Views as Rich Menus for Other Views: A Case Study on Personal Data Visualization

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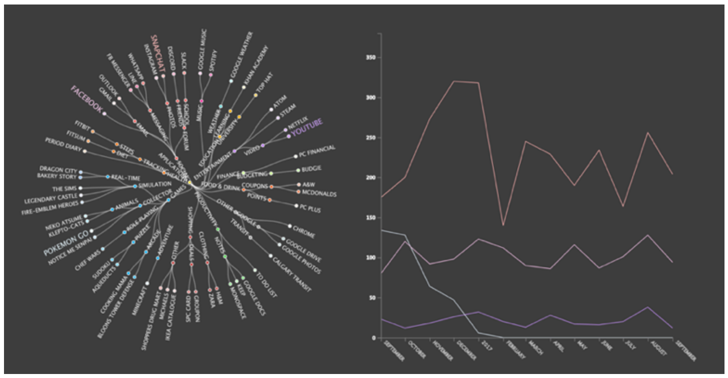

Figure 1: The figure shows a visualization that makes use of two views to show hierarchical text data alongside numerical data. The visualization exhibits personal mobile phone data usage over the course of a year from 2016 to 2017. The graph on the left is a radial tree layout which displays the mobile apps laid out in a hierarchy, with each app categorized by application type. The graph on the right is a line chart that shows data usage over time for apps selected in the left graph. The x-axis shows months and the y-axis shows data usage in megabytes (MB).

Abstract

Visualization systems with multiple views are often used to represent data from different perspectives. There are many advantages in doing so, such as providing a way for users to understand a dataset by revealing its various attributes in separate views and offering additional information that could be more useful than if it was just one graph. However, this can often make data seem complicated and overwhelming as each view remains independent. We present a visualization that utilizes multiple views as a means for interaction and unifying the different data dimensions of a multi-view system. This creates a cohesive visualization that displays different aspects of the data, in this case, hierarchical text data and numerical data. With this personal data visualization, we offer a potential solution for relating additional data structures through interaction while maintaining different data types shown and linking multiple views to form a larger connected graph.

Keywords: Personal visualization, multiple views, interaction.

1 Introduction

Personal visualizations tend to be simple and accessible. This is because they are not often intended for complex analysis situations. However, as more visually literate people are continuing to create their own visualizations, the complexity of personal visualizations might increase. Here we discuss a personal visualization of mobile phone usage data. The challenge here was to show both the hierarchical relationship between the different apps and app types in relationship to their usage trends. The visualization we designed (refer to Figure 1) combines two views: one of a radial tree layout and the other a line graph. The interaction between the two links the higher-level hierarchical text data in the tree layout with the lower level numerical data of mobile data usage. This interaction links the different attributes of the data and provides meaning to the overall structure of the multi-view system.

Visualization systems that comprise multiple views have proven to offer a variety of benefits – one advantage being the discovery of unforeseen relationships [1]. With multiple view systems, a user can analyze different aspects of the data while the system offers a method to understand these characteristics in a variety of ways. Traditionally, multiple views have mostly been considered from the perspective of providing these different perspectives on a dataset.

In this paper, we introduce a personal data visualization that incorporates multiple views for interaction where one view controls another view while still maintaining data representation in each graph. Rather than the controller being a button or menu, the control is a visualization on its own and gives additional information about the data in a cohesive way.

2 Related Work

Throughout the design of this visualization, several previously explored multiple-view aspects were considered.

Baldonado et al. [1] offer eight guidelines for the design of multiple view systems in order to describe and explain the different dimensions. One particularly interesting rule is the Rule of Parsimony–that is, using multiple views minimally. The risk with having more than one view in a visualization is that added complexity might be overwhelming or confusing. As a designer, minimizing complexity as much as possible while retaining substance can be beneficial for understanding the data. An approach we pursue for accomplishing this is by using one view as an interaction tool and connecting another view to it. This bridge can create a relationship that unifies the views to form a

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visualization that may be more understandable. Having one view rely on another may also minimize confusion, as it gives meaning to each visualization and connects it to the bigger picture while clearly demonstrating important aspects of the data.

VisLinks [2] presents a method for exploring relationships between visualizations by using multiple layouts and comparisons in a 3D space. This perspective on how different visualizations are linked offers an interesting format for how different graphs can be virtually connected. This technique lets people interact to manipulate the graphs and the views. Knowing and representing the connections between different graphs is useful in forming an understanding of data and helps make the multiple-view system more cohesive. However, the complexity of seeing and understanding data in a 3D space can be challenging. A user must understand not only the three dimensions in relation to each other, but also how to read and analyze the links that connect the views. As an alternative approach to show connections between multiple-views in 2D, we use view juxtaposition and interactivity to reveal the relationship between the two views.

Of particular interest is the recently introduced notion of using a view as a toolbox [3]. This idea is the idea that when showing more than one visualization view in the same system, it is possible to utilize one or more of the views as a means for manipulating the data in other views. While in practice most multi-view systems use some factors of this, thinking of a view as a type of toolbox can provide new freedoms. Examples of these interactions range from simple tool views such as zooming and panning to more embellished interface components on a menu, like range sliders [4].

We present an example of the two-view personal visualization that uses one of its views as a toolbox, where it acts as the controller for the other view. Although the toolbox notion offers more possibilities than what we present here, our visualization demonstrates the general idea and explores its uses as an interactive data viewing system, letting people control what they want to see by using one view to influence what is shown on the other.

3 Using Multiple Views to Provide Interaction

3.1 Data Collection

We collected the data using an Android phone's default "Settings" application, where any user can find their own statistics of data usage per application. There is a total of 58 apps in the dataset and the data runs from 2016 to 2017. We categorized each application under a main category, such as Games or Education, with a specific sub-category, like Arcade or Adventure. This information was found to be particularly interesting because it gave insight on which specific apps the user finds most valuable when on-the-go and which apps they would be the most willing to spend money on in an area without Wi-Fi. Trends over time also allow a user to see their monthly phone usage habits.

3.2 The Visualization

We created this visualization using D3.js. The visual representation consists of a radial tree layout and a basic line graph that shows the application data usage for a year's worth of time.

3.2.1 Data Mapping

We chose a tree layout because it clearly represents hierarchical data and allows the category of an app to be easily seen and to provides information about app type. The text was formatted to fit with the circular layout to keep the relationship of the text and the hierarchy clear. The text of the app names also acts as a legend for the interaction (see Figure 2). The second view holds a line chart that displays the numerical data associated with each application of how much data was used for that app in that month. We chose this because it demonstrates trends of data usage over time. The apps are each given their own color. Each color was derived from the corresponding category color to which it belongs.

3.2.2 Interaction

The radial tree layout is used as an interactive legend to control which apps are shown. Having this legend act as a control also offers another layer of information to the data as it is also a graph in itself. The user can choose any app they are interested in. To reduce clutter, the application can be deselected to remove it from the graph. When a user selects an app, the data usage trend of the app is shown over the course of a year. In this case, the tree layout both a visualization and an interactive legend that gives meaning to the line chart and that allows people to control another view by interacting with it.

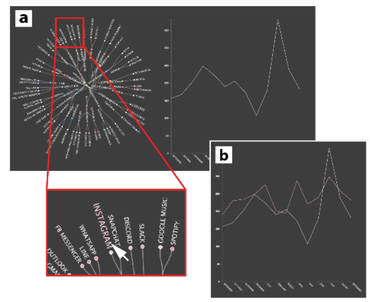

Figure 2: The figure shows a) the application name when the user selects it on the radial tree layout. It is emphasized with a unique color and b) the corresponding data for that selected app is then displayed beside it on the line graph.

4 Conclusion and Future Work

We presented a visualization that leverages the idea of using multiple views as a form of interaction. This visualization represents personal data about mobile data usage and connects two separate graphs to showcase hierarchical and temporal data. This connection works well for wider screens such as on a desktop where the two views can be shown at the same time. However, our approach is more problematic to use with smaller screen sizes, which would require users to scroll back and forth to view the information. Further research into supporting multiple-view systems for smaller screen sizes to maintain cohesion and informativeness could be a promising future direction for the exploration and usage of multi-view visualizations.

Acknowledgements

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