t-Room: Telecollaborative Room for Everyday Interaction

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Abstract

The *t-Room* project, which was initiated in the fall of 2003, create a telecollaborative room that overcomes the time and space barriers in communication, enabling people and things to resonate with each other. Users will be able to interact with various media to enhance their creativity in remote rooms. In the t-Room system, a network connects two or more remote rooms in which users can experience everyday interaction. Various types of awareness are shared among the rooms, and an environment for telecollaboration in everyday life is created. The media available include not only commonly used ones, such as natural language, vision, and sound, but also the non-verbal media that have not been investigated extensively so far, such as eye gaze, human movement, gesture, and music. Awareness is acquired by interaction through these media. By sharing and controlling the awareness information among the rooms, users can feel as if they are in the same room. We briefly mention a system architecture and technical issues to be solved.

1. Introduction and Background

Collaboration with others is an essential activity for creative life. We refer to collaboration as an effective means for creating something new collaboratively. There are several frameworks and models for creativity; among them, the Genex framework by Shneiderman is helpful because it takes into account not only the moment of creation but also the processes before and after the moment [Sh00]. The Genex framework involves four activities and four levels of relationships; the four activities are collect (information gathering), relate (communicating with mentors), create (innovation itself), and donate (disseminating innovations), and the four levels are self, family & friends, colleagues & neighbors, and citizens & markets. The Genex framework suggests that creation in itself requires collaboration at various levels. Along this line, many collaborative systems have been developed, and many researchers have come to recognize the importance of awareness information in remote collaborative systems [DB92, MB97]. Nishigaki and Ishii claimed that collaboration can work well on an appropriate hierarchy of communication and awareness [NI92].

The definition of “awareness” is still ambiguous and varying. According to Liechti and Sumi [LS02], awareness means the ability to maintain consistent knowledge about the situation and activities of other people, and the types of awareness include group, workspace, peripheral, and context. It is thus desirable for users in remote collaborative systems to share these types of awareness.

Media and interaction technologies have been intensively studied in the framework of context-aware computing, ubiquitous computing, and sensor-fusion computing [AAB00, MIT00, Na02]. These research projects attempted to break from the traditional closed desktop computing environment and move into the open real world, such as daily life at home, where users are intimately involved in everyday interaction with various pervasive media. One of the research trends underlying these projects is broadening of the types of media that carry awareness information and deepening of the reasoning about it.

Traditional computer science mainly calculates discrete symbols and static patterns in a well-restricted domain that is abstract and isolated from the real world. Computer science researchers have developed various algorithms that rely strongly on co-occurrence and chaining relationships at a superficial level. However, the algorithms are insufficient for precise and flexible analysis, inference, control, or prediction of events and things in the real world for two reasons. One is that the deep structures and meanings of events and things are not taken into account. The other is that only a few kinds of media for observing the real world are available. Hence, a system can neither acquire appropriate awareness information nor create useful knowledge. The previous projects have investigated object location, time, and (continuous time-series) sensor data as new information sources that can convey the primary everyday-life meanings of events and things in the real world.

Our aim is to advance this research trend in two ways. One is incorporating even newer media such as eye gaze [OMY04], human movement [YAS03], gesture, and music [HA03]. Such media provide awareness information that is more closely related to human activity and intention. The other is formalizing the interaction through the media. That is, we would explore a new paradigm in which interaction through the media is regarded as computation in the sense of computer science [We95].

2. Architecture

Based on this background, we initiated a research project called *t-Room*. The aim of the t-Room project is to create a telecollaborative system in which users can interact with various media to enhance their creativities. Accordingly, various types of awareness information are shared among remote rooms (Fig. 1).

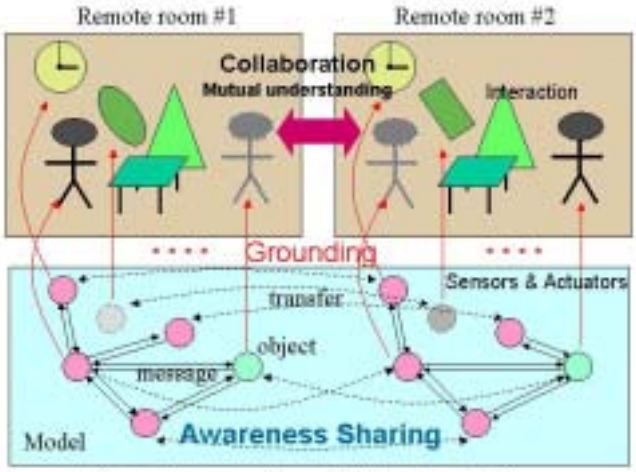

Fig. 1 Awareness Sharing Mechanism of t-Room

The person on the left in each room is actually in room #1, and the other person is actually in room #2. They are interacting with various things surrounding them via media. The t-Room system captures through sensors their interactive activities, from which awareness information is acquired. Then, the system transfers the awareness information to the other room, and simulates the actions in the other room. During the reproduction, the system can appropriately modify the awareness information, integrate pieces of awareness information in distinct modality, and change modality as needed. Two people can share a feeling as if both people were actually in the same room [Ha98]. In this sense, the t-Room system can be regarded to some extent as a shared ubiquitous environment.

The technical issues to be solved are: (1) grounding objects and messages onto things and events in the rooms, (2) formalizing media interaction, and (3) integrating awareness information for reproducing the feeling of a single room.

3. Concluding Remarks

Related work includes CSCW and teleconferencing. Well-known telecollaborative systems include Colab [SFB87], ClearBoard [IK92], and HyperMirror [MM98].

We plan to complete prototyping of the t-Room system within three years, with possible scenarios including asynchronous meetings and collaborative musical composition.

References

[AAB00] G.D. Abowd, et al., Living laboratories: The future computing environments group at the georgia institute of technology, In *Extended Abstracts of the ACM Conference on Human Factors in Computing Systems (CHI 2000)*, pp. 215-216 (2000).

[DB92] P. Dourish, and V. Bellotti, Awareness and Coordination in Shared Workspaces, In *Proc. of CSCW'92* (1992).

[Ha98] Y. Harada, Communication with the feeling of a single room, In *Proc. of Workshop on Interactive System and Software '98* (1998). In Japanese.

[HA03] K. Hirata, and T. Aoyagi, Computational Music Representation based on GTTM and DOOD, *Computer Music Journal*, The MIT Press, Vol.27, No.3, (2003).

[IK92] H. Ishii and M. Kobayashi, ClearBoard: A Seamless Media for Shared Drawing and Conversation with Eye-Contact, In *Proc. of the ACM Conference on Human Factors in Computing Systems (CHI '92)*, pp. 525-532 (1992).

[LS02] O. Liechti and Y. Sumi, Editorial: Awareness and the WWW, *Int. J. Human-Computer Studies*, No.56, pp.1-5 (2002).

[MB97] S.E. McDaniel and T. Brinck, Awareness in Collaborative Systems: A CHI 97 Workshop, *ACM SIGCHI Bulletin*, Vol.29, No.4 (1997).

[MIT00] *MIT Project Oxygen, Pervasive, Human-Centered Computing*, http://oxygen.lcs.mit.edu/ (2000).

[MM98] O. Morikawa and T. Maesako, HyperMirror: Toward Pleasant-to-use Video Mediated Communication System, In *Proc. of CSCW'98* (1998).

[Na02] H. Nakashima, Cyber assist project for situated human support, In *Proc. of The Eighth International Conference on Distributed Multimedia Systems*, ISBN 1-891706-11-X, Knowledge Systems Institute (2002).

[NI92] T. Nishigaki and H. Ishii, Conversation, In *Organization and Groupware: Knowledge Creation in Post-Restructuring Era*, T. Nishigaki (Ed.), NTT Publishing Co., Ltd., p.32 (1992). In Japanese.

[OMY04] T. Ohno, and N. Mukawa, A Free-head, Simple Calibration, Gaze Tracking System That Enables Gaze-Based Interaction, In *Proc. of Symp. on Eye Tracking Research & Applications 2004* (2004).

[SFB87] M. Stefik et al., Beyond the Chalkboard, *CACM*, Vol.30, No.1 (1987).

[Sh00] B. Shneiderman, Creating Creativity: User Interfaces for Supporting Innovation, *ACM Transactions on Computer-Human Interaction (TOCHI)*, Vol.7 Issue 1 (2000).

[We95] P. Wegner, Interaction as a basis for empirical computer science, *ACM Computing Surveys*, Vol.27, No.1 (1995)

[YAS03] Y. Yanagisawa, J. Akahani, and T. Satoh, Shape-based Similarity Query for Trajectory of Mobile Objects, In *Proc. of 4th Intl. Conf. on Mobile Data Management (MDM2003)* (2003).