
Information Visualization and Interaction Techniques for Collaboration across Multiple Displays

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Abstract

This two day workshop looks at the challenges and issues associated with supporting collaborative analytical reasoning tasks over a range of displays and interaction environments. The focus is not only on visualization and interaction, but also on perception, cognition, and sense-making in collaborative settings.

Keywords

Information visualization, collaboration, display, interaction techniques.

ACM Classification Keywords

H5.3. Information interfaces and presentation (e.g., HCI): Group and Organization Interfaces.

Motivation

Most visualization tools available today have been optimized for conventional desktop displays and interaction devices and single-user interaction. The production of diverse, multi-sources, and dynamic data, though, is growing at exceptional rates. Such increasing complexity implies the need for collaboration in the analysis and management of information. Data need then to be processed and analyzed in social

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contexts in which interaction with other people and with the artifacts that embody collective knowledge plays a fundamental role. Additional complexity arises from the need to merge and synthesize different perspectives and to exploit the analytical and creative potential of multiple individuals, that can be distributed, provide different competences and skills, and interact with different artifacts. Technology promises to support such collaboration, but several challenges need to be faced to realize the vision of supporting collaborative analytical reasoning.

In this workshop, we want to exchange findings about extending interactive visualization tools in two ways. First, we will investigate visualization across different display form factors. We are interested in display devices ranging in size from wristwatches and hand-held personal data assistants (PDAs) to high-resolution full-wall and theater-sized displays, as well as multi-display environments. Second, we are interested in using such systems for collaborative sense-making involving two or more users.

Emerging challenges

One critical challenge that the research community must face is how to represent a huge volume of dynamic information in multi-display environments. The representation has to make the information suitable for processing, analysis, sense-making and interaction between users and information, and between users and users, so that from data, collective knowledge can be achieved. Card [1] maintains that in contrast to Human-Computer Interaction, a new broader field of investigation needs to emerge, i.e. Human-Information Interaction. Most of the aspects distinguishing such a field are based on the Information

Foraging Theory [5]. According to this theory, people seek information according to a cost structure of information and economy of attention. Information scent, i.e. proximal cues perceived by the user that indicate the value, cost of access, and location of distal information content, assumes a determinant role in addressing people's attention. In terms of design of information representation and machine aids, this theory implies to accomplish the following goals [1]:

- Support semantic analysis
- Adapt information environments according to issues of maximization of rate of information gain with respect to interaction cost
- Understand and represent cost structure
- Support external cognition.

The research in information visualization makes use of interactive representations, typically visual, of abstract data to reinforce cognition. Visualization tools have proven to help information analysts with discovery and confirmation tasks, but the tools are still inadequate for many complicated problems and are not keeping pace with advances in data generation. The goal of supporting analytical reasoning is made even more compelling when collaboration is involved.

The high-level challenge of supporting collaborative analytical reasoning and interaction can then be declined in the following issues:

- shared use of information, by multiple users across multiple displays;

- adaptation to competences, roles, location, tasks, technical environment, of multiple users;
- conceptual consistency of information interaction across different displays, in space and time;
- representation of different layers of abstraction, adapted to tasks, users and displays;
- rights management and allocation policies considering private and shared working information spaces;
- representation of dynamic information spaces conveying situational awareness, and notifying about changes in information stream and patterns;
- visualization for information synthesis of multi-source, multi-dimensional and time-varying information streams into a single scalable representation.

Design of affordances for information

To enable users to process, analyze, reason-on and interact-with large amounts of dynamic data, new scientific principles for depicting information and interaction paradigms need to be defined based on cognitive and perceptual principles. In the Personal Computer environment, classical GUIs rely on visual cues and metaphors to suggest the interaction operated with mouse and keyboard on virtual information. In the real physical world objects provide affordances for manipulation. When dealing with novel interaction paradigms, enabling gestures, gaze, speech, haptic interaction, affordances for information dynamically spanning across multiple contexts need to be designed for users' construction of an interaction conceptual model [6]. The concept of affordances is familiar especially to product design, as in Norman [4]. Ecological approaches [3] focus on perception and

action based on human attributes: in this context affordances can be described as properties of the world defined with respect to people's interaction with it [2]. We perceive the environment directly in terms of its potential for action: in the physical experience we explore the outside world with our senses, making inferences of objects physical behavior thanks to a semantic of perception. Objects of everyday life already carry information per se: their shape, color, texture, weight, temperature, material, all the aspects related to their physical features. Designing affordances for large volumes of digital information in such a way to enable interaction and collaboration needs to identify the salient attributes of digital information and to represent them in a way suitable for analysis, understanding and action. Furthermore, information may appear differently when associated with different objects, or when assuming a different status. In this sense the representation of digital information should provide affordances that can be mapped to a certain status and suggest certain actions. The investigation of multimodal interaction techniques, when relying on the understanding of human attention, perception, memory and problem solving strategies, provides a powerful approach to the design of affordances for information spaces.

Workshop topics

This workshop aims to raise discussions on the topics by leveraging the shared experiences and different perspectives among the attendees. This promises to provide a multifaceted and comprehensive overview of the main work that has been done in this area, and of the challenges that interdisciplinary research still needs to cope with.

Themes that are relevant for this workshop include, but are not limited to:

- large displays: work on information visualization and interaction techniques for collaboration
- small displays: user interfaces for mobile visualization platforms;
- multiple displays: information visualization for interaction across different devices or/and locations;
- visualization and manipulation of information on wall displays, table-top displays, tiled displays, projection based displays, interactive rooms;
- shared displays: interfaces for multi-user interaction, allocation of interaction policies; input/output devices for collaboration;
- awareness displays: displays for peripheral attention; multimodal interfaces; kinesiology-based interfaces;
- perception, cognition, sense-making and reasoning supported by large information spaces.
- new collaboration patterns within and among communities: impact of large, shared as well as distributed and small in field displays on collaboration, education, social behavior and decision making processes; activity theory approaches; ethnographic studies; comparative studies on different domains and device technology.

Whom is this workshop for

Coherently with our focus on collaboration, we foster the exchange and interaction among participants from different communities, such as computer science, interaction design, arts, CSCW and CSCL, ethnography

and sociology, enhancing an interdisciplinary approach and cross-fertilization among communities.

The workshop will provide the opportunity for participants to establish contacts to draw and work on a shared research agenda. Participants both from academics and industry are invited to join in a synergetic collaboration, in line with Card's "use-inspired basic research" approach [1]: this should maximize the exploitation of existing understanding and existing technology, residing respectively in pure basic research and applied research and development, to achieve progress both in understanding and technology.

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