

Inventing the Future of Multi-Display Environments (position paper)

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INTRODUCTION

Multi-display Environments (MDEs) are now fairly common in entertainment systems, offices and meeting rooms. The possibility of combining several displays into the same interface has also captured the imagination of many in the interface design and research community because they offer three main advantages with respect to more traditional environments:

- Using several monitors is a fairly cheap way of increasing the user-system visual communication bandwidth (more pixels, added screen real estate)
- MDEs naturally support groups of people (e.g. by allowing private information to be presented in personal displays and common information in the shared space)
- MDEs can integrate displays that are adequate to serve specific tasks (e.g. tabletops for map analysis and tablet-PCs for taking notes)

These and other desirable properties can enable the design of future environments that are more efficient, flexible, and that enable better collaboration. However, it is not yet very clear what kind of applications or tasks are best supported by MDEs, or how to best combine multiple displays to form a consistent interface that will actually simplify tasks and empower users.

BOTTOM-UP APPROACHES

Most current research in the field of MDEs has focused on adapting operations that were present in ordinary desktop user interfaces to the new requirements of multiple discontinuous display spaces. For example, moving the cursor between displays [1, 10], passing application windows around displays [2], and adapting the representation of information to complex display environments [11]. The assumption under most of this research is that, by solving the problems that existing paradigms cause in MDEs, one at a time, we will eventually achieve interfaces that are better than the original start point.

This type of bottom-up research is important, and is already helping to shape the second generation of MDE interfaces; however, it has some inherent problems on the long run: it only expands current interface paradigms (e.g. windows,

menus, pointers) which might not necessarily be optimal for MDEs; it does not take into account ways of accomplishing tasks that might arise from the new application scenarios (collaborative, co-located); and it generates a multiplicity of solutions that are difficult to evaluate, compare to each other, and combine into a consistent unified interface.

TOP-DOWN APPROACHES

Starting in the 1980's, a number of co-located decision support systems [6], and smart rooms [14, 17, 4] have been created that intend to support actual use scenarios. Although these systems can help us understand the challenges of building software and hardware for actual groups in real settings, this kind of top down research also has important drawbacks. For example, the technical challenges involved (network infrastructure, application migration) usually take precedence over exploring novel interaction paradigms, and the implementation details limit the type and amount of interaction techniques that can be tested, usually defaulting in mere extensions of traditional interfaces.

THE FUTURE OF MULTI-DISPLAY ENVIRONMENTS

I believe that the MDE research community has now the opportunity to fill in the gap in between dominant bottom-up and top-down approaches and generate a new breed of interfaces that can revolutionize the way we support collaboration in co-located spaces. In my opinion, this will require experimenting with a new set of ideas and paradigms based on interaction and collaboration that depart significantly from current established interaction techniques and standard WIMP interfaces.

At the same time, we will have to create prototypes of these new paradigms that do not take a lifetime to build, but provide enough fidelity that will allow us to evaluate the merit of the idea. Determining what the right level of detail is for the implementation of the new paradigms will be a major challenge, but the hardest challenge is obviously to figure out what kind of paradigms and radically new approaches can be useful in collaborative MDEs.

Although it is soon to even preview these new MDEs, there are plenty of sources of inspiration to come up with new ideas around which to organize new MDEs:

CSCW theories

Theories of collaborative work have already been applied to design groupware systems (e.g. [5]), however, with current technology and new theoretical developments we can start rethinking how to support the actual process of collaboration and moving away from the artifacts of collaboration that we have been using so far (documents, communication channels, etc.) Can we design interfaces that represent the data in the same way that groups of people represent it in their heads? Can we organize communication in the group so that it takes the appropriate modality at each moment, without disrupting the natural flow of work?

Rethinking the concept of display

In the WIMP world a display is an array of pixels that represents graphical information to the user. Taking a broader look at the concept of display (e.g. [12]) can help us get out of the box of cursors and windows into new ways to organize interaction, visualization, and collaboration. Are displays separate entities or do combinations of them form larger entities? Can we think of displays combined with people as data processing units?

Find the synergies of new display types

The last decades have seen important advances in the form factors and technologies that displays can adopt (e.g. tabletops, small displays, electronic paper, projected interfaces, pen-based input, non-flat displays or three-dimensional displays). Some researchers have already found new synergies between existing display types (e.g. portable devices and tabletop displays [18], vertical displays with tabletop displays [3], portable devices and large displays [16]), but there is a number of combinations of display types that have not yet been explored. Can we find new ways to interact with a combination of 2D and 3D displays? Can we use mobile displays as navigation guides for data presented on fixed displays? What value do flexible displays add to collaborative situations?

EXPECTATIONS FOR THE WORKSHOP

I believe that the “Beyond the Laboratory: Supporting Authentic Collaboration with Multiple Displays” workshop can be useful to find a number of interesting scenarios for MDEs, to spawn new ideas on how to organize MDE interfaces and, in general, as an ideal venue to generate discussion on how to improve co-located collaborative systems.

EXPERIENCE

At the Interaction Lab, University of Saskatchewan, we have pursued an active MDE research agenda for more than 4 years. Research includes the evaluation of interaction techniques for cross-display reaching [7], analysis of multi-monitor cursor transition [8], the design of new techniques for object manipulation in MDEs [10], the design of visualization techniques for complex MDEs [11], and the analysis of fundamental effects on co-located collaboration [9, 13].

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