

Sociometric Feedback: Bringing Social Signals to Telepresence

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ABSTRACT

We propose using Sociometric badges to automatically measure social signals in distributed collaboration. Often distributed collaboration is more difficult than co-located collaboration as many of the social signals are lost. Sociometric badges can help distributed group members to have a better understanding of the members that are not co-present. We share examples of social signal visualizations in both short-term and long-term collaboration settings. We believe that automatic measurement of social signals can help distributed group collaboration by enhancing the telepresence of team members.

INTRODUCTION

Recall the last time you were in a meeting with a new group of people. You introduced yourself, and then your group members started to talk about the tasks and roles of the group. But as the conversation developed, the content of the conversation was not the only thing that you were focusing on: your senses were intensely observing the signals that are underneath the spoken language. Information such as who is sitting next to whom, who talks the most, who sounds the most confident, who asks questions, and who replies are all information that gave you a sense of how the group works and how you should behave in the group. Now imagine that this first encounter with the group was through a video conference call. Your ears, eyes, and brain had to work even harder to get a sense of the other group members: are they paying attention, are they looking at you, or did you just say something stupid? You noticed that your behavior is somewhat different from what you normally do when you are in the same room with people: you either talked more or less than usual; you didn't know when you are supposed to speak; and sometimes you were less confident about what you just said.

A similar thing happens to long-term collaborations. Co-located groups have a sense of who is the go-to person for questions, which members take lunch breaks together, and

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CSCW, November 8-12, 2008, San Diego, CA
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Figure 1. The Meeting Mediator: Sociometric badges (right bottom) capture group dynamics which is displayed as real-time feedback on mobile phones (left top).

who are the really busy members that should not be disturbed. However, these information are hidden in distributed groups. It takes effort and time to figure out the answers to the previous questions, which come almost effortlessly in co-located settings.

Then why are distributed collaborations so different from co-located collaborations? It is surely not the content that is missing, as we have no problem sending and receiving content using voice or text. Then what is the missing piece that makes distributed collaborations so much harder than co-located collaborations? We believe social signals are the answer. Many of the social signal exchanges that provide context to the interactions are lost in distributed collaborations. This makes it harder for group members to understand how the group works, and how they should behave. Additionally, the lack of feedback from one another makes it difficult to reflect on their own behavior. The common use of question marks, exclamation marks, capital letters, and smiley faces are all examples of people trying to augment social signals in text based communication. The advance in communication technology has enabled some level of exchange in social signals. State-of-the-art video conferencing systems allow the exchange of richer visual signals, however there are still many social signals that are lost during the communication. Sense of proximity, back channel conversations, and eye contact are examples of social signals that are still not communicated in computer mediated com-

munication.

With the advance of sensing technology, many social signals can be measured using sensors. Many of the signals that we sense when we are co-located with people, can now be measured even when we are not in the same room. Once we can automatically measure social signals, we can provide the sociometric data as another level of information to telepresence. The concept is extending that of Portholes[1]. Portholes provided awareness of distributed group members' presence by showing snapshots of deskspaces. Sociometric sensors can not only provide location information but also provide social information such as who meets whom and how they interacted. All this information can be capture and visualized in real time for members to utilize.

SOCIOMETRIC BADGES

We introduce our prototype that captures social signals of both co-located and distributed team members: the Sociometric badge (figure 1). It is an electronic sensing device that collects and analyzes social behavioral data. It is intended to be worn around one's neck allowing voice capture and IR transmission and reception [2]. Its current capabilities include:

- Extracting speech features in real-time to measure non-linguistic social signals: The badge does not record any speech content, but is capable of identifying social signals such as enthusiasm, interest level, persuasiveness [3] and nervous energy [4] of the user. Turn taking or short affirming phrases reveal social dynamics that can be measured through synchronization of multiple badges.
- Measuring body movement using a single 3-axis accelerometer: This can detect individual activities such as gesturing, walking, and sitting as well as social interactions such as body movement mimicry or rhythmic patterns.
- Detecting proximity data using a 2.4 GHz radio or Bluetooth to understand the relational distance and position of multiple wearers: This function can be used to detect the distribution of group members.
- Capturing and identifying face-to-face interaction using an IR sensor: By detecting the face-to-face alignment of individuals we are able to detect encounters as well as postural direction.
- Real-time sending and receiving of information over 2.4GHz radio to and from different users and base stations for real-time communication: The data transfer between individuals can be both on a one-to-one level or initiated by a central server to obtain data from the whole network.
- Performing indoor user localization by measuring received signal strength from fixed based stations.
- Communicating with Bluetooth enabled devices such as mobile phones or Bluetooth headsets: Coupling with other commercial devices allow flexibility in output channels.

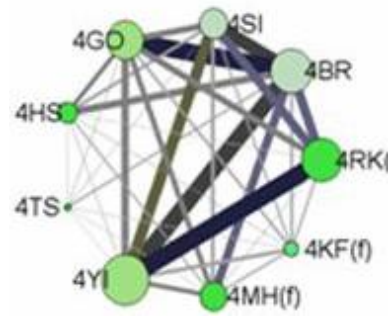


Figure 2. Visualization of Meeting Dynamics of a US-Japanese Student Leadership Forum.

EXAMPLES OF SOCIOMETRIC FEEDBACK

Short-term Collaboration

We deployed the sociometric badges at a leadership forum held in Tokyo, Japan to measure the meeting dynamics of teams. The Forum involved a group project that involved creative engineering that required cooperation of all group members. The Forum brought together 20 students from the US, mostly from universities in the Greater Boston area, and 20 students from Japan, mostly from universities in the Tokyo area, working in teams of 6 to 8 people.

Figure 2 shows the meeting dynamics of one of the meetings. The size of each circle represents the amount of time a person participated in the conversation. The color of the circle represents how interactive each person was based on their turn-taking pattern (the greener, the more interactive), and the width of the edges represents the turn-taking patterns (the thicker links indicate that the two had a lot of back-and-forth conversations). In this particular team, half of the students in the team were Japanese and the other half were American. We can observe from the width of the links (turn-taking frequency) that the American students (4HS, 4GO, 4SI, 4BR) interacted mostly among themselves in this meeting. We can also see that some of the students did not participate much in the conversation and the style of conversation is different for each participant. These are information that is available even to distributed teams. However the sense of overall balance of participation and turn taking patterns are hard to obtain when social signals and feedback are lost as in distributed meetings. We believe we can help distributed collaboration by measuring these social signals and providing them in real-time.

Long-term Collaboration

We deployed the Sociometric badges for a longer period of time to understand the overall interaction patterns of distributed teams. The badges were deployed to four teams in a US bank call center over the course of one week. The teams were located in different parts of a 1200-cubicle building. Figure 3 shows social network diagram generated by sociometric badges. Each colored circle indicates a member of the team, and different color denotes a different team. The thickness of lines connecting the circles show the amount of face-to-face time the two individuals had (thicker means

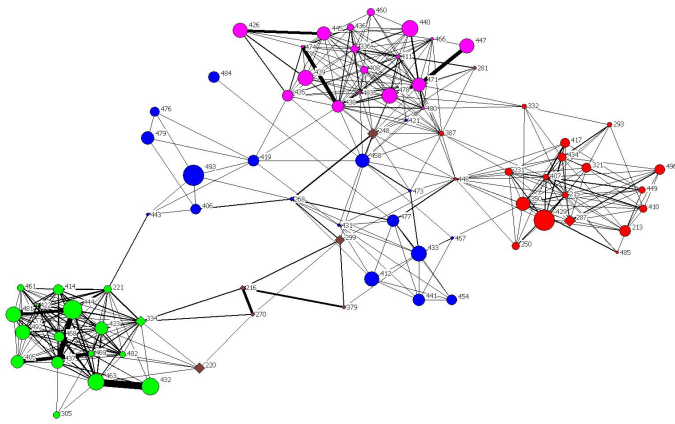


Figure 3. Social Network Diagram of a US bank call center over a course of a week.

more interaction time). The positioning of each circle is decided by the social importance (betweenness) and the strength of ties of other nodes. We can see that team green had a very tight relationship among themselves where as team blue didn't talk to each other much. However the blue team took a bridge role, connecting team green to the other two teams. These are information that is hard to obtain even if you are co-located with all the team members. Automatically measuring the strength of social ties can provide useful information to team collaboration.

CONCLUSION

Social signals are important factors in group collaboration which are easily lost on distributed collaboration. Through our preliminary studies we showed that Sociometric sensors can measure social signals of both co-located and distributed teams. This information can be offered to distributed teams to enhance telepresence of team members, allowing richer understanding of dispersed members.

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