Chapter 9
Multipoint Multimedia Conferencing System for Efficient and Effective Remote Collaboration

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ABSTRACT
A multipoint, multimedia conferencing system called FocusShare is described. It uses IPv6/IPv4 multicasting for real-time collaboration, enabling video, audio, and group-awareness and attention-sharing information to be shared. Multiple telepointers provide group-awareness information and make it easy to share attention and intention. In addition to pointing with the telepointers, users can add graphical annotations to video streams and share them with one another. The system also supports attention-sharing using video processing techniques. FocusShare is a modularly designed suite consisting of several simple tools, along with tools for remotely controlling them. The modular design and flexible management functions enable the system to be easily adapted to various situations entailing different numbers of displays with different resolutions at multiple sites. The remote control tools enable the chairperson or conference organizer to simultaneously change the settings for a set of tools distributed at multiple sites. Evaluation showed that the implemented attention-sharing techniques are useful: FocusShare was more positively evaluated than conventional video conferencing systems.

INTRODUCTION
Conventional videoconferencing standards using Internet protocols (IPs), such as H.323 (ITU-T, 2007), are widely used and commercial videoconferencing products based on H.323 are widely available. Microsoft NetMeeting (Summers, 1998), Ekiga (Sandras 2001), and other videoconferencing software systems based on H.323 can be used on personal computers (PCs). Video chat systems, such as Yahoo! Messenger and Windows Messenger,
and Skype video can also be used on PCs. While these systems can be used in distance education, they are inadequate and inefficient for large-scale distance education, as explained below.

Conventional videoconferencing systems based on H.323 do not adequately provide group-awareness and attention-sharing information to participants. Such information would enable participants to better understand the situations and intentions of others. We think that this basic information is important in distance education and remote collaboration. There are various methods for providing group-awareness and attention-sharing information. For example, group-awareness can be provided by pointing using telepointers and attention-sharing by using either telepointers or video processing techniques like zooming. Telepointers play an important role in interactive distance education (Adams et al., 2005).

Conventional videoconferencing systems only support one telepointer or none at all. While some systems allow it to be shared among users, it is usually controlled by one user at a time. Before someone else can use it, the current user must relinquish control. This control transfer is time-consuming and slows down communications. Multiple telepointers would eliminate this problem, so multiple telepointers should be supported.

Conventional H.323-compliant systems are designed for point-to-point connections. Since these systems cannot use the multicast capability of IPv6/IPv4 (Internet protocol version 6/version 4) networks, they are not efficient for large-scale distance education on multicast-capable networks. Multicast support is an important requirement for large-scale distance education.

Moreover, as large numbers of people can attend lectures in distance education, differences in system settings for the different locations can be a problem. Instructing participants individually about settings via video and/or audio is tedious and time-consuming. Remote adjustment would facilitate the preparation and management of remote lectures. Although general-purpose remote control software tools are available, they generally cannot handle multiple sites simultaneously. Tools that can handle multiple sites are thus needed.

Conventional videoconferencing systems restrict display and window configurations and are not easily adapted to differences in environments. They usually support only one type of display. Some conventional systems are based on H.239 (ITU-T, 2003), which defines dual video stream functions, such as People+Context, and data collaboration. They support one main display and another display, but the use of dual video stream functions requires two displays at every site. Any site with only one display cannot participate in a conference that uses dual video stream functions. Moreover, any site with more than two displays cannot fully utilize the available displays even when multiple sites send and receive videos simultaneously. To process multiple video streams, a conventional videoconferencing system usually uses a multipoint control unit (MCU), which composes one video stream from multiple video streams and sends it to the receivers. The resolution of the composed video stream is inferior to a total resolution of the original streams. It would obviously be better if all displays could be effectively used when multiple displays are available and multiple video streams are received even if the display resolutions differ between sites.

Conventional videoconferencing systems usually display a video as a full screen or in a window. They do not allow the users to view multiple videos in multiple windows on a display. In other words, they lack flexibility in their display configuration.

To overcome the above inadequacies and inefficiencies for large-scale distance education, we developed a multipoint multimedia conferencing system called FocusShare that supports group-awareness using multiple telepointers and other attention-sharing techniques using video processing like partial zooming and nonlinear zooming. FocusShare enables video, audio, and telepointers to be shared using IPv4/IPv6 multicasting.