

publications

Osmose: Towards Broadening the Aesthetics of Virtual Reality

references

Osmose

Char Davies and John Harrison
Softimage Inc.

...by changing space, by leaving the space of one's usual sensibilities, one enters into communication with a space that is psychically innovating... For we do not change place, we change our nature.

Gaston Bachelard, *The Poetics of Space*, 1964

Introduction

Osmose is an immersive virtual environment, produced by Softimage in 1994/95. One of the primary goals of Osmose was to push the expressive capabilities of existing 3D tools, to demonstrate that an alternative aesthetic and interactive sensibility is possible for real-time, interactive, 3D computer graphics.

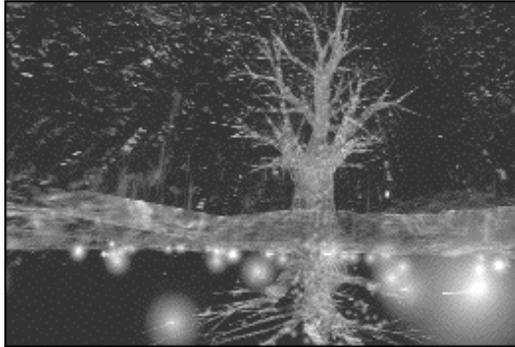
Osmose was created under the direction of Char Davies, the Director of Visual Research at Softimage. A former painter, as well as a creator of 3D computer graphic stills, Davies has a particular artistic vision which has driven the project. Davies has been striving for years to represent space as a luminous enveloping medium. This has led her from painting to 3D computer graphics, and finally into creating immersive virtual spaces.

One of Davies' intentions for Osmose was to create a space that is "psychically innovating," one in which, to quote Bachelard, participants do not change "place," but change their own nature. Osmose was therefore designed to explore the potential of immersive virtual space to allow participants to shed their habitual ways of looking at (and behaving in) the world. By doing this, we hoped they would then emerge from the virtual world to experience the real world in a fresh way, reawakening a fundamental sense of their own "being-in-the-world." We hoped that this could be accomplished through the visual, aural and interactive aesthetic of the work [4].

The Challenge

Visual

Most existing virtual environments are based on photo-realistic hard-edged objects in empty space. However, Davies' visual aesthetic involves the creation of ambiguity - suggesting meaning rather than explicitly illustrating. This tends to *evoke* a range of associations and interpretations in the mind of the viewer.



Previously, Davies had accomplished this in her paintings and 3D computer graphic stills in the following ways [18, 23]. First, she worked extensively with transparency and subdued colour to break down boundaries between objects, and suggest fluctuations between "figure" and "ground." Second, her representations are neither realistic, nor abstract, but somewhere in between. Such metaphor rather than illustration.

Such an aesthetic are quite different from the conventions of current real-time computer graphics, which instead strive for realism [12, 15, 25].

Davies' aesthetic turned out to be very difficult to render in real time. For example, some of the 3D computer graphic stills she created using her principles took over 40 hours to render. To create a sense of immersion in virtual reality, however, each frame needed to be rendered in 1/30th of a second or less - requiring a speedup of a factor of more than four million.

To achieve both the aesthetic Davies intended and the performance necessary for VR, two main computer graphic techniques were used.

First, we used models with transparent texture maps. The models and textures were generally created to be ambiguous (such as using loose, vertical strokes to suggest the edge of a forest, or luminous flecks in the sky to suggest air). However, a few more recognizable shapes (such as a tree and rocks) were included to give a sense of grounding to the work - yet even these models were given abstract and open textures, so as not to be illustrative.

The use of transparent texture maps enabled us to "dissolve" the hard edges of objects - so that we could make complex looking models with relatively few polygons.

The use of transparency also enabled us to dissolve the boundaries between objects and space. By deliberate misuse of the Z-buffer, we were able to selectively reverse the sense of figure and ground, with more distant objects often passing in front of closer ones (the transparency helped keep this from being disconcerting when viewed in stereo). This allowed us to "play" with figure and ground relationships, creating perceptual fluidity.

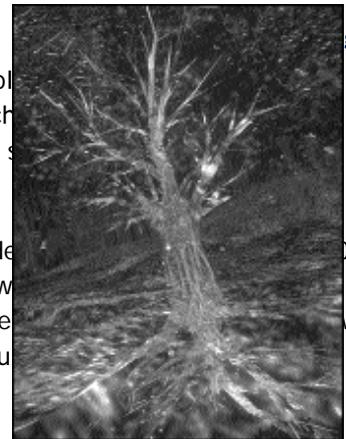
The colours and tonalities of the models and texture maps were intentionally made to be subtle, so that boundaries were less perceptible between differently coloured objects, or between figure and ground - again allowing us to play in the ambiguous zone of suggestion rather than illustration.



The second main graphics technique was to fill the various worlds in Osmose with many simple particle systems - soft luminous particles following animated splines. These particles were intended to represent the flow of a stream, or the flight of a bird or the swarming of insects (depending on their position and motion). This, along with the textured models throughout, helped give the impression of being completely surrounded in enveloping space. Almost all of the world spaces were created using these two techniques, guided by the intent to use nature as a metaphor [1, 11]. The worlds include a central clearing with its archetypal tree, a forest, the interior of a leaf, a subterranean world, a pond, and finally a "life-world," which symbolically represented all the

... were created using a simpler, more linear aesthetic. The first, an infinite 3D grid, was used as an introduction to the work - serving as a placeholder and also to make reference to the Cartesian space which is central to computer graphics. The transition to the non-Cartesian space was therefore dramatic.

The other two "linear" world spaces were a world of code (lines of code developed specifically for Osmose) and a world of text (excerpts of relevant philosophical and poetic texts). The first and one above, function as conceptual parentheses around



Navigation/Interaction

We wanted to develop a method of navigation and interaction to complement the painterly visual aesthetic.

First, we desired to facilitate an experience of "being in the world" rather than "doing." That is, we wanted to encourage immersants to calm their minds and contemplate the virtual world - rather than rushing around grabbing or destroying things [2, 20]. We also hoped to find a way to dissolve boundaries between interior *self* and exterior *worldspace* [14] (hence, the title "Osmose," French for osmosis).

Second, we wanted to create a strong sense of full body immersion in a fully enveloping space. We wanted participants to feel centered in their physical bodies during immersion, in a way that is similar to the effect of practicing tai-chi or meditation. As well, we wanted to enable a sensation of floating - with emphasis on vertical movements rather than horizontal or frontal movements.

Creating this sensation of gently floating - while feeling centered or grounded in the body - meant that traditional methods of VR navigation (such as using a joystick or pointing using a glove) would not be appropriate. Since these traditional techniques require handling devices outside the body core, we felt they tended to reinforce the desire to control, as well as to create a sense of disembodiment [13, 21]. As a result, we developed an alternative technique based on balance and breathing.

This technique was inspired by Davies' scuba diving experiences [4], by how members of the team moved in their dreams and by writings on the phenomenology of the body and various meditation traditions [14].

Sensors were used to measure the tilt of the immersants' spines, and the expansion and contraction of their chests. This allowed us to move immersants horizontally through the virtual space in whatever direction they tilt, and move them upwards when they fill their lungs, and downwards when they empty their lungs (similar to scuba diving). This allowed free motion in all directions, while keeping immersants aware of their body functions of breath and balance.



As a result of this technique, immersants have a strong impression of being centered in their body in the virtual space. With this sense of centering also comes relaxation and calm, partly because of the deep breathing. Immersants are, as in scuba diving, discouraged from reaching out and touching things in Osmose (we intentionally did not track their hand positions). This gives a sense of "being" in the world, rather than "doing" things to it. All of this helped people to *experience* the work rather than attempt to drive it.

As mentioned above, this is in deliberate contrast to more conventional approaches of "driving" or "controlling" objects in the virtual space. Such approaches tend to foster a sense of mastery and control of objects within the space, often encourage speed and aggression. We hoped to show that this was possible, but also that these alternatives could open up new ways of thinking about the potential of VR [3, 8].

Finally, in keeping with the contemplative nature of Osmose, switching between the various worlds is accomplished using long, slow fades to and from transparency. For example, as one moves towards the edge of the clearing, the clearing starts to fade away while the leaves of the forest fade in, creating a perceptually ambiguous area where the two spaces coexist.

Sound

An aesthetic for sound which would complement the visuals was also desired.

To achieve this, the sounds used in Osmose were sampled from two human voices (male and female). Then, these samples were processed so they would be neither literal, nor abstract, but evocative. The subliminal presence of human voices throughout also supports the work's intent to reaffirm the role of the physical body in the virtual space.

Some of these sounds were attached to objects in the VR space, fully localized in three dimensions.

Many current VR environments have "sound effects," which are attached to objects, or triggered according to the user's activities. However, we wanted to go further, adding an ambiance of continuous, melodic sound.

One challenge for the sound designers was to make this sound emotional without creating a linear composition - since these sound

cycles would need to happen in real time, according to the explorations of the

immersant. To this end, melodies were associated with each of the different worlds - but carefully composed so as to mesh well with each other through the transitions. One can hear the melodies coming and going as immersants float between the worlds, giving an extra cue as to the location in the virtual space.

This use of ambient sound throughout was seen as an important way to heighten the feeling of presence in the virtual space [10].

Installation

We wanted Osmose to be a solitary, intimate experience, one in which connection is made to the "depths" of one's own self, not to other people. In addition, the sense of full body immersion in enveloping space was an essential aspect of this work. Thus, we decided to use a head-mounted display for the participant, rather than using other, less-immersive techniques.

However, we also wanted this to be an experience which more than one person could share, highlighting for an audience the relation between immersants' body gestures and the progressing journey.

Achieving both these goals at the same time was accomplished as follows:

A separate "chamber" was constructed so that immersants could experience Osmose in complete privacy, without having a crowd of strangers watching their every move.

The view of Osmose that the immersant saw was also projected in real time in 3D on a large screen in the audience area - so that with polarized glasses, the audience could vicariously experience the space. This required the total of four views to be rendered at all times - two with the viewing parameters for the immersant's HMD, and two with the (very different) viewing parameters for the stereo projection.

The shadow of the immersant was projected on a vertical translucent screen which was also visible in the audience space, facing the video screen. This helped emphasize the role of the body, poeticizing the movements of the immersant, and highlighting the relationship between body gestures and the resulting visuals and sound.

Headphones and speakers were also installed for the audience to experience the sound. The public area was designed to enhance the sensibility of the work.



Technical Details

Osmose was quite a complex work of virtual reality to produce.

The software was written with the aid of the Softimage SAAPHIRE and DKit development libraries, as well as SGI's Performer and GL graphics libraries. The software runs using a parallel processing model, with the usual separation of the application, cull and draw processes, as well as many more processes for computing the particle animations, and reading/writing to the various VR devices.

To render the graphics in real time in response to the movements of the immersant, a three pipe Onyx RealityEngine2 was used for the first two public installations of Osmose. Two graphics pipes were used to independently render the left and right eye views for the immersant at 20-30fps, while the third pipe rendered both of the left

and right eye views of the stereo projection (with a frame rate of 10-15fps, since only one pipe was dedicated to the two views). This Onyx was loaned to us by Silicon Graphics for the exhibitions.

A Division DVisor HMD was used for the immersant. This device was selected for its wide field of view, because immersion was considered more important than resolution for this particular application.

A Polhemus Fastrak was used to track the position of the immersants' heads and the tilt of their spines.

A custom breathing vest was constructed to measure the expansion and contraction of the immersants' chests.

A variety of sound equipment was also used. A Macintosh computer controlled the various MIDI devices, receiving instructions via a serial connection to the Onyx. A Crystal River Acoustetron was used to localize up to eight sounds in 3D space at any given time. A pair of Kurzweil samplers, an effects box and a Mackie automated mixer were also used.

The Effect Osmose Has on Participants

During public installations of Osmose, immersants are placed in Osmose for 15 minute sessions. We've found that this amount of time is needed to allow them to become comfortable with the interface, explore the spaces and then "let go."

We expected immersants to become calm, and feel a loosening of the boundaries between self and world. Many of them do experience this, giving up goal-oriented interaction for a sense of contemplative free-fall. However, many also experienced a range of sensations and emotions which we did not predict; these seemed to involve an altered mind/body state [6, 17]. In this state, it seems they paradoxically feel both disembodied (because of the visual aesthetic, being able to float and pass through things) and embodied (due to reliance on breath and balance), simultaneously.

Judging from participant response, immersion in Osmose appears to temporarily suspend some people's capacity for rational thought and conversation. For many it is an emotional, even euphoric, experience. People feel free of their bodies and yet, paradoxically, grounded in them at the same time. Some feel an intense sense of loss when the immersive session is ending, and even cry afterwards.

We think that such responses are primarily due to the visual, aural and interactive aesthetics of the work. By enabling people to experience the unusual sensations of seeing and floating through things, they are freed of their usual, habitual ways of being in the world: this effect, in combination with the use of breath, solitary immersion and metaphorical content, appears to induce heightened awareness [5, 7].

Conclusion

We believe that Osmose has indeed expanded the range of visual, aural and interactive aesthetics that are possible within immersive virtual environments.

Osmose demonstrates a different use for immersive space from that usually associated with virtual reality [9, 16, 19, 22, 24]. While many other virtual environments attempt to simulate physical reality as we know it, Osmose demonstrates the potential of VR to create spaces which are not based on physical reality nor on our ingrained habitual responses to physical reality. Osmose

demonstrates a space which, as Bachelard wrote [1], is unlike that of our usual sensibilities - and thus can become psychically innovating.

As a result, we believe Osmose has shown VR's potential for exploration of the subjective perception of consciousness, or embodied *being* (with all the attendant therapeutic and philosophical implications).

Osmose demonstrates that an alternative aesthetic is indeed possible for real-time, interactive 3D computer graphics, and that this can lead to the development of a significant and unusually compelling virtual environment.

Credits

- Char Davies conceived Osmose and directed the development - providing the vision and the aesthetic for the work.
- Georges Mauro created the models and animations in Osmose using Softimage®3D.
- John Harrison developed the custom software for Osmose.
- Rick Bidlack and Dorota Blaszcak composed the sound for Osmose.

