The eFacilitator: A Discussion Capture and Annotation Tool for a Pervasive Computing Environment

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The Problem: We are developing a discussion capture and facilitation tool that will let a group note taker capture ideas and decisions on an electronic whiteboard. These ideas will be saved along with a full audio/video capture of the event into the participants' personal, pervasive data bins.

Motivation: As computational power and sensing equipment become increasingly cheap, it becomes feasible to embed computing everywhere: in every room and pocket. This ubiquity presents many opportunities and challenges for application developers. How can the massive amount of data from the sensors be indexed and retrieved? How can humans maintain their privacy with cameras everywhere? What kind of communications infrastructure is needed to support all of the human-human, human-machine, and machine-machine interactions?

The eFacilitator is a collaborative application that demonstrates the utility of pervasive computing and tests the existing infrastructures, helping to drive their future development. Meetings are the primary social tool for group decision making and consensus building. Many organizational researchers have studied ways to make meetings more effective. A key outcome of their work is the meeting record, a group memory of the ideas discussed and the decisions made. Today, meeting records are created using ordinary whiteboards and post-it notes. They require a human recorder to copy the notes from the board and distribute them to the participants. This recording is time-consuming, and it serves as the only record of what took place. The eFacilitator makes it simple to create electronic meeting records, it is automatically distributed to the participants, and it also indexes the full audio/video of the event.

Figure 1: A screen shot of the notes for a party planning meeting

Previous Work: Electronic whiteboards have been used often for capturing meeting notes and discussions. Researchers at Xerox Parc developed the Liveboard, the first electronic whiteboard. They subsequently built a note-taking tool from their Tivoli gesture recognition tool[3]. This system allows free-form sketches to be grouped and manipulated using different pen-based gestures. It also indexes into an audio record of the meeting. This system is more free-form than the eFacilitator, however, so it is not able to extract the same level of semantics from the
The idea of a personal agent was articulated by Pattie Maes in 1994[2]. In her vision, agents work autonomously on behalf of their owner. They learn over time from the user’s corrections and clarifications and through interactions with other agents. The purpose of the agent is to aid users in getting information and performing computational tasks, potentially using other agents. More recently, the Haystack project at MIT has focused the need for agents that operate entirely on a user’s personal data[1]. The ubiquitous computing literature has always stressed the need for an everywhere-available personalized information sphere.

**Approach:** The whiteboard interface to the eFacilitator is implemented as a hierarchy of topics. A topic is like an electronic post-it note. Any sketch can be drawn here, and the topic window expands to any size. Each topic window has a set of controls to manipulate it. A topic can be expanded or contracted, revealing and hiding its children respectively. It can be moved around, changing its location relative to its parent. It can be copied and added as a child of another topic. Finally, it can be shrunk and magnified. The notes are laid out using a custom layout manager that ensures that notes do not overlap each other when they are moved about.

Video and audio of the meeting will be saved using the Java Media Framework and the MPEG 4 specification. To save files, we will use a secure file server. Reads and writes to this system will be authenticated and encrypted. Access permissions depend on the identity of the caller.

When the user requests that a meeting be saved, the program will determine who is in the meeting room, and it will send all of the media data to each of the participants’ personal agents. This media will be signed by the agent responsible for the room’s computers and sensors. To determine who is present at the meeting, each participant will carry an H21, which uses the cricket system to pinpoint location. The room will know its own geography, so it will know which H21s are in it.

In addition to the meeting record, a small amount of metadata will be stored. This will include the time, location, and the participants at the session. This metadata will be used to index the meeting record for later retrieval. This metadata will be an RDF file stored with the notes and multimedia.

For retrieval, there will be a simple prompt where the user can ask questions of their agent. The retrieval engine will apply both a grammar parser and a simple bag-of-words search engine to the query. It will return the best results of both. The user will be able to make requests like: “Get the meeting I had with Howie last week”, “Get the collaboration meeting on August 1st,” or “Get the section of the meeting where we talked about security.”

**Impact:** The importance of this application lies in its incorporation of all of the major elements of pervasive computing: sensors, handheld computers, location awareness, multiagent systems, and anytime/anywhere personalized information access. By providing an application that people actually use, we hope to discover the directions that our pervasive infrastructure must take.

It will also demonstrate a vision whereby users are able to get all of the benefits of an intelligent environment watching them while largely maintaining their privacy. While many environments may record a user’s actions, this data will be carefully guarded and distributed only to the people who can benefit by it.

**Future Work:** The diversity of components in this application presents many opportunities for additional work. Specifically, a user’s activities can be captured in situations other than meetings. Her activity calendar, emails, current work, and her day-to-day life captured on video are all candidates for things to put in the common data store. Another area of development is the query interface itself. The retrieval agent should adapt over time both with and without direct user supervision. The final extension area to this work is the agent to agent communication. This should also adapt over time, so that the user can ask a question of its own agent, which will be able to find another agent that has this knowledge if it does not know it itself.

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**References:**
