

Future Tech: **Virtual Reality**

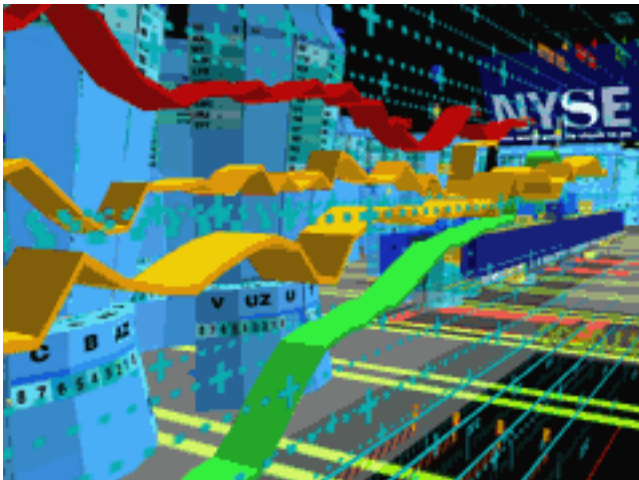
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Toss the tv and forget the Net--soon artificial worlds will be coming at you from everywhere

by Fenella Saunders

The floor of the New York Stock Exchange is a riot of tossed papers and traders shouting orders and furiously pounding computer keys. But Anne Allen, senior vice president of floor operations, calmly goes about her work as if she were living in a separate world. Tucked away in her steel-and-glass alcove, she ignores the noise and flashing numbers. Instead, she focuses her attention on NYSE's new virtual trading floor, a flat 6-by-4-foot display panel showing a computer-generated model of all the trading activity.

With a flick of her mouse, Allen can zero in on icons depicting real-time changes in the price and volume of a particular stock or group of stocks and instantly spot suspicious price changes or trading patterns. The colorful graphics and symbols of the virtual trading floor allow her to monitor the pulse of the Exchange as never before. "People first thought it was just a pretty face, but they're beginning to rely on it already," Allen says. "It gives a better sense of what's going on and makes things a lot faster."



A synthetic stock exchange turns dry data into dramatic graphs of daily activity (above) and intuitively displays the information in a virtual replica of the real trading floor (below).

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Soon such virtual worlds may be common in the office and the home. When computer scientist Jaron Lanier coined the term virtual reality in the mid-1980s, he imagined a system that would let people interact effortlessly with a world of computer-generated images. Virtual reality pioneers donned heavy headsets to view crude, jerky video displays. After a decade of low-profile development, however, the technology is finally catching up with Lanier's vision. Today rooms filled with sharp, three-dimensional projections let architects walk the streets of nonexistent cities and help prospectors determine where to drill for oil. In a few years, virtual reality may enable you to turn your office into a client's boardroom or transform your living room into a gallery in the Louvre, all with the flick of a switch.

Even those clunky headsets--in improved form--are finding some startling applications. Instead of building expensive and time-consuming mock-ups, automakers now create virtual versions of new cars to look for design problems or make sure the controls are easily reachable. In a pilot program, the Naval Research Laboratory in Washington, D.C., ran a group of firefighters through a smoke-filled virtual ship before testing them in a real one. Psychologists at Georgia Tech in Atlanta use a virtual reality system to help people overcome fear of flying or fear of heights without having to visit a real plane or tall rooftop.

But the wires and helmets are still awfully constraining. So a group at the University of Illinois at Chicago set out to allow people to roam freely through their artificial worlds. The Illinois team created the CAVE (Cave Automatic Virtual Environment), a 10-foot-cube room where rear-mounted projectors beam highly detailed images onto the floor and walls. A person in the room needs to wear a lightweight pair of liquid-crystal glasses that trick the eyes into seeing two sets of pictures as one three-dimensional panoramic image. Using electromagnetic signals, the CAVE can detect a person's position and gestures and move around virtual

objects accordingly.

The CAVE environment feels convincingly and disconcertingly real. When the CAVE first appeared, "it was radical," says computer scientist Jason Leigh of the University of Illinois group. "Now we talk to architects who say, 'Oh my god, this is exactly like what's in my mind.'" Within the CAVE, an architect and his clients can examine a building from all directions, scrutinize the interior, and see exactly how the structure will fit into the surrounding environment.

Oil companies use CAVEs to render abstract geologic soundings as intuitive three-dimensional models of rock layers and oil deposits. "It's decreasing the number of dry wells they drill, which is great for the environment and saves tens of millions of dollars," says Linda Jacobson of sgi, a California-based company that makes supercomputers for virtual reality. Sarnoff Corporation in New Jersey has a projective system that can plot the locations of emergency vehicles or truck fleets on a 3-D map and instantly zoom in on any location. A virtual air traffic control tower, recently installed at nasa Ames Research Center in California, looks almost exactly like the real thing but with projection screens in place of the windows. In the safety of this simulated setting, engineers and controllers can try out more efficient runway designs and plane takeoff and landing patterns.



Virtual rooms, called CAVEs, let designers stroll through a proposed station for a European bullet train (left) or fine-tune the components of an auto suspension before it is built (right).

left: COURTESY PYRAMID SYSTEMS, INC. DIVISION, INC., AND SGI; bottom: COURTESY PYRAMID SYSTEMS, INC. DIVISION, INC., MOTOR COACH INTERNATIONAL, AND SGI

It's just a matter of time before the benefits of virtual reality filter down into the office and home. Leigh and his colleagues have already proposed creating a CAVE for the workplace by covering the walls and desktops with screens in a setup called "teleimmersion." Projectors mounted behind the screens would beam images, completely immersing the person in a virtual world--a chat with your business partner in Asia, perhaps, or a v-mail showing your idea for a new jacket design.

Greg Welch of the University of North Carolina in Chapel Hill and Jaron Lanier favor creating teleimmersion environments in less clinical settings. As part of a national initiative that also includes the University of Pennsylvania, Brown University, and the Naval Postgraduate School, they are searching for a way to project images onto any surface in an ordinary room. Their goal is to create an augmented office that looks completely normal until the projectors light up. Then it can transform into just about any place or any thing. "I want my office, when I flick a switch, to turn into my collaborator's office so I can talk to him in a way that's as close as possible to my actually being there," says Welch.

The first challenge is to program a computer to understand what's in a room. Computers have a hard time judging the distance or shape of a surface when there aren't a lot of visual landmarks, Lanier says. So he and Welch are developing a system that flashes a reference pattern that lets the computer constantly analyze the 3-D structure of the room. The pattern flickers so quickly the eye can't see it. Once the computer knows the exact shape of all the parts of the room, "I can treat your tissue box and paper and computer as an oddly shaped, moving display screen," says Lanier. Apart from eyeglasses that show the 3-D effect, the system requires no special viewing equipment.

In a few years, computers should be powerful enough to create the kind of real-time images Lanier and Welch have in mind. Their research is also driving the development of Internet2, a superfast global communications network capable of transmitting those images in a flash. Welch predicts the necessary technology should mostly be in place by 2010.

The ultimate goal is an everyday virtual reality system that surpasses the realism of television and the connectedness of the current Internet. Someday families may walk through a museum in another country without leaving home, or play virtual Ping-Pong with pals in China. To get a taste of the future, Welch replaced his computer monitor with an 8-by-4-foot screen, operated by two manually calibrated projectors. "It's amazing," he says. "Once you see all this beautiful projected imagery, you'll never go back."

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