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Hands-on Haptics: Exploring Non-Visual Visualization Using The Sense of Touch

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INTRODUCTION

The explosion of software applications, digitally stored data and the subsequent growth in on-line communities, has frequently been denied to visually impaired and blind computer users due to the visual-centric nature of presentation methods employed. Haptic interfaces, such as force feedback and tactile devices, offer the opportunity to present dynamic “visualizations” in a non-visual manner to the sense of touch: whether the data being visualized is real-time stock exchange data in the form of a graph, maps from route-finding applications, or the progress of a multiplayer on-line game. In keeping with the 2005 conference theme of the relationship between technology and community, this workshop will explore ways that this information can be made available to visually impaired and blind users, or in situations within which visual feedback is problematic (when the visual sense is overloaded or otherwise occupied e.g. on the move, performing a visual monitoring task etc.). Haptic devices are also potentially useful as a means of providing extra parameters for use in multidimensional visualization for sighted users, in addition to visual cues.

The first devices for haptic force feedback were developed within the field of teleoperation, to provide tighter sensory coupling between a human operator and remotely operated robotic manipulator [3]. The introduction of the first commercially available force feedback devices in the mid-1990s, for example, the PHANTOM from Sensable Technologies [5] brought force feedback to the desktop. Subsequently, there has been an explosion in the number and variety of applications designed with haptic interaction. Previous workshops in this area have brought together researchers from many diverse areas including mechanical and electrical engineering, human computer interaction (HCI), perception and psychophysics, and art and design. For example, workshops and symposiums in 2000, 2002 and

2004 have looked at the issues facing haptics in the field of HCI [2], touch and blindness [1], and haptics in multimodal visualization (www.m2vis.org), respectively. A number of papers have appeared in CHI related to this topic, for example, Oakley *et al.* reported on the use of haptics as a means of reducing visual overload in a conventional desktop [6]. Sjostrom outlined a number of guidelines for using haptic technology to provide novel computer interaction techniques for visually impaired people [7]. Finally, Wall and Brewster discussed the use of material properties as a means of presenting numerical data in haptic visualizations [8].

These workshops and papers have highlighted the fact that haptic interfaces offer a potential means of making visualizations of data available to the blind and visually impaired community, and to provide an alternative to visual presentation of information in desktop applications. However, haptic approaches to visualization have, almost without exception, attempted to recreate common, visually-mediated representations of data, such as bar charts and line graphs. This workshop will encourage designers to think outside the box in terms of creating haptic visualizations. The haptic sense is different to the visual sense in many ways, including being localized to a small number of contact points with the external environment. Uniquely amongst the five senses, it is bidirectional, being able to interact with objects as well as sense their properties. The sense of touch is of a very high resolution, and is often socially loaded, or associated with non-verbal communication and expression [4]. Visualizations designed for the haptic sense should therefore be seeking to exploit potential benefits of these features, rather than pandering to established visual conventions. Locating the workshop within a CHI conference will promote interdisciplinary communication within an international environment, where a combination of industry, designers and users can contribute their unique perspectives.

This workshop is timely and important for the haptic research community, as haptic technologies have still to find widespread application outside “high cost, low volume” domains such as medical simulation and training, the oil and gas industries, industrial teleoperation and specialist 3D modeling and design applications. The availability of more compact, lower cost devices suitable for the desktop have put

force feedback interfaces within the reach of individuals and small to medium sized institutions such as schools and colleges, creating a potentially much wider base of users. Hence there is an increased need to develop heuristics, guidelines and standards for their use. This workshop will bring together practitioners from industry and academia focused on establishing guidelines for the use of haptics in visualization.

GOALS

This workshop will bring together a small group consisting of designers, developers and users of haptic interface devices, specifically in the context of visualization of numerical or other data in a non-visual manner. We are looking to attract attendees to stimulate exchange and brainstorming, with the following aims:

1. Review and discuss current examples of haptic visualizations with a view to identifying common solutions, new directions and unsolved challenges.
2. Collate shared experiences and results from designing with haptic feedback, designing and working with the visually impaired community, perceptual and psychophysical results with implications for designing using haptics.
3. Discuss whether haptic visualizations should be adopting conventions used in commonly encountered visual representations of data (for example, pie charts, bar charts, line graphs), or whether there are alternative designs more suited to the haptic sense.
4. Create tangible mock-ups which exemplify successful or promising design strategies identified by the workshop participants.

STRUCTURE

The workshop will consist of two days. **Day one** will be for participants to give their position statements in the form of a short talk but more importantly, a demo. The talk and demo will focus on the problems and potential solutions involved with haptic visualization. Hands on demos will be emphasized as this is a vital aspect of the workshop that would not be possible during a paper session or with a larger gathering of attendees. Discussion between participants following the demos and presentations will be encouraged. By the end of the day we will have a description of the problems, potential strengths and drawbacks of haptic presentation, and also some potential design suggestions/solutions.

Day two will be the hands on day! Participants will work together in small groups to produce one or more tangible mock-ups of haptic visualizations exemplifying the design solutions worked out during day one. The designs will not be competing as such, but it will likely be difficult to include all of the examples within one prototype. Raw materials for construction will be provided by the organizers, but

participants will be expected to design with whatever materials come to hand, by seeking out examples of objects that demonstrate haptic properties that can be incorporated in to the design to illustrate the principles. A spokesperson for each group will then present the prototype to the workshop members, followed by a discussion. At the culmination of the second day, and the workshop as a whole, the participants will have further refined the design solutions for haptic visualizations, and have documented examples of tangible mock-ups which can be taken forward for development with haptic interface devices.

OUTCOMES OF THE WORKSHOP

Outcomes of the workshop will be disseminated to the wider community using a SIGCHI Bulletin article, and will be made available on a public workshop website. The organizers will submit a summary paper to a suitable conference disseminating the findings of the workshop to the haptics community.

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