Cognition, Perception and Experience in the Virtual Environment: Do You See What I See?

Organizer:
Linda Jacobson, Silicon Graphics, Inc.
Panelists:
Charlotte Davies, SoftImage
Brenda Laurel, Interval Research
Dr. Creve Maples, Muse Technologies
Mark D. Pesce, Big Book
Dr. Mark Schlager, SRI International
Rob Tow, Interval Research

Description

Virtual reality is real. “We will see high-resolution, low-lag systems doing serious applications within three years,” predicted Frederick Brooks, Jr. at SIGGRAPH 94. And indeed we have.

We now possess the algorithms, architecture and hardware. We know the techniques: we understand how to define geometries and assign object behaviors, and we map textures, incorporate collision detection and implement level-of-detail switching. We adopt psychological depth cues from the field of 3D design, implementing linear perspective, motion parallax and occlusion to impart the illusion of three-dimensional space. In giving virtual objects their attributes, we consider the participant’s relationship to those objects.

Nonetheless, as various SIGGRAPH 95 panelists pointed out, “Little is understood about how to usefully interact in three dimensions in ways that really help perform tasks” and “There has been a surprising lack of real-world applications in the virtual world...We are unfamiliar with this new medium, unable to utilize its power and to compensate for its limitations.”

That is because the primary difficulties facing application developers are not technological, but conceptual.We know the language but we don’t know the grammar. We haven’t defined the stylistic guidelines. We know how to apply real-time, immersive, interactive techniques using virtual reality technologies, but we don’t take a uniform approach to applying our knowledge of how these inputs affect us, and as a result have not developed a consistent UI.

Through virtual reality, we move beyond cognitive computing into the realm of experiential computing. To build useful applications, we must understand how and why experiential computing is fundamentally different from cognitive computing, and how it lets us tap into human capabilities in a way no interface and no form of computer graphics has done before.

This is especially important when we consider that today’s successful commercial virtual reality applications are used for training in cognitive tasks and design of products we use everyday. Previous SIGGRAPH panels wondered how to work effectively within immersive environments and explored the state of aesthetics in the virtual environment. If we want to discover how to work effectively and implement aesthetics within immersive environments, we must discover how we learn in those environments and establish a set of guidelines outlining our discoveries. We must bring a greater degree of involvement of cognitive psychology and human-perception experts into the mix of those developing VR technologies and applications.To move into experiential computing, we must be able to communicate how and where humans operate cognitively, perceptually, and experientially. We must create the cyberspatial equivalent of Strunk & White’s Elements of Style.

Some issues to be aired during this panel include: how humans perceive information visually, auditorially and proprioceptively; how the mind works when seeking known or unknown information; imagery and associative memory techniques and how they relate to virtual environments; perceptual and cognitive constancy when updating displays.

This panel aims to launch discussion in the SIGGRAPH community of how we see in cyberspace...and to integrate into our understanding of virtual reality’s potential these facts registered by Diane Ackerman in her Natural History of the Senses: “The body edits and prunes experience before sending it to the brain for contemplation or action. Not every vagary of sunlight registers on the retina. Not everything we feel is felt powerfully enough to send a message to the brain...[m]uch is lost in translation, or is censored, and in any case our nerves don’t fire all at once. Some of them remain silent, while others respond.

> “Our senses also crave novelty. Any change alerts them, and they send a signal to the brain. If there’s no change, no novelty, they doze and register little or nothing....A constant state—even of excitement—in time becomes tedious, fades into the background, because our senses have evolved to report changes, what’s new, something startling that has to be appraised, a morsel to eat, a sudden danger....The body’s quest isn’t for truth, it’s for survival!”

Panel Format

This is an “issue” panel, in which each panelist will provide a brief statement describing his or her perspective of cognition/perception/experience relative to virtual reality, followed by a lively discussion in which it is expected that the panelists will in some cases disagree with each other, and in others, elaborate upon each other’s statements.

It is the goal of the panel organizer to provide a summation of the points made through the Silicon Graphics Web site at `http://www.sgi.com/.`

Charlotte Davies

Conventional design for virtual reality tends to reflect our cultural world-view, resulting in virtual environments filled with static, solid, hard-edged objects in empty space. Similarly, most user interaction tends to be based on metaphors for manipulating machines. Such approaches, ignoring how we subjectively experience being-in-the-world, limit the expressive potential of the medium. There are, however, alternatives.

OSMOSE, the immersive virtual environment that I created with my team at Softimage last year, is an example: photo-realism, linear perspective and Cartesian notions of space have been abandoned for an aesthetic based on transparency, tonal subtlety and spatial ambiguity, for the goal is to evoke multiple meaningful associations rather than merely illustrate. The sound in OSMOSE also seeks to achieve this, further emotionally involving the participant within the space. Directly manipulative interface methods, such as joystick or glove, have been replaced by bodily processes of breathing and balance. Whereas the former methods tend to reduce participation to disembodied eye and controlling hand, these far more intuitive techniques ground the immersive experience in the participant’s own body, creating a calming and centering effect and leading to heightened awareness and receptivity.

Several thousand people have been immersed in OSMOSE in the past year. Their responses have confirmed the author’s belief that immersive virtual space, when approached with a certain sensibility, has intriguing potential as an educational medium.

Brenda Laurel

Style is a very sticky wicket. The purpose that a work is intended to serve, its form or genre, the materials it encompasses, and the maker's skills, beliefs, and values all influence style strongly. Although Aristotle did not discuss style directly in the Poetics, some twentieth-century structuralists would say that style is the point of articulation between the conceptual elements of a form and the sensible aspects of its unfolding. This provides a neat analytical springboard for examining the root assumptions about the powers of the medium and its fundamental forms. From there we should be able to see ideas embedded in the medium that illuminate the relationships among senses, emotions, thought and reason, and action in virtual environments. These relationships, variously worked out, are the elements of style.

Dr. Creve Maples

Richard Hamming said, "The purpose of computing is insight, not numbers." Today, as the Information Age moves forward, computers touch all aspects of our lives. Far from achieving "insight," however, there is often a feeling that we are slowly sinking under the enormous volumes of data. Helping people to explore, question, and understand complex information is an important criterion for future computational environments. Highly interactive human-computer environments can allow practical solutions to some problems far more rapidly than either human or computer operating independently. User interaction with synthetic, immersive environments presents an exciting and relatively uncharted area.

The human mind is capable of absorbing and processing large volumes of information. Most of this processing, however, occurs at a precognitive level, the results of which serve to alert the cognitive mind to areas of potential interest. Toward that end, and in concert with the idea of a humanistically organized software environment, five areas of human-computer interaction have been defined and investigated: Exploration, Navigation, Presentation, Interaction, and Examination. These five areas serve to define a functional arena for interactive environments and provide the foundation for device and model independent tools.

Mark D. Pesce

We're all taught how to read and write – how many of us are taught to sculpt, or to design a building? Although we all experience the immediacy of space, we're not trained in the canons of architecture. How then, can we expect to develop any interface of immediacy, when we're functionally ignorant of the processes which underlie this experience?

The ideal – an interface which disappears into a "virtual" reality – has seen its realization in only a few works, such as PLACEHOLDER (by Brenda Laurel, Rachel Strickland and Rob Tow) and OSMOSE (by Char Davies), in part because researchers are unable to leave their own thought processes behind and design transparently. In looking to the real, we find a design guide for the virtual; in looking inside ourselves, we find ontology as interface, being as doing.

Dr. Mark Schlager

Virtual environment technology allows developers great freedom in designing spaces, objects, and systems and the perceptual mechanisms through which users interact with them and each other. Steps can be taken to ensure that resulting designs support cognitive aspects of learning activities. Developing virtual environments that support learning requires an understanding of the relationships between the cognitive capacities of the learner, the environment and activities being modeled, and the technical affordances of VR that support information encoding, development of knowledge structures, and performance. For example, input modality and display perspective (e.g., position, ground, and field of view) can be used to enhance information encoding and retrieval. The model of the world represented by the VR designer can support the formation or enhancement of the user's own mental representation by simplifying a complex system and revealing patterns that are difficult to discern. My hope is that the VR research and VR development communities can begin to establish a common language for discussing these issues and jointly formulate a set of design guidelines.

Rob Tow

Twelve percent of women are heterozygous for anomalous color vision, and are tetrachromatic – they see subtle colors that men never will, because men have only one X chromosome, and can at best be trichromatic. People who grow up in Western architectures, with sharp right angles and many vertical and horizontal edges, have more cortical detectors for vertical and horizontal lines than do people who grow up in societies which are uncarpentered and agrarian; they see media such as halftoned pictures with forty-five degree angled screens subtly differently. Kamala and Amala, the famous "wolf-girls" of Bengal, never learned language after they were found in the wild and taken into an English family.

We are all different; from our various genetics, and from the differing interactions of our growing bodies with the external world, both physical and social. Our brains and our bodies gain much of their structure from interacting with the world in the realm of the senses; the structure of the external world is reflected within our own structure – and just as cats raised in an environment with no vertical components don't build cortical detectors for vertical shapes, we have not built cognitive structures for the worlds in which our children will develop – VR will change the very nature of the human mind and soul as it changes the sensory and social worlds in which we live and act. Our children will grow up immersed in this Novum Organum, and we will stand at the edge of the flow that separates them from us, unable to follow them because we literally will not see what they see. Unlike Moses' promised land, this New Atlantis will be of our own making, created as we exteriorize our minds and culture into Turing complete agencies.