Tele-Reality in the Wild

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Abstract. We are rapidly moving toward a world where personal networked video cameras are ubiquitous. Already, camera-equipped cell phones are becoming commonplace. Imagine being able to tap into all of these real-time video feeds to remotely explore the world live. We introduce RealityFlythrough, a tele-reality/telepresence system that makes this vision possible. By situating live 2d video feeds in a 3d model of the world, RealityFlythrough allows any space to be explored remotely. No special cameras, tripods, rigs, scaffolding, or lighting is required to create the model, and no lengthy preprocessing of images is necessary. Rather than try to achieve photorealism at every point in space, we instead focus on providing the user with a sense of how the video streams relate to one another spatially. By providing cues in the form of dynamic transitions, we can approximate photorealistic tele-reality while harnessing cameras "in the wild." This video describes the RealityFlythrough system, and reports on a live tele-reality experience. We find that tele-reality can work in the wild using only commodity hardware and off-the-shelf software, and that imperfect transitions are sensible and provide a compelling user experience.

1 Introduction

We are rapidly moving toward a world where personal networked video cameras will be ubiquitous. Already, camera-equipped cell phones are becoming commonplace. Imagine being able to tap into their live video feeds to remotely explore the world in real time. We introduce RealityFlythrough, a tele-reality/telepresence system that makes this vision possible.

There are numerous applications for such a system, but perhaps the most compelling involves disaster response. Consider, for example, first responders equipped with head-mounted wireless video cameras encountering the chaos of a disaster site. As they fan out through the site, they continuously broadcast their location, orientation, and what they see to a RealityFlythrough server. The responders' central command virtually explores the site by viewing these video feeds to get a sense of the big picture. They can then direct medics to the injured, firefighters to potential flare-ups, and engineers to structural weaknesses. As more people enter the site and fixed cameras are positioned, the naturalness of the flythrough is enhanced until ultimately the entire space is covered and central command can "fly" around the site looking for hot spots without constraints.

There are many other applications for RealityFlythrough, ranging from the disabled remotely exploring the world, to sports fans remotely flying around a stadium selecting the optimal vantage point for viewing the game.

An early description of tele-reality in the academic literature was presented by Szeliski [1]. He suggests that the ultimate in tele-reality is dynamic tele-reality, a live immersive real-time flythrough of the world. The distinction between tele-reality and telepresence is subtle and not entirely clear. Telepresence typically involves the remote control of a robotic camera [2], while tele-reality builds a model by using multiple cameras and allows what are called novel views from locations that are not covered by cameras. Much research has been done by the graphics and vision communities in texturing virtual reality with photos, with a focus on creating photorealism at every point in space [3]. These systems require extensive preprocessing of the images and special cameras, rigs, scaffolding, and lighting to achieve the effect. They are solving a different set of problems and are operating under a different set of assumptions. These approaches will not work in the wild, where cameras are moving, and the images are live video feeds that cannot be preprocessed.

RealityFlythrough addresses these problems by relaxing the requirement for photorealism [4] during the transitions between images. Transitions are a dynamic, real-time blend from the point of view of one camera to the point of view of another, and are designed to help the user generate an internal conceptual model of the space. See video for examples. Although it is possible to stop mid-transition to see a novel view, the emphasis is on displaying the real images captured from cameras. The transitions from camera to camera are provided mainly to help the user make sense of how the images are related to one another spatially.

The focus of this video is to show that tele-reality can be made to work while relaxing the constraints of a tightly controlled environment; that is, to work in the wild, affordably. We have managed to create a compelling tele-reality experience using commodity components and off-the-shelf software. With consumer GPS's, inexpensive web cameras, and standard video conferencing software, we were able to construct an environment that provides a live, immersive tele-reality experience. We found that a pair of research subjects remotely exploring a physical space had a compelling experience and were able to determine key facts about the activities going on there.

Crucial to the success of this work is the sense-making qualities of the transitions we designed and the comfort the user has with viewing them. Early results from a more controlled study reveal that user behavior is on the whole more like operating a true flythrough, and less like operating a multi-camera security system.

References

1. Szeliski, R.: Image mosaicing for tele-reality applications. In: WACV94. (1994) 44–53
2. Kuzuoka, H., Ishimo, G., Nishimura, Y., Suzuki, R., Kondo, K.: Can the gesturecam be a surrogate? In: ECSCW. (1995) 179–
3. Kanade, T., Rander, P., Vedula, S., Saito, H.: Virtualized reality: digitizing a 3d time varying event as is and in real time (1999)
4. Hollan, J., Stornetta, S.: Beyond being there. In: Proceedings of the SIGCHI conference on Human factors in computing systems, ACM Press (1992) 119–125