Graphics and the Web

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The Internet, manifest as the World Wide Web and as email, is revolutionary. It overshadows the personal computer, enticing more "regular folks" with the ability to browse, shop and communicate than ever wanted to format a document or balance their checkbook. It has brought the issue of censorship vs. protection to a new level of complexity for schools, parents and libraries. It is accused of breaking up marriages and turning people away from the "real world" of interhuman relationships. It is even luring people away from their televisions.

Why the Internet/WWW is so popular, and how it will evolve, is probably one of the primary concerns in business and politics today. This article probably won't generate any hot new .com's (if it does, please let me in on the IPO). My goal is to point out those trends I think will influence the future of the web, with special attention to its impact on graphics.

The new medium

Long ago, if you wanted to hear a story, you had to find a storyteller. If you wanted to learn a new skill, you needed to find a teacher. If you wanted to see the pyramids, you had to travel to Egypt. Over time, an array of what is now called *media*—books, film, video—have been developed that allows a storyteller or teacher to reach people never seen. These stories include pictures, allowing the viewer to see things and places only travelers could in the past, or to see things that no one could see without special cameras or special effects. Ideas are encapsulated and preserved through time, to be experienced without any direct contact with the creator or any of the physical reality described.

Any form of media is continuously evolving, reflecting new technologies and social demands. When a new form of expression is created, it first mimics a known form, and then develops its own metaphors and genres.

Books and other forms of printed words are so ubiquitous in modern life that it is hard to appreciate that universal literacy is a relatively new concept. It did not stem naturally from Gutenberg's press—it took the industrial revolution, almost 400 years later, to create a society that included readers of all social classes. Books, originally elaborate, formal volumes owned only by the wealthy classes or the clergy, rapidly evolved to serve a wide variety of tastes and incomes. Newspapers, posters, handbills, annotated maps, scrolling signs, even labels on fruit all evolved because of the cultural assumption that everyone could read.

Movies and videos tell their stories through moving pictures, dialogue and music. Originally, movies were simply filmed plays, where the camera sat as a member of the audience. Close-ups, jump cuts and other changes of camera angle were all revolutionary in their time. Now, there is a rich language in the presentation of moving pictures that is the basis of modern cinematography. Once available only in theatres, videotapes and VCR's allow "films" to be home entertainment as well. The creation of sequels, director's cuts, or other derivative products that are only available on video or DVD is part of the current evolution of movies.

Television, for better or for worse, is probably the most powerful influence on though and culture in western civilization. Unlike movies, it has always come right into our homes. Programming comes in a wide variety of forms, catering to a broad range of tastes and interests. Television evolved from radio, another broadcast medium, and was originally visually static. Over time, however, animated cartoons, sitcoms, soap operas, Sesame Street and MTV changed the look

and feel of television. Now, the immense bandwidths of cable and satellite connections, plus novel appliances like TiVo, are foreshadowing new forms of television. No longer do we all sit down on Sunday and watch Ed Sullivan—our TV 2000 will be highly customized.

Clearly the web can be described as a new medium. Currently heavy on the written word combined with a bit of simple graphics, it can also support video, interaction and sound. Plus, it is a medium of interpersonal communication. Email, chat rooms, bulletin boards and multi-user environments support interactions between individuals and within communities. On the web, it is practical to recreate the contact between the author and the reader that is missing in our "traditional" media. The web as a medium circumvents the centralized production and distribution systems economically necessary for other media. It is relatively easy to produce a web site, and also relatively easy to find at least a small audience. This supports a proliferation of specialized publications and audiences rather than supporting only high-volume "best sellers." As the modalities of the web become richer, it will impact the production of movies, music, and even performances in the same way.

What does it mean for graphics?

Computer graphics is the digital creation of pictures. It has become a tool applied to all media, both to directly create content (illustrations, animations, special effects), and as an intrinsic part of the infrastructure (Postscript printing, digital matting, compositing and editing). Because the web is already digital, and because there is little entrenched practice to overcome, the evolution of graphics on the web should be very fast.

The most commonly stated limitation for Internet graphics is bandwidth. However, there is a rush to create better, cheaper, faster ways of accessing the Internet. The telecommunication companies, finally convinced that transmitting data is their real future, are actively promoting and supporting Digital Subscriber Line (DSL) services. Cable TV companies, traditional providers of giant one-way media pipes, are offering cable modem services. Satellite communication systems to provide high-speed access for wireless users are being developed, in spite of their enormous upfront cost. Given the commercial obsession for video, it seems pretty safe to assume that enough bandwidth for realtime video will become readily available just as fast as big business can make it happen.

The next most glaring current limitation is rendering speed, especially for shaded, animated, 3D graphics. But, the continuous application of Moore's Law to general-purpose processors and specialized graphics systems will quickly render this issue unimportant. Not that there won't always be ways to use up more cycles, but it is already possible to make effective 3D graphics that runs effectively on desktop systems—just look at the games industry. And, with the evolution of systems like the Sony Playstation, limitations on displaying graphics are just going to vanish.

The real frontier for web graphics is content. That, and creating the infrastructure that will support rich, imaginative graphical content robustly. Both good content and good infrastructure are hard problems. Fortunately, solutions to both can evolve.

The World Wide Wasteland

Given how much public concern there is over whether children are reading enough, it is hard to believe that sitting alone, reading a book, was once considered a highly unnatural activity. The concerns are familiar. How good could it be for the human mind to be lost in contemplation of this object, isolated from human interaction, being exposed to ideas that might do it harm? Its powers were suspect. Victorian ladies were warned of that too much novel reading could adversely impact their health as well as their morals. Even today, too much immersion in solitary reading

gives parents cause for concern. "Go play with your friends" or "go outside and DO something" are not unknown, even among those of us equally guilty of getting lost in a book.

So it goes with computers and the web. Ann Landers provides advice to spouses whose web-addicted partners are neglecting their home lives. We worry that alienated teenage boys can implement their violent plans with information found on the web. There is kinky sex on the web, mindless games on the web, and people dressed as mutant aliens on the web. Even if our children are only researching Egypt, we worry that some how they are substituting inferior "virtual reality" for true reality. But how real is the world represented by our traditional media? There are books and movies containing kinky sex, mindless games and people dressed as mutant aliens. There are also books and movies about Egypt. What distinguishes the good from the bad is not their form, but the quality of their content.

It is a basic part of growing up today to learn that you can't believe everything you read, that most of television is trash, and that just because someone managed to get it published doesn't mean you want to know about it. Because the web is a new medium, and one that is growing at breakneck speed, it is indeed harder to discriminate the good from the bad. But, patterns are beginning to emerge. The graphic design of a website can speak volumes about its creator and its intended audience. Websites can represent a known editorial viewpoint (like the New York Times or Ziff-Davis) or be supported by known institutions like the US Patent Office or the Louvre.

Portals, indexing services and search engines that help to find sites of interest often present a viewpoint as well as an indexing service. The "get what I like" search engine is already foreshadowed—more evolution this direction seems clear. But, while there is much attention directed towards making sure that the user finds absolutely every site of interest, this is rarely necessary, or possibly even very important.

Communities of practice

The classic view of the websurfer, alone in his sea of information, is rapidly being replaced by one of chatty old ladies gossiping over their virtual back fence. Or, by the busy mother arranging playdates via email and avoiding stress-filled shopping trips by ordering online. Or, by the collector who feeds his obsession with worldwide access to shops, auctions, and like-minded enthusiasts. In this view, the web is a vast collection of overlaid communities, created by mutual interests and habits rather than geography. A community has its own style and habits, created in part by using similar resources. The physical equivalent is the local mall or town center, or the word of mouth recommendation of services.

Similarly, the development of rich media on the web will be supported by communities of enthusiasts who will recommend and share common infrastructure and design tools. Cutting edge designers, media-savvy youths, and cyberspace pioneers are already creating highly visual, interactive content, i.e. Computer graphics, on the web. Most requires a plug-in, and it is often far from robust. But it's there, and getting better all the time. The point is, it doesn't need to be ubiquitously accessible to flourish—it just needs a community to support it.

Standards

Standards are important (remember betamax?), but they are intrinsically slow and difficult to develop. The right balance between innovation and stability is very hard to maintain, especially in the web environment where the rate of change is so fast. The Web3D effort, for example, shows this clearly. Substantial effort was made to create an official standard, VRML 97. However, the showcase for Web3D at SIGGRAPH '99, the Web3D Round-Up, showed little VRML. It did, however, show an exciting array of Web3D technologies, many derived from VRML. But this year, innovation pushed ahead of stability. VRML and Java3D are now "old" technologies. The Web3D

consortium is hard at work producing the next generation standard, which links the concepts in VRML 97 to XML. SGI no longer has the funds or the interest to sponsor events such as the Web3D Round-up, but Intel does.

While I would hesitate to predict a timeframe, it seems inevitable that standards for graphics on the web will first proliferate then stabilize. Support for image file formats has made the web a pictorial medium right from the start. Animations and interactions were introduced with animated GIF images and imagemaps, then extended with Java and JavaScript. Many graphics vendors have created plugins that display their proprietary file formats such as Shockwave, Quicktime, or Flash. The Java runtime available in commercial browsers enables a variety of custom graphics implementations as well at the ones from Sun (Java 2D and Java3D). The MPEG-4 standard, now nearing completion, provides an integration of video, sound and computer graphics. It joins VRML as an ISO certified web-graphics standard. XML is being designed as a way to integrate the wealth of graphical models for the web. Time will reveal the winning ideas out of this cornucopia of methods, and community pressure will force standardization.

Conclusions

The Internet/WWW is well on its way to becoming the most interesting form of media the world has yet seen. Supported by distributed communities, financed by e-commerce and entertainment, it will become one of the standard ways we interpret the world. Professionally produced web pages will dazzle, mixing text, graphics, sound, video and interaction with finesse and style. Web-literacy (both viewing and creation) will become a standard skill for modern life. This will push universal literacy in computer graphics like no other medium. Cyberspace, complete with attractive avatars and good sound, will involve even those people who never got past the pizza-delivery sequence in *Snow Crash*. While e-commerce focuses on the virtual shopping mall, I place my bet on collaboration and performance as the forces that will drive the immersive view of the web medium. Whether it's "yet another meeting," fantasy games, or a way to see and hear the garage band of a friend who happens to live across the country, the opportunity to be there at the click of a link will become irresistible.