Interactive Visualization of Prices and Earnings around the Globe

Luc Girardin
Macrofocus GmbH
luc.girardin@macrofocus.com

Dominique Brodbeck
Macrofocus GmbH
dominique.brodbeck@macrofocus.com

Abstract

We developed an interactive visualization system that supports analysis and exploration of a large number of prices and earnings indicators that have been collected for 58 cities around the world. This system is embedded in a conceptual framework of best practices in information visualization that we developed over the course of various past projects. It is made of several components that are tightly integrated and successfully reveal the data in its complexity.

1. Introduction

Periodically, the UBS Swiss Economic Research group publishes a survey of international prices and wages. The 2000 edition of this report [1] contains data for a set of 58 cities, covering a large range (> 100) of characteristics such as prices for food, income and working hours of engineers, or the working time required to buy a hamburger.

Over the past few years, we created various (research and commercial) interactive visualization systems and developed a conceptual framework of best practices based on the experience gained. We used the opportunity that this fascinating and accessible data set presents, to create a demonstration application that showcases our approach.

2. Conceptual framework

From the development of interactive visualization applications over the course of the last few years, a set of rules emerged that seem to be important to build systems that deliver on the promises of information visualization. These rules form the basis of a conceptual framework that we use as a foundation for building new applications. Some of the main rules are:

- integrated systems: the system should provide all the essential tools and views in a single integrated frame to preserve spatial continuity;
- highly interactive: the system should provide immediate feedback for all actions to preserve temporal continuity and to encourage exploration;
- different views: the system should provide different views onto the same data to emphasize different aspects and perspectives;
- tightly linked: the views should be tightly coupled so that changes in one view are reflected in the others;
- information design: data should be shown with clarity and precision and the overall look and feel should create a pleasurable user experience.

3. City'O'Scope

The interactive visualization system that we developed to explore and analyze the prices and earnings data - called City'O'Scope - follows the principles outlined in our conceptual framework. It is composed of several linked views that present the multiple facets of the data. In the following we will briefly describe each of these views and the combination of information visualization techniques that they use. The system has been fully implemented in Java.

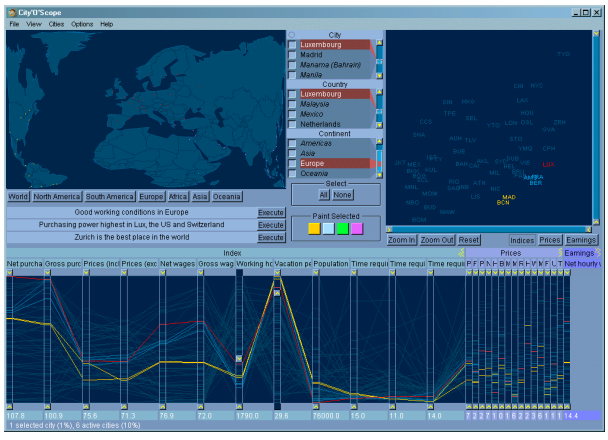

Figure 1: City'O'Scope and its multiple integrated views: world map (upper left), lists (upper center), thematic map (upper right), and the parallel coordinates view (bottom).

World map

The 58 cities of the survey are distributed around the world in a rather inhomogeneous way. The information density in Europe for example is much higher than in Africa. We therefore implemented the world map viewer as a variation of the Cartesian fisheye view with a central non-distorted focus region [2]. This allows preservation of context while focusing, and is in this case not disorienting because of the well-know shape of the world.

List views

Our list component has the particularity of being bidirectional, i.e. that one or multiple items can be selected in the list and that the selection will be reflected in the other views, but also that selection in another view will be reflected in the list. In addition, a world-in-miniature view is provided within the slider, showing the selected items. This way, one can easily step through the selected objects.

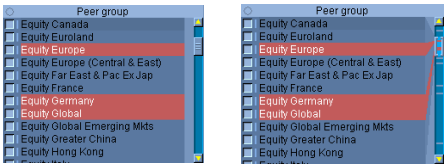

Figure 2: A list as we can find it in most application (left) and our enhanced version with a world-in-miniature view within the slider (right).

Thematic map

The thematic map helps to gain an overview of the global relationships between objects: cities are placed on a map so that similar cities are located close to each other and dissimilar ones far apart. Similarity is defined by taking into account all of the relevant attributes of a city for a particular theme. Three thematic maps are created using a multidimensional scaling technique based on a forced-based layout algorithm [3]. The switching from one map to another is animated to help understand their differences.

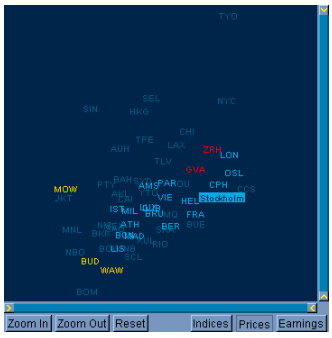

Figure 3: The similarity map showing each city airport code. Hovering the mouse over the city pops up its name.

Collapsible parallel coordinates and range sliders

The parallel coordinates [4] view shows one axis for each attribute that characterizes the cities. Connecting the actual values for one specific city on all the axes, leads to a polygonal line which forms a visual representation of the characteristics of this city. Differences between cities can easily be spotted by comparing the lines representing them.

Range sliders are embedded within the parallel coordinate plot. Cities whose value for that attribute falls outside of the specified range are "greyed" out and can not be selected anymore. A combination of range sliders can be used to dynamically formulate queries such as which city has low food prices and medium prices for services.

Because of the large number of attributes, we added the possibility of collapsing multiple attributes into either a compact list of range sliders or to a single aggregating attribute.

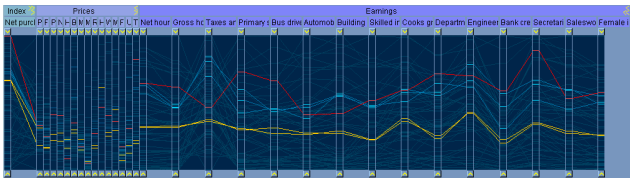

Figure 4: The parallel coordinates view and its three states: completely collapsed (indices), half-collapsed (prices), and fully expanded (earnings).

4. Conclusion

The emerging field on information visualization has produced many innovative techniques that help humans access and understand large amounts of complex information. Taking these techniques out of the research domain and creating effective information visualization applications has remained difficult. In this paper we outlined the lessons that we learned from creating such applications and presented an example application based on these principles.

5. References

[1] UBS Swiss Economic Research, “Prices and Earnings around the Globe”, 2000.

[2] Manojit Sarkar and Marc H. Brown, “Graphical fisheye views“, Communications of the ACM, 37, 12, July 1994.

[3] Matthew Chalmers, “A Linear Iteration Time Layout Algorithm for Visualising High-Dimensional Data”, Proc. IEEE Visualization 96, San Francisco, October 1996.

[4] A. Inselberg, “n-dimensional graphics, part I -- lines and hyperplanes”, Technical Report G320-2711, IBM Los Angeles Scientific Center, Los Angeles, 1981.