Global Multi-User Virtual Environments

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Summary: Wolfgang Felger

Research and development activities are facing a continuing globalization. Networks are getting more important than companies or institutes. Main reasons for this trend are:

- (Faster) access to new knowledge and technology and its improved transfer.
- Economic reasons.
- Use the particular advantages of multicultural work environments.

Together with a steadily improving technology, the global information society is not far away. In particular, the networking and virtual environment technologies are making much progress and are ready to enable shared, distributed, cooperative activities.

This panel addresses network infrastructure, systems, and applications related to multi-user virtual environments, especially the global (intercontinental/international) aspects of these issues. The panelists will summarize their "lessons learned," will highlight latest activities, and share with the audience their short/mid-term vision on global, multi-user virtual environments.

The panelists intend to enrich their presentations with (multicontinental) live demonstrations. Furthermore, specific applications are showcased at "Digital Bayou" (Where No Man Has Gone Before).

Lennart E. Fahlen

The objective of this panel is to discuss the long term development of future large-scale social electronic spaces. In this time and age, this means networked computer systems that exploit the idea of a place inhabited by users who communicate with one another using the natural and informal means appropriate to a range of social situations (e.g. work, family, leisure, etc.). Ideally, such systems should support many thousands of users engaged in real time interaction with one another.

Below are a number notions relevant to the above goals:

- Users as inhabitants of electronic spaces. Users should experience a sense of immersion within a computer system, as opposed to only interacting with it.
- Infrastructures need to support real-time events similar in scale to gatherings of people in the physical world (e.g. on the scale of today's largest sports and entertainment events). The construction of such large scale electronic spaces introduces critical problems of scale. Some issues to be considered are network-, processing- and perceptual scaleability and the unavoidable latencies caused by the geographical separation of users and nodes.
- The network and software infrastructure required to deliver such applications to the general citizen. Today the WWW provides for large scale multimedia information access and distribution. But seen from the perspective of "users being social beings inhabiting an electronic space," the Web carries severe shortcomings: asymmetry between information provision and consumption, the environment is strangely uninhabited, users are only visible through the information they provide or through a number-of-visitors statistic, there is no provision for real-time interaction and feedback, etc.
- Interaction metaphors and techniques which seamlessly combine information visualization, and access with social interaction. How should socially inhabited electronic spaces be structured, and what tools are needed to construct them? Furthermore, how should people be supported in exploring and navigating such spaces, and how might the structure afford possibilities for social interaction?
- Spatial metaphors seem to present solutions to some technical issues such as access to computational resources, as well as to other people. These alternatives are more promising than traditional solutions (i.e. password protection, passing of tokens etc.).
- How to provide a sense of personal presence and awareness, both direct and peripherally, with other people within an electronic space, and how to achieve this through user embodiment and other representation techniques. A number of social studies show the importance of mutual and peripheral awareness phenomena to the coordination of social interaction. Most current systems have major difficulties conveying presence of other users, awareness of what these other users are doing, and providing mechanisms to represent a user as an embodiment within a single application.
- Techniques for integrating electronic spaces with physical spaces, including notions of shared augmented reality and shared augmented virtuality.
- Intelligent agents as inhabitants of social computing environments (i.e. in the presence of many humans and other agents).
- To see such real and virtual information spaces as inhabited social environments, capable of supporting participation in many different activities and social relations. Also, one should not forget that such environments must be expressive, aesthetic, dramatic, motivational, and inherently enjoyable to use and inhabit.

In summary my position is very much defined by terms such as "inhabited," "social interaction," "awareness," "spatial metaphors," and "mass participation." Furthermore, it has very little to do with "photo realistic rendering," and concerns itself much more with a paradigm shift that views virtual reality and related technologies as providing inhabited social spaces and by conceiving of users as citizens and social beings both at work and play.

R. Bowen Loftin

Opportunities to exploit shared virtual environments abound. Collaborations in art, business, education, engineering, and science could all benefit from the ability of collaborators to share the same environments and the same experiences while directly interacting with information displayed in useful ways. Endeavors in all these spheres of activity are increasingly global in scope, challenging the ability of communications technologies and display/interaction metaphors to enable the sharing of complex environments in real-time. This panel presentation will describe a successful demonstration of a shared virtual environment for training an international astronaut team, and will conclude with an overview of current applications in computational chemistry and science education.

Historically, NASA has trained teams of astronauts by bringing them to the Johnson Space Center in Houston to undergo generic training followed by mission-specific training. The latter begins after a crew has been selected for a mission, often as much as two years before launch.

While some Space Shuttle flights have included an astronaut from a foreign country, the International Space Station will be consistently crewed by teams of astronauts from two or more of the partner nations. Not surprisingly, the international partners in the Space Station program would prefer to significantly reduce the need for their citizen astronauts to travel to and remain in Houston for training.

As a means of demonstrating the feasibility of using shared virtual environments to support the training of international astronaut teams, an experiment was conducted on September 20, 1995. Astronaut Bernard Harris (physically located at the Johnson Space Center in Houston) entered a virtual environment with Astronaut Ulf Merbold (physically located at the Fraunhofer Institute for Computer Graphics in Darmstadt, Germany). Their shared environment consisted of models of the Space Shuttle payload bay and the Hubble Space Telescope (HST). The two astronauts spent over thirty minutes performing the major activities associated with the changeout of the HST's Solar Array Drive Electronics (SADE). Their work included the real-time hand-off of the replacement SADE in exchange for the original SADE. At the conclusion of the task the two astronauts shook hands and waved good-bye.

The positive reaction of both astronauts to this experiment, has led to plans for the development of applications in support of future international missions, and an increase from two to three sites. Before the end of this century, efforts will be made to support shared environment between the ground-based installations and Low Earth Orbit for both "just-in-time" training and performance support for maintenance, science, and emergency medical services.

Applications are also under development that will support the training of multi–service military teams assigned to Operations Other Than War (such as the current peacekeeping operations in Bosnia, or humanitarian relief). Finally, this same technology is being explored as a means of allowing students from widely–separated geographical locations to jointly perform experiments and observations in simulated environments.

The computer graphics community must not believe that the only barriers to the effective use of shared virtual environments are bandwidth and rendering performance. A multitude of psychological, cultural, and human-computer interaction problems must also be successfully solved. The task of creating the technological infrastructure for sharing virtual environments on a global scale is surpassed only by the task of understanding how best to utilize applications built within the context of this infrastructure.

Michael R. Macedonia

This presentation will describe the infrastructure required to support VR in a global environment. Moreover, it will discuss a project that CRCG is participating in to develop that infrastructure – the MAY project.

CRCG has focused its research efforts toward determining how computer networks can be made to transform the workplace into a shared environment, allowing real-time interaction among people and processes without regard to their location. It is this illusion that allows the use of VR and telepresence for applications like distance learning, distributed interactive simulation, and group entertainment.

Emerging international broadband networks will enable the use of VR for applications that span the globe. These tools will support communication among multiple users in order to bridge long distances and different times. Common research, and business and social contacts across continents will become as simple as meetings between partners in one room. For example, the goal of manufacturing enterprises will be able to design, develop, prototype, and test new products in a seamless virtual environment with engineers in Detroit, designers in Munich, and managers in Milan. This is one of the goals of the MAY project.

The MAY project will test emerging communication facilities between research and industrial sites in Germany and the United States of America. The communication makes use of advanced collaboration tools like BERKOM, GroupX and Mbone over a high-speed intercontinental ATM link.

MAY comprises several different goals:

- MAY is intended to gain experience with multimegabit communication facilities bridging large geographical distances and grossly different time zones. The usefulness of group applications for research and industrial activities under the above circumstances will be evaluated.
- MAY shall provide solutions for problems that occur using long distance links like echo in headset-free environments, and the small working time overlap in "continuous development around the clock" scenarios.
- Data load patterns of the link will be monitored to gain knowledge about the resource allocation requirements for these advanced high speed applications.

Gurminder Singh

Nearly half the world's computers are idle at any given time. But at the same time, people face serious deficiency of computing and network resources when it comes to running large scale multi-user virtual worlds. We have been developing architectures to support large numbers of concurrent virtual world users on off-the-shelf PCs and Internet. The first system we developed, called WorldNet, is currently being used to develop several commercial products.

Based on the WorldNet experience, we are currently developing an architecture, named NetEffect, to support and run large scale multi-user virtual worlds that span across continents. The idea is to utilize idle computers located around the world to facilitate communication among virtual worlds. Our architecture is based on using distributed cooperating servers that are able to migrate from one workstation to another.

People around the world are able to volunteer their workstations to act as servers when they are not using them. For example, a person in Vancouver, Canada can volunteer his workstation from 7PM to 7AM every day; this is the time slot when he does not use his machine and is happy if it can be put a better use. We run a collection of master servers around the world on fixed Internet addresses which know about the availability of volunteered machines. The master servers ensure that when a particular server workstation's free time is up, the server is migrated to another available machine; all virtual world clients connected to that server are also migrated to the new server. The client virtual worlds, during their session keep moving around from one server to another without being affected in any significant way.

Based on the above architecture, we are developing interactive discovery learning applications for children. These applications enable children to learn new, useful information through interaction with a game-like interface, and through collaboration with other children on the network. Collaboration among children is supported by enabling and encouraging them to share objects and information with one another.