Sketching Interactions in Visual Exploration
for single and multiple users in wall-display environments

Abstract: Large high-resolution displays allow multiple users to see, explore and understand larger amounts of data than traditional monitors. But deciding on appropriate interaction techniques is not a simple matter. This is particularly the case for data visualizations which have a large number of parameters that users can manipulate to explore their data. The goal of this thesis is to design, built and evaluate means to tailor interaction for specific user needs, by providing them *the ability to directly sketch themselves the interfaces that are appropriate to their tasks*.

Context: Wall display environments are becoming more and more attractive for data visualization analysis, and it is not uncommon to see complete rooms covered on all sides by high-resolution displays constructed for visualization research and applications[1]. Nevertheless, designing appropriate interactions for visualizations on wall displays is one of the major identified challenges (e.g. [1]).

In wall displays environments, where users can move freely around the space and place themselves at different locations, mice and keyboards are unsuitable, while touch interaction is not enough to accommodate large distances. Mobile devices, like smartphones or handheld tablets (e.g. iPad or GalaxyTabs), have been used to interact with large information spaces on wall displays (e.g. [2]). Nevertheless, we still require a large amount of pixels on the mobile devices in order to present all the available controllers for complex actions required in data visualization exploration, such as selecting and manipulating multiple visual parameters, or data filtering and transformation. Moreover, when multiple users interact with these controllers, maintaining awareness of the environment becomes even more challenging.

Sketching the interactive components of the interface presents an intriguing alternative. Sketching affords informal graphical representations, supports personalization and facilitates annotation and collaboration [3]. In information visualization researchers have identified the benefits of sketching as a means to render [4, 5], create and edit [6, 7] visualizations. Nevertheless, this work is the first to consider using sketching as a means to directly interact and explore visualizations.

Objective: The purpose of this PhD thesis topic is the design, implementation and study through user evaluations the use of sketching as a means to explore data visualizations. Four distinct, but complementary directions of research related to this topic are:

- Designing and building functional sketching interactions for data visualization exploration.
- Extending sketching interactions within collaborative environments.
- Experimentally evaluating with users sketching interactions as a means for data exploration.
- Building a theoretical framework of the use of sketching interaction in visual exploration.

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[1] http://labs.cs.sunysb.edu/labs/vislab/reality-deck-home/

Work Program: The PhD student should have initially a strong background in mobile and information visualization development and an understanding of human-computer interaction and empirical research methods. At the beginning, the student will be acquainted with research surrounding wall-display interaction, sketching, and collaborative work. The student will start with investigating how users would sketch simple widgets (e.g. specific sliders, buttons, etc) and implement a prototype mobile system supporting these sketches. Evaluating these designs with users will ensure a first publication of scientific results and acquire the necessary skills for publishing scientific results. Based on these findings, the student will pick the next related research problems that seems novel, including extending these designs to collaborative settings. The outcome of the PhD thesis may be a general framework for the design and evaluation of sketching interfaces for visual exploration, especially in the context of wall displays.

Prerequisites: The candidate must:

- Hold a Masters degree in computer science or equivalent
- Have sufficient training or experience in software development, especially in mobile devices and information visualization toolkits
- Have basic knowledge of information visualization, human-computer interaction, and empirical research methods
- Be creative and possess good analytical thinking skills
- Have a decent level of oral and written English.

References:

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