

Next generation tools for architects: Northwest researchers shape the future of computer-assisted design

by Denise Fulton

The fall 2002 issue of Northwest Science & Technology, now on newsstands (see list of outlets at end of story), includes articles, briefs and insight pieces including the following story. Published three times a year by the University of Washington, the magazine features work by researchers in Washington, Oregon, Idaho, Montana, Alaska and British Columbia.

A sketchpad, a pencil, an easel, and a straight edge.

For thousands of years, these simple items composed the basic tool kit designers used to translate the pictures in their minds into architectural triumphs. When paired with a creator's vision, these tools produced the first drafts of what eventually became the world's most wondrous structures—from the gothic beauty of the Parthenon to the visual splendor of the Sydney Opera House.

Regardless of their scale or grandeur, most buildings evolved through a common progression: from the architect's vision and a series of meetings with engineers and builders, to a final schematic plan, and, at last, construction. Then, in the 1990s, everything changed. With the introduction of computers, the microprocessor, keyboard, and mouse replaced the simple tools of architecture -- and forever altered the way designers work.

This shift has piqued the interest of researchers at the University of Washington's (UW) Design Machine Group, or DMG -- an innovator's workshop aimed at shaping the future of computer-aided architectural design.

Research at the DMG spans a broad spectrum: from an examination of the nature of the communication process that occurs between collaborators, to an exploration of the advantages to be gained by infusing drawing tools with artificial intelligence.

DMG director Mark Gross, co-directors Ellen Yi-Luen Do and Brian Johnson, and a team of UW researchers and students convene daily in the basement of the UW's architecture building to develop the design tools of the future. The DMG team hopes to unleash the computer's potential as a knowledge tool without completely replacing the traditional tools of design.

It's widely recognized in the field of architecture that the onset of computerization had a profound impact on the act of designing. "Replacing the pen with the keyboard inflicted unintended consequences on designers," says Gross.

Before computer-aided design (CAD), designers discovered and learned as they drew, and plans evolved through the kinetic act of sketching.

With CAD, designers are forced to make precise decisions at each step. Once these decisions are entered in

the computer, designers are not likely to go back and change them. The DMG researchers are working to change this by offering tools that keep architects' work computerized but restore the less precise act of sketching.

"We are frustrated with today's CAD tools because they won't allow you to 'ballpark,'" says Do, referring to the existing commercial software options. "There is a virtue in sketching and drawing -- it provides the ability to be vague when you are just beginning a design."

To facilitate the kind of "ballparking" Do describes, the researchers have focused part of their work on creating computer-aided freehand drawing tools that use pen-based interfaces to translate designers' early sketches into computerized form.

Unlike commercial CAD options, these tools actually interpret designers' sketches in order to generate three-dimensional (3D) representations. This differs significantly from commercial CAD products, which require designers to enter precise values at every stage.

Do is particularly passionate about restoring creativity and freedom to the early stages of the design process through innovative drawing tools. With pen in hand, she offers a quick demonstration of one of her research projects: Sketch VR.

What looks at first like nothing more than a series of random slashes and squiggles on an electronic graphics tablet is quickly converted into a 3D virtual world on a computer screen. As she draws two-dimensional shapes on her graphics pad, the program translates the input into the 3D image that appears. Do's three-dimensional world is not restricted to the walls, doors, and stairways one expects to see on a traditional builder's floor plan: the program also recognizes furniture, televisions, and lamps. "We are exploring what we can do with three-dimensional space," she says.

Another area of interest is the impact computers have had on the interpersonal communication that occurs between architects and their collaborators throughout the design process. Johnson and students explore ways to use microprocessors as communication tools and to implement new uses of the virtual environment. Much of this work represents interdisciplinary exploration in architecture, computer science, technical communication, and psychology.

Johnson developed Compadres, a Web interface designed for collaborators working at different locations. Users customize their personal work areas and then communicate to the team through a shared interface. Compadres is a centralized communication hub that is meant to eliminate some of the variables that can arise when designers are forced to communicate by less reliable methods like faxes or e-mail.

Other tools under development at the DMG include: Mouse Haus, an urban design tool that simulates pedestrian activity; Smart Objects, a collaborative, Web-based environment that enables designers to alter objects in an electronic model in order to compose new forms; and Gesture Modeling, an interface that enables designers to make three-dimensional forms using hand gestures.

A visit to the DMG lab reveals an environment that is a reflection of Gross, Do, and Johnson's shared sense that creativity requires a nurturing community. The directors have created an open, two-room studio in the basement of one of the oldest buildings on the UW campus. Tall panes of glass divide the lab's two rooms creating a bright, natural environment despite the subterranean locale. Currently, the DMG team has more than 35 research projects underway.

UW's architecture chair Jeffrey Ochsner notes the DMG lab was the direct result of a departmental desire to emerge as leaders in architectural research, and a 1997 mandate from UW president Richard McCormick to expand students' skills in order to prepare them for the high-tech industries that characterize Washington State. By 1998, Ochsner and his department developed a strategy.

"We're in Puget Sound, where so much software is written. We didn't want to become obsolete. Given this locale, we felt we could use our resources on campus and in the community to rise to prominence in this field," says Ochsner. "Everyone saw that it was important to address and embrace information technology and the digital world."

According to Ochsner, research is something new to the architecture field as a whole. "Traditionally, we were a professional school-twenty-five years ago there really weren't any Ph.D.s in architecture walking around." The initiative to create an architectural research lab gained momentum with support from then dean Jerry Finrow and, according to Ochsner, collective support from the department, the provost, and the UW as a whole. Ochsner is excited to see how far the DMG has come in a short time.

Practitioners take notice

During its short tenure in the Northwest, the DMG has worked in earnest to connect with the local architectural design community. Gross firmly believes that educating practitioners is time well spent: "Every tool in professional practice has its roots in a lab like ours. It takes time for research ideas to reach the marketplace as productive tools. But there's no doubt: the design tools of tomorrow are born in university research labs like the DMG."

Various Northwest organizations have invited DMG researchers to discuss their vision of the future of design. Misun Chung, an architect at Seattle's Olson Sundburg Kundig Allen Architects, invited DMG members to make a presentation at her firm earlier this year. Chung says the ideas were enthusiastically received.

"So many software programs we use today are focused on rendering two-dimensional schematics. The DMG's tools are fabulous in terms of three-dimensional design-everybody can understand them because they can actually 'see' the output. It seems like this will enhance designing not just for heavy computer users, but for everybody in the design process," Chung says.

Architects at Chung's firm follow a process common in today's architectural design industry. Design teams are lead by senior architects called "principals" who negotiate with the clients and start with sketches. Once a basic design is developed, the computer-savvy members of the team translate the sketches into AutoCad in order to develop the floor plan. At that point, the principals are cut out of the hands-on processes in the design loop.

"Principals used to be able to come in on the weekend and just go in and add their ideas to a design. Today, they feel like they don't have control of the design because of CAD-they see the [DMG] tools as a way that they can get a handle on their designs again," Chung says.

Engineers and builders also welcome the potential of these tools, although, perhaps for more pragmatic reasons. The construction industry in particular is eager to cut costs by building efficiency into the information flow between project participants. That enthusiasm is tempered, however, with a caution that the tools that emerge must be compatible with the legacy systems-and they have to be quick to install and ready to use.

Gross says the DMG team is well aware that practitioners want something that is ready to use and not a

prototype. The faculty members are seeking to build a community of potential stakeholders who are interested in sharing, advancing, and applying design tool research. He emphasizes that they are not making retail products, but rather promoting the ideas that they hope will shape the next generation of tools. "We are open to all ways of seeing our prototypes move toward practical reality," Gross says. "But, this is not a company and these are not products-these are ideas."

Engineer David Lake of Seattle's Engineers Northwest saw a demonstration of DMG's ideas at the Olympic Reprographics Trade Show in Seattle last January. Lake says that the difficulties of shifting technologies can be prohibitive in the competitive engineering field: "Once you invest in technology it's tough to change."

Reservations aside, Lake says he sees the potential benefits that the DMG's work could have in the building industry as a whole. He was particularly intrigued by Sketch VR: "It's stunning to me that you could take a sketch pad and quickly sketch an idea and have it in 3-D in a matter of seconds," Lake says. "Right now, the process takes so much longer."

Lake's firm specializes in commercial business construction. He says that following the architectural specifications for entrances and canopies is one of the biggest challenges. For a commercial building, designing an attractive, welcoming entrance is critical. Engineers like Lake enter the picture and reconcile the designer's vision with physical and economic reality.

Lake believes that the tools under development at the DMG have the potential to enhance future collaboration. "It's exciting to see that these kinds of things are coming. We are in such a competitive business-being faster and better at working with clients would be a real advantage."

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