Interactive Visual Data Query & Exploration

Techniques for visual data analytics through visual query modelling and multidimensional data interaction

Phi Giang Pham

Supervisor: Associate Professor Dr. **Mao Lin Huang**

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Certificate of Original Authorship

I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Date: 22 – Jan – 2018

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Abstract

The direct data manipulation through visualization and associated navigation techniques has been implemented for many years. However, these methods are not uniformly discussed in the context of user interface design. During the history of user interface development, the interaction between humans and computers is almost to be done through software widgets. Since in the last decade, many advanced data visualization and interaction techniques have been developed, now it is the time to bring them into the formal discussion about the context of user interface design, data queries, and data manipulation. The dissertation attempts to fulfill the gap between visual user interface design and interactive data visualization.

In relational data queries, many visualization techniques have featured advanced interactive operation; however, a majority of those would concentrate on the traditional style, instead of a modern approach. This is the reason why today in visual analytics truly direct manipulation is highly encouraged, instead of the conventional methods.

This dissertation focuses on the investigation of modern data query approaches. It attempts to model the new data query methods that apply those advanced visualization and interaction techniques to facilitate the data analysis procedures. The second contribution of the dissertation is the design of new interaction methods for multi-dimensional data visualization.

We first introduce a new framework which includes straightforward manipulation techniques for relational data discovery. These novel techniques, named *MCquery*, *SumUp,* and *FigAxis*, are exclusively developed for the key characteristics of relational data such as *data models* and *data dimensions*. The core methodology is about interactive visual query design based upon node-link graphics, parallel coordinate geometries, and scatterplot visualization, where the direct interaction is performed by friendly action such as clicks and brushes. The tools materialized from these techniques can help to reduce users' cognitive and behavioral effort efficiently in dealing with the issues of information search-retrieval, quantitative data analysis, and correlation examination.