Recent Developments in Virtual Experience Design and Production

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ABSTRACT

Today, the media of VR and Telepresence are in their infancy and the emphasis is still on technology and engineering. But, it is not the hardware people might use that will determine whether VR becomes a powerful medium - instead, it will be the experiences that they are able to have that will drive its acceptance and impact. A critical challenge in the elaboration of these telepresence capabilities will be the development of environments that are as unpredictable and rich in interconnected processes as an actual location or experience. This paper will describe the recent development of several Virtual Experiences including: "Menagerie", an immersive Virtual Environment inhabited by virtual characters designed to respond to and interact with its users; and " The Virtual Brewery", an immersive public VR installation that provides multiple levels of interaction in an artistic interpretation of the brewing process.

Keywords: virtual environment, telepresence, virtual world design, vr, realtime computer graphics, interactive computer graphics, interactive art.

1. FROM SIMULATION TO 'INTELLIGENT' SYSTEMS

Telepresence is a term used to describe a mediated experience that enables people to feel as if they are actually present in a different place or time. The current state of Telepresence technology has evolved through rich, multidisciplinary developments in many different fields, for a wide spectrum of applications. In particular, the increasing knowledge about how humans sense, process, and act on information in the world around them has fostered the development of technologies that provide a rudimentary but adequate sense of presence in a synthetic or remotely sensed environment. As this convergence of disciplines progresses, the experiences possible through Telepresence will become more and more compelling.

In essence, Telepresence is a medium. A key feature of a medium is that it can be employed to represent a variety of different kinds of content. Today, the medium of Telepresence is in its infancy and the emphasis is still on technology and engineering. But, it is not the hardware people might use that will determine whether telepresence becomes a powerful medium - instead, it will be the experiences that they are able to have that will drive its acceptance and impact. A critical challenge in the elaboration of these telepresence capabilities will be the development of environments that are as unpredictable and rich in interconnected processes as an actual location. In addition, these environments and their virtual inhabitants will be smart enough to learn about the user and to evolve accordingly. Rapidly approaching the kind of fantastic animated cybernetic systems described by science fiction writer Orson Scott Card (1), these intelligent environments will be invested with new dimensions of symbolism and meaning as they extend their presence throughout the digital network and immerse us in their digital sensuality (2). Exploring the boundaries of these issues will launch this new medium far beyond its origins in photo-realistic computer graphics and traditional simulation.

2. VIRTUAL ENVIRONMENTS IN PUBLIC SPACES

During the past year, virtual environment and telepresence technologies have been used in a number of installations specifically designed for public access. Although a number of design and engineering trade-offs must be made to adapt this technology for large numbers of visitors, these first attempts have been reasonably successful and well received by the public. Exemplary public VR installations include:

> • "Perceptual Arena", an interactive virtual environment designed by European artist, Ulrike Gabriel, was installed for a month in the Hillside Plaza Gallery in the Daikanyama area of Tokyo. It included a headmounted display and dataglove for gallery visitors to interact with an abstract and constantly changing virtual world generated by an SGI ONYX computer system. The project was sponsored by ARTLAB, a division of the Japan based consumer electronics company, Canon, Inc. (3)
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> • Sega Enterprises, Ltd. opened "Joypolis", a "high-tech" theme park in Yokohama, Japan that includes a Virtual Reality game called "VR1". Visitors wear low-cost head-mounted displays with sensors to track head position that immerses them in a full 360-degree computer generated image surround. While looking around, they can also see virtual representations of other visitors seated near them. In addition, the helmeted visitors are divided into groups of eight and seated on top of motion simulator platforms that are programmed to emulate the motions of a virtual aircraft.

> • Most recently, Walt Disney Imagineering (WDI), has developed and installed a VR attraction for the Innoventions Pavilion at Disney's Epcot Center in Florida. The experience is based on Disney's popular animated feature, Aladdin, and uses a headmounted display suspended from the ceiling with realtime graphics provided by many Onyx computer systems, specially modified by SGI. . Guests can explore and interact with animated characters in the world of Agrabah while riding on a virtual magic carpet (4).

3. "MENAGERIE"

As a demonstration of the potential for the development of compelling interactive virtual experiences, a collaborative project was initiated in 1993 to create one of the first fully immersive Virtual Environment installations. The result is a virtual world called "Menagerie", that is inhabited by virtual characters and presences specially designed to respond to and interact with its users (5). This experience allows a visitor to become visually and aurally immersed in a 3D computer generated environment that is inhabited by many virtual animals. The animals enter and exit the space through portholes and doors that materialize and dematerialize around the viewer. As a user explores the virtual space, they encounter several species of computer-generated animals, birds, and insects that move about independently, and interactively respond to the users presence in various ways. For example, if the user moves towards a group of birds gathered on the ground, they might take off and swirl around the user with realistic flocking behavior, fly off into the distance, and return to the ground in another location. Several four-legged animals will approach the user with different gaits and behavioral reactions. The visitor might also turn toward the 3D localized sound of other animals as they follow from behind.

A primary objective of this project was to explore the ability to develop virtual characters that can respond with a variety of simple behaviors that are calculated in real time, and can interact with the user in ways that are unpredictable and never repeated. The ability to populate these environments with virtual characters

such as this is an important step towards the development of 'intelligent', responsive virtual environments that will also incorporate physically based modeling and the ability to collect information about a visitor's interactions and preferences to modify and personalize the experience for that particular user. The ability of a virtual environment to change in response to a user's actions will add an important new dimension to the experience of presence and immersion in these virtual worldsS(6).

The hardware configuration of this system includes a Head-coupled, stereoscopic color viewer (Fakespace "BOOM-2C Viewer'"), and special DSP hardware (Crystal River Engineering "Beachtron") that provides realistic, 3D localized sound cues linked to characters and events in the virtual space. Also, the virtual environment and characters surrounding the user are generated by a high performance, real-time computer graphics platform (Silicon Graphics "Reality Engine").

"Menagerie" was first installed in the Galeries Contemporaines of the Centre Georges Pomidou as part of the exhibition "Real-Virtual" by Scott Fisher in January, 1993. This was part of a larger, ongoing exhibit to present new developments in Art and Technology at the Pompidou called "Revue Virtuelle" and curated by Martine Moinot, Christine van Assche, and Jean-Louis Boissier. In August 1993, this experience was installed in the Tomorrow's Realities Gallery exhibit at SIGGRAPH '93 in Anaheim, California. Most recently, it has been licensed for use in several additional installations for public access.

4. THE "VIRTUAL BREWERY ADVENTURE"

The "Virtual Brewery Adventure" is a recent, immersive virtual environment experience developed for Sapporo Beer of Japan. The exhibit is permanently installed in the Visitor's Center of Sapporo's new office building located in the Yebisu Gardens Place Development in the Ebisu area of Tokyo - originally the site of Sapporo's Yebisu Brewery built in 1887. The Virtual Brewery has been opened to the general public 6 days a week since the complex opened in October 1995. (Fig.1)
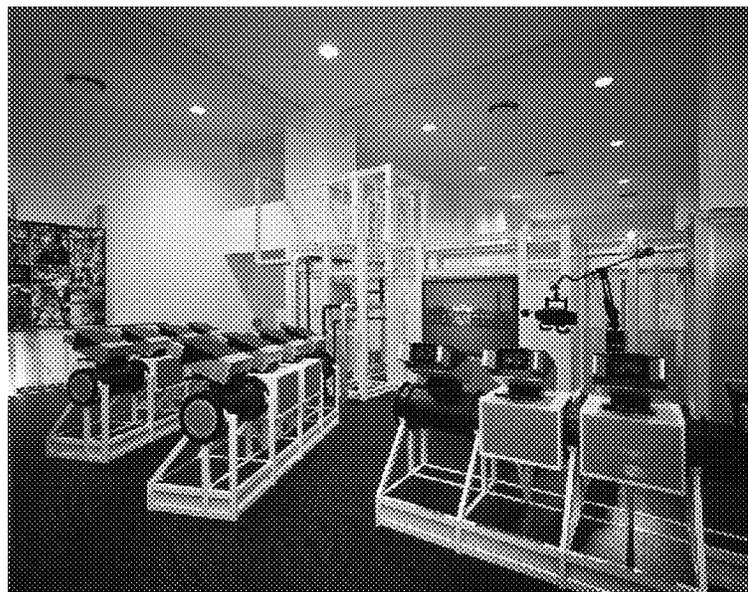

Fig. 1. The Virtual Brewery Adventure Installation

Sapporo contacted Telepresence Research in the fall of 1993 for preliminary negotiations and storyboard planning. By April 1994, after the experience content was agreed upon, the firms signed a formal agreement for the project implementation. Four months later Telepresence delivered the hardware and software, and spent a month in Tokyo installing everything. Telepresence Research produced, directed, and designed the brewery's virtual world. The company drew on the expertise of its strategic alliance for help with the innovative sound system, graphics, and interactive viewing platform. The project team included Fakespace, Inc., Crystal River Engineering, Silicon Graphics, Inc., and Magic Box Productions.

4.1 Experience Description

The "Virtual Brewery Adventure" takes the visitor on a physically impossible journey that lasts about five minutes. The ride begins outside the old Sapporo Brewery, which has disappeared from the physical world but remains in this virtual space. The first image they encounter is a 2D view of Sapporo's old Yebisu Brewery under construction at the end of the 19th Century.   Suddenly, they plunge through the image into a virtual world containing a 3D, color reconstruction of the old brewery.

They can examine the building from the outside, taking a few seconds to admire the surrounding foliage and an impressive, looming Mount Fuji. A texture-mapped guide greets them at the door and waves them through to a corridor lined with giant, glass-walled tanks full of bubbling brew. More guides in the control room explain each of four possible experiences. (Fig.2) They direct the visitor's attention to four large 3D windows through which they glimpse particular stages in the beer-making process: brewing, fermentation, filtration, and bottling. They choose one segment by plunging into the control panel below the appropriate window.
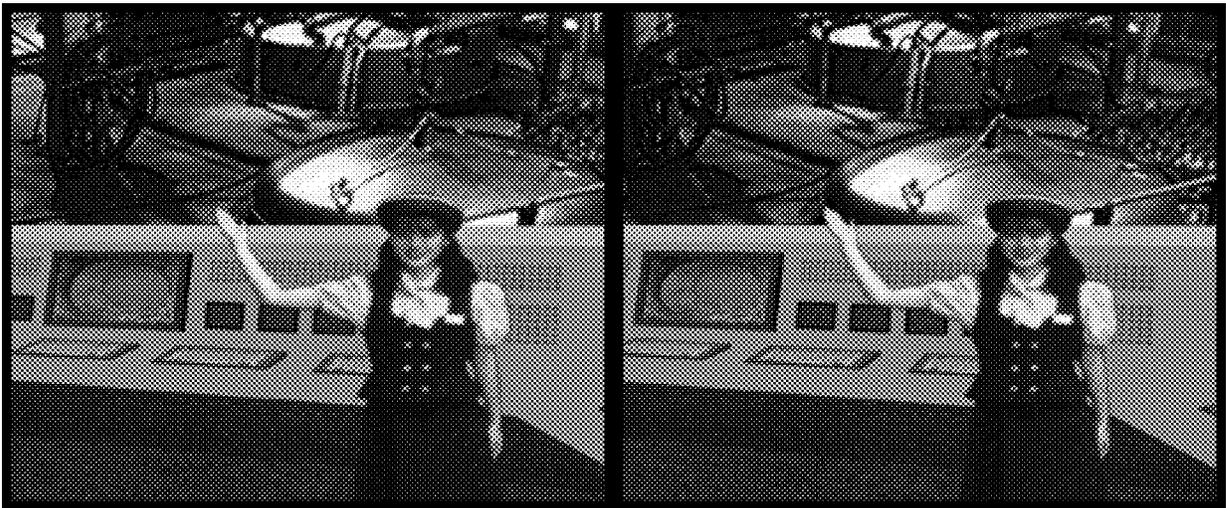

Fig. 2. The control room in the Virtual Brewery (stereoscopic image).

For example, if the visitor chooses the fermentation process, they enter a tank where yeast is added to the cooled "wort". Inside the tank, they fly through a vast liquid-filled space that contains a 3D representation of the molecular structure of beer and its components. In this case, huge models of yeast surround the user and quickly expand into large colonies. Eventually the visitor breaches the surface of the liquid and flies through peaks of foam generated as a byproduct of the yeast and glucose interaction. Each of the elements

has a unique sound associated with it and additional sounds surround the visitor when various objects interact with each other.
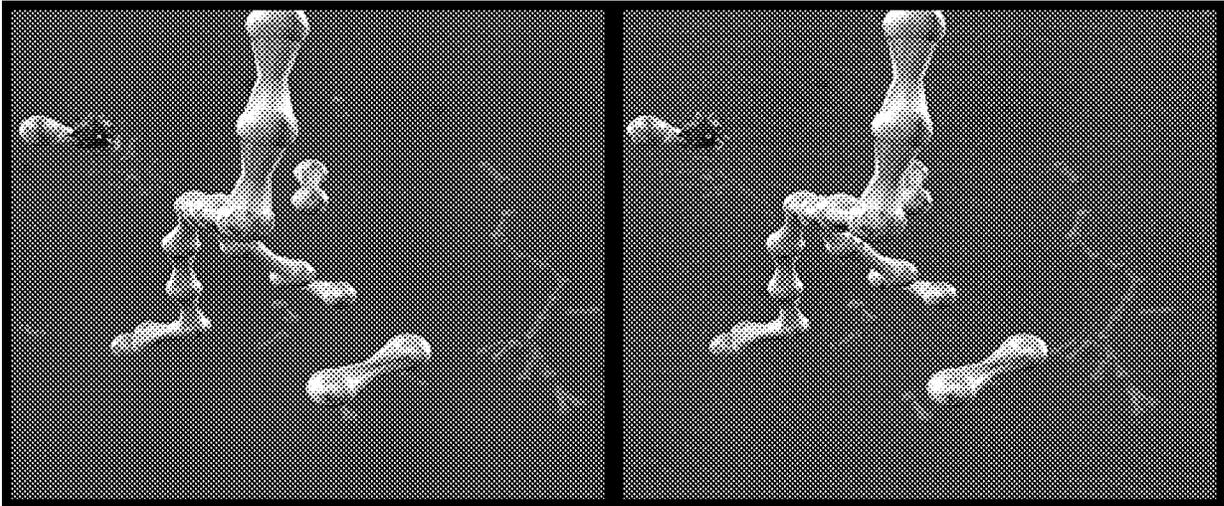

Fig.3. - Early stages of the brewing process (stereoscopic image).

If the visitor chooses a different process in the control room, they can enter another virtual world at a different scale that represents that stage in the brewing process. If they choose to fly through the brewing tank, enormous hops whiz past, and explode noisily by their left ear or below their feet. As they careen through the filter processing world, they can see colored impurities stick in the web like mesh and disappear behind them. In the bottling plant they can fly through lines of softly clanking bottles as they fill with liquid and hear the pneumatic slap of labels on glass. Because of time limits for each visitor, one experience can be explored at a time and a return visit is required to see additional experiences. The scenarios are designed to provide a quick and entertaining introduction to the elements, equipment, and science used in the process of brewing beer. (Fig. 3)

4.2 Display Hardware and System Configuration

The exhibit combines several technology subsystems to allow different levels of interaction with the Virtual Brewery world:

The primary viewing station provides a head-coupled, high-resolution, stereoscopic color viewer that is comfortably used like a pair of very wide-angle binoculars looking into the virtual space (Fakespace "BOOM3C+ Viewer"). Realistic, 3D localized sound cues are linked to characters and events in the virtual space by means of a special 3D sound system (Crystal River Engineering "AcoustetronII"). And, the virtual environment is generated by a high performance, real-time computer graphics platform (Silicon Graphics "ONYX Reality EngineII").

Surrounding this station, there are 12 additional 3D viewing stations where visitors can see and hear the experience through the viewpoint of the BOOM user as they navigate through the virtual world.

Also, a large rear-screen video projector and several monitors display 2D images and sounds of the virtual world throughout the exhibit space.

4.3 Graphics and Interaction Software

The Virtual Brewery software was designed to run on a Silicon Graphics Onyx system. The configuration of the system includes 4 processors, 256MB of Ram, 2 RS-232 ports , and Reality Engine 2 graphics capability with two Raster Manager boards. The bulk of the software used to generate and integrate the various 'sub-worlds' for the experience was specifically written for this project by Telepresence Research, Inc., and was developed in the C language (with an object-oriented approach). This custom software also includes routines for generating B-Spline curves of travel through the Virtual environment, for performing (2D) intersections with arbitrary polygons (boundary detection), and for loading Alias triangle files into SGI's Performer format for realtime playback and interaction.

Modeling of the objects and structures that make up the virtual world was done with two commercially available software packages: The interior architecture models were primarily developed with MultigenS(®) developed by Multigen, Inc. The main exterior model of the old brewery was developed from a CAD database in TDI Explore format that was translated into Multigen format for final integration. All of the models in the final microworlds and bottling process visualization were done with the Poweranimator V5 package from Alias Research, Inc. of Toronto.

Several software libraries were also used that are routinely distributed by Fakespace, Inc. for use in integrating SGI graphics software with their BOOM3C product. Additional software developed by Crystal River Engineering, Inc. for use with their Acoustetron ll product was used in conjunction with custom software developed in collaboration with Telepresence Research to link and trigger sounds designed specifically for the experience.

4.4 Innovations in Design and Implementation

Sapporo wanted an innovative, high-tech centerpiece for its new Visitor's Center in the multibillion-dollar complex, built on the site of the original Sapporo Brewery. The exhibit had to be interactive, educational, fun to use, and accessible to a large number of people. The "Virtual Brewery Adventure" has been a unique and highly successful implementation of a publicly accessible VR installation. In particular, it was designed to accommodate a large number of viewers; and this consideration drove innovations in both hardware and experience design:

> • The experience is an artistic interpretation of a scientific process. Some of the environments are quite realistic; others are highly stylized and even surreal. But overall, they provide clear, engaging representations of the brewing process for the general public.

> • As an experiment in non-photorealistic virtual environments, this project combined a photo realistic structure (the old Sapporo Brewery) with a 'non-realistic' fantasy environment (the micro-worlds). The objective was to give viewers an immersive experience they can never have in the physical world -- letting them see the unseen.

• This exhibit also provides a unique sense of historical context to visitors by interactively presenting an accurate virtual model of the old brewery structure that previously occupied the same location (7).

A number of design innovations were developed to meet throughput and time requirements for public access while still providing the opportunity to interact with the virtual world. And most importantly, the structure of the program lets the users see something different on every visit. Specific features include:

•The overall exhibit configuration was designed to allow visitors to choose their level of immersion in the experience. The main viewing station provides full interactivity with the ability to control their point of view and motion through the virtual worlds for one user at a time. The 3D viewing stations can accommodate 12 visitors at a time and provide visual and auditory immersion. The large 2D display screens can be seen by many visitors at one time and provide a preview of the interactive experience.

•The use of Virtual Guides inside the experience help to explain to the visitors what they are seeing, where to go, and what interactions they can make. And they also help manage the throughput timing when someone lingers too long.

•The final microworld experiences were designed so that the visitors at the primary viewing station can look in any direction as they are flown along a pre-computed path through the environment. But because of the fast pace and content, most visitors do not notice the lack of position control as they look around.

Several technical innovations specific to this installation were also developed and include the following:
• Development of animated, photorealistic virtual characters that can make simple gestures and interact with visitors.

•Implementation of a unique display technique to combine photographic-resolution, stereoscopic imagery with 3D CG imagery.

•Development of a very robust software interface that allows non-technical attendants to startup, operate, and shutdown a complicated technology configuration on a daily basis with little training.

Sapporo modestly projected around 150,000 visitors for the exhibit's first year -- but in the first month alone, over 100,000 people have visited the Center to immerse themselves in virtual beer. More recently, attendance has jumped to as high as 7,000 visitors in one day.

5. ACKNOWLEDGMENTS

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The Virtual Worlds software developed for the "Virtual Brewery Adventure" was written and implemented by Glen Fraser, Telepresence Research, Inc.

The "Virtual Brewery Adventure" sound design is by composer, Mark Trayle, with sound software by Glen Fraser, Telepresence Research, Inc. and Toni Schneider, Crystal River Engineering, Inc.

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For additional online information and graphics from "Menagerie" and the "Virtual Brewery Adventure", please access the Telepresence Research Web page: http://www.telepresence.com/TR/index.html

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