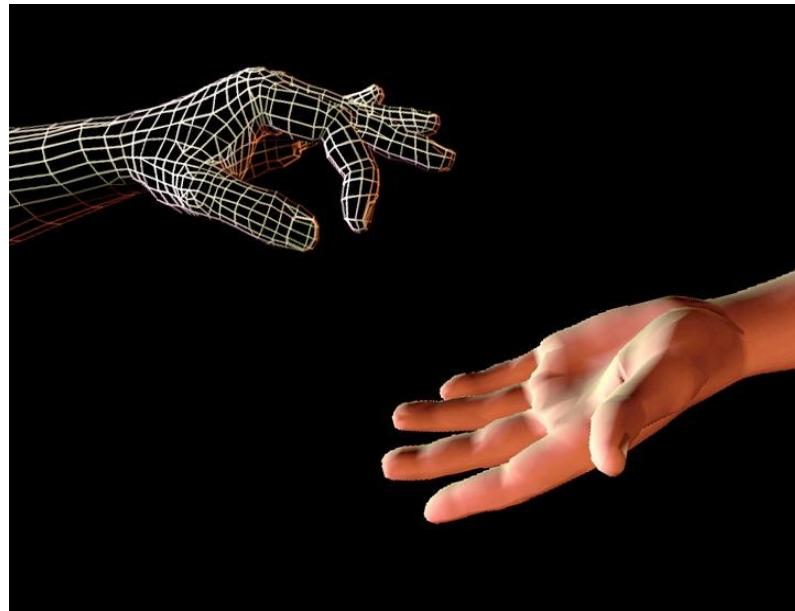


TELE IMMERSION

Virtuality meets Reality



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ABSTRACT

Tele-immersion is a new communication medium trying to create the illusion that users at geographically dispersed places share the same physical space possibly augmented by virtual components. This is the First "Network Computer," with Input, Processing and Output at different locations

Tele-immersion may be the next major development in information technology. Users will feel like they are actually looking, talking, and meeting with each other face-to-face in the same room, even though they may be miles apart physically.

Tele-immersion is an advanced form of virtual reality that uses a "tele-cubicle" which is equipped with large screens, scanners, sensors, and cameras. Through the virtual environment, participants are able to interact with other group members. Also, virtual objects and data can be passed through the walls between participants, and placed on the shared table in the middle for viewing. The result is that when a participant moves his or her head, the view of the others shifts almost as seamlessly as if the meeting were occurring face-to-face. When participants lean forward, their peers appear larger; when they recline, their virtual friends shrink in size.

This technology is to be implemented with Internet2 and has the potential to significantly impact educational, scientific,

Tele-immersion can be viewed as a networked collaborative virtual reality that uses avatars to represent collaborators and makes no attempt to blend real and synthetic objects.

Manufacturing, and many other fields like Interactive Scientific Visualization, Molecular Engineering, Virtual nuclear test, Education and Training, Army training, Art and Entertainment, Virtual game, Industrial Design and many more.

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II. INTRODUCTION

What Is Tele immersion???

Tele-immersion is a new communication medium trying to create the illusion that users at geographically dispersed places share the same physical space possibly augmented by virtual components.

Overview

Tele-immersion is a technology to be implemented with Internet2 that will enable users in different geographic locations to come together in a simulated environment to interact. Users will feel like they are actually looking, talking, and meeting with each other face-to-face in the same room. Even though they may be miles apart physically. In a tele-immersive environment, computer recognized the presence and movements of individuals as well as physical and virtual objects. They can then track these people and nonliving objects and project them in a realistic way across multiple, geographically distributed environments on stereo-immersive surfaces.



Tele-immersion will create a real-time situation for us in which we can communicate with others as if in the same room. The new era of Internet beckons us with 3D telecommunication technologies.

History

Advanced Network & Services was a major player in the initiative of Tele-Immersion. It is a non-profit making company that is dedicated to the progression of education by the research into advanced computer network applications and technology. The head of Advanced Network and Services proposed Tele-immersion as the application to drive forward Internet2 research. Thus the National Tele-immersion Initiative was formed. There are four groups that are currently working on the project, these are:

- Advanced Network and Services, New York, Chief Scientist: Jaron Lanier
- Brown University, Providence, Rhode Island, Principal Investigator: Dr Andries van Dam (1997/present)
- University of North Carolina at Chapel Hill, Principal Investigator: Dr Henry Fuchs (1997/present)
- University of Pennsylvania, Principal Investigator: Dr Ruzena Bajcsy (1997-present)

III. Tele Immersion V/s Virtual Reality

Tele-immersion has evolved from two main areas: virtual reality and networking. Teleimmersion may sound like virtual reality but there are major differences between the two

technologies. While virtual reality allows you to move in a computer-generated 3-D environment, tele immersion can only create a 3d environment that you can see but not interact with. Tele-Immersion is more like photography. "It's measuring the real world and conveying the results to the sensory system. However, interaction is possible by combining the two technologies."

IV. Tele-Immersion V/s Videoconferencing

Videoconferencing is already commonly used in business. It uses internet telephone technology and video cameras to bring together people at widely dispersed places on video monitors to have meetings. But the ability of people to interact in these situations is limited.

Tele-immersion takes the concept of videoconferencing a step further. In the future, if you wanted to talk to-say-George in the New York office, you would command your computer to place the call. Suddenly one wall of your office would vanish and you would see George in his office in 3D as if the wall had suddenly become a window. George would be able to see you and your office in much the same way.

This would happen in a computer with thousands of times the capacity of present day desktops that would generate the holographic image. Using cameras spaced around the office, it would recognize the presence and movements of people and objects inside the office. It would track their movements. Then it would project the image on a stereo-immersive surface, that is to say your office wall.

V. Internet2

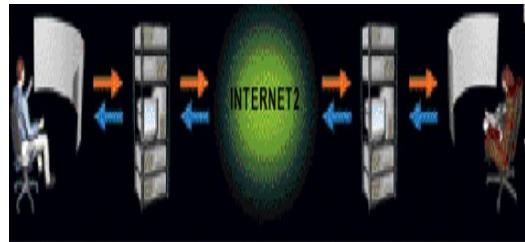
Internet2 is a consortium being led by 206 universities working in partnership with industry and government to develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow's Internet. Internet2 is recreating the partnership among academia, industry and government that fostered today's Internet in its infancy. The group is building high-speed networks and developing software with the aim of transmitting data at speeds an order of magnitude faster than the Net does now. The primary goals of Internet2 are to:

- Create a leading edge network capability for the national research community
- Enable revolutionary Internet applications
- Ensure the rapid transfer of new network services and applications to the broader Internet community.

through polarized goggles (like those used at 3D movie screenings). These create slightly different images in each eye which deliver the 3D tele-presence to our senses. This result is much more advanced than preceding avatars and works with the principles of our own natural sight.

VI. How does Tele-Immersion Work????

From the sender: Parallel processors accept visual inputs from the cameras and reinterpret the scene as a 3-Dimensional computer model.



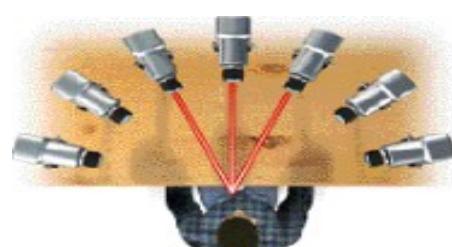
To the receiver: Specific rendering of remote people and places are synthesized from the model as it is received to match the point of view of each eye of a user. The whole process repeats many times a second to keep up with the user head motion.

The Technology

Present forms of teleconference are only 2-dimensional and are at best basic. For example, one cannot achieve eye contact with the other person; there is no support for the non-verbal forms of human communication. Tele-immersion will change this. By the use of multiple digital cameras, many different angles will be captured. This combined with tracking gear that is worn on their heads creates a sculpture-like representation of the user. These images are then fed to the human eye

Generating the 3-D Image:

1. An array of cameras views people and their surroundings from different angle. Each camera generates an image from its point of view many times in a second.

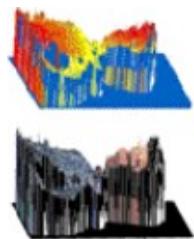


2. Each set of the images taken at a given instant is sorted into subsets of overlapping trios of images



3. From each trio of images, a “disparity map” is calculated, reflecting the degree of variation among the images at all points in the visual field. The disparities are then

analyzed to yield depths that would account for the differences between what each camera sees. These depth values are combined into a “bas relief” depth map of the scene



4. All the depth maps are combined into a single viewpoint independent sculptural model of the scene at a given moment. Process of combining depth maps provides opportunities for removing spurious points and noise.



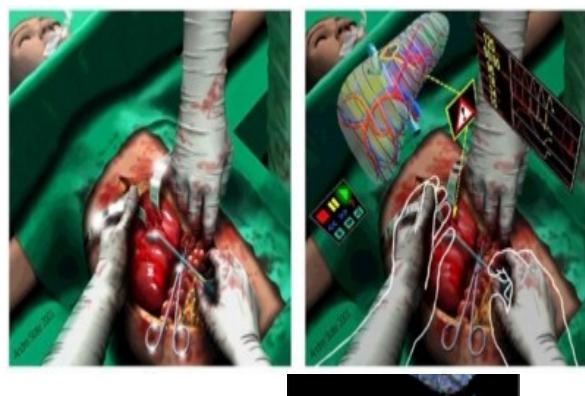
Telecubical

Users will communicate by using this technology. It consists of a Stereo immersive desk surface and two stereo immersive wall surfaces. These three display surfaces join to form a virtual conference table in the centre. This will allow the realistic inclusion of teleimmersion into the work environment, as it will take up the usual amount of desk space.

VII. APPLICATIONS

A. Medical

Teleimmersion can be immense use the field of medicine. It is impossible to treat a patient over the phone or give instructions for a tumor to be removed without physically being there. With the help of teleimmersion, 3d surgical learning for virtual operation can now take place and, in the future, the hope is to be able to carry out real surgery on real patients.



A geographically distanced surgeon could be teleimmersed into an operation theatre to perform an operation. This could potentially be life saving if the patient is in need of special care (either a technique or a piece of equipment), which is not available at the particular location. Teleimmersion will give surgeons the ability to superimpose anatomic images rights on their patients.

B. Education

In education, teleimmersion can be used to bring together students at remote sites in a single environment. Relationship among educational institutions could improve tremendously in the future with the use of teleimmersion. Already, the academic world is sharing information on research and development to better the end results. Teleimmersion will only promote this collaboration.

C. Future Office

In years to come, instead of asking for a colleague on the phone one will find it easier to instruct your computer to find him. Once he does that, he will probably see a flicker on one of his office walls and find that his colleague, who's physically present in another city, is sitting right across him as if he was right there. The person at the other end will experience the same immersive connection. With the teleimmersion bringing two or more distant people together in a single, simulated office setting business travel will become quite redundant.

D. Business Meeting

When tele-immersion technology becomes available, the very way we do business and indeed communicate will change. No longer will people have to travel long distances at great expense in order to conduct business meetings. All that would be necessary would be to use a tele-immersion system to set up a virtual shared conference room with participants separated by thousands of miles of physical space, but being able to interact as if they were in the same room.

VIII. TECHNICAL CONUNDRUMS

During the experiments conducted, the images were transmitted at a speed of three frames per second, causing them to be somewhat jerky. The problem was that today's Internet can't ship data fast enough. To look anything like reality, Tele-Immersion will have to be able to move mountains of data-spatial and visual information about people and their environments-across the Internet in a trice. Today's 256-kilobit-per-second connections can't do that. Even the bare-bones demonstration at Chapel Hill needed 60 megabits per second. High-quality Tele-Immersion will require even more-around 1.2 gigabits per second.

Also in the experiment conducted in May 2000, participants were required to wear 3D goggles in order to be able to view the three dimensional images being projected. Due to this complete physical presence of other person could not be felt.

In addition to high-speed networks, Tele-Immersion will require supercomputers to

perform the trillions of calculations that are needed to portray environments in 3D. This kind of computer power would have to be on tap over the Internet.

Anyplace with an Internet2 connection will be able to have a cubicle set up for viewing remote images. Remote or small college and small businesses will not be connected. "It's not viable for everyone's home.

The Technology is expensive for small business oriented or home users.

IX. OVERCOMING TECHNICAL CONUNDRUMS

Developing Internet 2

This will replace the current internet infrastructure. It is a consortium made up of the US government, industry and academia (180universities) that has been formed for creating tomorrow's internet. This new network will have a higher bandwidth and speeds that are 1000 times faster than today's internet. This high bandwidth, high speed network is necessary to transfer the large amounts of data that teleimmersion will produce.

Haptic sensors

These would allow touching projections as if they were real.

Bandwidth issues:

It is estimated that as much as 1.2 gigabits per sec will be needed for future high quality effects. This is much higher than the average home connection bandwidth. The exact amount of bandwidth needed for each scene depends on the complexity of the background. With time, the number of megabits used will fall as advanced compression techniques are established.

Display technologies

Stereo immersive displays would have to present a clear view of the scenes being transmitted.

GRID

To solve the problem of **supercomputers**, something in the form of a network called the Grid has been developed. The system has been tested on the Internet2, the broadband version of the Internet for transmitting high volumes of data. These would perform the trillions of calculations needed to create a holographic environment. A network of computers that share power could also possibly support these environments.

CONCLUSION

Tele-immersion will revamp the way people think and communicate. When tele-immersion becomes commonplace, it will probably enable a wide variety of important applications. Teams of engineers might collaborate at great distances on computerized designs for new machines that can be tinkered with as though they were real models on a shared workbench. Archaeologists from around the world might experience being present during a crucial dig. Rarefied experts in building inspection

or engine repair might be able to visit locations without losing time to air travel.

Business travel might be replaced to a significant degree by tele-immersion in 10 years. This is not only because tele-immersion will become better and cheaper but because air travel will face limits to growth because of safety, land use and environmental concerns.

Hence Tele Immersion enhances how people use computers and want to leverage the work of the people.