Peony: An integrated InfoVis design and development platform*

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ABSTRACT

We describe an integrated Information Visualization (InfoVis) development platform called Peony. Rather than being a low level InfoVis development toolkit, it is targeted at the full range of InfoVis users, including the InfoVis application designers from various application domains, the InfoVis component designers, and the professional InfoVis algorithm designers. Various interaction techniques and algorithms are supported in different separable modules, making it easy to build different visualizations by composing them in different ways. Peony’s high performance design enables it to handle huge datasets efficiently and we ran a number of performance tests to compare it to existing libraries. The core of the Peony platform has been implemented both in Java, as well as in ActionScript to facilitate web deployment.

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1 INTRODUCTION

Information Visualization’s capability to help users gain insight into large amounts of information quickly has made it a valuable tool in both research and industry. Many different visualizations have been designed for different application areas to help people better understand the data [2]. All these visualizations share common functionality that has to be implemented for every single visualization. Apart from that, developing InfoVis applications requires the programmer(s) to have expertise in many different areas. To facilitate InfoVis application design, in this paper, we propose Peony, a general InfoVis development platform. Compared with most frameworks such as prefuse [4], piccolo [1] and the InfoVis toolkit [3], it provides a general architecture both at the concept level and at the implementation level. Peony consists of a framework of toolkits and component libraries and supports a novel InfoVis development pattern based on agile software development. Different classes of InfoVis techniques are modeled as eight monolithic units and grouped in a standard pipeline according to the reference model of information visualization [2]. The Peony architecture helps designers focus more on InfoVis technologies rather than their implementation details and running pipelines. Moreover, based on the same architectural design, Peony has multiple implementations on different platforms, e.g., Java and Flash ActionScript. Various applications have been designed based on Peony as illustrated in Figure 1.

*Peony is currently in an open source process to IBM AlphaWork

Figure 1: Application examples based on Peony platform. (a) is the structure browser by using FanLens. (b) is the Paper citation network browser by using Trammel Map [6]. (c) is to visualize NSF program funding by using the stacked graph. (d) is the static visualization of NSF programs by using the cascading treemap [5]. (e) is a hyperbolic tree browser used for visualizing the organization structures of IBM. (f) is the visual structure management wiki which is based on the web version Peony.

2 ARCHITECTURE DESIGN

The architecture of Peony, as illustrated in Figure 2, is a platform addressing the requirements of multiple user roles. Four user categories have been identified according to these roles. They are: the traditional InfoVis researchers and designers such as the algorithm designers, the InfoVis component designers, the application designers from various domains, and the end users who use various InfoVis tools in their daily works. Obviously, from the first category to the last one, less visualization knowledge is required for the user. The InfoVis technology researchers and designers are usually experts who create various InfoVis technologies such as layout algorithms and distortion techniques. The component designers use these technologies to produce visualization solutions for various types of data. These solutions are then encapsulated as independent InfoVis components which are reusable and extendable. Finally, the application designers deploy InfoVis components into various tools for end users in different application domains. Splitting the user roles allows users to focus more on the design tasks at hand, rather than on the lower level details.

Along with the four different user groups, we split the Peony architecture into four parts. Each part supports a user category separately. The framework is designed for the professional InfoVis researchers and designers. It handles the lowest level processes of visualization and provides the most general interfaces for users. A set of well-designed InfoVis widgets such as layout algorithms, animators and interaction controllers are grouped as a toolkit upon the framework. The component designers use these widgets to build various visualization components such as hyperbolic trees and ra-
Figure 2: An overview of the different modules in the Peony InfoVis platform.

dial graph layouts. A visualization component library is built by grouping these components together in multiple ways as illustrated in Figure 4. Finally, a plugin based application framework is also provided to serve the application designers.

Figure 3: The peony platform architecture. Eight monolithic units are mentioned in this pattern. A layer groups all the units together and drives them by following the reference model of information visualization.

All the designs are brought together in the architecture illustrated in Figure 3. It separates the framework modules into eight monolithic modules, which are all coordinated by a single layer in a display. This facilitates separation of concerns, and lets different designers work on different parts of the visualization without the need for interface coordination and frequent synchronization. The Peony platform therefore lends itself well to agile software development, where different teams of developers and designers produce separate sections of a larger program in rapid iterations. This iterative design cycle is especially important in visualization development, where the desired end result is not always known in advance. Because the visualization pipeline is already implemented in the layer, visualization designers can focus their attention on the desired end result for a particular module instead of worrying about how to integrate it into the final visualization. We have built an InfoVis toolkit consisting of different implementations of each of these modules, as well as a component library that aggregates the modules in different ways.

3 Conclusion and Future Work

In this paper we have introduced Peony, an integrated InfoVis design and development platform. Its key features can be concluded as: providing a total solution for full range of InfoVis users; providing a flexible and extensible infrastructure to support integration; providing a set of reusable interaction widgets which can be seamlessly integrated with any visualization components in this platform. Several experiments and evaluations show that it is a high performance and powerful toolkit which can be used in many application cases. Future work will be focused on building architectural designs for Visual Analytic and building more web based visualization components and interaction widgets.

References