Timeline: Video Traces for Awareness

Michael Nunes[†], Saul Greenberg[†], Sheelagh Carpendale[†] and Carl Gutwin[‡]

University of Calgary
2500 University Drive NW
Calgary, AB, Canada T2M 1N4

{nunes,saul,sheelagh@cs.ucalgary.ca

[‡]University of Saskatchewan
57 Campus Drive
Saskatoon, SK, S7N 5A9

gutwin@cs.usask.ca

ABSTRACT

Always-on media spaces broadcast video to provide awareness and encourage interaction between collaborators. This video can be captured on the fly and presented as a *video trace* – a visualization allowing viewers to rapidly explore the history of the video stream, ostensibly to gain a better understanding of the activities and availability their collaborators. We present a visualization system that allows detailed exploration of a large video stream. However, the system is so effective that it raises significant privacy concerns.

Categories and Subject Descriptors

H.5.1 [**Multimedia Information Systems**]: Video

General Terms

Human Factors.

Keywords

Video media spaces, video history.

1. INTRODUCTION

Always on video media spaces (VMS) provide awareness and encourage interaction between collaborators. Once the subject of esoteric research, both the Internet and the wide availability of inexpensive web cameras now let people easily create their own video media spaces.

The collocated environment provides cues such as arrivals and departures, presence in offices, opening and closing of office doors, and presence of artifacts such as briefcases or jackets that allow us to track the presence and work rhythms of colleagues. In contrast, a VMS provides a narrow view, typically a headshot, which viewers may only glance at periodically. Thus it becomes easy for the viewer to miss important events that may be useful in gauging availability.

The goal in our video traces project is to explore visualization systems that capture the video streams broadcast in a VMS and allow collaborators to easily and rapidly explore the history of each other's VMS stream. In this paper we present an example visualization called Timeline.

2. RELATED WORK

Gutwin [3] suggested the idea of *traces* – visualizations of the recent past – as a way to help groupware users increase their understanding of each other's actions. While his paper applied the idea to telepointer tracking, Gutwin also suggested that traces might be used with video to allow for casual awareness. In a similar vein, the 'When Did Keith Leave?' system by Hudson and Smith [4] selects and displays several frames from a video stream that shows significant visual differences in activity. Their focus was on demonstrating how privacy issues might arise as a tradeoff of providing awareness information: while collaborators can benefit by using the system to see each others recent activities and events, it also serves as a (perhaps unintended) surveillance system.

In Timeline, we use the idea of the *video slices* technique [2,5], to show the passage of time in a video stream. A video slice is created by sampling a single pixel column from successive video frames. By abutting these columns we see a cross-section visualizing the video stream over time. Video Streamer [2], for example, used video slices to create a 3D block for rapid video editing. Artifacts of the Presence Era, by Viegas et al. [5], was an art installation system that provided a temporal visualization of a video stream of people visiting a museum using a layered rock formation metaphor. Layers were added to the visualization by periodically taking slices from video frames. Visitors could navigate and uncover past images by turning a knob. Similarly, the Last Clock by Angesleva and Cooper [1] used video slices to populate a visualization resembling the face of a clock. As the hands moved around the clock, the current (rotated) video slice replaced the underlying portion of the clock face.
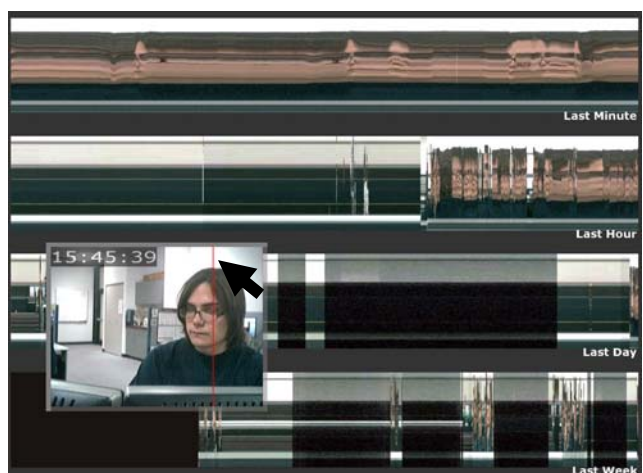

Figure 1. **An example of the Timeline showing the video history of a personal workspace over several days.**
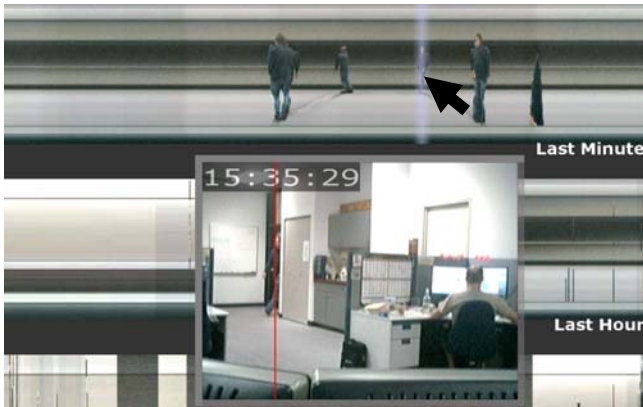
Figure 2. The visualization is focused on the distant door. The video is quickly replayed by scrubbing over the visualization.

These video visualization projects were mostly focused on visualizing the passage of time. Our own interest took this one step further: how collaborators could find and understand the detailed activities and events occurring within the video stream.

3. TIMELINE

Timeline replicates and extends ideas presented in systems such as the Last Clock [1], and Artifacts of the Presence Era [5]. It too uses video slices to create composite images, and forms a timepiece, similar to the Last Clock [1], using multiple rows showing the last minute, hour, day, and week of video. Figure 1 illustrates the Timeline visualization after running for several days. The contiguous video slices in each row give observers a sense of the video history, where changes and perturbations are easily seen. The current video image is displayed in the floating video window.

One way in which Timeline extends on previous systems is by allowing viewers to adjust the focus area. The red line in the video indicates the column from which the video slices are taken. Viewers can interactively update the visualization to a different area by moving this line over a new column in the video frame. As the line is adjusted, the entire visualization is updated immediately.

Another significant improvement on previous systems is that Timeline allows for very rapid and detailed exploration of the video history. Clicking and moving scrubs over any of the visualization lines, where the user can rapidly replay and view the images from the video history underneath. This is illustrated in Figure 2 where the viewer has selected a region of the minute line (as indicated by the translucent band) over a perturbation. The video window reveals that it was someone just entering the room.

Quickly scrubbing over one of the visualization lines allows the viewer to replay the video at a very high speed. However the granularity of the playback detail in the day and week lines is much coarser than in the minute and hour lines as more time elapses between selectable frames. To fix this, Timeline provides detailed exploration of the distant past by allowing one to select an area in one of the coarser grained lines for further exploration. Timeline then retrieves the detailed video and freezes the finer grained visualizations to show how they were at the selected point in time. This is illustrated in Figure 3 where a point has been selected in the day line and is being displayed in the hour line as indicated by the green braces between these lines. The search has
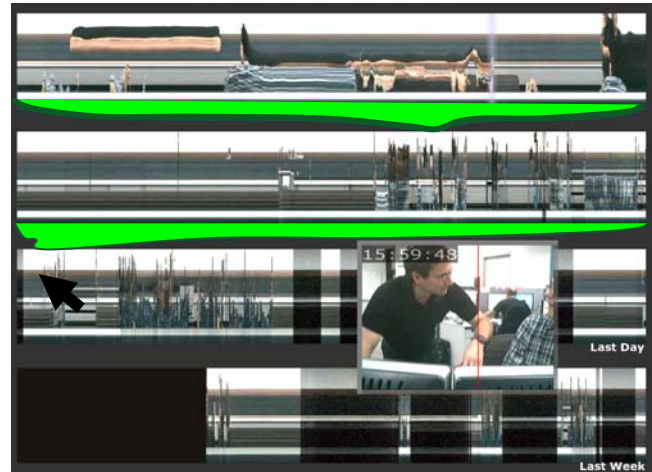

Figure 3. Regions in coarser grained lines can be selected for detailed exploration in the finer grained lines.

been refined further by selecting a point in the frozen hour line to be displayed in the minute line.

While the images produced by the visualization may appear to be difficult to understand at first, viewers quickly learn to read its perturbations. For example Figure 1 shows the Timeline focused on a person at their desk. In the minute line the perturbations and partial scans of their face indicate their presence, while the hour line shows that they have been there for about 20 minutes. The day and week lines give a broader overview, showing night and day and giving a sense of the activity over the last few days. As another example Figure 2 shows the Timeline with the focus column set on the distant doorway. As people enter and exit the room, the visualization in the minute line shows their recognizable scanned image as they cross the boundary, while the hour shows this change as a single column perturbation.

The Timeline system is exceptionally powerful in its ability to allow viewers to explore a large history of video data. However, it is this power that could make it a very invasive system. Potentially embarrassing or inappropriate behavior is not only captured, but easily found and replayed. Because of this it is difficult to predict where it might best be used and the cultural practices that would be created around it. Perhaps it would be suited to areas that are largely accepted as public rather than private offices and workspaces. Or perhaps it would work well between tight teams or social intimates with a strong desire to stay connected. Or perhaps CSCW is the wrong venue; it may better serve as a system for security and surveillance.

4. REFERENCES

[1] Angesleva, J. and Cooper, R. 2005. Last Clock. *IEEE Comput. Graph. Appl.* 25, 1, 20-23.

[2] Elliot, E. and Davenport, G. 1994. Video streamer. *Conference Companion, ACM CHI.* 65-68.

[3] Gutwin, Carl. 2002. Traces: Visualizing the Immediate Past to Support Group Interaction. *Proc Graphics Interface.*

[4] Hudson, S. E. and Smith, I. 1996. Techniques for addressing fundamental privacy and disruption tradeoffs in awareness support systems. *Proc ACM CSCW,* 248-257.

[5] Viégas, F. B., Perry, E., Howe, E., and Donath, J. 2004. Artifacts of the Presence Era: Using Information Visualization to Create an Evocative Souvenir. *Proc IEEE Symp. on information Visualization* (Infovis'04). 105-111.