ViCAT: Visualisation and Interaction on a Collaborative Access Table

Fang Chen[1], Benjamin Close[1,2], Peter Eades[1], Julien Epps[1], Peter Hutterer[1,2], Serge Lichman[1], Masa Takatsuka[1,3], Bruce Thomas[1,2], Mike Wu[1]
[1]*IMAGEN Program, National ICT Australia*
[2]*School of Computer Science, The University of South Australia*
[3]*School of Information Technology, The University of Sydney*
julien.epps@nicta.com.au; masa@vislab.usyd.edu.au; bruce.thomas@unisa.edu.au

Abstract

Despite many years of research in the area of human-computer interaction, there are still remarkably few computing platforms in existence that permit remote collaboration over various software applications in an intense manner. Visualisation and Interaction on a Collaborative Access Table (ViCAT) is a new project whose aim is to allow intense collaboration between multiple users at multiple remotely located sites, as if the users were gathered around a physical table. This paper introduces the ViCAT design philosophy and how it addresses the mixed presence groupware concept, and then describes the relationship between the ViCAT project and current horizontal interactive human-computer systems research.

1. Introduction

Horizontal computing interfaces are inherently different from the desktop paradigm, in terms of user perceptions of the applications that should be used with them, the feasible input and output methods, and the opportunity for team-based rather than individual work. Horizontal interactive human-computer systems research has seen the development of a number of table-based computing prototypes, such as the metaDESK [7] and the InteracTable [3].

In this paper, we describe ViCAT, a networked computing platform that extends the notion of a physical table as a place for meeting, sharing ideas and working together in an intense manner to the world of remote collaborative computing. For the purposes of this paper, 'intense collaboration' refers to the shared use of a fully-fledged application where more than one user is able to enter input simultaneously (as opposed to the more common 'chalk passing' approach to multi-user input), while remaining aware of other users' activities.

2. Design

ViCAT's design allows remote groups to interact simultaneously to perform a common goal. ViCAT comprises a large vertical rear-projected screen, on which the various remote collaborators are shown, and a large horizontal screen, onto which the shared application is rear-projected, as seen in Fig. 1. Using hand gestures without obscuring the projected image provides a major improvement in usability, according to informal user feedback. AccessGrid [1] is used to provide video over IP feeds of remote coworkers.

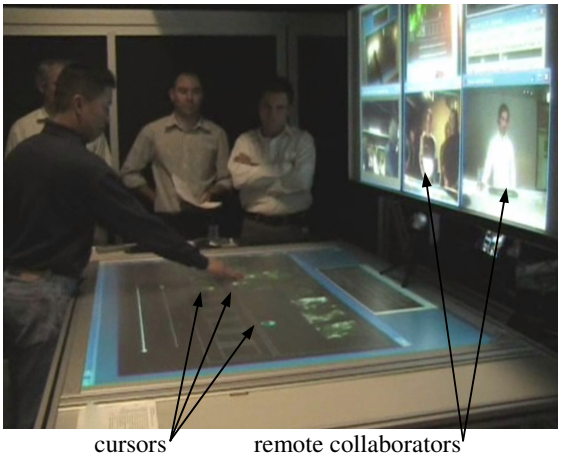

Figure 1. The ViCAT table at one of four sites, sharing a multimodal video editing application on the horizontal screen.

ViCAT uses Mixed Presence Groupware [4]; this is the combination of Single Display Groupware (SDG) and Shared Display Groupware (ShDG). In SDG multiple people share one display on one machine, while ShDG users share one common desktop (or just one window) across different hosts. ShDG does not however have support for an arbitrary number of users on each host.

Mixed Presence Groupware has the capability of supporting any number of users on each host in the network, while still sharing one common view on an application. It is anticipated that Mixed Presence Groupware in ViCAT will be the key to facilitating multiple simultaneous interactions, and will serve as a basis for developing new social interaction protocols to enable fluid group collaboration.

Proceedings of the First IEEE International Workshop on Horizontal Interactive Human-Computer Systems (TABLETOP '06)
0-7695-2494-X/05 $20.00 © 2006 IEEE

3. Discussion

The ViCAT project endeavours to further the state of the art in horizontal interactive human-computer systems based on the following novel combination:

(i) Support for input from more than one user at each remote site, using an implementation of Mixed Presence Groupware that is compatible with many existing Java-based single-user applications.

(ii) The use of multimodal fused speech and manual gesture input as a more 'natural' input alternative to a mouse and keyboard in the context of a collaborative environment, where maintaining eye contact is very important. The manual gesture input is achieved via use of a video camera mounted above the horizontal display, and is able to accurately track and recognize a number of different hand gestures. Previously, gesture input has been used without speech in a single-site tabletop configuration [2], limiting the scope of the possible types of input and requiring the user to remember a number of new gestures. Speech recognition for a limited vocabulary (e.g. 10-50 commands) can provide a high degree of accuracy, although careful microphone placement is needed to ensure robustness. In ViCAT, we find that a Bluetooth headset provides excellent robustness.

The ViCAT project attempts to extend the current coverage of the horizontal interactive human-computer systems research domain by creating a tighter coupling between the interaction protocols of physical and virtual meeting tables through:

(i) Allowing all input devices to be concurrently active, just as everyone in a meeting could potentially write on some common document or whiteboard simultaneously.

(ii) Providing alternative input modes to the mouse and keyboard, neither of which normally appears on a physical meeting table.

(iii) Distinguishing between human–human communications and human-machine commands in a natural manner (e.g. by use of a special gesture). Previous attempts have used push-to-talk or keyword spotting mechanisms, which are less convenient or more error-prone than our proposed approach.

Future directions for horizontal interactive human-computer systems research in the ViCAT project include:

(i) Adding semi-transparent arm 'shadows' to the gesture-based cursors, so that remote coworkers can see not only what has been done by another user after the fact, but what that user intends to do *a priori*. This may be done in a manner somewhat similar to [5, 6].

(ii) Tightly synchronized communication allows a common abstract picture of a task or data set to be presented and manipulated by a group of geographically distributed users. This differs from traditional visualisations, which are normally controlled by one person at a time, and the potential for this has yet to be investigated.

(iii) Further research into the range of different types of gesture, the feasibility of and scope for two-handed gesture input, and the relative benefits of manual gesture compared with the more conventional mouse and stylus inputs.

(iv) Audio-visual cues may provide improved interaction with remote coworkers, and may provide an opportunity to reduce the cognitive load on users, who already need to follow multiple cursors.

(v) Exploration of applications that use a shared level surface, for example architecture designs, puzzles and games based on physical markers, graphic editing, teleradiology, geographical information systems, military planning or computer-aided design.

4. Conclusion

The ViCAT project uses a horizontal computing surface to support intense remote collaboration via an implementation of Mixed Presence Groupware and newer modes of input. The research trajectory for ViCAT includes social protocols to convey the intention of user inputs, designing 'natural' methods for input, and testing new applications for horizontal interactive human-computer systems.

5. References

[1] Childers, L., Disz, T., Olson, R., Papka, M., Stevens, R., and Udeshi, T., "Access Grid: Immersive Group-to-Group Collaborative Visualization", in *Proc. 4th Int. Immersive Projection Technology Workshop*, 2000.

[2] Ishii, Y., Nakanishi, Y., Koike, H., Oka, K., and Sato, Y., "EnhancedMovie: Movie editing on an augmented desk", in *Proc. 5th Int. Conf. Ubiquitous Comp.*, 2003, pp. 153-154.

[3] Streitz, N.A., Geißler, J., Holmer, T., Konomi, S., Müller-Tomfelde, C., Reischl, W., Rexroth, P., Seitz, P., and Steinmetz, R., "i-LAND: An interactive Landscape for Creativitiy and Innovation", in *Proc. ACM Conf. on Human Factors in Comp. Sys. (CHI),* 1999, pp. 120-127.

[4] Tang, A., Boyle, M., and Greenberg, S., "Display and presence disparity in mixed presence groupware", in CRPIT 28: *Proc. 5th Australasian User Interface Conf.*, Australian Computer Society, Inc., 2004, pp. 73-82.

[5] Tang, A., Neustaedter, C., and Greenberg, S., "Embodiments for mixed presence groupware". *Technical Report 2004-769-34*, Dept of Computer Science, University of Calgary, Calgary, Alberta, Canada, 2004.

[6] Tang, J. C., Minneman, S. L., "Videowhiteboard: Video shadows to support remote collaboration", in *Proc. Conf. on Computer Human Interaction (CHI)*, 1991, pp. 315-322.

[7] Ullmer, B., and Ishii, H., "The metaDESK: Models and prototypes for tangible user interfaces", in *Proc. Symp. on User Interface Software and Technology*, 1997, pp. 223-232.