Prototype System of Mutual Telexistence

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This prototype allows for face-to-face communication between remote users.[1]

Unlike most conventional tele-conferencing systems, which limit the users' viewpoint to a fixed position, a mutual telexistence system should provide images of the other users that correspond to the change of a user's eye position in the computer-generated 3D space. On the other hand, with "image-based rendering," complex photo-realistic images can be effectively synthesized at arbitrary viewpoints. However, with this technique, the system must synthesize the image in real-time for smooth communication. This prototype system includes the following features to fulfill this real-time request:

1. Geometric information such as a "depth map" is needless. Only one parameter of the object's distance is required. So, the system does not include a time-consuming process such as pattern matching. Data processed by the rendering computer are reduced in advance at the stage of capturing the source image. This means that the rendering computer doesn't have to deal with bulky data of the "plenoptic function."

2. Fast rendering is enabled by using graphic hardware acceleration of texture mapping. The system is comprised of relatively low-cost general graphic hardware.

The prototype system includes a camera unit, the rendering PC, and the control PC. In the camera unit, 12 small color CCD cameras are aligned horizontally in a row on the linear actuator at intervals of 54mm. These cameras rotate around their optical axes, so the direction of their scanning lines is vertical. Moreover, all the cameras are synchronized by the same genlock signal, and a video switch is installed between the camera unit and the rendering PC. This design allows the rendering PC to selectively capture only one scanning line among 12 video streams, which reduces data and the number of video capturing devices required. The rendering PC synthesizes the images of the object from arbitrary viewpoints by texture-mapping long tile images on a transparent plane in the computer-generated 3D space. The control PC indicates the channel of this switch and controls the motion of the linear actuator.

Figure 2. shows a video sequence synthesized by the system. Moving human figures are successfully rendered in real-time.

More specific technical data is available at: www.star.t.u-tokyo.ac.jp/projects/mutel/
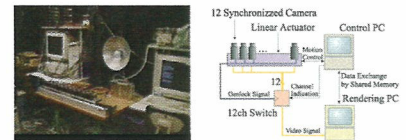

Figure.1
Left: overview of the prototype system.
Right: block diagram of the prototype system.

Figure.2 Synthesized video sequence.

Reference
1. Susumu Tachi, Taro Maeda, Yasuyuki Yanagida, Masaaki Koyanagi, and Hiroki Yokoyama: A Method of Mutual Tele-Existence in a Virtual Environment. In Proceedings of ICAT 98, pp9-18, 1996.