Reflect: A Table for Self-Regulation in Face-to-Face Meetings

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ABSTRACT
Can we design a table that would transform everyday conversations? Can we improve group collaboration processes by displaying relevant information about ongoing social dynamics? We are interested in building interactive furniture adapted to face-to-face collaboration that do not mediate but rather augment a discussion. This research investigates three complementary goals: (a) to develop new technologies for sensing group behavior and conversation dynamics, (b) to build dynamic visualizations of these interactive processes, (c) to run evaluations in order to determine the impact of these visualizations on group processes.

Categories and Subject Descriptors: K.3.1 [**Computer Uses in Education**]: Collaborative Learning

Additional Keywords and Phrases: Interactive Furniture, Computer-Supported Collaborative Work, Ubiquitous Computing

INTRODUCTION
In situations of face-to-face collaboration, it is often the case that unbalanced participation leads to undesirable results. These results take the form of suboptimal decisions due to poor information sharing or lower learning outcomes for members of a group that did not participate in the group learning process [2, 4, 5, 6]. One way to overcome this effect is by encouraging members of a group to participate equally. This could be achieved by indicating to individual members their level of participation in a shared display.

There have been several recent attempts to enhance conversation with visualizations of member participation. Bergstrom and Karahalios [1] present an approach that transforms the conversation history into a interesting graphical representation that they refer to as a *Conversation Clock*. The visualization used was designed to show a great deal of information on what has taken place over a long period of time, without emphasizing particular aspects of the collaboration. DiMicco [3, 4] uses a display that is projected on some shared surface such as the tabletop or a wall in order to show relevant information on the conversation taking place. The information displayed varies and can show dominance, turn-taking patterns among other things. The *Conversation Table* is a similar project in which the table itself is augmented with microphones and a single line of LEDs that react to the users' speech [7].

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We present our ongoing work on an interactive table, *Reflect*, that monitors the interaction taking place around it with embedded microphones and provides the group with a mirror of its interaction. Our current prototype displays a territorial visualization that shows the levels of participation of individual group members. We wish to augment our table with information on higher level conversation episodes that we detect from audio features of participants' speech.

Figure 1: The current prototype of *Reflect*.

CURRENT PROTOTYPE
Our current prototype of *Reflect* is a small conference table that monitors, via embedded microphones, the conversation that is taking place around it. In the middle of the table a LED display presents the users with a real-time visualization of their interaction. The display shows a very important aspect of collaboration, namely participation levels.

We use a territorial metaphor to indicate levels of participation among the members of the group. The area around each member illuminates as they speak, and a circle grows around a member as they take up more and more talking time. Eventually, participants who have dominated the conversation will have very large "territories" compared to those that are less active. This could evoke strong reactions from participants who can see that their space is "invaded" by the dominant

speaker, prompting them to regulate the conversation by participating more.

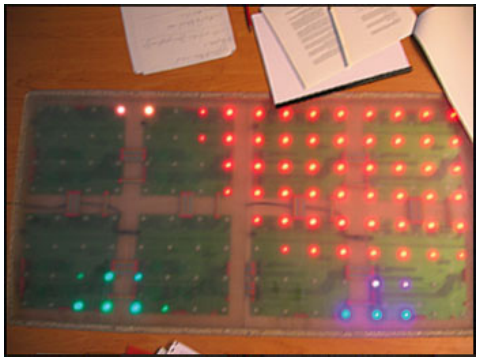

Figure 2: The territorial display clearly highlights the imbalance in a conversation.

PLANNED EXPERIMENTAL STUDY

In order to evaluate the effectiveness of our design, we will conduct an experimental user study that will involve groups of four people chosen from our university campus. Each group will be asked to solve two tasks, very similar in structure, but different in content. One of the tasks will be performed with the support of the *Reflect* table. Our hypothesis is that the use of the territorial visualization will influence participants by causing overparticipating members to reduce their level of participation and underparticipating members to increase theirs.

CURRENT AND FUTURE WORK

Our next prototype of *Reflect* will focus on analyzing the dynamics of the conversation by focusing more on *how* the participants are interacting rather than *how much* they are interacting as is the case with the current prototype. We are interested in understanding how the participants go about their collaboration by detecting the occurrence of high-level conversation episodes such as questions, explanations, agreements and disagreements, among others. The motivation here is that by detecting these kind of episodes, we can provide participants with feedback on how the collaboration is taking place. For example, it would be interesting to distinguish between a situation where two members participate equally and a situation where they participate equally in terms of talk time but with one member mostly asking questions and the other mostly giving answers.

In order to detect these episodes, we are working on using machine learning techniques on features of the speaker's voice. Our preliminary studies have shown that it may be possible to distinguish voices of students giving factual statements from those giving elaborated explanations using only prosodic features of the voice. These results encourage us to push forward this approach of using prosodic features of voice in order to distinguish different episodes in a conversation.

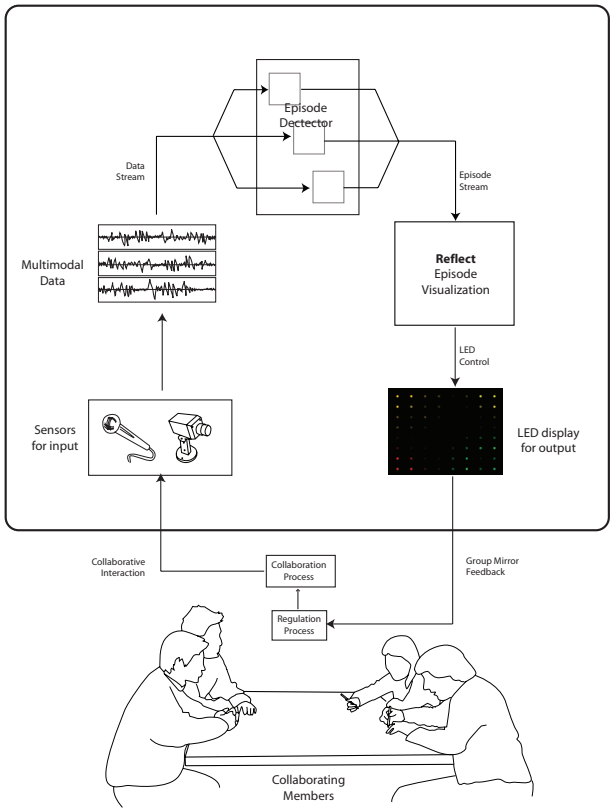

Figure 3: The general architecture of Reflect includes the episode detector that will be developed for the future prototype of *Reflect*.

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