

# Enhancing Visual Comparisons in Interactive Graphs

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## ABSTRACT

Bar and line graphs are a good medium when trying to understand overall trends and general relationships between data items. Sometimes it is, however, desirable to make more detailed comparisons between data items. In this case good tools are valuable, especially when examining a dense graph. This paper introduces two techniques that can be used in such tools. Spatial grouping and visual landmarks can be applied in a way that takes full advantage of the attributes of the human attention mechanism to facilitate visual comparisons.

## Keywords

Information visualization, interactive graphs

## INTRODUCTION

Static bar and line graphs are widely used techniques in information visualization. Such graphs are excellent mediums for understanding the overall trends and relationships between data items, because many data items are shown simultaneously. However, making detailed comparisons between only a few items can be a bit of a problem. This is especially true when the compared items are spatially far apart and the graph is dense.

When just a few items have to be compared, the attributes of those particular items must be retrieved into the short-term memory where the comparison can be carried out. This information retrieval must be fast due to the time constraints of the human memory system. This could be hard to accomplish if the eye has no clear paths to follow.

Making the graph interactive can enhance such comparisons. Like Dix and Ellis [2] suggest, extra value can be added to the visualization even with the simplest interaction. This paper introduces two techniques for making the visual search easier. 1) *Spatial grouping* helps visual search by placing the compared items next to each other. Attention shifting is easy when the required eye movement is minimal. 2) *Visual landmarks* help visual search by placing attention-catching marks in the picture. These

marks guide the eye to the correct position. An interactive graph using both of these techniques is implemented in IMIS [3] reporting tool.

## SPATIAL GROUPING

Spatial grouping is an old technique that is commonly used in static visualizations. For example, comparing three years of company data is easily done this way (see Figure 1). When using this technique in an interactive visualization, the problem is not the technique itself, but the control mechanism for the grouping.

## Interaction

A special widget was designed to control the grouping of the data in the graph. With this widget, called Multiple Range Slider, the user can define how many value ranges should be compared, which are these value ranges, and what is their size. Figure 1 shows the widget in action. In the picture the user has selected three time ranges (years -95, -96 and -98) for comparison and the graph shows the grouped data. The corresponding months of each time range are grouped together. Because of the grouping, the compared items are next to each other and thus easy to find.

The buttons labeled '+' and '-' are used to add and remove value ranges, respectively. An individual range functions like a thumb in Range Slider [4], i.e., the size of the range is adjusted by dragging from the edges of the range. Here the sizes of the ranges are constrained to be equal, so changing the size of a range changes the sizes of all the ranges. The feedback about this is given to the user in real time. Dragging a range from the center moves it. The first

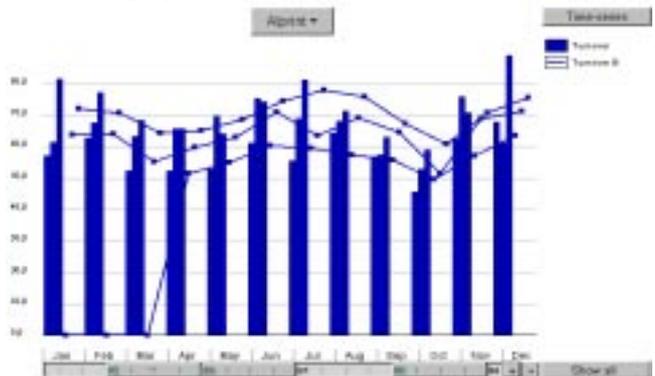


Figure 1. A comparison enhanced with spatial grouping.

range is an exception: moving it moves all the ranges by the same amount. This makes it easy to change the view without changing the relative positions of the compared value ranges.

### VISUAL LANDMARKS

Spatial grouping can not always be used to facilitate comparisons. Sometimes there are only a few items that need to be compared. In order to keep the cognitive load minimal, the overall context should not change while making the comparison. When the context remains the same, the user does not have to reorient him/herself to the picture. Visual landmarks that are added to the picture fulfill these requirements.

### Underlying Principles

The visual appearance of the landmarks is based on attributes of the human attention system. The system functions in a way where attention is automatically shifted toward either movement or areas with strong patterns of color, intensity or size contrast [1, p. 25]. All these features of a picture are preattentive, so no cognitive effort is needed in the perception process.

The attributes of the attention system are utilized in the solution in a straightforward manner. The items of interest are presented in stronger color or in higher intensity than the rest of the picture. As a result, attention is easily shifted toward the interesting items.

Interesting items could be simply marked by replacing the original color of the element with a stronger one or with a more intense hue. This would, however, add obtrusive visual clutter to the visualization. Therefore the landmarks are created by fading other elements. This technique produces no extra clutter, preserves the overall context of the picture and still offers clear landmarks for the eye to follow.

### Interaction

A simple point and click syntax is used for controlling the visual landmarks. The user may select multiple values from the x-axis of the graph and/or multiple time-series from the graph legend. The corresponding value ranges and/or time-series are then highlighted. To make landmark removal easy, a button ('Show all') is provided.

Figure 2 shows an example of the landmarks. In the picture the user has wanted to focus on three months and only two

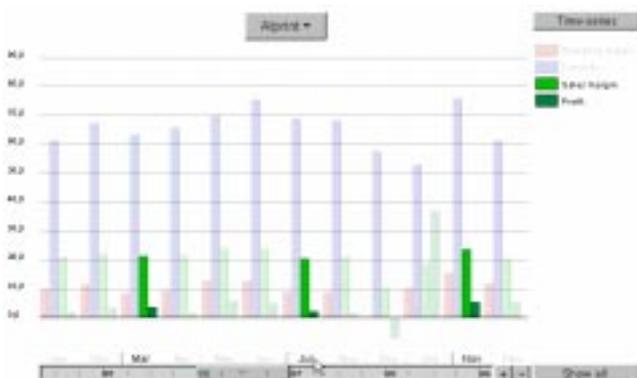


Figure 2. A comparison enhanced with landmarks.

time-series. The use of the landmarks makes the comparison of the interesting items faster, easier and more robust.

The described visual landmarks can also be used to facilitate the reading of a spatially grouped graph. Grouped views get easily quite dense and focusing becomes hard, like in Figure 1. In this situation, the user may focus his/her attention using visual landmarks. When the mouse cursor is placed over a thumb in the slider, the corresponding elements in the graph get highlighted using the landmark technique (Figure 3).

### CONCLUSIONS AND FUTURE WORK

This paper presented an interaction technique for controlling spatial grouping in graphs and a visualization technique for making unobtrusive visual landmarks. The former technique was based on a new widget which enables users to make complex queries simply and at the same time gives them good control over the visualization of the results. The visual landmarks, on the other hand, were based on fading items of lesser interest. This preserves overall context of the visualization, but does not add visual clutter. In the future a formal usability test will be carried out.

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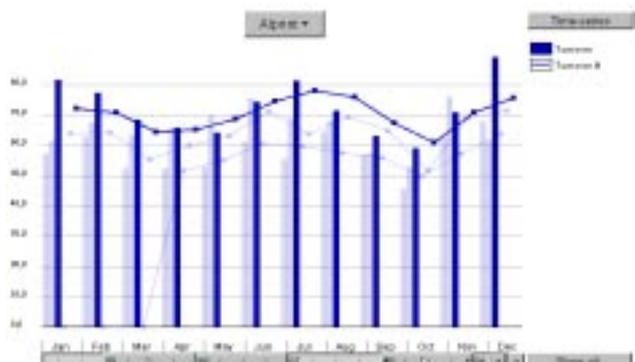


Figure 3. Spatial grouping and landmarks combined.