Large-Format Displays

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Imagine a future when every surface in every built space is a high-resolution active display with sensing capabilities.

Scenario: I'm walking down the hall toward my office when I'm reminded that I'm late for a meeting with Mary to discuss the design of the students' center being built on campus. Unsure of the location of her office, I tap on the wall next to me and a large floorplan appears. After following a path displayed on the floor to guide me, I arrive at her office, and we begin to work. Mary and I view an immersive walkthrough of the design on her "smart wall," and I draw modifications with a virtual marker, whose strokes are recognized and used to manipulate the computer model …

Scenarios like this one are no longer science fiction—the technologies to make interactive display surfaces commonplace are being invented and deployed right now. Soon we will move into a new era of computing—ubiquitous visual computing based on enormous visual information and natural user interactions. The reasons for this new era are two-fold: increased computer performance and developed display techonology.

First, continuous rapid improvements in CPU performance, storage density, and network bandwidth have provided sufficient bandwidth and computational resources to support high-resolution displays and natural human-computer interactions. Nowadays, the main bandwidth bottleneck in an interactive computer system occurs in the link between computer and human, not between computer components within the system.

Second, large-format display devices, such as projectors and flat panels, are rapidly becoming commodity items. Meanwhile, new display technologies, such as organic light-emitting diodes (OLED), will soon become available at inexpensive prices. They can be attached to almost any kind of surface, allowing unlimited freedom of design for the interiors and exteriors of rooms and buildings.

We believe that new display technologies will revolutionize the way we use computers, making us rethink the relationship between information technology and our society. As an example, consider how wall-sized displays enable qualitatively different human-computer interactions than traditional desktop displays.

A recent paper by Mayer divides viewing experience into four categories.[1] The first category is the "postage-stamp experience," where the field of view is constrained by desktop system bandwidth limitations and display technology limitations. The second is the "television experience." Television is ubiquitous and it's the baseline of multimedia applications on a digital computer. The third is the "theatrical experience," where emotions are involved. A theater offers a large field of view to enable viewers to use eye scan motion to experience the image. Yet, it's constrained by the frame size. The last is the "immersive experience," which is when the scope and resolution of the imagery become large enough that viewers can leave the center of their focus and turn both their head and their attention to discover and study details of the scene and contextual environment, such as in an iMax movie theater.

Unfortunately, current desktop display devices lack the field of view to provide anything more than a "television experience." In contrast, large-scale displays can immerse users' entire fields of view in computer-generated imagery. Their high resolution enables visualization of detailed data sets, their size creates the illusion of immersion, and the space in front of them supports natural interactive collaborations among multiple simultaneous viewers.

Traditionally, large-format electronic displays have been used mostly for specialized, high-end applications such as flight simulators, scientific visualization, and mechanical CAD. However, recently, the software and hardware required to build large displays have dramatically improved in price and performance, and several research and commercial instituitions are developing new methods for building and using them. As lower cost

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technologies develop, their use will spread to everyday activities and any man-made surface will become a potential display site. To accelerate their widespread deployment, we must face the questions of understanding how to use new technologies to construct large-format displays and how to use them in applications such as education, scientific research, computer-aided design, medicine, business, entertainment, and daily life.

In this special issue, we collected eight articles that describe recent research and experiences in building and using large-format display systems. The first article surveys several current approaches to building multiprojector display systems, addressing issues regarding screen materials, projector selection, computer systems, input devices, and image generation software. The next six articles focus on new research challenges, including computer system architectures, multiprojector calibration and blending methods, novel human-computer interaction techniques, remote visualization strategies, and content design methodologies. The final two articles present case studies in using large-format displays: one focuses on the evolution of display surfaces in the automotive industry from their traditional forms (paper, blackboards) to their current electronic forms (display walls, caves), while the other describes the experiences of a research group in replacing their desktop monitors with wall-sized displays. We hope that you enjoy these articles and are inspired to experiment with a large-format display of your own. ■

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Reference

1. T. Mayer, "New Options and Considerations for Creating Enhanced Viewing Experiences," *Computer Graphics*, May 1997, Vol. 31, No. 2, pp. 32-34.

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