Advanced 3D Visualization Web Technology and its Use in Military and Intelligence Applications

Dusan Toman

DIMENSION 5, Ltd. (Miner3D.com)
Hurbanova 36 SK-920 01 Hlohovec, Slovakia
dusan@miner3D.com

Dr. Alexander Kos

AKos Consulting & Solutions GmbH
Austr. 26, D-79585 Steinen, Germany
alexander.kos@akosgmbh.de

Abstract. Web technologies achieved significant improvements in last years, but many application areas are not yet Web-impacted. Upcoming software products enhance feature sets of Web browsers and make it possible to use systems based on new Web technologies as advanced application framework for complex information retrieval, control, monitoring or analysis systems.

In this paper, we illustrate a new interactive, high-density and information-centric user interface. We show the communication protocol and the architecture of a new 3D Web authoring software. Some applications are discussed with special focus on military and intelligence applications.

Keywords: 3D, Web, user interface, visualization, navigation, real-time

1. Introduction

The boom of the Internet in 90s brought the networking infrastructure to almost every business computer. Even about 60 percent of the households in the United States, the world's most wired country, have Internet access. (Howe, 2001) Today's Web technologies give us many advantages: networking is now system independent, the Internet is nearly everywhere, it is accessible, extremely easy-to-use and even affordable. Many millions of users have the new knowledge and use it daily.

2. User Interface Issues

Unfortunately, the great accessibility is paid by many limitations. Today's Web is built mostly on HTML. The language was designed in early 90s and its main goal was to describe static documents consisting of formatted texts and pictures. It becomes evident now that problems with user interface influence that otherwise very positive feeling.

The expectations were set too high. Is a Web document reading really so different from the old, hard-encoded experience of reading texts written on paper? Static Web pages offer essentially the same content presented on paper, which makes the online experience more like reading in a dusty library than participating in a new medium. (Howe, 2001) The way we use computers today mirrors the way we used to read and write in traditional paper media of the past. Using the simple analogy of the monitor as the paper, the keyboard as the pen, and the act of scrolling as turning a page, we can see how this kind of human interaction with technology is not as advanced as it can be in 21st century.

Mostly because of the reasons mentioned above, many important application areas are not yet Web-impacted, or the real impact is far under our previous expectations. The flat and static nature of HTML pages prevents also from using that, otherwise powerful and effective infrastructure, in series of high-end military and intelligence applications.

It becomes evident that people need much more of freedom for working with data than it is common on the today's Web. They intuitively tend to more natural way of presenting complex information. They feel that some kind of physical-like user interface, where more perceptual abilities of human can be deployed, could communicate information more effectively.

3. Extended Web

Do we remember the early days of television when TV programs looked like radio with announcer's picture? Similar evolution as that of TV is probably ahead of the Internet too. (Howe, 2001) It is necessary to see some technological enhancements to be able developing reasonably advanced Web applications that go beyond simple HTML hypertexts, while still have it quickly to train, easy to install, use and fully deployable. These enhancements will allow users to get real-time, interactive, less mediated experience over the next Network applications.

On the Web browser side it requires to provide additional code able to quickly download and plug into the browser. This code enhances the standard user interface by live and fully interactive graphic space. The new space is preferred to be 3D, giving more space for displaying data and application controls. It is expected the 3D space is intelligent enough and uses included conventions of standard interactions and feedback. This feature enables to provide user with good natural experience without extra coding for specific applications.

On the server and network side, it is necessary to use transparent protocols and languages allowing fast and inexpensive implementation and usage. Technically, using of today's object technologies (COM, .Net, CORBA), standard Internet protocols (HTTP, HTTPS) and languages (XML, HTML) provides a good base for developing of the Extended Web building blocks.

4. Miner 3D SITE

Miner3D SITE software is our development of the visions of the extended Web. It is actually the evolution of our visual data mining software and represents our 15-year experiences with 3D graphics. The system enhances Web browser's user interface and allows building of fully interactive Web pages capable of displaying complex and real-time information.

There is couple of 3D standard-candidates (VRML, X3D…) available also for Web use, but it all defines scenes statically. In fact, it puts emphasize on the look of the graphics, on graphics effects and bells and whistles, and strongly underestimates the information itself. Such scenes are actually hard-coded and thus not suitable for fast downloads and for visualizations of data generated in real-time.

Miner3D SITE software now consists of two main parts:

- The Viewer software, which resides on the Web browser. It creates the 3D graphics window and provides the interactivity and feedback. It is a COM object and allows very easy, fast and transparent downloads. Presently it works only with Internet Explorer on Windows, but versions for Netscape and for Mac are under development.
- Communication protocol used to transfer model properties (visualization rules) and data (content of the visualization). We had to define our own XML-based M3D protocol, which allows us developing of the needed protocol syntax. Saving of network bandwidth is another of positive side effects.

Combining features of the Viewer and of the M3D protocol we are getting live and information-centric nature of the visualization. The scenes may not be defined only at design time anymore. The designer defines actually the visualization rules, while the final look of a scene is defined mainly by the real data returned from server.

The universal design of the software makes it possible to use the same software in various applications, from information retrieval systems, complex site navigation, through real-time monitoring and control systems, to data analysis applications. In the following, we discuss three different applications related to military and intelligence area.

5. Visual Web Searching and Information Retrieval Systems

Archives and databases of defense agencies hold terabytes of data and instant and comfortable access to relevant information is crucial for many of its users. The basic problems of collecting, storing and indexing data has the technology solved yet, but the open issue still remains searching of the data and especially browsing through search results. Also practical Web searching experience says that 70% of all searches are failures (Funke, 2000). The common Web user interface is perfect for displaying just very small data sets, but it becomes difficult to browse hundreds and sometimes even tens of search results. The user interface completely fails in situations when systems return thousands hits or more.

The 3D Web software creates a high-density user interface, capable of displaying hundreds of data points at single computer screen. The interactivity of the visual navigation makes processing of search results faster and easier and provides user also with additional functionality (editing, deleting, selecting, saving result sets…). It is possible to encode dimensions of the information (data fields, columns; i.e. data source, document type, classifications, publication year, author, number of links…) into its 3D graphical attributes (position within the space, color, size, shape...) and deploy human's perceptual abilities to differentiate results and identify relevant information faster.

We used Miner3D SITE to develop a visual Web searching service (http://miner3D.com/search/) as an example of advanced information retrieval systems. The application allows visitor to browse search results returned from a prime Web search engine of his choice (Google, AltaVista, NorthernLight, MSN Search, Google Newsgroups…) within an artificial 3D information space. Results are visualized as graphic objects positioned by its relevancy, colorized according to a document's domain (blue hits = *.com, red hits = *.net, green hits = *.edu) and textured by most important text information (title, domain, text, size). At selected search engines we can use also height of the data objects to carry additional information (Google returns also document sizes, NorthernLight returns percentage of relevancy).

The 3D technology enables to design both completely artificial information spaces without any counterpart in the real world, as well as simplified virtual copies of physical archive rooms or libraries. The design of the information space can be fully customized to real applications. In conjunction with developer's access to full set of data dimensions available in database, it is possible to develop series of information retrieval applications reflecting specific needs of users.

6. Distributed Real-time Monitoring and Control Systems

There are many monitoring and control applications in use over the world and most of them use advanced graphical user interfaces. Usually the applications are standalone software programs and often require using a special hardware, or a complicated installation and setup process, or a lot of training.

A powerful real-time Web 3D environment providing the same functionality through common Web browser would be able to increase tremendously the number of users to virtually unlimited. Various visualization models with different access levels allow designing of complex, hierarchically structured operational, training or educational systems. The 3D Web environment provides an application also with nearly perfect communication infrastructure: exchanging situation data facts, real-time data update feed, issuing of commands and signals can go visually, by email, voice, video or any other Internet compatible channel. Low requirements for hardware with no need for installation and setup (the first visit at an URL performs the installation automatically and transparently) dramatically changes the economy of such systems by reducing assets and operating costs.

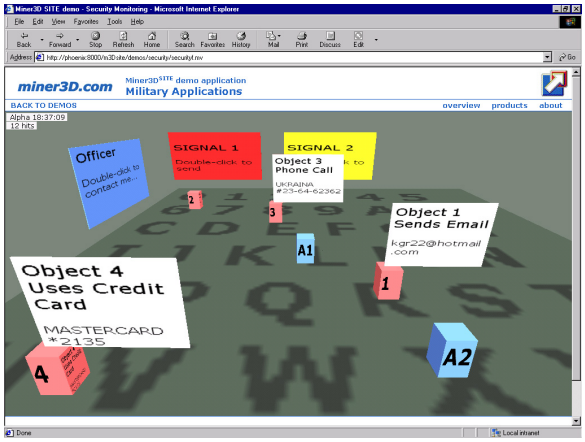

Figure 1: Screen shot of a real-time control and monitoring demo 3D Web application

For demo purposes, we created a very simple example of a distributed real-time monitoring and control application (http://miner3D.com/m3Dsite/demos/). A team of agents is monitoring members of a terrorist group. Real-time data feed of updates of objects' positions within a watched area and activity data of all objects is concentrated into single visualization. An operator, analyst or commander can watch the concentrated information, which is provided in a well-readable form. They all can maintain communication, take better decisions faster and can react immediately using the same environment.

7. Financial Transactions Data Analysis Systems

Last months show a growing interest in preventive and analytic operations as an important part of our defense efforts. Analyzing of financial and property transactions, bank operations and stock trades can reveal a potential criminal or terrorist activity.

The problem of such analyses is poor readability of accounting and bookkeeping records. This, combined with overload of raw data, prevents from revealing suspicious operations and many of them remain hidden. Our new visual method of analysis of accounting records materializes the abstract nature of financial transactions and shows also their historical or real-time dynamics.

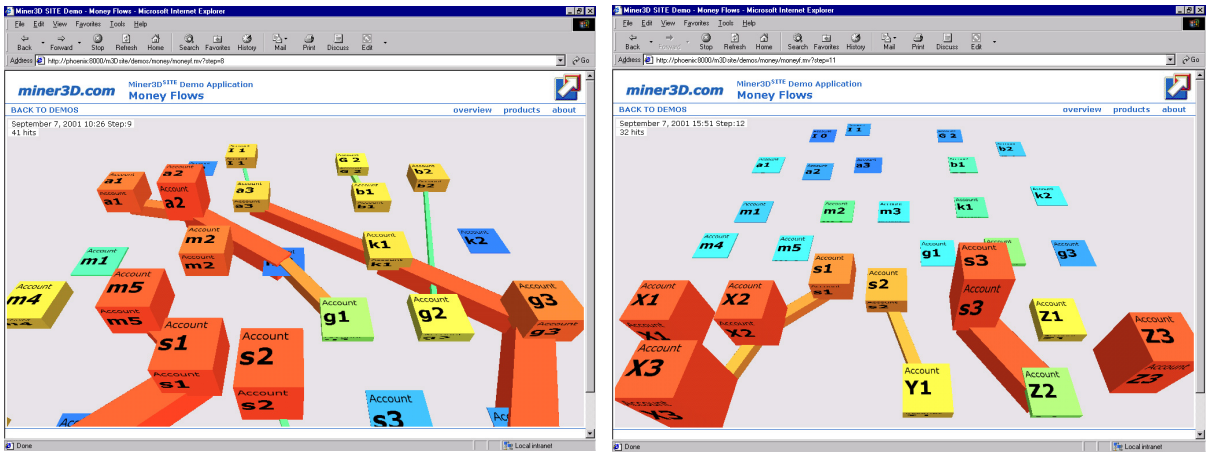

Figure 2: Screen shots of a financial transactions data analysis demo 3D Web application

In demo application (http://miner3D.com/m3Dsite/demos/), we use fictive data of series of bank transfers between nearly 30 accounts of companies and organizations belonging to several financial groups. The accounts are represented by bars and are positioned to form visual clusters demonstrating the groups. Heights of accounts reflect available sums, while transactions between accounts are visualized as pipes transferring money from one account to another. In several rounds of the whole transaction, cash from 2-3 accounts is transferred to 3-4 target accounts through series of smaller fictive operations used just to hide the real intention of the complex transaction. If the transaction is recorded using traditional accounting methods, it counts hundreds of lines and it takes hours even to experienced analyst to decode it. Our method dramatically reduces time to make a qualified decision and provides analyst also with additional clues and indices.

8. Conclusion

We tried to demonstrate the power and universality of the upcoming Web 3D applications and show its potential for future military and intelligence applications. The 3D Web technology brings new advanced features while maintaining high accessibility, ease-of-use, distribution and installation, as general benefits of Web technologies.

Our research and development will continue in improving of quality of user interface and its conventions, navigation, definition of the communication protocol, attributes of the graphics space (shapes, fonts, textures, images), as well as in the application area by identifying new potential application areas.

References

Miner3D.com (2001), DIMENSION 5, Ltd., http://miner3D.com

Funke, C. (2000) “Information Searching”, University Freiburg, Germany

Howe, C. D. (2001) “The End of the Web as We Know It”, Forrester Research, USA