Compass: Interaction Technique for Distraction Free Search on Large Displays

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Abstract
Searching of data elements on wall-sized, high-resolution displays, while analyzing spatial data sets, can become troublesome if the number of elements is vast. Common approaches, like highlighting, perform well for single user scenarios. Such feedbacks, however, are of distractive nature, since their main purpose is to attract users' attention. Therefore, if multiple users share the same display, then visual feedbacks can become a source of interference and, as a result, lessen overall effectiveness of the team. In this paper, we propose an interaction technique that makes use of synchronized information displays (a wall-sized display and a tracked smartphone) to visualize a virtual compass. The compass informs the user about the approximate direction of the target from user's current position. We also describe an experiment we are going to conduct in order to evaluate the technique.

Author Keywords
Interaction technique; Visual search; Large, high-resolution displays; Tracking; Mobile device

ACM Classification Keywords
H.5.2. Information interfaces and presentation (e.g., HCI): Graphical user interfaces (GUI);

Introduction

Wall-sized, high-resolution displays in conjunction with physical navigation allow for multiple user exploration and analysis of large, spatial data (e.g. maps, graphs) in more intuitive and effective way 1. They allow very accurate transition from focus (more details) to context (more content) by going away from a display, and vice versa by coming closer to the display. Using a mobile device as a personal display, the user can also visualize some objects of interest in a different way, or call up more information on the object 7. To do so, the user has usually to select an object of interest on the large display first. If, however, the interaction flow proceeds the other way around (e.g. the user selects an object from a list on the mobile device, and wants to find it on the large display to investigate it spatial relationships), then it is necessary to provide a visual cue about the object's location to the user. Such visual cues projected on a shared display can, though, have a negative effect in some multi-user scenarios 6.

We consider three types of multi-user work: *entirely engaged*, *mixed-focus collaboration*, and *entirely disengaged*. *Entirely engaged* type describes a situation whereby all team members work together on the same task and are aware of collaborators' actions. Hence, visual cues on a shared display will rather provide a positive effect.

Mixed-focus collaboration type defines a type of collaboration whereby participants change frequently between individual (partially disengaged) and group tasks (entirely engaged) 3. Visual cues on a shared display will ensure useful workspace awareness for users, while working on a group task 4. During the work on an individual task they might become an interference, though.

Entirely disengaged type means that users work on the same data, but do not collaborate with each other (e.g. they have totally different tasks). In that case visual cues on a shared display will exert a negative influence on users' performance.

We propose and evaluate a distraction-free interaction technique that utilizes the concept of synchronized information displays 2, 5. A mobile device and a wall-sized display are synchronized to provide personalized information to the user about the location of a particular data element. The generated cue is based on the well-known compass metaphor; it enables users' navigation in front of wall-sized displays by means of indication of a direction.

Compass - Prototype

Compass is an interaction technique that can be integrated into an application in order to aid the user in search of information on large, high-resolution displays. To evaluate the compass interaction technique against common approaches, we build a prototype system. The system comprises the following hardware components: a wall-sized, high-resolution display; an optical tracking system, which allows tracking of multiple targets in front of the display; two smartphones that runs a compass client. The smartphones were additionally equipped with reflecting markers, thus allowing the system to detect their position and orientation.

The main application of the prototype visualizes a large graph on the wall-sized display, and allows to highlight individual nodes of the graph. Additionally, we integrated

a compass server component into the application. The compass server is able to: receive requests from a compass client; make use of the tracking system to determine the position and orientation of a smartphone running the client; calculate the direction vector from the current position of the smartphone to a point on the large display, that represents the center of a requested node; convey the direction vector to the compass client. The smartphones run the compass client application that visualize the compass widget and allow to make requests for arbitrary nodes to the compass server. Figure 1 depicts schematically the compass client application visualizing the compass widget.

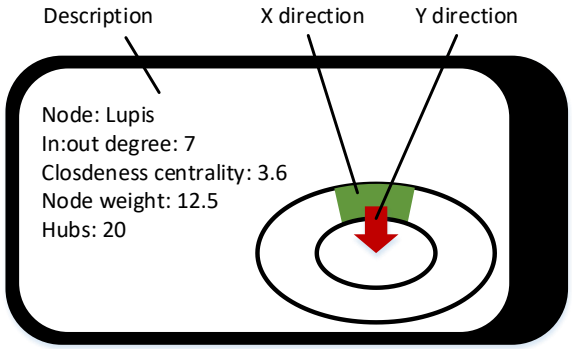

Figure 1 A smartphone running a compass client application that visualizes the compass widget

Experiment

Apparatus

The experiment is performed at a large curved tiled display wall comprising 35 LCD displays, ordered through a seven (column) by five (row) grid. Each of the columns has a relative angle difference of 10 degrees along the Y-axis to adjacent columns, as such creating a slight curvature. Each LCD display has a bezel of less than three millimeters, minimizing the visual rim effect. The LCD displays are 46” panels with a 1080p resolution, resulting in a total of 72 megapixels. The installation was driven by a cluster of three PCs, each equipped with three GeForce GTX 780 Ti, providing a total of twelve outputs per PC. This small cluster could run the Unity3D based graphics application used for the experiment fluently. A tracking system of seven ARTTrack cameras allows tracking of multiple targets in front of the display.

Task Description

The participants have to locate graph’s nodes on the wall-sized display described in the previous section. There are 30 nodes per condition to find. Each node on the wall-sized display is depicted as a circle with a unique symbol and a 4-figure code. Each participant is provided with a list of the nodes to locate. The lists contain only the symbols of nodes. Once a participant identified a node he has to enter the node’s code on his smartphone to confirm the finding. If the code was correct, the participant can proceed with a next node.

Method

We observe 12 teams of two persons each during accomplishment of search tasks on the large display. Each participant has its own list of nodes to search. This scenario mimics a typical stage of a mixed-focus collaboration 3, where team members work partially disengaged from other collaborators. However, it is not forbidden for participants to work together.

At the beginning of each search task (one node) the participants are at their initial positions (three meters away from the display, and one meter to the left/right

from display center). Once a participant found the proper node, he can either aid the partner or return to his initial position.

The experiment is of within-subject design with four conditions: *no cue*, *permanent on-screen cue*, *on request on-screen cue*, and *compass cue*. The *no cue* condition provides the user with no visual cue about the target node's location. In contrast, during the *permanent on-screen cue* condition the target is highlighted permanently on the large display. The *on request on-screen cue* gives the user a possibility to highlight the target on the large display by triggering a button on the smartphone. The target remains highlighted as long as the user holds the button. The *compass cue* condition makes use of the compass widget.

The *no cue* condition takes always place at the end of the experiment, while other conditions are mixed throughout the teams using the 3x3 Latin square.

We measure performance, and time of individual users and teams for statistical analysis. Additionally, we interview each user regarding perceived performance, workload, and the provided conditions.

References

1. Ball, R., North, C. and Bowman, D.A. 2007. Move to improve: Promoting physical navigation to increase user performance with large displays. *In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI﷽07). ACM* (2007).
2. Baus, J., Krüger, A. and Wahlster, W. 2002. A resource-adaptive mobile navigation system. (2002), 15.
3. Gutwin, C. and Greenberg, S. A Descriptive Framework of Workspace Awareness for Real-Time Groupware. *Computer Supported Cooperative Work (CSCW)*. 11, 3, 411–446.
4. Gutwin, C. and Greenberg, S. 1998. Design for individuals, design for groups: tradeoffs between power and workspace awareness. (1998), 207–216.
5. Rukzio, E., Schmidt, A. and Krüger, A. 2005. The rotating compass: a novel interaction technique for mobile navigation. (2005), 1761.
6. Tse, E., Histon, J., Scott, S.D. and Greenberg, S. 2004. Avoiding interference: how people use spatial separation and partitioning in SDG workspaces. (2004), 252.
7. von Zadow, U., Büschel, W., Langner, R. and Dachselt, R.I.M.L. 2014. SleeD: Using a Sleeve Display to Interact with Touch-sensitive Display Walls. (2014), 129–138.