Support for Group Work

Note: This version differs somewhat from the published version.

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Through networked computers and groupware, people can now work together through their machines

If you wander through almost any work place—an office, a factory, a school—and observe what people are doing, you would immediately notice that most people spend a good deal of their time interacting with others. You would see them gathered in face to face meetings, on the telephone, reading and answering correspondence, collaborating on a document, coordinating their schedules and negotiating commitments, chatting together over coffee, jointly operating machinery, and so on.

Given that people work together, it is surprising how little the computer has been used to support group work. Most people (including software designers and researchers) still view the computer as a tool to help them pursue their own isolated tasks. Programming environments, word processors, spread sheets, idea outliners, drawing tools (to name a few popular applications) are all built to support only personal work. Even the scientific field of human-computer interaction has, until recently, emphasized research studying a single user interacting with a computer.

In the mid-eighties, technology became cheap enough for many companies to supply their employees with interconnected computers, providing a platform that could make group work through technology realistic. This partially motivated researchers and developers to turn their attention to *groupware* and *computer supported cooperative work.*

Groupware is software that supports and augments group work. It is a technically-oriented label meant to differentiate "group-oriented" products, explicitly designed to assist groups of people working together, from "single-user" products that help people pursue only their isolated tasks. The more familiar groupware examples include electronic mail, bulletin boards, and asynchronous conferencing, while newer examples include group schedulers, group decision support systems, collaborative writing tools, screen-sharing software, computer equivalents to whiteboards, video and workstation conferencing, and so on.

In contrast, *computer-supported cooperative work* (CSCW) is the scientific discipline that motivates and validates groupware design. It is the study and theory of how people work together, and how the computer and related technologies affect group behavior. What is exciting about CSCW is its multi-disciplinary nature. It is an umbrella collecting researchers from a variety of specializations—Computer Science, Electrical Engineering, Cognitive Science, Psychology, Sociology, Anthropology, Ethnography, Management Information Systems—each contributing a different perspective and methodology for acquiring knowledge of groups, for suggesting how the group's work could be supported, and for building the technical platforms required. Researchers in CSCW must not only know about their own particular specialities, but must be conversant in how the other disciplines can contribute and interact with their own.

Some groupware applications

Electronic Mail (email) is the success story of groupware. Its big win over surface mail is its speed, with a turn-around time of seconds or minutes over even international distances. The result is that email is closer to message exchange than to physical mail, and often augments the roles conventionally assumed by inter-office memos, post-it notes, and even telephone calls. Email is especially good at getting around time-wasting "telephone tag" that haunts people trying to get in touch through the telephone. But email offers more than speed. Bored with plain text? With *multimedia mail*, your note can include typeset documents, graphics, animations, voice and video clips, and even a program that will automatically run when the reader activates the message. Annoyed at junk mail? *Intelligent filters* can scan your incoming messages and priorize mail, throw out junk mail, and move your messages into an appropriate location (such as an "urgent" folder). Does your mail follow a structured communication exchange? *Semi-formal* mail enforces a protocol, where message sequences are structured to fit the task on hand. For example, promises made to you through an email exchange will be listed on your screen as outstanding commitments. Want to get in touch with people of similar interests? You can read and post information to the on-line community through an electronic *bulletin board*, or have heated discussions with smaller groups through *asynchronous conferencing*. Interested in building these advanced email systems? You will find yourself dabbling in data communications, multi-media databases, email protocol standards, interface design, and even sociology.

Real-time face to face meetings are the cornerstone behind people working together. It is vital for brainstorming, for rapid evolution of ideas and arguments, for making decisions, and for information exchange. Technology can support real-time meetings in several ways. Consider an *electronic meeting room* where people seated around a table can see a wall-size computer screen, and can access it by connecting their personal computers to the screen via a wireless network. Instead of a mere whiteboard, the group has at hand all the power of contemporary computer applications. With *spreadsheets*, the group can re-work financial models on the fly and wrangle over the results. With a *brainstorming tool*, the group can generate and priorize ideas. Even a simple word processor can be used as a *public minutes tool*, where the group can verify that key points have been marked down. Through an *electronic facilitator*, participants can vote anonymously, with results tabulated automatically. Ever been bored at a meeting? Perhaps you (and others) could enter your mood status to the machine, which would then display the average mood of the group to the speaker.

Remote real time conferencing brings people together at the same time, even when some or all are physically distributed over different locations. *Video conferencing* gives a sense of presence by allowing distributed participants of a meeting to see one another over a video and audio link. *Shared workspaces* permits participants to work together through a shared media (see box). *Meeting schedulers* assist the daunting task of trying to collect all participants together at the same time.

Casual interaction, which is vital to initiate and coordinate collaboration, can be supported as well. For example, Xerox PARC's VIDEOWALL is a video-link connecting two distant laboratories by their coffee rooms, which encouraged spontaneous "drop-in" interactions between remotely-located people. BellCore's CRUISER system creates a virtual hallway where everyone has instant access to everyone else via a video link. A user can "video-peek" into someone's office to see who is there, wander the electronic hallway looking for several people, and can accidentally bump into others. With *shared electronic documents*, you are informed of others who are working on a document at the same time you are, and can then connect to them via an audio and video channel.

Shared cyberspace is the most innovative, unusual, and futuristic approach to remote interaction. Cyberspace immerses a person's senses into a three-dimensional simulated virtual world. Seeing the world in a stereoscopic head-mounted display that contains a small computer screen for each eye, one moves through the space using head and body gestures. Motion sensors pick up and translate real movements to virtual ones, and the view is adjusted accordingly. Users interact with the simulated world through a data-glove or data-suit that allows them to grasp and manipulate the virtual objects they see. Sounds are synthesized by 3-d audio techniques. The effect, although still primitive, is to exist and interact within a virtual environment. What makes it interesting to CSCW research is that the environment can be inhabited by several people. Imagine a virtual conference room, with attendees milling about, holding public and private conversations, and viewing and manipulating some of the 3-d objects around them. Or perhaps the cyberspace simulates a planet, where a class of students can fly over the planet's surface together and explore its features. Science fiction? Not quite, for shared cyberspace systems now exist in some research labs!

While there are many other exciting ways that the computer has been tapped to support group work, groupware development is still in its infancy. It is an area for invention and innovation and for turning conventional ideas on their head. It is an area that will fundamentally change the way people work and play together.

Advice

As CSCW is inter-disciplinary, you will have to go outside your department to get all the background required and do lots of extra reading (see the next section). While you do not have to be an expert in all fields, you must know enough about them to understand their literature and value. First, you need a reasonable foundation in human sciences; basic courses in human-factors, psychology and/or sociology will get you started. Second, you need to know how human sciences can be applied to groupware design and implementation. Here, a foundation in electrical engineering, computer science and a course in human-computer interaction is essential. Finally, your systems should be visually appealing to users and well packaged; a course in graphical and industrial design would have merit.

Read More About It

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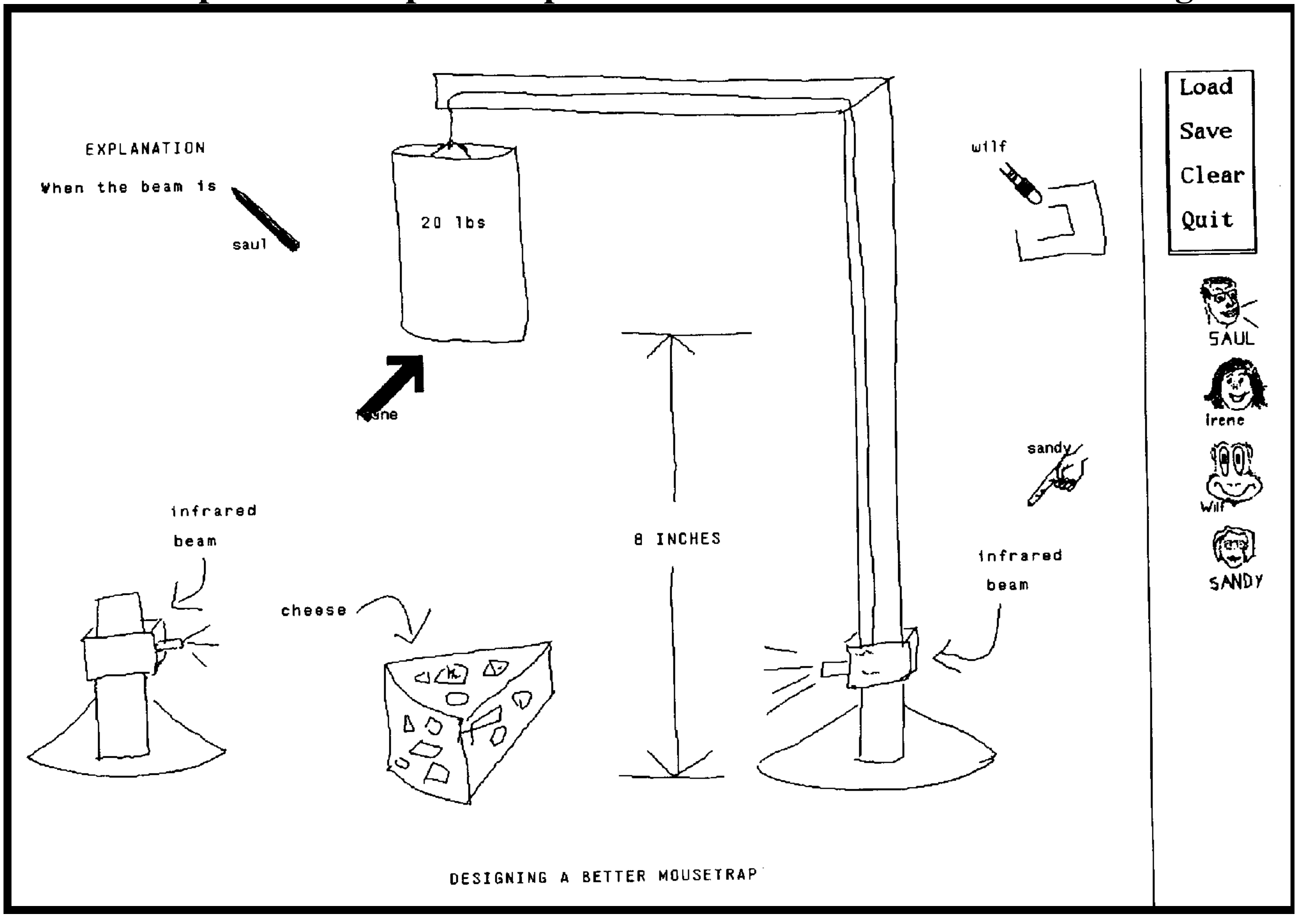
About the authors

Saul Greenberg is an Assistant Professor of Computer Science at the University of Calgary in Calgary, Canada. He is the editor of the book *Computer Supported Cooperative Work and Groupware* (Academic Press), and has published a variety of papers in the area. Dr Greenberg and his graduate students are currently designing, implementing and investigating the usability of several groupware systems. When not working, he is an avid ski-mountaineer and climber.

Mark Roseman is a graduate student in computer science (also at the University of Calgary), specializing in CSCW. His research interests include computer-supported group drawing and group writing, as well as the architectural considerations of groupware conferencing systems. Some of his other interests include philosophy and creative writing.

Example—A Group Sketchpad for Remote Real Time Conferencing



Successful groupware requires a sound combination of social study and technical innovation. As an example, we will progress through the design and implementation of a group sketchpad for real time remote conferencing.

Many corporations with offices in different cities tried to cut travel costs through video conferencing for meetings. These systems promote *tele-presence*, the feeling that participants are in the same room. Yet tele-presence is not enough, for real meetings are often centered around a shared workspace—a whiteboard, a large sheet of paper, an overhead projector—that participants use for presenting prepared material, working together on ideas, and recording group notes.

Perhaps our intuition would tell us that a shared workspace is just a place to record information, and that all we would need is to fax the drawings and notes as the meeting progresses. Sounds reasonable?

It wouldn't work. Consider a social study performed by researchers at Xerox PARC, who observed the use of whiteboards and large sheets of paper by teams meeting face to face. Analysis showed that only a quarter of all activities involved storing information. Team members used the workspace mostly to express ideas, where the process of creating a drawing was meant to stimulate group reaction and involvement. Gesturing, often overlooked as a workspace activity, played a prominent role. Gestures were used to enact ideas, to signal turn-taking and to focus the attention of the group. There was also much simultaneous work. Now reconsider the fax machine. We cannot gesture through it; we cannot see the other person work on a drawing; we cannot work on it simultaneously. So much for our intuition!

Several tools have been designed to support how people really work over a shared workspace. GROUPSKETCH, a multi-user sketchpad running on networked Sun workstations, is one such system we have built (see Figure). Each participant can do freehand drawing and erasing any time they wish, and all such actions are instantly visible on everyone else's screen. As well, each named cursor is displayed on all screens, allowing gesturing around the work surface, and indicating who is doing what. While simple in concept, usability studies show that people do, in fact, use GROUPSKETCH in much the same way they use traditional media.

Various further enhancements have been carried out. Some systems fuse video signals together to provide the shared workspace. We've been working on an object-based system called GROUPDRAW that raises new questions about how multi-user objects should be manipulated. On the technical side, some of the work is now being generalized into a toolkit of groupware components (e.g. for handling network communications, for conference registration, for shared cursors, for generalizing the sketchpad capabilities). On the usability side, we are looking at the effect of this technology as the group size increases.