

# 3-D Visualization

## O F F I C E O F T H E F U T U R E

BY CAMERON CROUCH

**I**magine walking into your office to find a 3-D virtual model of your latest architectural design hovering above your desk. You flip a switch and in front of the desk appears a window through which you can see your colleague, in his office in Tokyo. You are able to collaborate in real time, with your colleague simply turning his head to see the other side of the model, as if he were in the office with you.

This is a vision of the "Office of the Future" proposed by a group of computer scientists who use digital projection as the building block for new 3-D display and communications technology. The project is being conducted at the University of North Carolina at Chapel Hill by research associates Greg Welch and Herman Towles, under the direction of Prof. Henry Fuchs, along with Prof. Andy van Dam of Brown University, Prof. Kostas Daniilidis of the University of Pennsylvania, and Gwendolyn Huntoon at the Pittsburgh Supercomputing Center.

Office of the Future has two main components: one is the display of computer imagery in designated areas of the office; and the other, called "tele-immersion," strives to capture the office and its contents and display it elsewhere for the purposes of real-time, 3-D collaboration. Central to the project is the idea that, in the future, we will interact with projected computer imagery displayed all around the office rather than sit in front of a computer monitor.

"With projectors, the computer imagery becomes part of the office, not just displayed on it," Welch explains. "Spatially, it's a much more natural interaction, especially if you want to collaborate."

Although challenges remain, this display turnover may lurk just around the corner. Welch and Associate Professor Gary Bishop before him have already set up a simplified version, dubbed the "Office of Real Soon Now," in their own offices. They replaced their traditional cathode-ray tube (CRT) computer monitors with three DLP™ (Digital Light Processing) projectors that display imagery on the walls. "I have two projectors on top of a bookshelf which project images abutted on a whiteboard on the wall," Welch says. "The third projector hangs below the shelf and

projects images onto a whiteboard within a shelving unit on a side wall."

An advantage to the ample display is that images can be viewed from many angles and at a more comfortable distance than traditional monitors. Rather than sit at a desk, Welch now sometimes sits on a recliner and types on a keyboard perched on his lap.

With his PowerMac and video cards Welch can configure the dual projectors to create one large work area. He uses the large abutted images of the two projectors for collaboration with students or other visitors, keeping the third projector for more private work. Office of Real Soon Now employs standard, off-the-shelf equipment. To reduce the heat and noise generated by the projectors, Welch has his vented into the ceiling.

In the envisioned Office of the Future, imagery won't be restricted to projections on flat, square, whiteboard surfaces. "Today we have to mechanically align projectors, which is difficult," Welch explains. "We're working on software that would automatically align the imagery based on closed-loop feedback from cameras that continually look at the results of the projected imagery," allowing users to "wrap images around a wall or project them over bumps."

"We want the system to adapt to the structure of the office, not have the structure of the office have to be adapted to fit the projector," he said.

### FUTURE COLLABORATION

The Office of the Future vision also includes cameras for capturing the office — and what's being projected in it — and displaying it remotely in 3-D. "We envision units that look like track lights that are both cameras and projectors," Welch said. "When you want to collaborate, your colleague could view your office in some sort of 3-D window and see around as if they were there."

Barriers to tele-immersion today include the vast network capacity real-time rendering requires and the computational algorithms and speed needed. Despite the complexity, Welch's team has worked with the University of Pennsylvania and the Pittsburgh Supercomputing Center to achieve a real-time reconstruction of a room. "We're doing reconstructions



OFFICE OF THE FUTURE SKETCH

BY ANDREI STATE

