Study of Multiple View Layout Strategies in Visualisation

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ABSTRACT

Multiple views is a popular strategy in information visualisation, but for many years researchers have asked questions such as "how many views and what layout strategies do people use?" Answering these questions would help developers create suitable multiple-view systems, but to date there has been little research into these questions. In this short paper, we present initial results of a larger ongoing study looking at how multiple-views are used. For this study, we built a database of images containing screenshots of visualisation tools from articles presented at IEEE VIS from 2012 to 2017. We select suitable images across TVCG journal, conference, posters and workshop papers. We closely evaluate the layout of 340 images of multiple-view systems and consider the layout topology of each image. Our results show that in the past six years, developers use on average (just over) four views.

Keywords: Visualisation, Multiple Views, Layout strategies.

1 INTRODUCTION

Multiple views has been used in information visualisation for many years. There are different design strategies from view juxtaposition, superposition of many views, or cleverly merging the view information [2], such as by overloading or nesting [3]. In this paper we focus on view juxtaposition, where developers display information in many side-by-side views. One of the reasons developers use such duplication is to help users understand the displayed information. Perhaps a user understands better one style of visualisation in comparison to another, or perhaps one type of visualisation form makes it easier to perform a task, and another form makes it easier to perform a different task. So by using many different view types the user can gain a better understanding of the underlying data. Another reason to use multiple views is to compare data shown in similar views presented side-by-side. Such tools are described as small multiple views or parallel view systems. Additionally, the manipulation of data within these juxtaposed views is often linked together. In fact, Coordinated Multiple View systems [6] provide the backbone of most modern visualisation systems.

This research is part of an ongoing project investigating uses and layout strategies of multiple views. Our goal is to help and guide developers create well-designed multiview systems; to provide a framework and reference source that designers and developers of new systems will be able to use. This short paper fits within this long term strategy. The purpose of this paper is to report on a study investigating the quantity of views used in multiple view systems, based on tools presented at visualisation conferences. Counting view layouts helps us get one step closer to our goal.

2 BACKGROUND AND RELATED WORK

There are many different ways to layout juxtaposed views, and it is difficult for a designer to know which layout strategy is useful. Indeed, it is unclear which are the most popular layout configurations. We have been exploring layout strategies, and particularly for this paper we have been investigating the relationship between the *number of views* and the configuration of the *layout* of juxtaposed views. As researchers ourselves, we have developed and designed several Coordinated and Multiple View systems, and have had many discussions with other researchers about the use and layout strategies of multiple-views. But to date there is little quantitative research looking at view layout. Certainly there are several papers that provide guidelines for designers of multiple view systems. These include Baldonado et al. [8] who suggest that multiple views should be used parsimoniously, while on the other hand, Roberts [5] encourages designers to use many views. In other work, Roberts [6] provides a comprehensive review of coordinated multiple views techniques. In fact, the series of conferences on "Coordinated and Multiple View" that ran 2003 to 2007, published by IEEE provide a set of useful reference papers on various CMV techniques. Gleicher et al. [1, 2] provides a deep discussion into juxtaposition, superposition and explicit designs for multiple view systems, and Qu and Hullman [4] present strategies to keep multiple views consistent.

3 STUDY METHODOLOGY

To evaluate the multiple view layouts we went through three steps: (1) we decided which images we would use, and copied them from the papers into a separate database. (2) We considered each visualisation, made a sketch of the topology, and classified them according to their layout by physically organising the pieces of paper on a table. (3) We counted the different layouts and gathered quantitative data of the types and layouts.

3.1 Preparation and image selection

For our study, we chose to evaluate the tools presented at the recent six years of the IEEE VIS conference. There are over 2912 PDF files on the six years of USB memory sticks from the IEEE VIS conferences. Estimating that each file probably has more than one image, and that not every image presents a screen capture of a visualisation tool, we needed a strategy to select (and reduce) the quantity of images to evaluate. After deliberation and experimentation, our strategy was fourfold: (1) We removed all supplementary materials. (2) We removed papers that did not have visualisations, or only had one view, or only had illustrations and schematic diagrams. (3) We removed files that only had images that were clearly put-together or had been edited (by an image processing tool), we looked for telltale signs, such as miss-aligned sub-images or several image resolutions in different parts of the figure. We also removed papers that had displayed their images from several sub-figures. (4) We removed papers that only had extremely small sized figures at low image resolution, which would have been unclear to classify. This process resulted in a bank of 340 images. We labelled each image with a unique abbreviation (that we also use in LaTex to cite the paper). This meant that we could easily reference the image, and locate the associated publication.

3.2 Considering the topology, and sketching layouts

For this short paper we are only concerned with the topological layout of the designs. In other words we evaluated the structure of the layout, ignoring their relative sizes. For example, we consider a side-by-side two-view display with one small view and the other

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