

BY MAX NIKIAS

Immersive ENVIRONMENTS

You can count on it: The Internet's future is indeed three dimensional.

Our two-dimensional "postage stamp" world of computers, TV, and film will recede as new multimedia technologies now emerging from research labs provide us with the means to create three-dimensional immersive environments in our living room-or anywhere.

Visualize these scenes:

- In a distance learning class, a teacher and students are thousands of miles apart, yet they look and speak as if they are in the same room, the same discussion circle. They are interacting in real-time with full-sized avatars remarkably life-like, three-dimensional human representations. The students can even "touch" objects in a faraway museum, experiencing eminently realistic tactile sensations.
- On a factory floor, a worker has questions about how to use a piece of machinery, so he or she summons a remote expert for guidance. They talk in real-time, and the expert answers the questions.
- A man in his living room goes shopping by interacting in an immersive home shopping channel that allows him to see and talk to human representations of remote store clerks and "touch and feel" the products. Three-



A factory worker uses augmented reality in asking for guidance from a remote expert, who appears as a life-like 3D human representation.

dimensional audio makes it sound like the real experience of shopping in a mall.

- Grandparents who can't make the long trip to see the grandkids instead visit them in their own living room by way of an immersive environment.

These experiences may be facilitated by unnoticed screens or special goggles with object tracking capabilities that show both the virtual scene and the real world. And, if the high-speed history of information technology is any guide, these scenarios are possible within the next decade. But we won't be sitting around waiting: We will be using many of these technologies to re-make the Internet as they are developed along the way. For instance, new forms of Immersive Audio, or spatially-placed 3D sound, are being added to the Internet listening experience.

This new paradigm can be termed augmented reality—remote scenes are transmitted to a living room or factory floor to augment the real environment. A person sees the remote scene superimposed on his or her real environment. The factory worker sees the human representation of the remote expert standing in front of him as an addition to the real environment of the factory floor. Graphics and animation can be transmitted as well to augment the real environment. The real environment becomes immersed in a remote environment.

It's not virtual reality, in which a person sees only a virtual world by wearing a head-mounted display. But, rather, it's a combination of the real world with a virtual world, a virtual world that enhances and extends the real world with simulated visual, aural and tactile experiences.

At the Integrated Media Systems Center at the University of Southern California, we are developing such multimedia technologies as advanced interactivity features, video compression, 3D facial modeling and animation, and Immersive Audio(tm) for this new reality.



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The evolution of information technology points directly to the development of augmented reality's immersive environments. The true breakthroughs of the past 30 years include the establishment of ARPANET, the precursor to the Internet, the introduction of the microprocessor and the invention of the personal computer in the 1970s, and then the development of the Web browser in the 1990s.

With the development of e-commerce on the Web, there is tremendous pressure to come up with new ways to buy and sell products and services, to enhance the Web's capabilities by improving its speed, reliability and capacity.

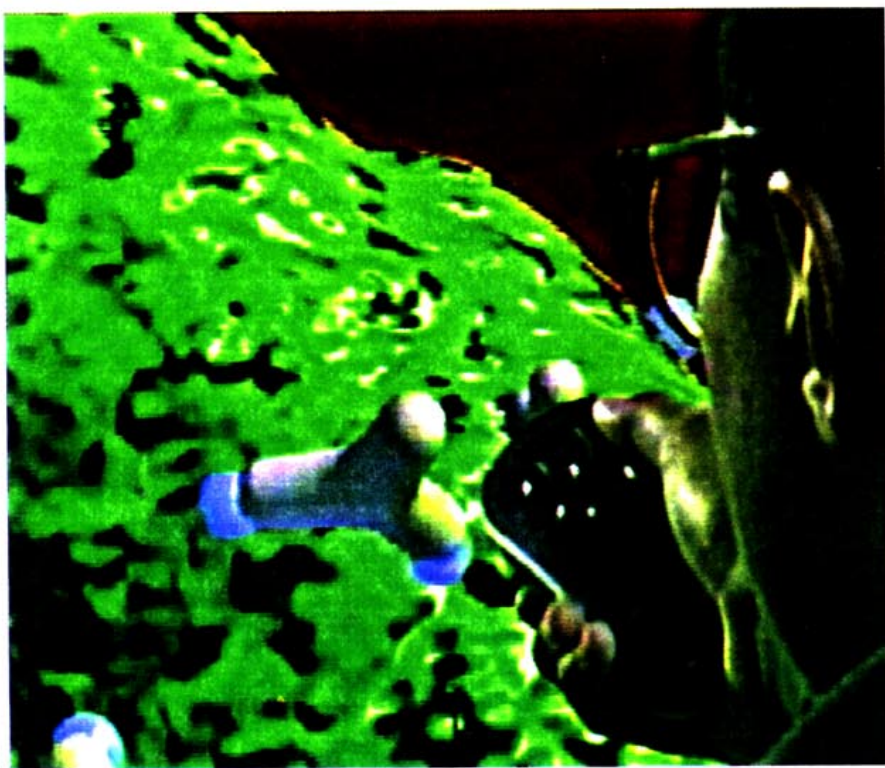
These pressures are leading us to experiment with improvements to how humans interact with computers, to question the clunky use of the keyboard and mouse, to search for more natural ways of interacting. They are leading us to find better ways of moving huge amounts of information from one place to another, to re-think the current modes of wired and wireless communications. They are leading us to devise new ways of searching for data in digital form and manipulating it, to investigate how we

might search databases by visual means for the visual media of photos or videos, instead of the way we have to do it now, by searching with words alone.

These explorations will lead us to a new discovery of dramatically new ways to synthesize multimedia for effects that immerse the senses and envelop us in immersive environments, moving from the two dimensions of computers, TV, and film to the three dimensions of augmented reality.

Forrester Research of Cambridge, Mass., spotted the trend recently, in commenting on how broadband capabilities will open up new possibilities: "Broadband's potential isn't in faster Web pages or interactive afterthoughts overlaid on old TV assets. Instead, a new

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A researcher examines a chemical bond in three dimensions.

form will emerge to redefine interactivity, immersing the audience in a collage of content and commerce.”

The key tool in creating this world of augmented reality is what is known in the Internet world as the integrated media system-computer-based technology that allows the creation of sophisticated multimedia information.

The integrated media system is linked by an advanced infrastructure of networked computers and multimedia equipment in a Media Immersion Environment, which serves as a testbed for new multimedia technologies. To achieve “breakthrough functionality,” the integrated media system goes beyond the general computing paradigm to create immersive environments with multimedia information, such as sound and video in three-dimensional form, engineered to be delivered easily over the evolving wired or wireless networks.

With the integrated media system paradigm, breakthroughs can be made in the four areas of human-computer interfaces, databases, communications and applications. Our common human-computer interfaces of the mouse, keyboard and even the monitor will give way to the spoken word and sense of touch. Database technology will be revamped to process and integrate video, audio and haptics (touch) data, which are much more difficult to manipulate than text data. Wired and wireless communications networks will be reworked for much greater speed and reliability. And, finally, new applications, or products, will be crafted using the new technologies and integrating results from “human factors” studies on how to design for the best use by people.

This integrated media system paradigm will propel the leap from our simple two dimensions to complex, three-dimensional immersive environments delivered over the Internet. The Net will become the quintessential integrated media system, opening on to a grand vista, a truly uncharted world of vast possibilities. **Z**

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