Exploring Arctic Cultures:
Constructing a Virtual World for the Geode,
a 3D Virtual Reality Theatre

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Abstract

With the establishment of multi-media, web-based learning environments and virtual worlds projected in 3D, new opportunities have been created that can be used to excite public interest in archaeology and world cultures. In 2008-2009, Dessault Systemes sponsored a competition for the design of 3D virtual worlds that would focus on archaeology, history, science and technology. Ultimately, the winners of this competition would have their creations exhibited in Paris at La Geode, the world's largest virtual reality centre. Located in the Parc de la Villette at the Cité des Sciences et de l'Industrie in Paris, La Geode houses a spherical theatre with a newly designed 3D projection system. Installed in 2007, the 180-degree screen is over 25 meters wide and provides attendees with a unique 3D immersive experience of past worlds and civilizations. The authors were one of ten groups selected to participate in this competition. This paper will discuss factors which constrained the authors during the development of a virtual world that explores Arctic Culture. Specifically, this research considers how competition requirements (user interactions, financial resources, hardware and software) directed the development of this virtual world. Also, strategies are suggested for improving the virtual experience of audience members in large venues containing several hundred seats.

Key words: Virtual reality, serious games, virtual heritage, Arctic

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1 Introduction

With the increasing requirement for public access to archaeological sites and research findings, there is a growing demand to convert academic research into an experience that excites the public.[1] At major museums around the world experimentation with new venues showing real-time 3D virtual reality is acting as a vehicle for increasing patronage. These 3D venues come in all sizes. In the largest venues, such as 3D theatres, museum visitors can now experience the construction of the

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[1] Addision, Alonzo C. "Emerging Trends in Virtual Heritage." *IEEE Multimedia*, (2000) April June: 22-25; Bauerlein, Johannes, Rafael Pokorski, Stefan Maass, and Jurgen Dolner, Visualization Project of Roman Cologne – How to make VR models Available for Sceintific Work, *Computer Application and Quantitative Methods in Archaeology, Proceedings*, (2007): 126; Carrozzino, M. C.Evangelista1, A.Scucces1, F.Tecchia1, G.Tennirelli, and M.Bergamasco1. "The Virtual Museum of Scuplture," 3rd *International Conference on Digital Interactive Media in Entertainment and Arts, DIMEA*,(2008): 100-106; Forte, Maurizio and Alberto Siliotti, editors. Virtual Archaeology, *Re-creating Ancient Worlds*, New York, New York: Harry N. Abrams, Inc. Publishers, (1997); Sanders, Donald H. "Why do Virtual Heritage?" *Computer Application and Quantitative Methods in Archaeology, Proceedings* (2006): 427-435.

Great Pyramids of Egypt, life in ancient Jerusalem,[2] an undersea adventure or space travel, all with I-Max format clarity. In smaller venues, such as simulators that seat a single individual or small group, the thrills of 3D flight can be encountered. When combined with motion platforms the experience can be both exhilarating and a bit scary. At a more subdued level, simulators at the Berlin Museum of Science and Technology have been used to recreate the feeling of being on the helm of a medieval merchant ship, while at the Kew Gardens [3], they have been used as windows into the micro-world of small multi-celled organisms.

Creating virtual experiences that can present research findings in an engaging 3D world is a challenge.[4] Unlike games, these experiences are constrained by time, interest and venue. Generally, the time available to capture the museum visitor's attention can be fairly brief. To be successful a single topic or place must be the focus of attention. Here the audience is confronted by a single event or situation, like finding the way out of a castle or exploring the tomb of ancient Pharos. Where the groups are small, controls are often in the hands of

a single individual.[5] With only one member of the group at the controls, being part of the decision making process is limited to verbal clues given to the helmsmen all the way through the virtual experience. This approach works best with children and young adolescents for whom there are fewer social barriers to group action and decision making. With larger audiences the degree of participation of members on the side will be greatly diminished. This becomes a particular challenge for museums attempting to create an interactive experience for an audience of several hundred. With only a single controller, it is difficult to imagine asking an audience for a course of action, other than "which way should we go? left or right? ". This problem certainly became apparent in the competition sponsored by Dessault Systemes in 2008. The requirements for "being simple, user-friendly and interactive" and yet to aim at a larger audience appear to be at cross-purposes. The author's response to this invited competition will serve as a case study revealing the challenges of creating a virtual world experience for the Geode, the largest 3D virtual reality theatre in the world.

2 BACKGROUND: COMPETITION

In 2008, Dessault Systemes announced a competition for designing virtual world experiences for the Geode in Paris. A goal of this competition was the promotion of 3DVIA, an integrated development platform. 3DVIA (Virtools) provides tools for creating interactive worlds for display on PC's, Caves, and 3D theatres. Virtools, acquired by Dessault Systemes Ltd in 2005, was later renamed 3DVIA. Ultimately, the virtual worlds resulting from this competition would be showcased in the Geode, the largest virtual reality theatre in the world. Re-Opening in 2008 after renovation, this spherical

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[2] Jerusalem Archaeological Park, www.israntique. org.il.

[3] "Room with a VR view for Kew". http://www.inition.co.uk/inition/news_2004kew _plankton.htm.

[4] Dell'Unto, Nicolò, Marco Di Ioia, Fabrizio Galeazzi, Alessia Moro, Eva Pietroni, Valentina Vassallo, Lola Vico. "The Reconstruction of the archaeological landscape through virtual reality applications: A Discussion about Method-olgogy," *Proceedings of the 2nd ISPRS International Workshop 3D-ARCH* 2007: *3D Virtual Reconstruction and Visualization of Complex Architectures*, ETH Zurich, Switzerland, 12-13, July, (2007); Li, F. and M. Maher. "Representing virtual places - a design model for metaphorical design," *ACADIA Proceedings*, (2000), www.people. arch.usyd. edu.au/~mary/Pubs/2000pdf/ACADIA2000.pdf

[5] Roussou, M. "Learning by Doing and Learning Through Play: An Exploration of Interactivity in Virtual Environments for Children," *ACM Computers in Entertainment*, 2:1, January (2004): 1-23.

shaped theatre is located in the Parc de la Villette at the Cité des Sciences et de l'Inustrie in Paris (figure 1). First constructed to show movies in IMAX format, it also has the capability of presenting 3D interactive worlds. In 2008, "Khufu", a virtual world developed by Jean-Pierre Houdin, was showcased in the Geode. Narrated by Jean Pierre Houdin, he used this world to explain his theory on the construction of the Pyramids of Giza to an audience of 400. Developed with 3DVIA, this initial production encouraged Dessault Systemes to support the virtual reality competition in 2008.[6]

Figure 1. La Geode, is the world's largest virtual reality centre.

A major goal of this competition was to promote the use of these venues for public promotion and communication of content on science, history and art. Of course this competition represents a public relations opportunity. As stated under the terms of the competition document, sponsorship of 3D virtual reality content has the power to change our perspective on how we view the world.

> Real-time 3D and virtual reality technologies, in much the same way as perspective, first invented in the 15th century, are revolutionizing the world in which we live. Whether applied in a scientific context, to aid communication and sharing, or as an interactive application, 3D is, without doubt, the tool and medium of the 21st century. By modifying our view of the world and by offering new interactive experiences, real-time 3D is, par excellence, a technology

dedicated to innovation in many fields, including entertainment. These technologies are no longer the sole domain of researchers and console «gamers». New concepts for the general public based on real-time 3D and virtual reality are emerging every year. Being simple, user-friendly and interactive, they are aimed at the broadest audience. New concepts for the general public based on real-time 3D and virtual reality are emerging every year. Being simple, user-friendly and interactive, they are aimed at the broadest audience. (Competition Document 2008) [7]

In supports of corporate core values Dessault Systemes is dedicated to the development and distribution of software used by industrial designers, architects and engineers. Clearly, the fact that such ventures have public relations value is evident in the airing of a commercial featuring the use of design software developed by Dessault Systemes. In this TV commercial, a designer interacts with a virtual model of a subway car containing animated characters. As each character communicates his individual reaction to the design, the engineer in the commercial effortless adapts the design to accommodate the needs of a cyclist and a passenger in a wheel-chair. Expanding the 3DVIA market share among game makers and developers of virtual worlds would be a benefit of this competition. Significant public relations value would be generated from having a series of virtual worlds shown at the Geode, eliciting the attention of the computer graphics and game making community in this new approach to public edutainment.

The process of selecting competitors was done in two stages. First, a call for proposals was made by Dessault Systmes in 2008. From this group, no more than ten participants would be selected to submit their creations (virtual worlds) to a jury composed of designers and executives from the Dessault Systemes. Competitors were to address one of several themes: history and civilization, science and technology, human adventure, nature or great discovery. For those submitting work

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[6] Dessault Systemes, Virtual Reality Competition, www.3ds.com/vrexperience/.

[7] Ibid.

under the topic, history and civilization, "the Palace of Versailles and the City of Troy", were suggested as possible themes. As a prize, each of the ten competitors would be given a license for 3DVIA to build their worlds to run on in the Geode. Ultimately, the winner of the competition would have their work shown in the Geode and published on the web as part of a marketing program for Dessault Systemes. [8]

3   DESIGNING FOR THE GEODE

Because of the unique characteristics of this $1000m^2$ stereoscopic hemispherical-screen, special consideration must be given to the distinctive visual experiences for an audience of 400 (figure 1). For maximum visual impact, objects should be displayed in the near foreground against a distant background. In creating a world that can showcase the Geode's unique space and display, competitors need to pay special attention to placement and movement in a scene. 3D movie goers know that objects placed in the centre of the field view close to the projection plane will appear as striking 3D objects that almost demand you reach out and touch them. In contrast objects placed at a distance appear flat because of their reduced parallax. Experience working with this principle, will enable designers to develop the more striking scenes that characterize successful 3D movies and virtual environments. That this sense of 3D may also vary depending on the viewer's specific location within the theatre adds a layer of complexity to modeling and programming within the virtual world. Creating objects which avoid a distorted appearance from any position with in the theatre could only come from experimenting within the environment of this particular theatre. [9]

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[8] Ibid

[9]   Gaitatzes, Athanasios, Georgios Papaioannou, Dimitrios Christopoulos. "Media Productions for a Dome Display System," *VRST*, November 1-3 (2006):261-264.

For the Geode Theatre, frame rates of 120 hz are required for smooth motion. A six PC cluster provides the computing power for rendering scenes in this space. It is not unusual that worlds created for a single PC will not work when placed on a cluster. In the Geode, 3DVIA runs on a cluster consisting of six computers each supporting two projectors needed for passive stereo. With this arrangement, there are limits to the geometric complexity of a digital world; if limits are exceeded, visual effects can be noticeable to the audience. Symptoms of this constraint are that objects in moving from an area of the screen controlled by one PC to another in the cluster may disappear or appear late due to the lag in communication between master and slave increasing beyond acceptable limits.

One issue not addressed by the competition guidelines was the level of interaction needed within the virtual world. Given the open ended nature of this competition, it was up to the each team or individual to interpret this requirement. In most games it is possible for the player to assume an avatar to interact within a virtual world. Most genres including driving games, fight games, fantasy games and simulations allow gamers to indulge in experiences that have traditionally been the domain of film and television. A variety of peripherals, including keyboards, mice, joysticks, driving wheels, and flight controllers give direct access to movement and interaction with these virtual worlds. With the introduction of the Intendo Wii, the use of highly sensitive motion sensors has evolved a variety of controllers, including zappers, balance boards, tennis rackets, swords, and driving wheels. In these landscapes, gamers can drive cars, battle real and imaginary foe, and interact with other gamers on line to solve problems or fight battles. In a theatre of 400 with a single narrator or guide, there is very limited opportunity to introduce interaction into the virtual environment. The resulting constraint dictates an experience which is more like a guided tour as found on a travel network than as usually found in an interactive world, where each participant can independently explore the game-space.

With the production of high quality full length animation features and realistic video games audiences have increasingly become more

discriminating. Building a virtual world that will satisfy an audience is no small task. With a phase one budget of 1500 Euros, limited resources could be spent on programmers, artists, 3D modelers, script writers and the purchase of content such as music and images. [10] For those participating in this competition, clearly some perceived value from possibly showcasing their work in an international venue would offset the development costs of their submission.

4   CASE STUDY: EXPLORING ARCTIC CULTURES

A Strategy for Creating a Virtual World

With limited resources, using assets from previous projects is a logical response, such as code, 3D objects, characters and texture maps. For many game makers, their ability to succeed in a competitive market is dependent on having a library of assets that can be repurposed. This provides some level of assurance that project goals can be met within tight financial and time constraints. In this project it was possible to draw upon assets from worlds created over several years including 3D computer reconstructions of a Thule Inuit whalebone house and an Inuvialuit sodhouse. In addition to these completed structures, learning objects created with long and short range scanners were also utilized in this project. These objects ranged in size from a small ulu, an whale oil lamp, to the much larger skeleton of an North Atlantic Right whale. Previous success building worlds in 3DVIA (Virtools) for a different virtual reality theatre (four screens powered by a Cluster with four computers) provided some assurance that the completed world would function in the Geode theatre.

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Using a traditional story or myth as the underlying plot for a game is a common strategy among game developers. In this project, myths and stories collected by researchers visiting the far North, including Knud Ramussen of the Danish Fifth Thule Expedition (1921-24), provided the background for the virtual experience focused on life in the arctic. One story in particular, "The Raven's Story", became the underlying plot line for the virtual world.[11] Ultimately, a quest, a genre that is well understood by game makers, was used as the armature for "Exploring Arctic Cultures". In a quest, the lead character can be in search of magical ring or an all powerful sword or suit of armor. To acquire these objects of great power, the heroine or hero must fight and defeat a series of real and mythical adversaries through cunning and skill. Over time the character improves their skills as he/she encounters more formidable foes. Unlike a game, this virtual world designed for the Geode competition is constrained by time. Gamers will spend many hours over the course of days, weeks and sometime years to acquire the skill needed to overpower their enemies, as they gain access to higher levels in the game. In the Geode venue, presentations are constrained by a 30-45 minute window. In this venue the storyline would ultimately have to be simple enough for an audience of 400 to appreciate, without a very detailed explanation. Certainly with a large group, developing specific skills needed in a game would be inappropriate. Besides, with a single guide or narrator each show would most likely follow a closely confined path.

The Virtual Word Experience

Like most games, this virtual world begins with a Prologue. In the Prologue, you are introduced to your virtual arctic experience which opens with your avatar seated in a Kayak facing a world of icebergs, birds and sea creatures.

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[10] Lin, James Quo-Ping and H. Wei-Hsin Din. "Using Animation and Interactive Virtual Technology to Create Interpretive Materials for Museum Learning and Promotion*." SIGGRAPH Asia 2008* (2008).

[11] Rasmussen, Knud edited and translated by W. Worster. *Eskimo Folk Tales*. London: Gylglendal, (1921).

Over a thousand years ago, in the land of the far North of what is now Canada, lived a people who lived near the sea. They lived in houses made from the bones of whales they hunted from their kayaks and umiaqs made from wood and animal skin. From our virtual kayak we will experience the North, re-live some of the myths of the Inuit people. The harshness of life in the North means that offending the spirits of the world could risk survival. Like the Raven, he too liked to paddle his kayak out to sea. To learn more about the Raven and his life journey, you will need to look for clues. Look for the whale oil lamps that light your journey home. If you should lose your way, look for the raven and the whales, who will show you the way. Your first clue, you should see a lamp burning bright directly in front of you.[12]

In the Prologue, you are given your mission, to find your way home with the help of mythical creatures. To help guide your way home, whale oil lamps which appear suspended about the water light your journey. At the beginning of your quest you are introduced to the Raven, whose story will be retold during your journey (figure 2).
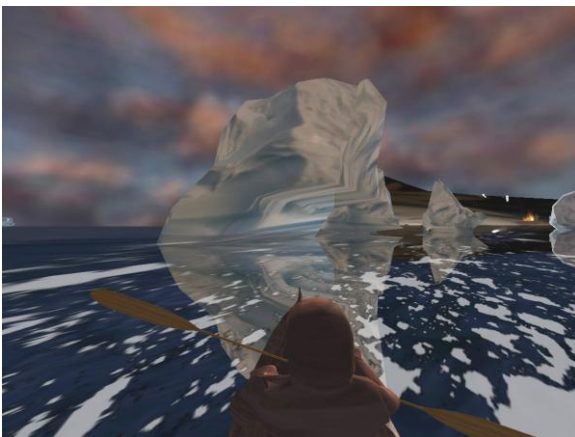
There are many Inuit myths that explain the mysteries of the world and its origins. From the very beginning of time, the Inuit people believed that Raven made the world. To the Inuit, the Raven was both a supernatural being and a bird with a man inside. After the Raven had created everything, he decided to remain on the earth. The Raven loved the people and the animals in this world, and was curious about them all. Even though he had made the world, he did not know everything there was to know. In the virtual journey you are about to take you will learn about Raven and his world. [13]

Many of these explanations are given by 3D likenesses created by Inuit carvers. As you approach the whale oil lamps, a likeness of an Inuit carving of a mythical figure appears before you. Along the way, you are told stories about the moon, constellations, and the icebergs. The first of these stories told to you is by a carving of Sedna, a mermaid like creature (figure 3).

You have found your first clue. It is a whale oil lamp that keeps homes lit and warm. Whales blubber is what keeps these lamps lit during the cold winter months. As an Inuit hunter you must have great respect for Sedna, the Goddess of the sea and of the sea creatures who live in her domain. All who paddle in their kayaks know when she is anger, the seas are violent and storms are strong. Now Sedna is calm as she combs her long black hair releasing the seals and other animals which we must depend on for sustenance.

Figure 2. Prologue: The Raven's Story

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[12] Rasmussen, op.cit.; Rink, op.cit.

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[13] Melzack, Ronald. *Raven: Creator of the World,* Boston: Little Brown and Co. (1970); Simms, Laura. *Stories that Nourish the Hearts of Our Children*, New York: Holland-Knight Publication, (2001).

Figure 3. Sedna

Other stories are told by gulls, whales and dancing bears(figure 8).

> The Inuit respect all animals, and will offer seals and whales fresh water when caught, believing that the salt water of the sea makes them thirsty. The polar bear is especially revered, as he is as much at home on the land as in the sea. Polar bears were also powerful spirit helpers. That is why I dance, to show my pleasure and joy, and this is the legend of the dancing bear.[14]
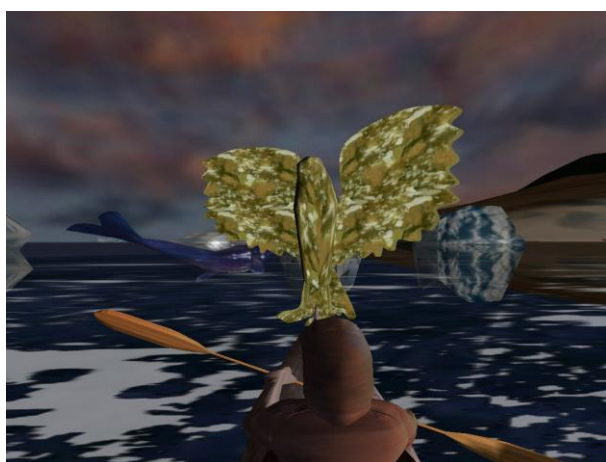

Figure 4. Raven

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[14] Angiju, Daniel Quama, Dancing Bear. 1978.

When you encounter the Raven flapping his wings, The Raven's story is retold (figure 4) .

> I am the raven, the trickster. You now know how much I like to paddle my kayak. Many years ago, I was paddling my kayak and wondered what does it look like inside a whale? So, I waited until a whale yawned and walked inside (figure 5). With a line attached to a whale tooth, walked deep inside to find a dancing girl strapped to the heart of the whale.
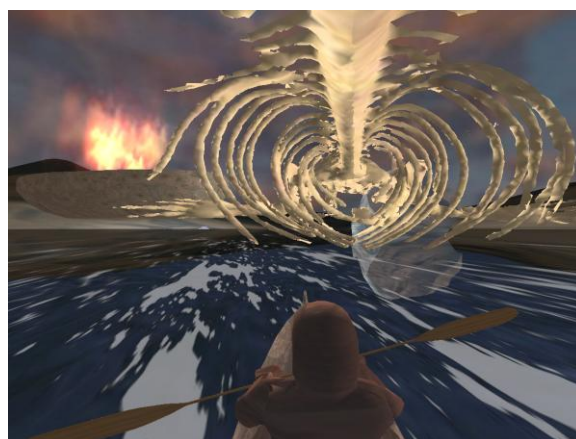

Figure 5. Inside the Whale Skeleton

> I said to her, I am Raven. I made the world. Will you come with me into the world and be my wife?" The maiden replied, "Raven, I cannot leave the whale. I am the heart and the soul of the whale. But if you want to stay here and keep me company, that would make me happy. "Raven pulled his beak back down over his face and covered his arms with his wings. He grabbed the girl. He heard the strings snap as he flew with her out of the whale up into the sky.

> As the Raven I heard the whale thrashing below in the ocean. I watched the whale's body as it was tossed by the waves onto the shore. The whale was dead and the girl in my arms grew smaller and smaller and disappeared.

> For weeks I cried and cried, then I danced the sky. From that point on, I have promised all humans and the animals that I

would always return to this world as long as we cared for one another, understanding that everything in this world lives and dies and that all human and animal have hearts and souls. In the history of the world, the raven's tears were the first tears. And my dance and song of grief and healing are the first song and the first dance.[15]

For the Inuit, the connection between one's life, nature and myth would have been reaffirmed by every day experiences.[16] To emphasize this connection, many of the mythical characters, represented by their likenesses in stone are found in natural state swimming, dancing or flying. The setting is also used to reinforce the sensation that you are in a mythical world. Here in the world of endless dusk, both night and day exist together. Huge icebergs mirrored by their reflection on the water, appear to be floating magically upon the sea, underscoring the connection between the mythical and physical world. [17]
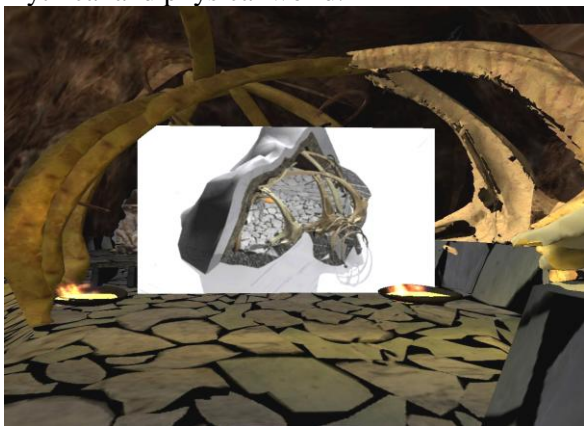

Figure 6. At the end our yourney you find yourself inside a traditional Arctic house.

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[15] Melzak, op.cit.

[16] Whitridge, Peter. "Landscapes, houses, bodies, things: 'place' and the archaeology of Inuit imaginaries" *Journal of Archaeological Method and Theory* (2004) 11/2: 213-250.

[17] Losh. E. The Palace of Memory: "Virtual Tourism and Tours of Duty in Tactical Iraqi and Virtual Iraq," *Proceedings of the 2006 International Conference on Games* (2006): 77-86.

At the end of your journey, you find yourself inside a traditional Inuit house (figure 6). Here objects, which have been created by laser scanning actual artifacts, can be found. Each is a mnemonic placeholder for accounts on everyday life. [18] In this space you find an ulu, harpoon, snowknife, adz, sewing needle and thimble. Accompanied by video and animations, objects are shown in context. In one video, on making an Inuit parka, the ulu, needle and thimble being used to fashion traditional clothing appear before you in 3D. In another video, a pick, adz and snowknife are shown being used to create basic shelter.

Design Details: Vitual World Creation is a Learning Experience

To heighten the sense of 3D, objects are choreographed to appear in both the middle and foreground. In the foreground, the kayak with its avatar paddling on the water is placed against a moving background of icebergs and swimming sea creatures. As these objects come closer to the viewing plane, the perception of 3D is heightened. Adding to this sense of 3D, gulls, first appearing at a distance fly towards the kayak and pass overhead (figure 7).
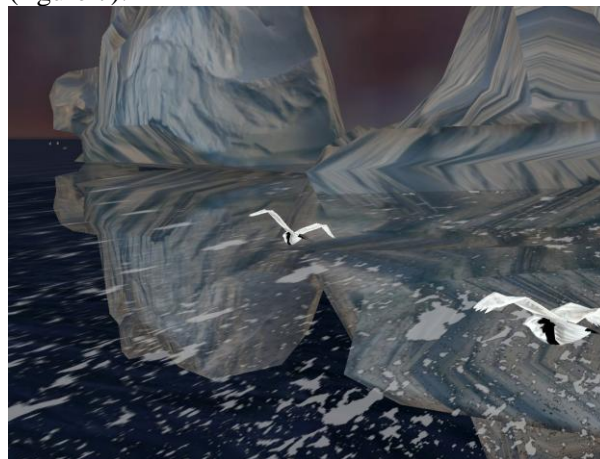

Figure 7. Gulls flying overhead add to the 3D experience.

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[18] Sabo III., George and John D. Jacobs. "Aspects of Thule Culture Adaptations in Southern Baffin Island." *Arctic* (1980) 33:3, 487-504

Finally, when each new clue is discovered, each Inuit carving slowly emerges from the vanishing point in the scene, coming to reset just above the avatar. Placement of these carvings in the sweet spot of the screen provides the members of the audience with the greatest sense of 3D (figure 8). In this location, objects are animated to simulate flying or swimming, increasing interest as the object appears to be floating just in front of the screen.

Figure 8. Dancing Bear appears in the sweet spot of the screen for maximum impact.

In creating the Raven's World, managing the complexity of the scene was important to maintain smooth motion of characters and objects. There are always limits on the total number of polyfaces that can be rendered in a scene; beyond the limit, motion becomes choppy. Complex geometries are reserved for objects that will be placed close to the screen, where the eye can pick up small incongruities. When objects are animated, as in the case of whales, birds and bears, forms are optimized to reduce the demands on the CPU. Finally, objects at a distance are rendered as simple geometric forms. By utilizing texture maps with simulated shadows, it is possible to create a sense of reflection, light and shade without making significant demands on the PC cluster. By considering the demands of the cluster, there is an added benefit in the potential for placing the world on the web: download capacity of a world that will function on older computers with less graphics capability.

Unlike a video game where the user is intimately involved in decisions on navigation and exploration, in a theatre experience, a narrator guides the experience for several hundred attendees in the audience. In the Raven's world, at the beginning scene we find ourselves in a virtual kayak. Like the Raven, we become part of a mini-saga. We can paddle our sea craft avoiding icebergs and whales, in our search for clues. However, with only a single avatar, our encounters are directed by the narrator in the theatre. Nevertheless, in the hands of a skilled guide, it would be possible to individualize each show by taking different routes through the virtual space. In subsequent versions of the world, it would also be possible to add a sufficient number of clues to create a more varied experience for each audience. The addition of activities such as throwing a harpoon from the kayak or a virtual dog sled ride could make each show more dynamic and exciting.

5   EPILOGUE AND CONCLUSION

In April the finalists from the ten competitors were to be selected, and asked to complete their virtual world proposals. None were selected, from the group of ten. According to the jury made up of representatives of the Dessault Systemes, none of the submissions met the requirements for a world to be showcased at the Geode. As stated by the jury, the lack of interactivity, and the linear narrative style was contrary to the requirements and made the submissions difficult to use in the Geode. The jury's decision points out the struggle that designers of 3D content have in creating for public venues. Only recently has 3D projection made its way into the largest of museums. Those installations which exist are largely used for the projection of 3D movies. Movies today, have profited from over a century of filmmakers' experimentation with plot lines and special effects. The visual interest added by 3D technology produce a sense of heightened realism in a visual medium already well understood by the public. When these movies are produced at higher resolution for I-Max theatres they introduce a "wow factor" that can increase audience draw and revenue streams for museums and movie theatres. The announcement of Disney and Pixar in 2008 is that all future animated features will be produce in 3D. "Up" a full length animated feature in 3D produced by Pixar and Disney and released in May

2009 attest to the power of this new format for increasing revenues at movie theatres in the future.[19]

Unlike film, games and virtual worlds are an experience designed for a single player as a one-on-one experience. When these worlds are scaled up to include the multi-user on-line experience, MMORPG (massively multiplayer online role-playing game), game players still interact in front of a single display and hold a game controller. In this virtual space, gamers can work on-line to defeat a common foe. Practice and knowledge of the rules of engagement is essential for success. The design of an Interactive 3D world for a large audience poses interesting and challenging problems. In a 400 seat theatre with a single screen there is little opportunity for input into the group experience. Clearly, experimentation is needed to make this format a success in the future. How can each member of the audience be given some level of participation in the action is a question raised by this project. Required may be a new type of input device located in the arm rest of each theatre seat. Ultimately, input from each member of the audience would need to be filtered, examined and translated into a group action or decision that would impact the plot line, characters and movement through the virtual space. An interactive theatre may also require secondary displays mounted in front of each seat, offering each audience member a customized view of the shared experience on the screen.

Future experimentation may suggest that to encourage a degree of participation, no more than half a dozen participants should share a single viewing space. Each team would compete in a larger world space. Museum administrators and producers of entertainment and educational experience should not despair. Any public art form requires experimentation before it reaches a level of maturity and commercial success. If we are to learn from the history of the film, it took many years of experimentation to create films with engaging plotlines and characters. In the history of 3D interactive worlds for virtual reality theatres, we may be at the same point that movies were at the beginning of their history when audiences were first treated to the Lumiere Brothers' one min film L' Arrivée d'un train à La Ciotat,1895. At this showing, a locomotive steaming out of a tunnel produced such a scare, that the audience felt compelled to rush out of the theatre into the street. With opportunities to experiment with 3D real time projection, new art forms will emerge that will take full advantage of this new interactive format. Until then, there are still 3D movies to show in these 3D virtual reality theatres.

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[19] Press Release, Disney Studio to Debut Special Limited Engagement, Double Feature, of Disney-Pixar's "Toy Story" and Toy Story 2" Excluseively in Disney Digital 3D on October 2n2. . (March 31, 2009)
http://www.pixar.com/companyinfo/press_box/news/20090331.htm

Press, Release, The Walt Disney Studios Rolls out Slate of 10 New Animiated Motion Pictures Through 2012, (April 8, 2008). http://www.pixar.com/companyinfo/press_box/news/20080408.htm

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