The Ultimate Display—What Will It Be?

Future trends in display technology range from autostereoscopic and volumetric display techniques to computer-generated holography, projector-based concepts, and new rendering schemes. In this special issue, leading experts from science and industry discuss the possibilities, developments, limitations, and potential pitfalls of these emerging trends.

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Following its invention in the late 1920s, television radically shaped the 20th century. Today, we view most of our visual entertainment and professional day-to-day operations on newer, more innovative displays. Bulky cathode ray tubes, for instance, have mostly disappeared from our desks, having been widely replaced by flat panels. The form factor of home entertainment displays, as another example, is evolving from small cubes to large planes.

Technological and applicability issues constrain flat-panel technology’s maximum size. If their limits are reached, video projectors have a great potential to continue this trend. Furthermore, most of us routinely carry around small displays as part of mobile phones, personal digital assistants, navigation systems, or laptops.

What will come next? What will TVs be like another 80 years from now? Will pixels die out and turn into voxels or hogels? Will interactive 3D experiences rule out passive 2D? These and other questions are of particular interest—especially considering that it is likely that most of us will witness this evolution.

The articles in this issue of Computer present future trends in display technology, ranging from autostereoscopic and volumetric display techniques to computer-generated holography, projector-based concepts, and new rendering schemes. The authors of these articles are leading experts from science and industry who discuss the possibilities, developments, and limitations of tomorrow’s displays; review fundamental facts; describe emerging trends; and point out potential pitfalls.

IN THIS ISSUE

Autostereoscopic displays provide 3D perception without the need for special glasses or other headgear. These displays have become available for the consumer market during the past decade, and they are now used in several application domains, such as science, medicine, and entertainment.

In “Autostereoscopic 3D Displays,” Neil A. Dodgson provides a general review of autostereoscopic display techniques and explains the principles of two-view and multiview displays. He also discusses several autostereoscopic display technologies including spatial multiplexing, multiprojector, time-sequencing, and hybrid approaches.

Conventional autostereoscopic displays that utilize parallax barrier masks or lenticular lens sheets create two or more viewing zones from a two-dimensional raster display. Volumetric displays are autostereoscopic displays that project volume filling three-dimensional imagery directly in space. One main advantage is that such voxel-
elized images provide correct spatial accommodation.

In “Volumetric 3D Displays and Application Infrastructure,” Gregg E. Favalora describes and compares two commercial systems: Actuality’s Perspecta Spatial 3-D display and the DepthCube volumetric display from LightSpace Technologies. Favalora addresses hardware and software issues and questions whether or not holograms are volumetric.

Holograms have often fired the display community’s imagination. These 3D images can actually reconstruct the same wavefront that a physical object would reflect and consequently support all depth queues. It isn’t possible to distinguish between a real object and a good hologram of it.

Computer-generated holograms share the advantages of optical holograms but target interactivity. In “Computer-Generated Holography as a Generic Display Technology,” Chris Slinger and colleagues highlight recent CGH advances and discuss challenges, practical implementations, optical hardware considerations, and appropriate rendering algorithms for CGH displays.

It is obvious that the demands on resolution and rendering performance for future displays will keep on increasing. But how will we meet these requirements? This is the question that Benjamin Watson and David Luebke address in “The Ultimate Display: Where Will All the Pixels Come From?” They discuss the nature and magnitude of these resolution requirements and review real-time rendering approaches for multigigapixel displays. In particular, they summarize an adaptive frameless rendering approach that reduces the display’s bandwidth requirements by computing only a scene’s changing pixels instead of rasterizing all pixels in parallel.

In “Smoke, Mirrors, and Manufacturable Displays,” Mary Lou Jepsen argues that the ultimate display will not be an ultrahigh-resolution, 3D, holographic projection of arbitrary size. Instead, it is simply a display that is good enough for the job at hand. Jepsen points out that the smoke and mirrors are the manufacturable parts of these cutting-edge display prototypes. She discusses the slow pace of evolution in display manufacturing, reviews the current status of the global display manufacturing infrastructure, and identifies several problems, solutions, and killer applications for small, medium, and big displays.

We don’t know what the ultimate display will be and we don’t know if it ever will become available. We do know, however, that novel ideas will keep on driving research and development and that technological advances will continue to pave the way for forthcoming display generations. The years to come will certainly be exciting.

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