu/meditation/proj_frameset.htm

This project uses virtual reality to guide users through meditation and relaxation techniques. Research focuses on the mental and physical benefits of meditation on those who regularly engage in meditation techniques. My project also guides a user through the meditative process of a mandala creation. However, this guidance is focused on the actual ritual process that monks use in achieving a meditative state, rather than the actual physiological processes involved in meditation (deep breathing, slowed heart rate). Also my project will not use actual VR technology.spaces.

(continued)

Related Works

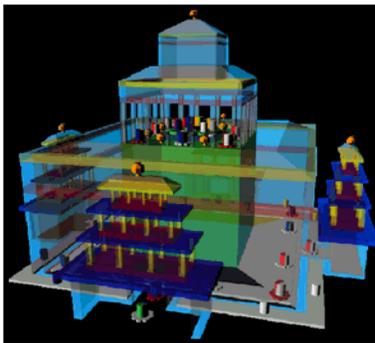


Buddhist Basics & Kalachakra Animated: An Interactive Multimedia CD Rom

She Drup Ling Graz / ArtRebel9

http://www.snowlionpub.com/search.php?in_item_id=6441

This multimedia 2-CD set details the teachings contained within the Kalachakra initiation. Navigation is derived from traditional website "point and click" methods, and the design is stylistically high-end. While it contains Quicktime movies of fly-throughs of 3D computer-generated mandalas, it does not allow the user options for autonomous exploration of the 3D virtual mandala. Also, it does not offer opportunities for users to create a virtual mandala. It does, however, contain a great wealth of information, and a secure area only for initiated Kalachakra practitioners.



Kalachakranet.org

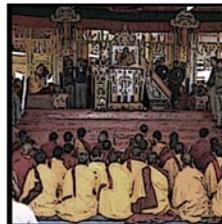
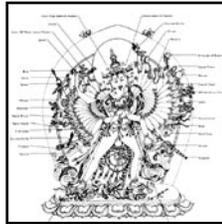
http://kalachakranet.org/mandala_kalachakra.html

On this site, users can go through a VRML walkthrough of a 3D version of the Kalachakra mandala. This 3D version of the mandala shows the architectural structure and the gods/goddess, which are symbolized by colored cylinders. Pairs of deities are shown using two adjoined half-cylinders. The site mentions that while the dimensions are not exact, the design of this project should give users an idea of how the temple is laid out. This 3D virtual mandala is more detailed in its construction than the one contained within my project.

APPENDIX: Environment 01

Pathway to Mahabodhi Temple & Tree of Enlightenment

IMAGES:



TEXT:

1.1

In Buddhism, deities are not gods to be worshipped. Instead, they signify a specific aspect of the Buddha mind to which practitioners should aspire. Kalachakra, which translates into “cycles of time”, is a deity representing omniscience - understanding events and perceptions from the past, present, and future. He holds a different implement with each of his twenty-four arms, and is usually represented holding court with his consort Vishvamata.

1.2

Kalachakra is also a specific Buddhist tantra, or teaching. It is one of the most advanced and detailed tantras in the Buddhist practice, complete with its own text, prayers, ritual dances, meditations, and mandala. It is believed to serve as a path to Enlightenment, and one of the highest motivations for practicing the Kalachakra tantra is the potential for becoming Enlightened within this lifetime.

1.3

In order to practice this tantra, an individual must receive an empowerment ritual from a fully qualified spiritual master. During this conferring of the initiation, participants are led through complex visualizations, which purify the individual, remove obstacles, and activate the mental and physical qualities of the deity Kalachakra within them. Receiving the initiation allows the individuals to hear the tantra, follow the path, and teach its wisdom.

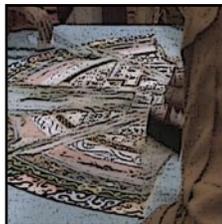
1.4

Kalachakra also is associated with the spread of world peace, and is one of the few tantras that are regularly conferred to large groups of people. According to its history, Buddha offered the Kalachakra initiation to the king of Shambhala and his court. Eventually, their descendents offered it to all of the citizens of Shambhala to unify them against invaders and destruction. This is the origin of Kalachakra’s connection with world peace.

APPENDIX: Environment 01 (continued)

Pathway to Mahabodhi Temple & Tree of Enlightenment

IMAGES:



TEXT:

1.5

Usually, details about the empowerment rituals are kept very secret, and are only revealed to those taking the initiation. However, the current Dalai Lama thought misconceptions about these rituals and the meaning behind the mandala were causing more harm than good; therefore, he felt it would be beneficial to make more information available about the Kalachakra initiation, and present it as a cultural offering to the world.

1.6

The current Dalai Lama, Ven. Tenzin Gyatso, has conferred the Kalachakra initiation thirty times since 1954. Although he has led the ceremonies numerous times, the initiation may be led by other spiritual masters who are schooled in the tantra. The Kalachakra initiation has been held all over the world, in locations such as India, Europe, the US, Australia, Canada, and Mongolia. The first two times the Dalai Lama conferred it were held in Tibet, before he was forced into exile.

1.7

Generally speaking, the Kalachakra Initiation is given over the course of twelve days. During this time, fifteen separate initiations are conferred. The first seven are called the Seven Childhood Initiations. The next eight initiations are considered to be more secret, and are offered to more advanced practitioners. Preparation rituals are conducted for ten of the twelve days, of which eight are conducted by the vajra master with monks and without the students.

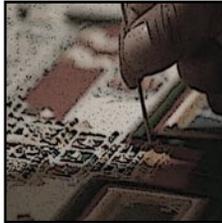
1.8

On the ninth day, students take part in a series of activities called "The Preparation of the Disciple". The component of the initiation which actually confers empowerment occurs on the tenth and eleventh days. The last day of the initiation ceremony involves dismantling, or destroying, a sand mandala. The Kalachakra Initiation calls upon the students to envision themselves and the vajra master as the actual embodiment of the deity Kalachakra. With these vivid visualizations, participants are believed to open themselves to new mental patterns.

APPENDIX: Environment 01 (continued)

Pathway to Mahabodhi Temple & Tree of Enlightenment

IMAGES:



TEXT:

1.9

As stated previously, the Kalachakra initiation requires that a mandala be built. A mandala is a detailed symbolic representation which may contain such things as deities, offerings, and palaces. It has been likened to visual scripture, in that it may be read and interpreted, and memorized as a meditation guide.

1.10

While mandalas may be created as three-dimensional forms, they are usually shown within a two-dimensional context, as a type of blueprint representing a three-dimensional space. The mandala is meant as a tool to teach the students about the tantra and deity, and provide a means for them to “enter into the mandala”, as well as the state of the Buddha mind that the representative deity embodies.

1.11

In the distance, you can see the Mahabodhi Temple and the Tree of Enlightenment, located in Bodh Gaya, India. This is a very sacred site within the Buddhist belief system, because it is thought that underneath this large bodhi tree Siddhartha received Enlightenment and became the Buddha. The Dalai Lama has conferred the Kalachakra Initiation here almost four times. In 2002, the proceedings were begun here; however, the Dalai Lama fell ill and needed to postpone the complete initiation until October 2002 in Austria.

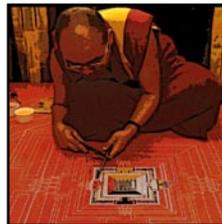
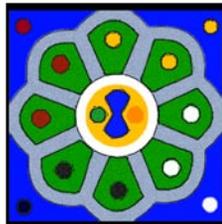
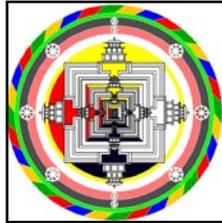
1.12

The mandala is constructed within a building almost a quarter of a mile from this site. The process must be carried out in a stable, protected area, because of the intricate and fragile nature of mandala construction. Here you may explore underneath the Tree of Enlightenment and visit the west side of the temple, or you may continue on to the mandala construction simulation.

APPENDIX: Environment 02

Mandala Creation Room

IMAGES:



TEXT:

2.1

The Kalachakra Mandala is a detailed symbolic design which represents the five-story palace belonging to Kalachakra, as well as a total of 722 deities within it.

2.2

In Buddhism, deities' full-body representations need to be drawn in specific proportions; otherwise, they can not be blessed. Because this mandala can not spatially accommodate the full representations of these 722 deities, all of them, including Kalachakra and his consort Vishvamata, are symbolized by dots or Sanskrit seed syllables. Kalachakra, however, is represented in the center of the mandala as a vajra, which is a scepter symbolizing the indestructible mind.

2.3

During the Kalachakra Initiation, it traditionally requires six days for the mandala to be created, and up to sixteen well-trained monks participate in this process. There is no individual artistic expression in the creation of the mandala; these monks build the mandala according to strict guidelines that have been passed down over the centuries.

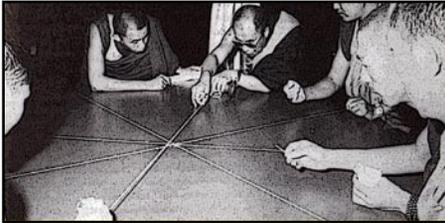
2.4

Since the creation of this ritual art is seen as a beneficent offering of Buddha's message, as well as a method of meditation, monks aspire to perfect representation as a means of accurately expressing its teachings to the viewers. These monks have memorized each detail as part of their training, and so are visually "reciting" the scripture of the tantra from memory as they lay down the designs.

APPENDIX: Environment 02 (continued)

Mandala Creation Room

IMAGES:



TEXT:

2.5

On the second day of the Kalachakra Initiation, the mandala is drawn with chalk and chalked string on the surface of a wooden table by learned monks, who use instructional guides which have supposedly remained consistent since they were originally conferred by Buddha. The entire outline originates from two perpendicular lines called the Brahman lines, which create the four quadrants of the mandala. The Lama conferring the initiation usually aids in laying down these initial lines by snapping the chalk string, called the “wisdom string”.

2.6

Mandalas may be painted with various materials, such as flower petals, colored rice, stone or jewel particles, or colored sand. Dyed sand is the most commonly used material for this purpose. In the Kalachakra Mandala, there are fourteen different colors of sand used: black, white, and light, medium, and dark values of red, blue, green, and yellow-gold.

2.7

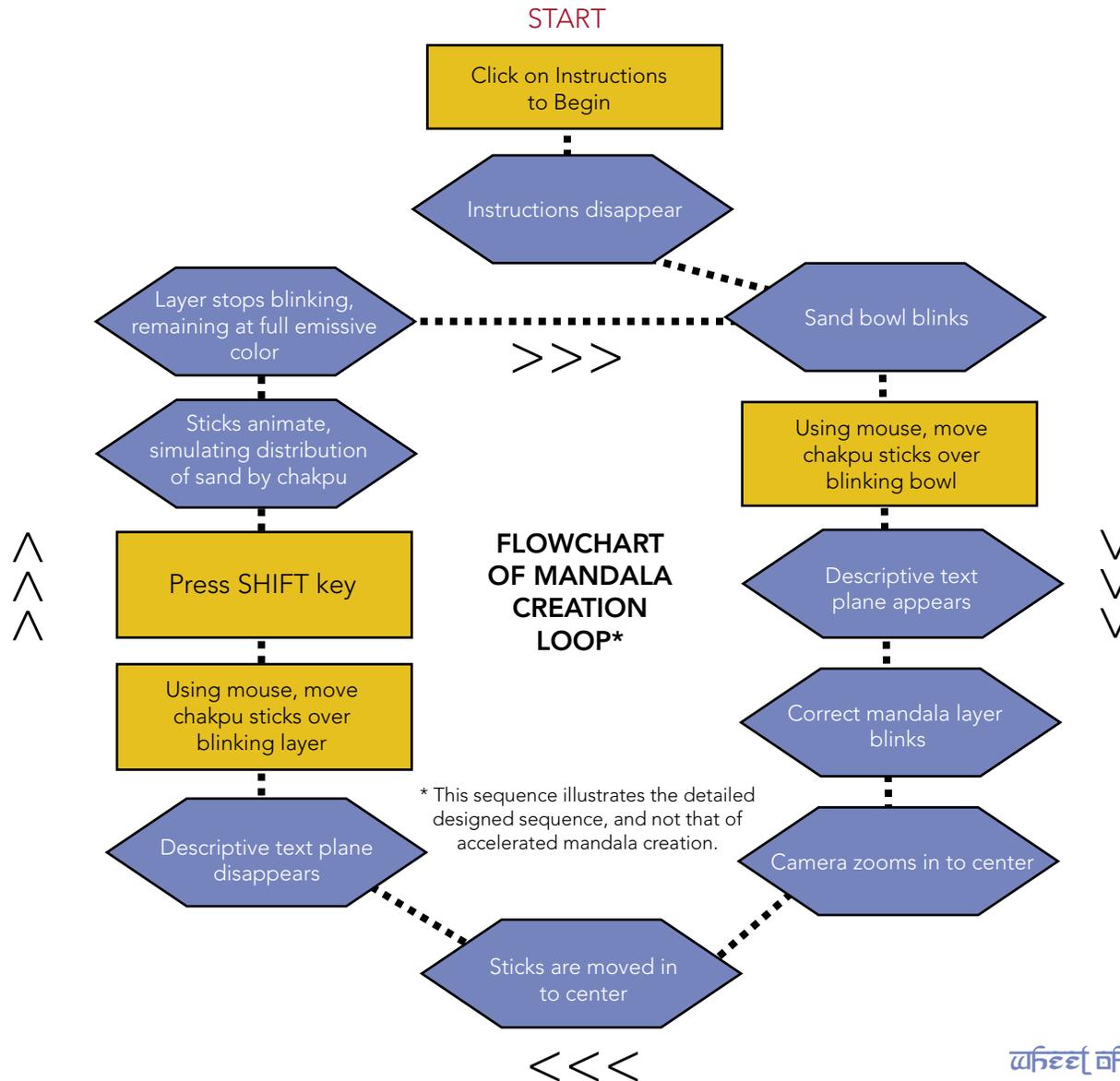
At the start of the mandala’s construction, four monks begin the process, one in each of the four quadrants. Once the mandala grows larger, four more assistants join in the process by filling in the color areas while the other four work on the design outlines. Early on, monks sit on the table, always facing the center. As the mandala grows outward from the center, the monks stand beside the table to carry out their designs. Because it is disrespectful to step on or over a ritual instrument, deity image, scripture, or mandala, monks pray at the beginning of each day so that the lines of the mandala are visualized as being suspended overhead while they work.

2.8

When creating a mandala, monks rub two long, metal funnels called “chakpu” together in order to distribute sand grains onto the mandala surface. Chakpu funnels come in a range of sizes. The larger ones are used for filling in larger areas of color, while smaller ones aid in laying down fine details. Rubbing the two sticks together quickly causes sand to flow out more quickly as well; slower scraping causes a slower flow of grains..

APPENDIX: Environment 02.1

Mandala Creation Process



APPENDIX: Environment 02.2

3D Mandala Extrusion

IMAGES:



TEXT:

3.1

The students receive the blessings and final initiations from the conferring lama on the eleventh day. They also make vows to abandon the fourteen root infractions, and offerings are made to the lama, who during the initiation is viewed as the embodiment of Kalachakra. On the twelfth, and final, day the students are prepared to view the construction, and finally are allowed in to see the newly built Kalachakra mandala.

3.2

You have just participated in a summary simulation of the building of the Kalachakra mandala. While you may have only spent hours or minutes in building this digital mandala, it takes eight to sixteen monks eight days to build the actual Kalachakra mandala using real sand (longer if it is created in front of a crowd as a cultural offering). Because of the deep inner meanings held within the construction and depictions of this mandala, monks at the Namgyal Monastery must undergo at least three years of artistic training and memorization before they are allowed to aid in the Kalachakra mandala construction.

3.3

You may have noticed that the mandala was built from its center outward, making the symbol of Kalachakra one of the first mandala objects to be created. During the Kalachakra teachings, however, the presiding Lama teaches the initiates about the mandala from its outermost rings towards the center, so Kalachakra is revealed to them at the end of the mandala description.

3.4

Since the sand mandalas are two-dimensional representations of a three-dimensional space, it makes it necessary for the builders and viewers of the mandala to envision within their minds an expanded view of the mandala, one in which it is a three-dimensional structure where the 722 deities are actually embodied. Some practitioners create the mandala as an actual three-dimensional sculpture, instead of using sand; however, this is not tradition within the actual Kalachakra initiation ceremony.

APPENDIX: Environment 02.2 (continued)

3D Mandala Extrusion

IMAGES:



TEXT:

3.5

On the twelfth day of the initiation, after all of the initiates have viewed the mandala, a dismantling ceremony takes place. During this ceremony, prayers are invoked to send the deities back to their own sacred homes from which they originated. Then the head Lama carefully picks up sand from the dots and Sanskrit symbols representing the numerous deities and deity groups, and places it into an urn. The deity sand is picked up starting on the outer perimeter, and is removed clockwise, winding in towards the center where Kalachakra and Vishvamati are found

3.6

On the outer edge of the eastern quadrant, the master drags a vajra towards the center; this removes the energy of the mandala. This is repeated in the other three directions, going clockwise. Then the monks begin sweeping the sand into piles. Where the sand grains individually are quite colorful, once the sand is swept together, the colors mix in such a way that they appear gray. Some is given to attendees of the ceremony; however, much of is taken to a nearby river, lake, or ocean during a procession. There, prayers are offered, and the sand is poured from the urn into the water.

3.7

The dismantling of the mandala illustrates the Buddhist idea of impermanence. The monks who participate in the ceremony see the sweeping away of the mandala as a way of preserving it. As the water carries away the grains of sand, and as those who received the mandala sand go back to their normal lives, the Buddhists believe the energy of the Kalachakra teachings spreads throughout the world, perpetuating the ideals of world peace.

Bibliography

1. Davis, J., *Apocalypse Now: How a hologram, a blimp, and a massively multi-player game could bring peace to the Holy Land*, in *Wired*. 2004.
2. McCormack, J. and A. Dorin. *Art, Emergence, and the Computational Sublime*. in *Second Iteration: a conference on generative systems in the electronic arts-CEMA*. 2001. Melbourne, Australia.
3. Csikszentmihalyi, M., *Flow: The psychology of optimal experience*. 1991, New York, NY: Harper Perinneal.
4. Yair, Y., *3D-Virtual Reality in Science Education: An Implication for Astronomy Teaching*. *Jl. of Computers in Mathematics and Science Teaching*, 2001. 20(3): p. 293-305.
5. Trindade, J., et al. *Virtual Environment of water molecules for learning and teaching science*. in *Proc. of the Eurographics Workshop, GVE'99-Computer Graphics and Visualization Education '99*. 1999. Coimbra, Portugal.
6. Kancherla, A.R., et al. *A novel virtual reality tool for teaching dynamic 3D anatomy*. in *Proc. of the IEEE Conference on Computer Vision, Virtual Reality and Robotics in Medicine (CVRMed'95)*. 1999.
7. Swan, G. and B. Hughes, *Constructivism: Definition and Implications for Implementation*. 1993.
8. Huang, H.-M., *Toward constructivism for adult learners in online learning environments*. *British Journal of Educational Technology*, 2002. 33(1): p. 27-37.
9. Bricken, M. and C.M. Byrne, *Summer students in virtual reality: A pilot study on educational applications of virtual reality technology*, in *Virtual reality: Applications and explorations*, A. Wexelblat, Editor. 1994, Academic Press: Boston. p. 199-218.
10. Dickey, M.D., *Teaching in 3D: Pedagogical Affordances and Constraints of 3D Virtual Worlds for Synchronous Distance Learning*. *Distance Education*, 2003. 24(1): p. 105-121.

Bibliography

11. Refsland, S.T., T. Ojika, and R. Stone, *Virtual Heritage: Breathing new life into our ancient past*. Multimedia, IEEE, 2000. 7(2): p. 20-21.
12. Niemeyer, G. and J. Daley. *Simulation: The Cultural Anticipation of Our Own Demise*. in Living Architectures Conference Presentation. 2000. Banff New Media Institute.
13. Koltko-Rivera, M.E., *The Potential Societal Impact of Virtual Reality*. 2005, Professional Services Group, Inc.
14. Turner, V., *Frame, Flow and Reflection: Ritual and Drama as Public Liminality*. Japanese Journal of Religious Studies, 1979: p. 465-499.
15. Heim, M., *Virtual Reality and the Tea Ceremony*, in *The Virtual Dimension: Architecture, Representation, and Crash Culture*, J. Beckmann, Editor. 1998, Princeton Architectural Press: Princeton, NJ.
16. Wertheim, M., *Pearly Gates of Cyberspace: A History of Space from Dante to the Internet*. 2000: Norton, W. W. & Company, Inc. 336.
17. Laurel, B. and R. Strickland, *Placeholder: Landscape and Narrative in Virtual Environments*. Computer Graphics, 1994. 28(2).
18. Bryant, B., *The Wheel of Time Sand Mandala New Revised Edition : Visual Scripture of Tibetan Buddhism* 2003, Ithaca, NY: Snow Lion Publications.
19. Morse, M., *Virtualities: Television, Media Art and Cyberculture*. 1998, Bloomington: Indiana University Press
20. Bachelard, G., *The Poetics of Space*. 1958, Boston: Beacon Press.
21. Heim, M., *The Feng Shui of Virtual Worlds*. Crossings: eJournal of Art and Technology, 2001. 1(1).
22. Dinh, H.Q., et al. *Evaluating the Importance of Multi-sensory Input on Memory and the Sense of Presence in Virtual Environments*. in IEEE Virtual Reality Conference. 1999. Houston, TX.
23. Kaur, K., *Designing Virtual Environments for Usability*. 1998, City University: London.

Bibliography

Berzin, A., *Taking the Kalachakra Initiation*. 1997, Ithaca, New York: Snow Lion Publications. 197.

Bryant, B., *The Wheel of Time Sand Mandala New Revised Edition : Visual Scripture of Tibetan Buddhism* 2003, Ithaca, NY: Snow Lion Publications.

Dalai Lama, T.G., *Kalachakra Tantra: Rite of Initiation*. 1999, Boston, MA: Wisdom Publications.

Herzog, W., *Wheel of Time*. 2003, Well-spring. p. 80 minutes.

Hind, R., *1000 Faces of God*. 2004, New York: Barnes & Noble Books. 320.

Lhundub, G., R. Jackson, and J. Newman, *The Wheel of Time: The Kalachakra in Context*. 1991, Ithaca, New York: Snow Lion Publications. 159.

Acknowledgements

I would like to express my thanks and gratitude to the following individuals and groups for their insight, support, and assistance in my thesis proceedings.

Thesis Committee:

Michael Nitsche - chair; LCC Associate Professor

Eugene Thacker - reader; LCC Associate Professor

Mirtha Ferrer - reader; creative director @ Virtually Better LLC

Snow Lion Publications, for without their strong body of research materials, especially Barry Bryant's book, this project could not have been done. Their publications have comprised the majority of my Buddhist sources, and they contributed to my work significantly.

My husband, who has been endlessly patient throughout this process, and who has been my biggest fan.

My family, who, although they have endured a lot these past few months, have been ever-present and supportive.

In closing, I have done my best to present an accurate overview of an initiation ceremony in which I have never participated. Even though my research has been as thorough as I could make it, it is entirely possible that, through my cultural ignorance, I have inadvertently missed important aspects that should be acknowledged. I have attempted to portray an unfamiliar ceremony with respect and good intentions, and hope not to cause offense to any Buddhist practitioner who feels that I overlooked details that should have addressed.