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Seamless Multiparty Videoconferencing System

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ABSTRACT

In this paper, an innovative multiparty videoconferencing system supporting eye contact and synchronous pointing based on the combination between human image and shared workspace is presented. We propose an idea to establish multiple eye contacts by representing each participant's eyes with a small video camera. Therefore, participants are able to be aware of who is visually attending to them. All participants' images are displayed as the image layer which is naturally merged with the shared workspace. With this method, the proposed system has the advantage of serving synchronous pointing of more than one site at a given time. The basic idea is to make camera's view overlapped with pointing area by using the technique of camera's angle and position. Therefore, multiple target points can be recognized simultaneously.

INTRODUCTION

Although the conventional videoconferencing systems are very effective as a means of remote person-to-person communication, they still do not totally fulfill the need of actual meetings. Since they generally present a variety of problems such as lack of eye contact, limited of viewing and no finger pointing. It can be seen that eye contact, facial expression and gesture provide a variety of non-verbal cues that are essential in human-human communication. Eye contact means that the eyes of one person meet those of the other person while talking or gazing at each other. The lack of eye contact in typical VC systems comes from the fact that when participants talk with each other, they look at image of remote site on their display rather than into the camera, which is typically mounted above, below, or beside the display. This spatial separation between camera and display has introduced a serious problem of unrealistic during the conference.

In addition, typical videoconferencing system still cannot support the presence of finger pointing since display's content does not overlap with camera's view and shared workspace is displayed as the separated window with participant's image.

We have developed the two-way videoconferencing system that supports eye contact and presence of pointing with seamless control between human image and shared workspace. The underlying concept behind this system is to place a small video camera at a common point of gaze direction between display and camera. The system makes it possible to support the finger pointing since camera's view is overlapped with area of display's content and by offering the seamless between image and shared workspace rather than placing them in the individual and arbitrarily separated window as in the conventional system. With the closer consideration, the system reveals a number of various problems in supporting multiparty videoconference. In this paper, we focus on the specific problems of multiple eye contacts and synchronous pointing. The proposed idea of seamless integration with the method of preserving eye contact and synchronous pointing by using technique of camera's position and angle will be described.

SEAMLESS INTEGRATION

One obvious problem on the conventional videoconferencing system is that it breaks down as the number of remote sites increases due to the decreasing size of the tiled images and shared workspace. Therefore, we propose an idea of seamless integration which human image and shared workspace are naturally merged. It can be considered that all participants' images and shared workspace are the primary layers of a seamless screen. This technique has the advantage that all parties can see each other as the full screen. In addition, this method also makes it possible for the users to freely control the seamless level according to the various situations during a conference. Seamless integration also has another main advantage of serving pointing and synchronous pointing for multiparty conference since participants can use their finger to indicate any point in the shared workspace.

MULTIPLE EYE CONTACTS

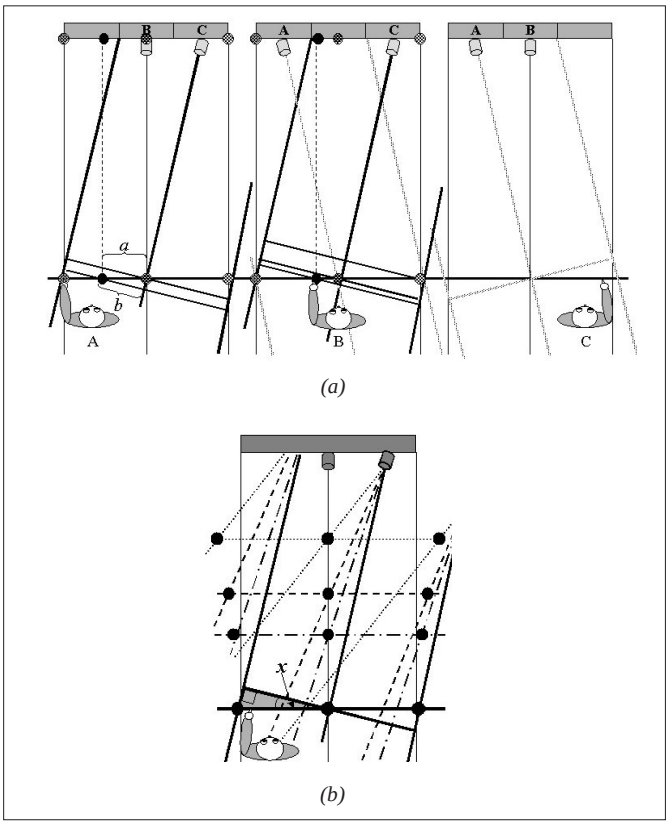
It could be realized that the eyes of users are an important cue for a decision making process and in increasing the feeling of presence between participants in a videoconference meeting. The participant will never perceive eye contact unless the gaze direction between camera and display are synchronized. Based on this fact, we realized that looking at camera can convey the feeling of perceiving eye contact or being attended at. Therefore, we represent eyes of each participant with a small video camera in front of his image. Each site will receive the video signal from the camera that placed at his position of all other sites. For example, in three-way videoconference, as illustrated in Figure 1 (a), the video image for site A comes from a video signal of a camera placed at A position of site B and C. The same manner is applied for site B and C. Then each participant is able to perceive the feeling of being attended at from the person who is looking at his image.

SYNCHRONOUS POINTING

Simple user interface such as finger pointing is considered to be one of significant parts to improve the efficiency of a conference. The underlying concept for supporting synchronous pointing is to make camera's view overlapped with pointing area. The technique of camera's angle and position has been introduced. The various methods of how to display human image for multiparty videoconference have been investigated. The method that provides the effective point of view for synchronous pointing, is to display all participants in the shifted position. The display will be divided into n vertical parts; where n is the total number of participants. Each participant has own area to display his image on the screen which is one of those n parts. All participants have their own space in front of the display during a conference.

Firstly, we define a pointing area and camera position. The pointing area is an area that parallels to the display's content and has the distance about 40 cm from the plane of participant's position. The position of camera is in the middle of each remote participant's area on the display. We make the camera's view overlapped with the pointing area by turning a camera to direct at the center of pointing area with a relatively small angle between plane of camera's view and display. As illustrated in Figure 1 (b), if the distance between display and participant is larger, the angle difference x between plane of camera's view and display will become smaller. If the angle x is small enough, a required point can be approximately to be a target point in the shared workspace since distance a and b are approximately to be the same as shown in Figure 1 (a). It can be seen that a vertical line at the middle of display is exactly with a vertical line at the middle of camera's view. The other positions can be approximately to be the same if the angle x is small enough. With this method, the upper-part body and target point of each participant can be observed clearly and simultaneously.

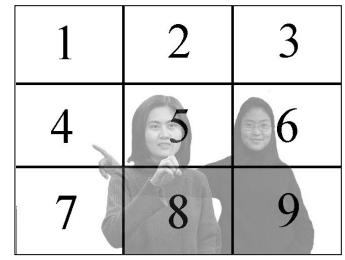
Figure 1. (a) Three-way videoconference with the technique of camera's angle and position, (b) The comparison of different angle between plane of camera's view and display



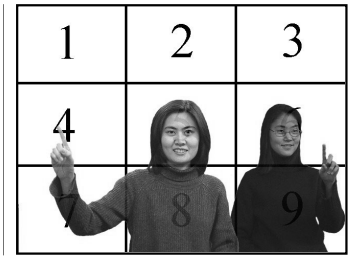
(a)

(b)

Figure 2. The view of site A in three-way videoconference (a) C is attending at A, (b) B is attending at A



(a)



(b)

EXPERIMENTAL RESULTS

We conducted the experiments to prove the proposed idea based on three-way videoconference. The plasma display's size of 90 cm×110 cm is used with the distance between display and pointing area of 150 cm. The angle x is about 13.5 degree. Figure 2 shows the system with supporting of synchronous pointing and multiple eye contacts from the view of site A according to three-way videoconference in Figure 1 (a). Figure 2 (a) shows that C is pointing and looking at A while B is pointing at B's area. We can see that A can perceive the feeling of eye contact with C and recognize that he is not attended from B. Figure 2 (b) shows that B is looking and pointing at A while C is pointing at C's area. It can be seen that A can perceive the feeling of eye contact with B and recognize that C is not looking at A. Moreover, the seamless level can be freely controlled according to the various situations during a meeting as shown in the difference transparent level of participant's image between Figure 2 (a) and Figure 2 (b).

CONCLUSION

We focus on the particular problems of supporting multiple eye contacts and synchronous pointing for multiparty videoconference. The method is based on the seamless integration and technique of camera's position and angle. Camera is considered to be the eyes of remote participants so that gazing toward someone can be effectively conveyed. By turning camera direct to the center of pointing area with relatively small angle between camera's view and display, participants are able to user their finger as a simple user interface to indicate the required point in the share workspace. The experimental results proved that the proposed idea has a good potential of serving synchronous pointing and multiple eye contacts. Developing the system for a large number of participants is the subject of our future work.

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