Conference Paper

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extending immersion in video conferencing

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Publication Date:
2006

Permanent Link:
https://doi.org/10.3929/ethz-a-005713962 →

MatrixView: Extending Immersion in Video Conferencing

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ABSTRACT

We present MatrixView (MV) – a setup to increase immersion in video conferencing systems. MV consists of a pan-tilt video camera mounted on a car which moves along a horizontal track. The car moves in such a way, that the user is kept in the center of the image ("Matrix" movie effect, see Figure 1). Using this setup in a video conference application, enables a remote user to manipulate his virtual position and orientation relatively to the acquired object or person. We use computer vision to track the remote observer's head and adjust the camera position according to the head movements. Alternatively the camera can be remote-controlled by using a GUI. Preliminary tests have given us a positive user feedback.

Figure 1: Different points of view of the camera

Keywords: Immersion in video conferencing, moving camera, remote collaboration, interactive viewport selection, adjustable point of view.

ACM Classification: H.4.3 [Communications Applications]: Computer conferencing, teleconferencing, and videoconferencing.

INTRODUCTION & RELATED WORK

Video conferencing (VC) is often used today, because contact is more intensive than in simple audio communications and facial expressions/gestures can be seen too. However, systems we use today only provide a low level of presence.

Several tools have been developed to overcome this lack of presence. Gaver et al. [1] have presented a system similar to MV, which used a very limited vertical and horizontal sliding mechanics (30 x 30cm) to move the camera and set focal points. Our system extends the interaction space to the width of 2m to create a significant change in perspective. Paulos and Canny presented Prop [2], small robots that could be remote-controlled via internet (Tele embodiments). The robots were each equipped with a camera, a display, and a remote controllable gripper. The robots were suitable to be used in open areas with few obstacles. An other system that combines a panoramic and a pan-tilt-zoom camera to create a more intuitive interaction have been tested by Liu et al. [3]. The system was designed for large conference rooms and one point of view while our system is able to additionally change the point of view for an observer.

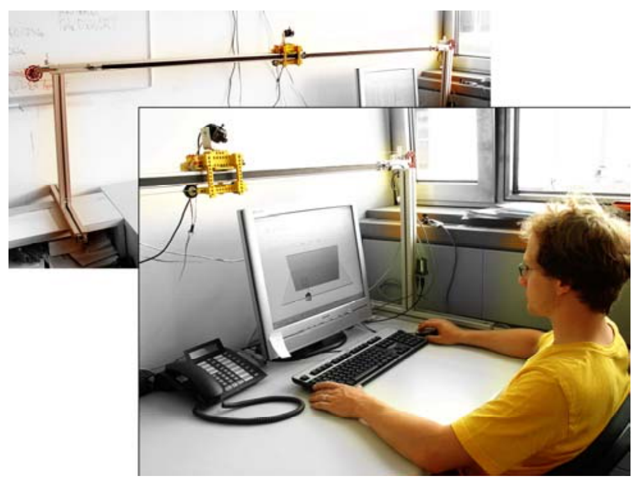

Figure 2: MatrixView: Pan, tilt camera on a rail acquiring a user from different view points

SYSTEM DESCRIPTION

We have built a system (Figure 2) to increase the feeling of presence during video conferencing by enabling a remote camera to be actively moved left and right on a horizontal rail mechanism. The focus of the camera is kept aligned to a target when moving. The view seen by the moving camera can be compared to the effect well known from the movie "Matrix". Existing pan-tilt-zoom cameras can not change the point of view; less spatial clues and depth are available. Whereas our system provides free view point selection in at least one dimension – improving the spatial experience. Such an extended interactivity in video conferencing is thought to increase the feeling of presence.

A server software is used to control the hardware and receive input from clients in the internet.

We have developed two kinds of software clients to control the camera:

- **Remote Head tracking**: We use a camera to acquire images of the remote user and run the OpenCV [4] face detect algorithm to detect the center of the user's face (Figure 4). The remote user can move his head left, right and up, down to control the camera's position and tilt. The center of focus is kept constant but can be changed by the local user.
- **Remote GUI**: We also developed a Flash interface. By moving the mouse left and right the position of the camera can be changed. The center of focus will be constant unless the remote user presses the mouse button and changes the center of focus (rectangle in Figure 3)

Figure 3: GUI: Horizontal mouse movement controls the camera's point of view. By clicking and selecting the focus can be set.

Figure 4: Head tracking software (client)

HARDWARE SETUP

The camera is mounted on a carrier actuated by two servo motors, which allow panning and tilting up to ± 90 degrees. A DC motor actuates the car with the pan-tilt camera on the beam. When the camera moves, the point of focus is kept constant (Figure 1) by calculating the required angles on a microcontroller.

PERFORMANCE

The movement of the camera slider is relatively fast: The camera can move from one end to the other in 2.2 s. The servo motors are very fast compared to the slider and move 180 degrees in 0.5 s. Since little attention has been paid to noise emission, the slider is not moving quietly.

RESULTS

Only few internal user tests have been performed so far. Tests included a normal video conference using Skype 2.0 [5], in which the remote user had full camera control. Another qualitative test was performed using MV to investigate a distant object placed in the focus of MV.

Users of the system were very interested in actively exploring the remote space and often used the facility of moving the camera. Shifting of the center of focus was very entertaining and helped in getting an idea of the three dimensionality of the distant environment and person.

CONCLUSION

We have presented a system that widens the interaction space in video conferencing sessions by facilitating the control of the remote camera's point of view. Our system provides fast and accurate control by using two ways of interaction. Head tracking is used to control the horizontal camera position as well as its inclination. Using the GUI based interaction it is also possible to set different center of foci.

OUTLOOK

Proper user tests will be performed to investigate the usability of the system. Additionally, we will have to design the system quieter since the noise is a distracting parameter and also affects the audio transmission. Another idea for further research is to design MV without any mechanical parts by using an array of cheap cameras and computer vision to morph between camera images.

The usage of a round shaped rail for the beam would also be interesting as it would intensify the "fly around"-effect even more.

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