Participatory Data Analytics

Collaborative Interfaces for Data Composition and Visualisation

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ABSTRACT

This research proposes the development of interfaces to support collaborative, community-driven inquiry into data, which we refer to as *Participatory Data Analytics*. Since the investigation is led by local communities, it is not possible to anticipate which data will be relevant and what questions are going to be asked. Therefore, users have to be able to construct and tailor visualisations to their own needs. The poster presents early work towards defining a suitable compositional model, which will allow users to mix, match, and manipulate data sets to obtain visual representations with little-to-no programming knowledge. Following a user-centred design process, we are subsequently planning to identify appropriate interaction techniques and metaphors for generating such visual specifications on wall-sized, multi-touch displays.

ACM Classification Keywords

H.1.2 Information Systems: User/Machine Systems—*Human information processing*; H.5.2 Information Interfaces and Presentation: User Interfaces

General Terms

Co-located Collaboration, Composition Algebra, Data Visualisation, Visual Analysis, Visualisation Formalism

INTRODUCTION

Existing research in *Sensors*, *Big Data*, *Visual Analytics*, or related fields often focuses on specialised tools and techniques for experts. It addresses technical challenges of data acquisition and processing, such as overcoming challenges of limited computational resources, large data sets, or distributed systems. By contrast, this research focuses on higher-level abstractions of data. It explores novel means of data presentation and interaction in order to open up the technology towards a broader audience. The compositional model aims to facilitate the creation of customised visualisations without the need for programming. With the collective interpretation capacity of end-users, such systems will allow fine-grained inquiry and promote better understanding of complex processes in our immediate environments.

RELATED WORK

There are three leading themes in this research. First, we take inspiration from related projects fostering *Public Engagement* and *Participatory Research*, for example in the area of crowd-sourced sensing [1, 2]. Second, we adopt the principles of *Exploratory Data Analysis* as a leading guide for our design, supporting an iterative process where users rapidly and incrementally develop visual specifications [3]. Third, we incorporate learnings from *Collaborative Visual Analytics* in order to minimise process loss and utilise implicit and explicit communication channels in co-located group work.

Figure 1. *Reactable* by Jordà et al. [4].

This research builds on existing work in Human-Computer Interaction, for example domain-specific visual and tangible programming environments like the *Reactable* (see figure 1) for music composition. The closest

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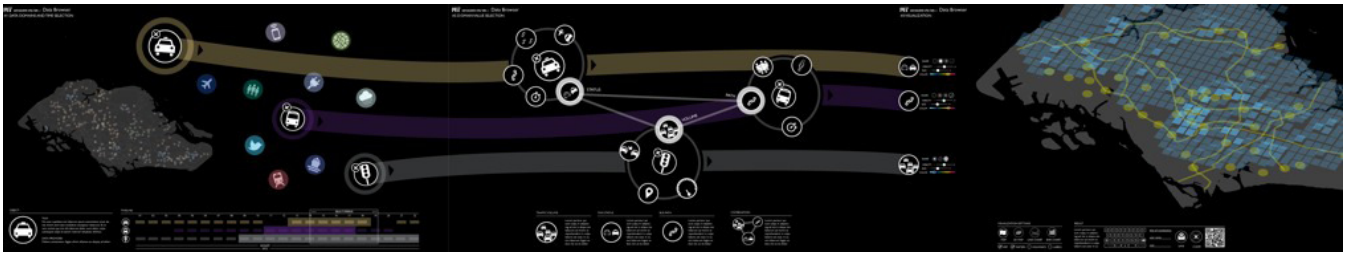

Figure 2. ***LIVE Singapore! Data Browser*** **at** ***MIT Senseable City Lab*** **by Kloeckl et al. [5].**

existing counterpart is *LIVE Singapore!* (see figure 2), however the proposed system aims to provide a compositional model with greater flexibility in terms of data and visual representations.

CURRENT PROGRESS

Conceptual work has started to develop a generic model for sensed and reported data sets. The model is specified in terms of an algebra with compositional objects and operations. Data sets are modelled as tabular data, accompanied by a set of meta-information that determines the applicability of mathematical operations, statistical methods, and ultimately visual representations. Similar classification schemes have been adopted by modern visualisation software packages like Tableau [3, 6].

The success of the project hinges on identifying a set of compositional operations at the right level of abstraction together with corresponding interface metaphors. Our present model is based on the compositional operations outlined in Wilkinson's *Grammar of Graphics* [7]. This allows the user-generated compositions to act as formal specifications for generating the visual representations. However, we are considering alternative forms of specification, such as Baudel's *Data-Linear Visualisations* [8] as we try to balance expressiveness and complexity. The current interface design is based on direct manipulation with abstract representations of data variables to change parameters of the visualisation.

FUTURE WORK

Preparations are underway to run a series of workshops using low-fidelity prototypes. Usage scenarios have been identified with distinct visualisation needs:

Commuting & Cycling The scenario will involve participants who either already track their commute or are interested in tracking it. It was chosen to explore the composition of spatial data sets and the resulting geographic/map-based visualisations.

Academics & Research Organisation The scenario will focus on researchers and the tools they use to support and quantify their academic life. It was chosen to explore the composition of graphs and text-based data sets and the resulting structural/network visualisations.

Small & Medium Enterprises The scenario will include local small business owners that want to leverage data in their business decisions. It was chosen to explore the composition of abstract and temporal data sets and the resulting statistical visualisations.

Based on the input from these initial workshops, a software prototype will be developed. Subsequently, the resulting application will be evaluated at Queensland University of Technology's large-scale, public learning and visualisation facilities [9].

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