3D and Multimedia on the Information Superhighway

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What has generated the unprecedented fascination with the Internet? What future lies ahead for computing as the Internet and its associated infrastructure expand? Will the network be able to cope with rising demands for carrying capacity and response speed? Will it change the way scientists, designers, artists, computer professionals, and home users work in the future? These are some of the wide-ranging questions being asked about the Internet and World Wide Web.

National networks

3D computer graphics and networks have been around for at least three decades, but only recently have they come together via client-server computing, which has made the local network an integral part of the application. Both the US and the UK originally implemented projects to develop national computing networks. In 1969, the Advanced Research Projects Agency (ARPA) implemented Arpanet to protect the US in the event of nuclear attack by routing messages from the east coast to the west coast and circumventing any parts of the network destroyed in an attack. In the UK, Janet (Joint Academic Network) began in the early 1970s to provide links between larger computer centers and smaller ones, allowing the latter to do remote job entry on the former and file transfers across the network.

Uses and applications

Both these networks (and their successors) have evolved into quite different tools than originally envisaged: They now primarily support electronic mail and the World Wide Web. Faster links between key nodes of national networks provide greater throughput—such links, often provided by ATM (Asynchronous Transfer Mode), attain speeds of 155 Mbits per second and above. Increasing traffic on many parts of the network has spurred plans to upgrade such backbones to support speeds of gigabits per second.

Collaborative working

Increasing capabilities of desktop machines, peripherals such as video cameras, and associated software now permit users and developers to link on a network

to view the same data and converse about it in real time using videoconferencing. This process is known as computer-supported collaborative work (CSCW) or virtual working. Many projects around the world are investigating paradigms to support such environments, the human factors issues, and the costs and benefits of different application domains.

World Wide Web

Key concepts behind the Web originated at CERN in Switzerland, where a distributed hypertext system made results from scientific experiments available to the researchers. This tool essentially organized information and provided a space for sharing ideas, giving universal access independent of physical location and type of computer platform used, and with unconstrained topology. Previously, such systems were very constrained, allowing no cross links among databases not directly connected. From 1992 on, distributed multimedia hypertext systems have emerged outside CERN, along with graphical browsers (such as Mosaic) provided by the National Center for Supercomputing Applications and later products developed by Netscape, Microsoft, and others.

Foreshortening of timescales

The last five years have seen a generation's worth of advances that would have taken 10 to 15 years at the previous rate of computer technology development. We are witnessing—and participating in—a revolution similar to that brought about by movable type (in the print industry) and broadcasting (in the media industry). It is clearly significant that this revolution has links to both these camps, hence the new medium's emphasis on instantaneous, ubiquitous, and cost-effective communication. The openness of Web standards should ensure no limitations on working at the frontier, with immediate access to all users worldwide.

Supporting new media

A variety of tools and techniques now being developed support images, moving images, audio, and virtual environments on the network. VRML and Java serve as the springboard for sophisticated animation environments that allow user interaction and intelligent objects that

can track their users. Developers can even add behaviors to their applications. The future looks unlimited.

Commercial issues

As industry and commerce move advertising, sales, and service support to the Web, issues arise concerning security, payment, intellectual property rights, efficiency and integrity of the Web, and the evolution of Web architectures to support user demand. Current trends at Microsoft and Netscape essentially make the PC desktop the browser, with common file access and common interfaces provided to disk, local area networks, and the Internet. Browsers written in Java will have mail and news clients and include a local desktop environment that will become a universal client. The trend from personal computer to networked computer and net-centric computing seems set to continue.

This special issue

In this issue, we address some of the questions prompted by growing network capabilities. We focus on collaborative work projects as precursors of everyday work styles in the fairly near future.

"Collaborative 3D Visualization with CSpray" by Alex Pang and Craig M. Wittenbrink adapts spray rendering to a multiuser collaborative environment. A small group of geographically distributed scientists can share their data and interactively create and analyze visualization products. CSpray has been used in a number of collaborative domains, including demonstration, education, and research.

The University of Geneva (Miralab) and the Swiss Federal Institute of Technology (Computer Graphics Laboratory) explore the representation of virtual humans in the context of network collaboration. The researchers hope to increase the sense of presence and identity and the effectiveness of the communication and collaboration.

A team from Portugal and Spain including Adetti, Universitat de Les Illes Balears, Instituto Superior Técnico, and INETI, describe mWorld, a multiuser 3D virtual environment with synchronous communication support. mWorld integrates data communication, 3D virtual scene generation, and design environments; compliant with Open Inventor and VRML, it can support a range of applications involving real-time group interactions.

Teams at the University of Bradford (UK), Limburg University (Belgium), European Design Center (the Netherlands), and others have joined to design and implement Visinet—a trans-European 3D collaborative design project. Visinet enables computer scientists, application developers, design specialists, and users to work together in shared environments supported by ATM networks. Experiments and trials have focused on the key application domains of architectural and industrial design, with measurements of network requirements geared to quantifying costs and benefits.

Michael Macedonia and Stefan Noll report on the development of an infrastructure for supporting distributed virtual environments between the US and Europe. They present two important application

Related Reading

- For a balanced look at the World Wide Web and its potential, see R. Cailliau and T. Berners-Lee, "The World Wide Web," *Comm. ACM*, Vol. 37, No. 8, 1994, p. 76.
- T. Berners-Lee, "WWW: Past, Present, and Future," *Computer*, Vol. 29, No. 10, Oct. 1996, pp. 69-77.

As the Internet grows in scope and number of connections, it fosters possibilities for collaborative work across distances. You can read about a number of the many applications and the challenges involved in implementing them in

R.T. Kouzes, J.D. Myers, and W.A. Wulf, "Collaboratories: Doing Science on the Internet," *Computer*, Vol. 29, No. 8, 1996, pp. 40-46.

The Internet in 3D: Information, Images, and Interaction, R.A. Earnshaw and J.A. Vince, eds. Academic Press, San Diego, Calif., 1997, p. 383.

To make Internet-based collaborative work practical requires resolving many networking technology issues, among them the kind of networks to use in connecting sites and users:

"Issues and Challenges in ATM Networks," special issue of *Comm. ACM*, Vol. 38, No. 2, 1995, pp. 28-109.

domains: remote astronaut training and collaborative telemedicine. Clearly, the potential uses of this technology are immense.

This snapshot of current work on new ways to use and exploit high-speed communications links demonstrates the network's essential role. Much work remains in user interface paradigms and identifying users (and their contributions) in multiuser environments. Clearly, though, 3D models, graphics, and multimedia are rapidly becoming an integral part of real-world environments and applications. ■

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