



LITERATURE SURVEY ON TELE-IMMERSION

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Abstract: Tele-Immersion helps users in different locations to collaborate in a shared, simulated environment as if they were in the same physical room. It's the ultimate synthesis of networking and media technologies to enhance collaborative environments. In the tele-immersive environment, computers recognize the presence and movements of individuals and objects, track those images, and then permit them to be projected in realistic, multiple, geographically distributed immersive environments where individuals can interact with each other and with computer generated models. With tele-immersion you will interact instantly with your friend on the other side of the globe through a simulated holographic environment. It will change the way we live.

Index Terms: Image processing, 3D images.

I. Introduction

Tele-immersion is a technology that will be implemented with internet2 which will enable users in different geographic locations to come together and interact in a simulated holographic environment. Users will feel as if they are actually looking, talking and meeting with each other face to face in the same place, 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 many geographic locations.

II. Objectives

Tele-immersion, a new medium for human interaction enabled by digital technologies, approximates the illusion that a user is in the same physical space as other people, even though the other participants might in fact be hundreds or thousands of miles away. It combines the display and interaction techniques of virtual reality with new vision technologies that transcend the traditional limitations of a camera. Rather than merely observing people and their immediate environment from one vantage point, tele-immersion stations convey them as "moving sculptures," without favoring a single point of view. The result is that all the participants, however distant, can share and explore a life-size space. Beyond improving on videoconferencing, tele-immersion was conceived as an ideal application for driving network engineering research, specifically for Internet2, the primary research consortium for advanced network studies in the U.S. If a computer network can support tele-immersion, it can probably support any other application. This is because tele-immersion demands as little delay as possible from flows of information (and as little inconsistency in delay), in addition to the more common demands for very large and reliable flows.[1]

III. Literature Survey

Tele-immersion sits at the crossroads of research in virtual reality and networking, as well as computer vision and user-interface research, a little background in these various fields of research is in order.

In 1965 Ivan Sutherland, who is widely regarded as the father of computer graphics, proposed what he called the "Ultimate Display." This display would allow the user to experience an entirely computer-rendered space as if it were real. Sutherland termed such a space a "Virtual World," invoking a term from the philosophy of aesthetics, particularly the writings of Suzanne K. Langer. In 1968 Sutherland realized a virtual world for the first time by means of a device called a head-mounted display. This was a helmet with a pair of display screens positioned in front of the eyes to give the wearer a sense of immersion in a stereoscopic, three-dimensional space. When the user moved his or her head, a computer would quickly recompute the images in front of each eye to maintain the illusion that the computer-rendered world remained stationary as the user explored it. In the course of the 1980s I unintentionally ended up at the helm of the first company to sell general-purpose tools for making and experiencing virtual worlds—in large part because of this magazine. Scientific American devoted its September 1984 issue to emerging digital technologies and chose to use one of my visual programming experiments as an illustration for the cover. Ivan invented "VPL Research" (for Visual Programming Language, or Virtual Programming Language), and thus was born VPL. After the issue's publication in Scientific American, investors came calling, and a company came to exist in reality. In the mid-1980s VPL began selling virtual world tools and was well known for its introduction of glove devices, which were featured on another Scientific American cover, in October 1987. VPL performed the first experiments in what I decided to call "virtual reality" in the mid- to late 1980s. Virtual reality combines the idea of virtual worlds with networking, placing multiple participants in a virtual space using head-mounted displays. In 1989 VPL introduced a product

called RB2, for “Reality Built for Two,” that allowed two participants to share a virtual world. One intriguing implication of virtual reality is that participants must be able to see representations of one another, often known as avatars. Although the computer power of the day limited our early avatars to extremely simple, cartoonish computer graphics that only roughly approximated the faces of users, they nonetheless transmitted the motions of their hosts faithfully and thereby conveyed a sense of presence, emotion and locus of interest. At first our virtual worlds were shared across only short physical distances, but we also performed some experiments with long-distance applications. The committee was able to set up virtual-reality sessions with participants in Japan and California and in Germany and California. These demonstrations did not strain the network, because only the participants’ motions needed to be sent, not the entire surface of each person, as is the case with tele-immersion. Computer-networking research started in the same era as research into virtual worlds.

The original network, the Arpanet, was conceived in the late 1960s. Other networks were inspired by it, and in the 1980s all of them merged into the Internet. As the Internet grew, various “backbones” were built. A backbone is a network within a network that lets information travel over exceptionally powerful, widely shared connections to go long distances more quickly. Some notable backbones designed to support research were the NSF net in the late 1980s and the vBNS in the mid-1990s. Each of these played a part in inspiring new applications for the Internet, such as the World Wide Web. Another backbone research project, called Abilene, began in 1998, and it was to serve a university consortium called Internet2.

Abilene now reaches more than 170 American research universities. If the only goal of Internet2 were to offer a high level of bandwidth (that is, a large number of bits per second), then the mere existence of Abilene and related resources would be sufficient. But Internet2 research targeted additional goals, among them the development of new protocols for handling applications that demand very high bandwidth and very low, controlled latencies (delays imposed by processing signals en route). Internet2 had a peculiar problem: no existing applications required the anticipated level of performance. Computer science has traditionally been driven by an educated guess that there will always be good uses for faster and more capacious digital tools, even if we don’t always know in advance what those uses will be.

In the case of advanced networking research, however, this faith wasn’t enough. The new ideas would have to be tested on something. Allan H. Weis, who had played a central role in building the NSF net, was in charge of a non profit research organization called Advanced Network and Services, which housed and administered the engineering office for Internet2. He used the term “tele-immersion” to conjure an ideal “driver” application and asked me to take the assignment as lead scientist for a National Tele-Immersion Initiative to create it. This was the logical extension of Ivan previous work in shared virtual worlds. Although many components, such as the display system, awaited invention or refinement before we could enjoy a working tele-immersion system, the biggest challenge was creating an appropriate way of visually sensing people and places. It might not be immediately apparent why this problem is different from video conferencing. Tele-immersion for the first time on May 9, 2000, virtually bringing together three locations. About a dozen dignitaries were physically at the tele cubicle in Chapel Hill. Seen through a pair of polarizing glasses, two walls of the cubicle dissolved into windows, revealing other offices with other people who were looking back at me. (The glasses helped to direct a slightly different view of the scenes to each eye, creating the stereo vision effect.) Through one wall I greeted Amela Sadagic, a researcher at my lab in Armonk, N.Y. Through the other wall was Jane Mulligan, a postdoctoral fellow at the University of Pennsylvania. Unlike the cartoonish virtual worlds I had worked with for many years, the remote people and places I was seeing were clearly derived from reality. They were not perfect by any means. There was “noise” in the system that looked something like confetti being dropped in the other people’s cubicles. The frame rate was low (2 to 3 fps), there was as much as one second of delay, and only one side of the conversation had access to a tele-immersive display. Nevertheless, here was a virtual world that was not a simplistic artistic representation of the real world but rather an authentic measurement- based rendition of it. In a later demo (in October 2000) most of the confetti was gone and the overall quality and speed of the system had increased, but the most important improvement came from researchers at Brown University led by Andries van Dam. They arrived in a tele-immersive session bearing virtual objects not derived from the physical scene. I sat across the table from Robert C. Zeleznik of Brown, who was physically at my lab in Armonk. He presented a simulated miniature office interior (about two feet wide) resting on the desk between us, and we used simulated laser pointers and other devices to modify walls and furniture in it collaboratively while we talked. This was a remarkable blending of the experience of using simulations associated with virtual reality and simply being with another person.

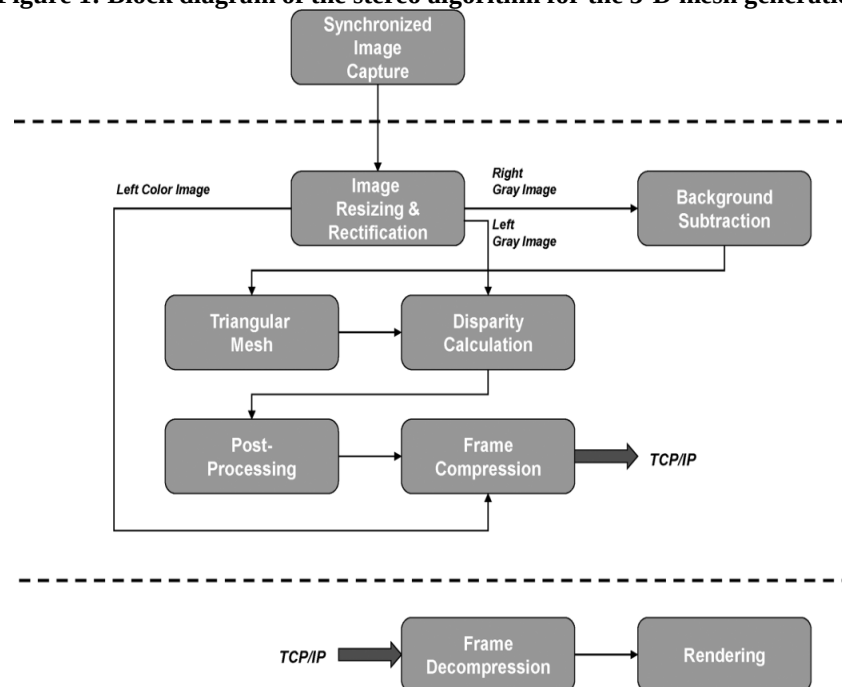
Recently the stereo matching problem is formulated as the process of computing a disparity map given a pair of stereo images. The disparity map associates every pixel with a disparity value, i.e., the positional offset between corresponding points in the stereo images. The stereo matching problem is well known in the field of computer vision, and has led researchers to develop a wide range of effective techniques, including image-segmentation, plane-fitting, belief propagation, and adaptive cos aggregation. These techniques provide excellent still-frame accuracy; however, high computational complexity often prohibits their application in real-time systems.

The emergence of many core, massively parallel graphics processing units (GPUs) and GPU-accelerated computing engines has enabled the implementation of high-accuracy real-time stereo matching methods. The compute unified device architecture (CUDA)[2][p94], a general-purpose parallel computing architecture and a complementary application programming interface developed by NVIDIA, is one of the most popular high-performance computing engines used by researchers to implement real-time stereo matching methods. Many of these methods achieve real-time performance by reducing the complexity of window-based matching cost aggregation. In addition, these methods typically avoid image segmentation, which requires a large number of computationally demanding iterations, and plane-fitting, which lacks the computational regularity necessary for parallelization.[2][p94].

IV. Concept

Tele-immersion consist of a three dimensional technology which helps to create a virtual environment for communication. An array of 8 cameras is used to capture the image in real world.

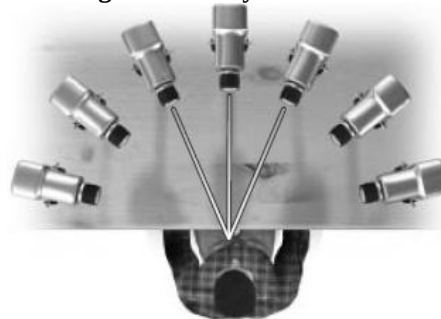
Figure 1: Block diagram of the stereo algorithm for the 3-D mesh generation



V. Generation of 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.

Figure 2: Array of camera



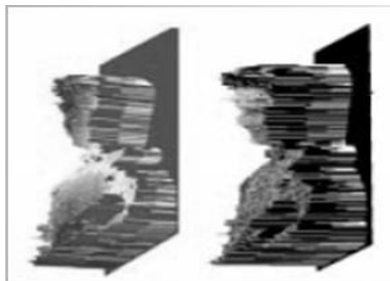
2. Each set of the images taken at a given Instant is sorted into subsets of overlapping trios of images.

Figure 3: Views taken by Camera



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 then Display map Combined.

Figure 4: Display map



4. All the depth maps are combined into a single viewpoint-independent sculptural model of the scene at a given moment.

Figure 5: Final View



When Tele-immersion becomes commonplace, it will probably enable a wide variety of important applications. 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.

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