Primitive Interaction Tasks for Multi-Display Environments (PrIME): A Hands-on Approach

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ABSTRACT
Cross-display interaction is a challenge for HCI researchers, because a naive adaptation of mechanisms in single-display workspaces might be inappropriate for teamwork in multi-user multi-display environments. In this paper, we identify a set of primitive cross-display interaction tasks, which, so far, have not been addressed in the literature. Additionally, we present our ideas to design a prototype that incorporates the identified primitive tasks, using an iPhone as a mobile input device with an integrated display.

Categories and Subject Descriptors
H.5.2 Information Interfaces and Presentation: User interfaces–Input devices and strategies, Interaction styles.

General Terms
Design, Experimentation, Human Factors.

Keywords
Input device, cross-display interaction, multi-display environment.

MOTIVATION
Meeting rooms are nowadays increasingly equipped with many displays in different sizes and with a variety of functionalities (e.g. touch sensitivity). This results in “coupled displays” [1] in the room, introducing new challenges for cross-display interaction.

Multiple displays are beneficial in collaborative work, or presentation sessions. For example, in a presentation meeting, one might want to show data about accidents in one particular year and at the same time show the geographical locations of these accidents in Google Earth on another display. Further displays could show a table of accident costs and impacts. Even though in most cases such a multi visualization option is possible when the displays are all connected to the same computer, the configuration of views is time-consuming. An intuitive interaction method is required in these situations.

Interaction in MDEs can be divided into two types: within-display interaction and between-display interaction. Within-display interaction includes the method of interaction well known from single-display workspaces. Between-display interaction (also known as cross-display interaction) includes a specific set of interaction tasks that can only be performed when two or more coupled displays are available; for example transferring an object from one display to another.

Between-display interaction is a challenge for HCI researchers and interaction designers and therefore is our research focus.

OUR CONTRIBUTION
As the first part of our research we identify the following primitive kinds of between-display interaction that are inspired by existing multi-display applications:

- **Object selection**: Selecting one or more objects from one or more displays
- **Object transfer**: Moving an object from one display to another
- **View management**: Viewing a selected area on another display as a new workspace
- **Visualization gallery**: Selecting objects for generating a new visualization of the data set or their metadata on another display.

These cross-display interaction primitives are a good basis for interaction designers, especially to design and evaluate a new input device for MDEs.

The second part of our research is to build a prototype that incorporates the interaction primitives in MDEs. We have selected the iPhone as an input device. Additionally, the system is aware of the orientation of the user (device), using the OptiTrack tracking system with attaching markers to the iPhone. This information is used to control the cursor.

Designing and evaluating this prototype helps the HCI community and us to answer the following research question which the state-of-the-art techniques have left unanswered:

Does a mobile input device with an integrated display improve performing cross-display interaction primitives in collaborative work?

REFERENCE