Perspectives on Time: Enhancing Utility with Flexibility

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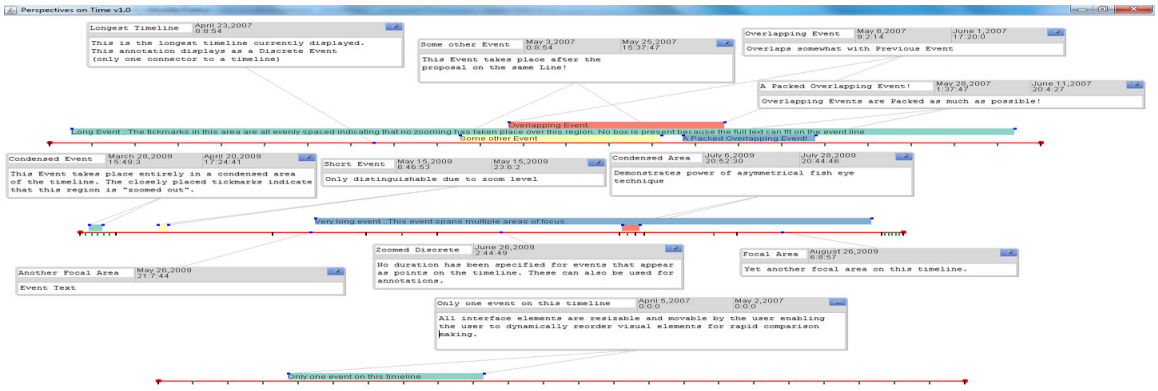

Figure 1. Three timelines with multiple events displayed

ABSTRACT

Perspectives provides a light-weight visualization environment for differing perspectives, perhaps incorrect or misleading ones, surrounding a series of events. A number of interaction techniques are applied to a Java user interface which enable case-building, hypothesis testing, and presentation of temporal categorical event sequences. Individual events may be entered, then placed and moved along timelines. Comparisons can then be made across more than one timeline in search of insights into the true timeline of events which occurred. The visualization of the data acts as the interface enabling greater focus and flexibility for comparisons and decision making.

KEYWORDS: Timelines, Temporal Data, Fisheye, Event Sequences.

INDEX TERMS: H.5.0 [Information Interfaces and Presentation]: General; J.0 [Computer Applications]: General

1 INTRODUCTION AND MOTIVATION

Time-oriented visualization is one of the prototypical problems in Information Visualization. A significant subset of temporal data is temporal categorical event sequences. The pervasiveness of timelines in different fields, lends an interesting quality to event sequence data visualization: timelines are a clear and understandable visualization for a wide variety of individuals across disciplines.

Despite the pervasiveness of timelines, generalizing the method of timeline creation is often messy. Visualizing vast differences in scale, duration of events, and annotating the events displayed can pose challenges. For example, the period from 1839 to 1914 is often referred to by historians as The Long Fuse (the lead-up to the First World War). Plotting events such as the American Civil War which lasted for 4 years alongside the minute-by-minute actions taken by the conspirators who murdered Franz Ferdinand is a challenging task to perform, in a reasonable amount of space, without losing context. Annotations pose another problem, particularly when a large number of events take place in the same time period and on different scales. In these cases, annotations can often overwhelm the user, losing the advantages that come with the timeline visualization.

Event sequences are visualized in different ways across different domains, but the overwhelming paradigm remains the timeline, seen in everything from Gantt charts to heart monitors. A wide variety of techniques exist for interacting with these different visualizations. Unfortunately, most of these methods make certain assumptions about the nature of analysis that is taking place, and the kinds of tasks that the user might wish to perform[1].

In this paper, we present *Perspectives on Time*, a system which enables new kinds of direct interaction with temporal categorical event sequences. *Perspectives on Time* is not simply a new tool for reading and displaying time-oriented data. Rather, our primary focus is enabling flexibility for the user in terms of the type of analysis they wish to perform. *Perspectives* provides a framework for data entry which makes no assumptions about the veracity of the data, nor the users' trust of the data. Our system is designed to allow for the rapid editing and testing of hypotheses based on comparisons.

Our work was partially inspired by the focus on comparisons and alignment demonstrated in Lifelines 2[2]. Lifelines 2 allows users to view multiple timelines simultaneously. Because it is designed with medical data in mind, these timelines typically correspond to different patients. The user may then specify a seminal event, which not only filters the timelines for those which record that event, but also aligns the timelines based on that event, rather than on objective date and time. As demonstrated in Lifelines 2, comparison based on alignment is extremely effective. We have taken the same concept and moved it one step further, by enabling

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arbitrary alignments on arbitrary time-scales in addition to other features.

Additional motivations rely on our desire to develop a method for working with uncertain data. In its current design, our system retains powerful exploratory capability enabling rapid hypothesis development and testing. We anticipate that these features will be of particular interest to investigatory teams in law enforcement who often encounter uncertain data and require the ability to quickly explore any number of variations in order to develop hypotheses.

2 DESIGN

We will now describe the design of our system, placing strong emphasis on the innovations over current time-oriented data visualization systems. The major innovations are the visualization as an interface to the data, the flexibility of arrangement and orientation, and the asymmetrical fish eye zoom. We will also briefly discuss the attributes of the data that our system visualizes.

2.1 The Visualization is the Interface

Systems such as Continuum[3], Simile[4], and LifeLines 2, which represent the state-of-the-art in event sequence data visualization all provide valuable contributions. One feature that is missing in each of these systems, however, is the ability to create or edit data on the fly. Creating or editing data on the fly is critical to hypothesis testing. There are two primary ways to bring data into *Perspectives*.

Events can be attached to the timeline in either one or two points in time (providing mechanisms for both discrete event visualization and visualization of events with specified duration). Events also contain both a title and a description.

Once the import has been run, the user is free to explore and alter the visualization as they see fit. At this point, the second mode of data creation comes into play. Whether the user has run an import or not, they are free to create new timelines and events at will. In the next section, we describe the data attributes, all of which can be edited without substantial limitations.

The ability to edit any and all of the data attributes in real time is critical to a number of analytic tasks: most notably hypothesis testing.

2.2 Data Attributes

The data that we visualize falls into two primary categories: timelines and events. A timeline is defined as a starting date/time and an ending date/time. Timelines contain additional visual attributes such as a length and position, as well as small tick marks which provide zoom context to the user. Events contain a title, a description, a start date/time and, optionally, an end date/time. Events are also associated with a timeline.

2.3 Flexibility of Arrangement and Orientation

Many of our design decisions were driven by a goal of enabling rapid and straightforward comparisons between timeline. For that reason, we attempted to make the interface as light-weight and free from distraction as possible. Our interface contains only one button. Every other user interaction is either click-and-drag, right-click, or double-click, with the exception of the text entry for dynamically created events and edits to existing events.

Events which contain both start and end points are displayed above the timeline as a thick line. If the system is able to display the title and description of the event in the line, then the somewhat more heavyweight event display is removed in order to put the labels directly on the data whenever possible.

Due to the lightweight and flexible nature of all elements of the interface, comparisons are extremely easy to make across timelines. Since the number of timelines is not limited, the user could easily create a dummy timeline in order to simulate comparison within a timeline. A simple comparison task, from start to finish, might take the following procedure.

First the user would create two timelines, each spanning the same duration of approximately the same length. The user would then populate those timelines with the events to be compared, then simply click and drag them until they are aligned.

Although we do enable such simple comparisons, the innovation lies in the flexibility. There is no systematic requirement that the timelines being compared are the same length, span the same duration, have similar fish-eye perspectives, or have the same number of foci. To take an example from LifeLines 2, the user could align all of the timelines based on a seminal event and then utilize our fish eye technique to compress all of the data between that seminal event and any number of subsequent seminal events, then make comparisons based on this multiple foci view, realigning as desired. They might even annotate interesting concurrent data by creating a new event and leaving it pinned up despite a compressed view of its time period.

2.4 Asymmetrical Fish Eye Zoom

One of the challenges for event sequence data visualization which we described in the introduction is the ability to simultaneously visualize data which describe events over vastly different granularities without losing context, in a reasonable amount of screen space. We decided that some kind of zooming would be necessary, which led us to fish eye techniques. With these conditions in mind, we developed a one sided fisheye zoom. A detailed description of this technique is outside of the scope of this poster.

3 CONTRIBUTIONS AND FUTURE WORK

Perspectives provides a *vastly* different toolset from prior temporal visualization systems. Temporal Visualization systems tend to focus on the questions surrounding data overload and differing scales. *Perspectives* provides an innovative response to both of these traditional questions in the one sided fish eye technique.

Perspectives goes further by providing an extremely light weight and dynamic interface, leaving design decisions surrounding placement and sizing to the user. On the fly data creation and editing is also supported in order to enable rapid hypothesis testing and annotation. Future work on *Perspectives* is likely to focus on visualization techniques for additional data dimensions such as uncertainty and reliability and event dependencies.

Additionally, we would like to migrate the interaction model to touch and gestural control. Due to our minimal reliance on text input and the light weight nature of our design, we believe that we can further reduce the cognitive overhead of the system through intuitive gestural control.

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