Seascape and Volcano: Visualizing Online Discussions Using Timeless Motion

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ABSTRACT
Motion is the strongest visual appeal to attention [2], yet it is rarely used in the visualization of large-scale quantitative information. Motion is complex; it can vary across numerous dimensions, each of which is potentially an information-bearing element in the visualization. Which dimensions are used and how the data is mapped onto them are the key questions in using motion effectively. In this paper we present two interfaces that use motion as the primary visual element for representing data. These interfaces, *Seascape* and *Volcano*, use periodic animation loops to represent key social interaction features in online discussions. We propose that motion may be particularly well suited for representing data about behavior and actions, creating visualizations that intuitively depict different levels and types of activity. In this paper we describe the interfaces we have built and present the results of preliminary user studies.

Keywords
Visualization, animation, motion, Usenet, user interface

INTRODUCTION
The classic graphical representations like color, shape, position and transparency of an object are limited for depicting the heterogeneous nature of data [6]. Current research shows that overuse of these representations exceeds the human's perceptual capacity to efficiently get the meaning of them [3]. Motion is a potentially useful dimension for visualizing large-scale data and activity. It is perceptually rich and catches our attention rapidly. Its pre-attentive and interpretative perceptual properties [2][4] make visualizing a large set of data possible. Yet there are very few visualizations that use motion to depict quantitative data due to technical problems and lack of guidelines of employing motion.

We also believe that motion is particularly apt for depicting social data and activity. Allison et al. [1] provide strong neurological evidence that certain kinds of motion (gaze, lips, hand and body movement) are closely related to human's perception of social information. Social interactions are not static. We notice that the dynamic and expressive nature of motion allows us to visualize some social patterns of online discussions more intuitively. Such patterns include the rhythm and activeness of a discussion.

We are using the problem of visualizing Usenet as our example for these studies. Usenet provides huge online spaces for people to express their views on or get information from many different topics. The simplicity of the text-based communication platform allows us to quickly browse through topics and access their content. It also speeds up the vigor of the social interactions happening within these online spaces. However, when the size of the discussion increases drastically, we fail to get a sense of what the group looks like at a glance.

Many projects have addressed to answer this problem by developing legible visualizations for large-scale online discussions. Loom [5] analyzes the structure of online discussions while Conversation Maps [7] reveals the social networks of a group. Netscan [8] and Conversation Thumbnails [10] explore systems for navigating and reading discussions. Most of them use static representations to depict the underlying social patterns.

There are many different ways of using motion [3] [6], including transformations of object (color change, growth, shape change) and movement of the object (in 2 or 3 dimensions). As the first step, we want to focus solely on the motion of a non-transforming object. Here we are using simple motions (movement along simple paths) – and will be looking to evaluate how well people perceive information mapped to variations in this movement, which include different types of paths (Seascape vs. Volcano), velocity along these paths, and the effects of different mappings. In addition, we use primitive graphical objects (squares and circles) as the vehicle to carry the motion dynamics. We limit our scope in the use of motion because we try to avoid overloading humans' perceptual capacity of interpreting large amounts of information in the early stage

of our study [3]. Nevertheless, we are combining this motion with another simple visualization dimension – object scale – in order to evaluate the effect of variations in the mapping of the data.

While we are interested in greater understanding of motion as a visualization element, we are also looking at the visualization in the context of a specific task, that of depicting behavior in a conversation space. In this paper, we present our experiments and discuss using motion for visualizing quantitative data. By visualizing Usenet, we would like to investigate whether motion can help people in perceiving different data more quickly, and how to use the screen space more efficiently.

TIMELESS MOTION

Motion is often used with time and its narrative quality tells a good story about the information it represents. Motion can be used to show groups changing over time. But in this stage, we want to focus on depicting information which enables people to understand groups at a glance. We would like to distinguish this type of motion from animated narrative. Imagine painting as a visualization employed by static representations and music as an animated visualization. How can we get a sense of the music as quickly as we perceive the painting at a glance?

Our answer to this question is *timeless motion* - the motion that has no beginning and end. It is pure motion that is perceived out of the dimension of time [2]. Timeless motion is similar to some mood-setting music loops in restaurants that you would immediately get a feel for by the beat and tempo. This is not about changes over time, not using motion to show temporal qualities but rather using short loops of motion to show the pattern and rhythm. The quality of these objects is what we are using to show information. For future works of motion exploration, we will investigate the context of using narrative animation and the display of the movement changing over time.

Our interface implements two different ways of using timeless motion in moving along horizontal and vertical axes. Figure 1 shows the Seascape interface. Each square particle represents a thread in a newsgroup. They are all animated as sine waves propagating and looping from left to right. Figure 2 shows the Volcano interface that loops the square particle bouncing up and down. The variation of speed, direction, amplitude and frequency in every square particle provides a quick impression of the group's activity.

WHAT IS THE DATA TO VISUALIZE?

There are many ways to quantify textual Usenet data to allow legible social meanings to emerge. Whittaker [11] suggests a series of quantifiable metrics to explain the dynamics of mass interaction. Boyd et al. [5] developed a framework comprising both quantitative and qualitative characteristics for recognizing large-scale textual discussions. As our focus is on the visual exploration of motion, we concentrate on visualizing the basic and most prominent characteristics of a newsgroup which can be determined statistically. These include size, activeness and recentness; they are quantified as follows:

Size: How many threads are in a group? How many individuals does a thread have? What is the length of the messages in a thread or posted by an individual?

Activeness: How many messages are there in a group? How many are posted by an individual?

Recentness: When was the thread initiated and last replied to?

We recognize that there are potential problems tying these numbers to social attributes. Linguistic and network analysis techniques are probably needed for the next step. But for the purpose of experimenting with motion, we will assume these quantities can give a sense of what a group's social interactions are.

MAPPING THE DATA TO SEASCAPE AND VOLCANO

As mentioned earlier, we are using short periodic loops to visualize large volumes of data. Frequency, velocity and amplitude of the wave's movement are the visual components that we tested with Usenet data. Seascape and volcano are the two interface designs that selected after experimenting with the mappings.

Seascape (Figure 1) visualizes a newsgroup as a sea of threads, where each is a square particle varying in size which propagates in the path of a sine wave. How fast the particle moves along the wave (velocity) shows how active the thread is. The frequency and the amplitude represent the recentness of a thread. Under this mapping, inactive threads form slower waveforms while active threads propagate across the screen faster. It creates an intuitive mapping with the seascape metaphor by representing an active group by vigorous waves. The amplitude and frequency shape the waveform; we use them to depict the recentness of a group because the waveform gives a sense of the dimension of time. Higher waves symbolize more recent threads while flatter waves illustrate older threads.

Figure 1. Seascape – A snapshot of an animated group

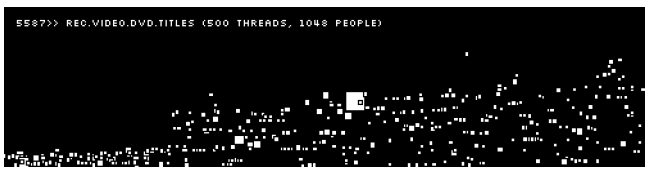

Figure 2. Volcano – A snapshot of an animated group

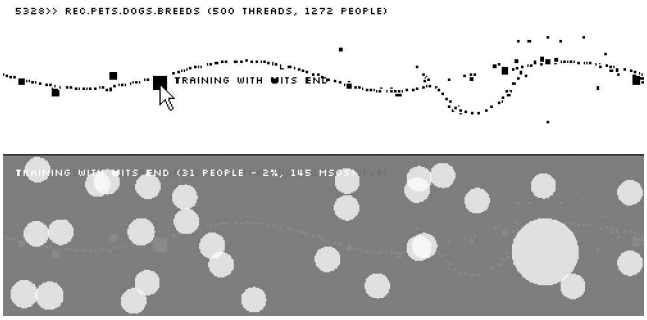

Figure 3. Zooming in from a group view to a thread view

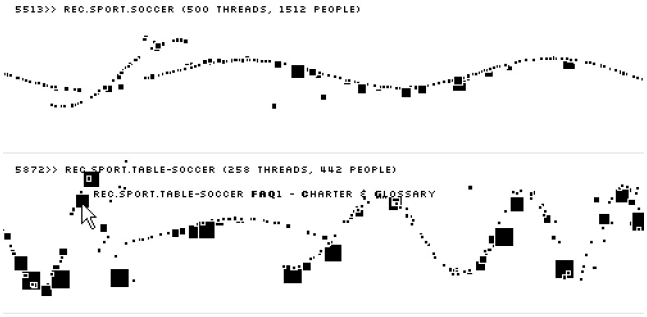

Figure 4. Comparing two newsgroups (snapshots of 2 animated groups)

Volcano (Figure 2) employs motion loops only in the vertical axis. A newsgroup is represented by a collection of square particles ejected from the ground. Similar to the former interface, they represent threads and evoke the metaphor of the movement of magma erupting through the surface of the planet. The speed of the bouncing particles denotes the activeness of the group while the vertical height shows the recentness of the group. Although volcano does not use spatial movement on the horizontal plane, it can show at a glance the temporal change by distributing the threads according to their initiation time, from left to right, along the x-axis.

Along with the motion properties, we also incorporate scale as a visual element in our visualization. It is another dominant feature that draws our attention among a large volume of data. The size of the object represents the length of the thread in terms of the number of unique lines in all of its messages. Size is the most direct mapping to the size of the content, giving the user a stronger sense of coherence among the visual attributes and data.

Group and thread view

We examine the Usenet in two different levels – group and thread. As discussed above, the group view is visualized by a collection of moving particles as threads. The thread view (Figure 3) is meant to be the microscopic view of the individuals inside one thread. We chose bubbles as the metaphor for individuals because bubbles are naturally embodied in seawater and magma.

To keep the design consistent and avoid ambiguity, we apply the same motion mappings to the bubbles. Size represents the length of the total messages posted by an individual. Speed represents the individual's activeness in the thread, measured by the number of posted messages. These mappings complement the square particles - the faster the bubbles move inside a thread, the more vigorous movement the outer square particle has. The same relationship applies to the size as well.

In the interface, the user can click on a square to bring out a zoom-in view that depicts floating bubbles as individuals. Knowing that the moving particles are difficult to catch, we implemented a one-click mechanism to toggle the start and the pause of the animation loop by a single click. In addition, rolling the mouse over a square particle can display its subject line interactively (Figure 3). By having a quick grasp of what the contents of the most eye-catching threads are, the user gains more context information to form the overall impression of the group.

Comparing different groups

At the heart of quantitative reasoning is a single question: Compared to what? Small multiple designs, multivariate and data bountiful, answer directly by visually enforcing comparison of changes, of the differences among objects, of the scope of alternatives. [9]

Tufte suggests using small multiple design to visualize and analyze quantitative data using static visualization. It is also applicable to the Usenet visualization especially because, from the user's point of view, one goal is to identify the salient features of the groups sharing similar topics in one view. But the question is how many groups should we lay out in a screen?

Bartram's discusses human's ability to identify 5 distinct unrelated motion trajectories in the same visual field [3]. She gives an insight into our interface design. Users can input a keyword into the interface and it will juxtapose up to five newsgroups in the same layout simultaneously. The vertical alignment of groups gives the user a glimpse of which group is more active, which group has more recent news and which group contains lengthier conversations. If the user is searching for some information from several unfamiliar groups, this feature offers a fast and useful visual clue of social activeness without needing the user to look into the threads.

Figure 4 shows a visualization of two Usenet groups returned by the keyword "soccer" using the Seascape interface. The second graph apparently has more lengthy messages than the first one shown, by the size of the square particles. On the other hand, the first graph displays a faster propagating wave. This implies that more messages are posted in the first group, which means it is more active. In this example, the big, slow-moving squares in the second graph stand out from the visual field. Those threads have very few messages (< 5) but their messages' length makes

them prominent. By rolling the mouse over those threads, we discovered that they were actually FAQ threads. By comparing different groups, we will discover more visual properties which reveal their structures and social patterns.

Implementation

The Seascape and Volcano interfaces are implemented as a Java application. It connects to a database of Usenet discussion archives. The database contains more than 3 million messages that were colleted periodically in 2002. The application allows the visualization to display 5000 messages in 5 different groups.

PRELIMINARY RESULTS

We conducted an informal user study for the seascape and volcano interfaces. Preliminary results indicate that users are interested in watching the visualization and find it easier for getting an overall impression of a group than a normal text-based interface. They can pick up quickly the metaphor of square particles as threads and bubbles as individuals. But some users needed more explanations to differentiate recentness and activeness.

Most users thought that the interface is fairly easy to use. They could navigate well between the group and the thread views (Figure 3). One tester pointed out that the grouping of the particles facilitated his comprehension of the group's posting distribution over time.

Also, the functionality of aligning multiple newsgroup visualizations aroused testers' interest in looking up random keywords and comparing the returned newsgroups. Their attention was caught by the visually dominating objects such as the fastest, the biggest, the slowest and the one which is oscillating with the largest amplitude. The results show that the interface holds the promise to provide an overall sense as well as to pop out the salient features of the group.

FUTURE WORK

These are not the only two ways of using motion in visualization. Our purpose is to explore the opportunities in using motion as the visual attribute in large-scale discussion visualization. In our future research, we will vary mappings to the motion properties. The animated narrative, growth in size, change in color and shape are also the areas in which we would like to take further step. We plan to explore other ways of applying motion to a large data set, for providing a dynamic, legible and navigable depiction of online discussion spaces.

Further research is needed to understand how people differently perceive motion and static representations differently and how these differences help to create a more intuitive and legible visualization for large amount of data. We will also look at how the current textual interface can be incorporated in the visualizations. One way to achieve this would be putting the list of threads and messages together with the Seascape and Volcano interface. Users could navigate both from the list and the visualization to access the actual message content. The visualization provides the user a sense of social structures and quantitative characteristics of the group while the textual list of threads simplifies the navigation process, so that the user can access the content faster.

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