Visualizing Communication Timelines Containing Sparsely Distributed Clusters

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Abstract

Online communication methods like instant messaging support the rapid exchange of messages and are readily being incorporated into the workplace. This paper describes a temporal visualization system that displays communications with the objective of helping collaborators and supervisors to gain insight into the effectiveness of group communications. A system is being developed for use with a virtual school environment to support collaboration between middle and high school students. The system differs from traditional timeline approaches in that its combination of multiple zoom levels and foci can accommodate sparsely distributed communication data.

Keywords: information visualization, CSCW, online communication, timelines.

1. Introduction

Online communication methods allow users to quickly and effectively exchange messages with people at geographically distant locations. Instant messaging and chat tools are used not only for informal communication, but also in the business world as a flexible alternative to email. Chat interfaces such as ConNexus specifically target people in the workplace by providing interaction cues to show availability and willingness to chat [10]. However, as online communication becomes more popular in work environments, specific support is needed that will help improve the efficiency and quality of group collaborations.

The Learning in Networked Communities (LiNC) Virtual School project [4] is a partnership between Virginia Tech and the Montgomery County Public Schools that links four middle and high school classrooms using a networked learning environment. The environment includes support for real-time chat, email, videoconferencing, and shared collaborative notebooks. Students at different schools collaborate on projects using the Virtual School, and data for their interactions is logged (videoconferences are transcribed).

Initially, visualization tools are needed for analysis purposes to help LiNC developers understand and improve the Virtual School environment and to enable teachers to more quickly absorb logged communications. In the future, visualizations will be incorporated into the Virtual School for real-time interaction. It is hoped that by showing participants how the communication developed, more utility can be gained from the information and the context of the communication can be more easily understood.

For visualization, communication timeline data offers additional challenges over other types of temporal data and requires special attention. Typically communication events occur in short dense clusters that are sparsely distributed over a very long time. That is, intense communication takes place for relatively short periods of time, followed by long periods of little or no communication. Furthermore, communications have senders and receivers and have multiple event types. For user tasks, it is often necessary to compare multiple portions of a communication or to review an old communication while participating in an ongoing one.

In previous work, post-mortem chat visualizations have been used to monitor, understand, and improve chat tools [1, 2]. Often chat tools will use visualization techniques to show clusters of activity, topic threads, and participant presence [2, 9]. However, prior work on an augmented chatting interface resulted in low subjective ratings, in part because users found the interface confusing and unclear [9]. MMVIS [3] supports analysis of videoconferencing events by displaying frequencies of events and frequencies of sequences of events.

Visualization of large timelines has been explored in several systems. The goal of these systems is to provide a visual overview of the entire timeline as well as enable access to detailed portions of the timeline. Lifelines [8] uses a 1-

dimensional zooming approach. Users start with a global view of the timeline and then zoom in to focus on single time period of interest. The Perspective Wall [7] projects timelines onto a 3-D wall, using the focus+context approach to provide details within the context of the overview. The Information Mural [5] uses the overview+detail approach to simultaneously display details of a region selected in the overview. These visualizations help users gain insight into the data by revealing temporal trends and anomalies. However, they are not well suited for communication data. Data with sparsely distributed clusters results in a few small overly dense regions of the display and most of the screen space empty and wasted. Details can be examined for only one cluster at a time.

The primary objective of the research described in this paper is to help collaborators and supervisors gain insight into the effectiveness of group communications by developing a visualization of online communications, called Virtual Communication Visualization (VCV). This research expands upon existing chat and timeline visualizations in four ways. First VCV has multiple zoom levels. VCV allows users to create multiple timelines, as they explore logged communication data in more detail, maintaining a valuable history context. Secondly, the visualization supports multiple foci. Multiple zooming levels and foci allow the user to compare communication events between relatively sparsely distributed communication clusters. Third, VCV automatically manages foci view layout, freeing the user to concentrate more on data discovery [6]. Finally, VCV is capable of representing sender and receiver relationships and a variety of communication methods, including chatting, videoconferencing, email, and other methods, all of which may be related.

2. User Interface

A communication event is a real-time chat message, a statement by a single participant in a videoconference, locking or unlocking a shared collaborative notebook, or saving a collaborative notebook. A communication event can be divided into several basic elements: the sender, the receiver(s), the message time (sending time and possibly a different receiving time), and the message content. The VCV visualization can easily import data with these minimal attributes.

The details of communication are important, but in order to grasp a global view of a collaborative effort, some details must be obscured. Initially users are not interested in the exact contents of a message. In the early stages of exploration, users are more interested in where and when communication occurs. After users gain insight into the general flow of communication, sections of data can be viewed more closely. The content of a message is available upon request.

The VCV user interface (Figure 3) consists of three main parts; the global timeline, the secondary timeline, and the conversation window. The conversation window is broken up into three parts; the summary timeline, the conversation graph, and the details area. Each part, respectively, provides an increasing amount of detail and a decreasing scope.

The global timeline displays all collaborative data currently loaded from input files. Each communication method has a unique icon. Communication usually occurs in grouped segments called work sessions. Work sessions can be selected by highlighting a time interval. All selected work sessions are then displayed on the secondary timeline.

The secondary timeline (see Figure 1) automatically resizes the selected work sessions such that the first communication event occurs at the left most pixel and the last event at the right most pixel. Similar to the global timeline, individual communication events can be highlighted on the secondary timeline.


Jan 15, 2000   Jan 25,

Selected Time Interval
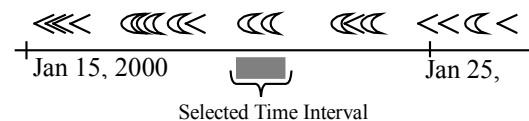
Figure 1: Sample secondary timeline with chat line $<$ and videoconference $⟨$ icons.

A more detailed view of the selected events is displayed in a conversation window. Multiple conversation windows can be created and compared from the secondary timeline. The conversation window contains a small timeline located in the middle called the summary timeline. The top section of the conversation window consists of a two dimensional graph (see Figure 2) with time as the x-axis and participants of conversation as the y-axis. Multiple windows share a common participant axis, allowing for communication comparisons. There are two icons for each communication event; one represents the sender and the other represents each receiver. Senders are always colored red.

The common color scheme helps to maintain consistency for different types of communication. Places where sender and receiver icons overlap

are easily detectable and correspond to quick exchanges of information. The sender or receiver icon can be selected by clicking. The contents of the selected message and any corresponding information are displayed in the details area located in the lower half of the conversation window.
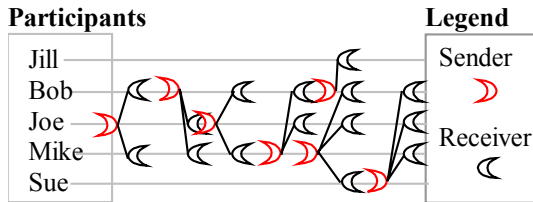

Figure 2: Sample conversation graph with videoconference icons.

3. Data Discovery Scenarios

Two data discovery scenarios from the LiNC Virtual School [4] for middle and high school students are presented in this section.

The first scenario takes the perspective of the student. The student has been absent and would like to catch up on the details of missed interactions. The student opens the VCV program and loads the classroom log files. Next the student locates the time period she was absent on the global timeline and selects all communication events during this time. At this point the student can see what communication methods have been employed most frequently while she was gone. She creates conversation windows for areas of intense communication. The student decides to read messages her teacher has sent to the class first and then she reviews comments from her group members. Her group mostly worked on editing two collaborative notebooks during her absence. She reviews the notebook changes and feels reasonably prepared for class the next day.

The second scenario takes the perspective of the teacher. The teacher would like to see how his students are progressing on their new robotics projects. He opens the VCV program and loads
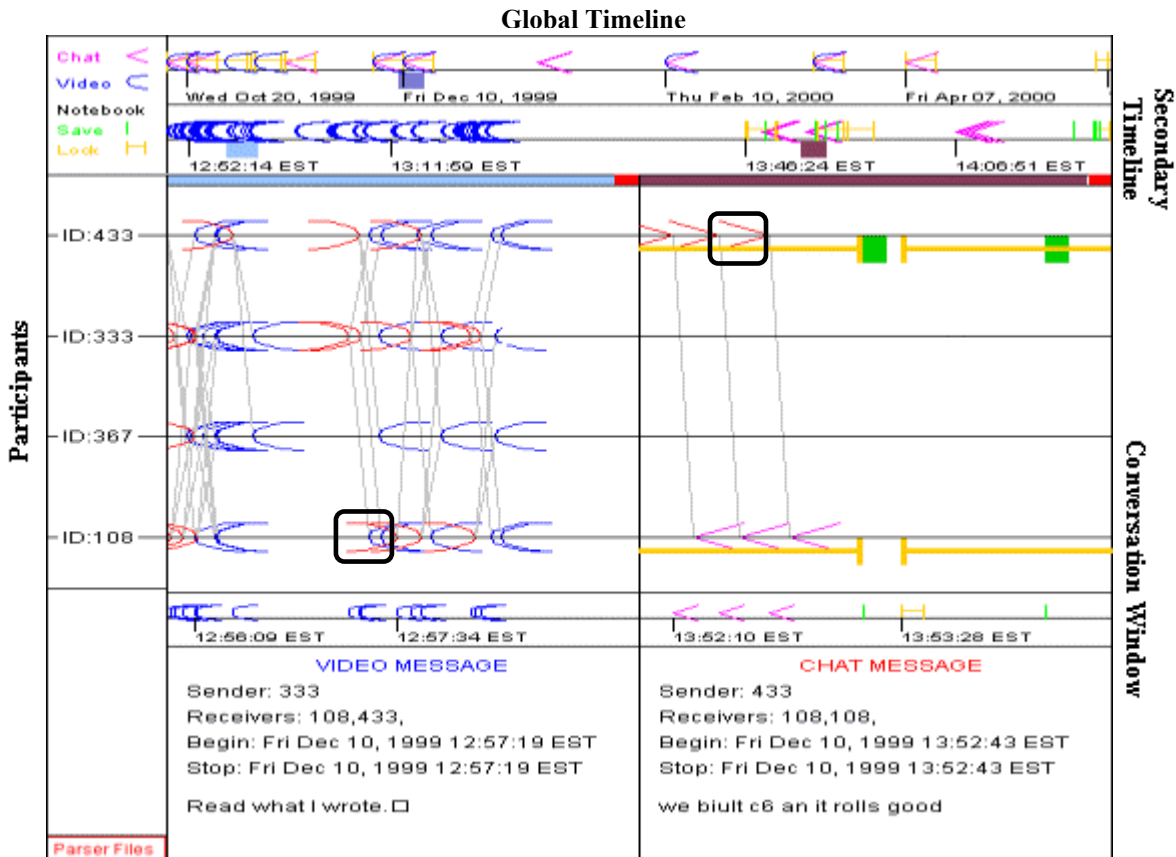
Figure 3. VCV screenshot showing exploration of a videoconference lab meeting followed by related collaborative notebook editing one hour later. The global timeline at the top shows the student activities over the school year. A work session is selected and shown in the secondary timeline. Two portions of the session are exploded and shown in conversation windows with participants on the y-axis. Selecting individual communication events shows their content at the bottom.

the classroom log files. His students meet every Wednesday and Friday with their counterparts on-line to synchronize activities. The teacher selects the last three weeks of communication events on the global timeline. He then creates conversation windows for events occurring on Wednesdays and Fridays. He then examines the group's communications. The groups appear to prefer video conferencing to other forms of communication. He examines the content of chat and video messages and soon discovers group one has not been using their time wisely. Groups two and three are doing well and nearing completion of the project, but group one's productive communications seem to have dwindled during the last 6 meetings. The teacher decides to speak with the group privately in the next class period.

4. Conclusions and Future Work

VCV's primary contributions for visualizing sparsely distributed clusters of communication data are:

- Multiple simultaneous zoom levels,
- Multiple foci,
- Automated foci layout and management,
- Multiple communication event types with senders and receivers.

VCV is adaptable to specific communication applications because of the consistent handling of multiple communication methods. While VCV does not support a large number of participants, there is a plethora of small to method sized (less than 15 participants) collaborative efforts in business and academia where VCV would be very effective. Such collaborative efforts are well within VCV capabilities even on modest display resolutions.

The visualization performs well with sparsely distributed data clusters. The ability to create multiple foci while maintaining an overview allows the user to compare distant communication events effectively. However, two timelines are not always sufficient for *extremely* sparsely distributed data. This could be improved by combining the concepts of a conversation window and the secondary timeline. The new interface will contain only one fixed timeline. Selected time intervals will create windows that expand to conversation windows but collapse to secondary timelines. Multiple timelines can then be dynamically created. The user will be able to select multiple foci on all timelines, enabling hierarchical foci.

Occlusion of icons is a problem throughout the visualization. The global timeline could reduce this problem by using special work session icons. These icons will contain the four most frequently occurring communication method icons in the work session. The color intensity of each communication method icon will be based on the number of corresponding events contained in the work session. A work session will be selected by clicking the icon.

6. References

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