

Orientation and Gesture on Horizontal Displays

Russell Kruger, Sheelagh Carpendale

Department of Computer Science, University of Calgary,
2500 University Dr. NW, Calgary, Alberta, Canada
{sheelagh, krugerj}@cpsc.ucalgary.ca

Abstract. Orientation has been recognized as a significant issue for software for horizontal displays. When people stand around a horizontal display, they view the contents from different angles. A common approach to this problem has been to orient objects towards the user who has currently selected them. In contrast, our observational study indicates that there may be many positive uses of variant orientation. Adjusting the orientation of objects can be used to establish personal space, create a public space, and is used as a significant part of gestures that direct comments, ask for help, and indicate interest. Many of these orientation adjustments or gestures are partial in that an angle is chosen somewhere between ideal for both people, and temporary in that objects are frequently rotated back. This indicates that it may be important to support partial and temporary rotations in order to provide people with the opportunity to use this type of gesturing when collaborating on a tabletop display.

1 Introduction

Orientation is frequently a concern when switching from a vertical display to a horizontal display [1,2,4]. It has been seen as a problem on horizontal displays because when people are seated around a horizontal work surface they see objects from different angles. Objects are the ‘right’ way up for some people and not for others. Most approaches to this orientation problem on tabletop displays have tried to orient objects according to the position of the current user. Personal Digital Historian [2] provides a circular tabletop display on which objects are laid out circularly with down considered as away from the centre. No matter from which direction you approach, the closest objects will be right way up for you. In ConnecTables [3], which are formed by linking small personal displays together to create a tiled larger display, objects are oriented in each section for a person located at the base of the section. Also, neural nets have been used to recognize a user’s stylus orientation and use this information to adjust the orientation of the objects when they are selected [1].

Tang [4] has observed that variant orientation on a horizontal work surface is not always a negative factor. He noted the familiar problems of people seeing things at odd angles and having difficulty reading and annotating because of this. However, he also noted that using someone else’s alignment conveyed support, that orientation was used to establish the intended audience, and that orientation was used to create a personal space. In our observational study we see similar uses of orientation.

2 Observational Study

In order to get a better understanding of the similarities and differences in how people use physical tables, electronic table-displays and vertical displays, we have

conducted an observational study. Pairs of participants were asked to make several puzzles: two on a physical table, two on an electronic table-display, the e-Table, and two on an upright display. In each condition one of the puzzles contained oriented information such as text and the other was composed of non-oriented information such as geometric shapes. To enable collaboration in both of the electronic conditions, each participant had their own mouse (Figure 1). The participants worked on the puzzles together without interference and the entire session was videotaped. There have been eight of these sessions, six of which have been videotaped. The issues discussed in this paper come from initial observations of this video data.



Figure 1: two people making a photographic image puzzle on the e-Table

3 Orientation Issues

This discussion draws from our initial observations of face-to-face collaboration in the puzzle study session just described. Many of our observations agree with Tang's dissertation on design activities for small groups [4]. At first one might think that orientation would have a negative effect on horizontal displays. Instead it seems merely as if it is different. Orientation seems to be one of the ways that people establish a sense of personal and public space. Personal objects are kept close and oriented appropriately for the person they belong to. Group objects are oriented according to what the group has decided is to be the accepted orientation. Use of orientation goes further than this. People can enter a particular piece into the current discussion by changing its orientation either for the other person or in-line with the group orientation. If an object is turned and aligned with the established group orientation it seems that others become more likely to feel free to pick it up. Also, orientation is used to make directed comments. An object can be rotated so that it is correctly oriented for a particular person. In this case, this motion is usually accompanied by a directed comment. As well, people indicated their interest in a piece being held by the other person

by tipping their head towards the correct orientation for that particular object. This gesture is usually noticed and responded to.

Most of these gestures in change of orientation are partial and temporary. They are partial in that the change of orientation is often not complete but sufficient to make it easier for the other person to see without totally compromising the person who is showing it. They are temporary in that these objects are often then turned back or aligned with the public objects.

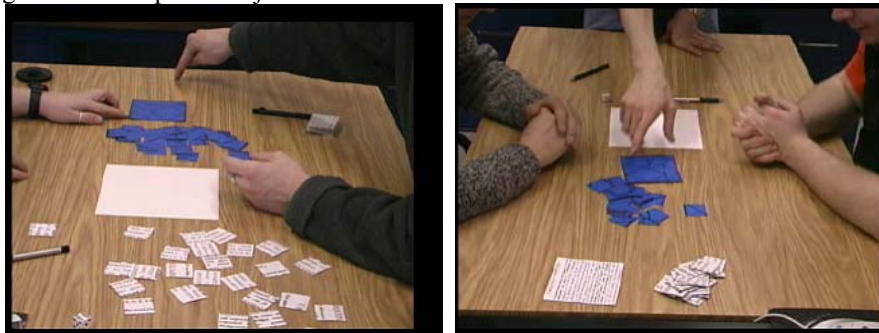


Figure 2: both of these images show the gestures used during a discussion establishing group orientation

Uses of variant orientation

- **Establishing group space.** The group decides what is to be the established orientation. This seems to take place with great ease. Often it is decided as people are sitting down. Most but not all people say that they really do not mind what their relationship to the established global orientation will be. In fact, being comfortable working when the global orientation is 'upside down' for them is a skill some people are proud of. However, this feeling that orientation did not matter usually changed as their work progressed, with most participants ending up saying it was a problem.
- **Establishing private space.** Orienting objects so that they are just right for oneself seems to be one way of establishing a personal space. Objects oriented in this way are, after all, actually harder for other people to see and read.
- **Orientation as a gesture.** This is one of the ways that people move objects from personal space into group space. Also, aligning an object so that it is just right for another person is a way of directing communication towards a particular person. Rotating part way towards another person is a way to try and establish collaboration. Partial rotation seemed to invite interaction. Figure 3 illustrates an incident of this nature. Participant A partially rotated the image of the finished puzzle. Participant B responded. Participant A turned the piece so that text was fully aligned for participant B. Participant A read (upside down now). Participant B assembled pieces. This seemed to be an effective strategy both were comfortable with.

Personal rotation of an object that is being held was very frequent and at times seemed almost continuous. Use of variant gestural orientation seemed to generally enhance cooperation. It would appear that orienting objects towards the current user would be important in allowing a user to establish their personal space. However, automatically orienting all objects, even if they are ‘correct’ for each user may interfere with natural uses of changes in orientation in gesturing to collaborators.



Figure 3: Two variant uses of orientation: The left image shows a partial rotation and the accompanying head gesture on the part of the recipient. The right image shows one person fully rotating an item, aligning it specifically for the other person

4 Conclusions

Our observations are leading us to consider that variant use of orientation may be an important factor in how horizontal work surfaces are used and have led us to consider both positive and negative aspects of orientation. It appears that some of the positive aspects of people’s use of orientation include rotating objects away from themselves. It appears that adjusting orientation is often an important part of a larger communication gesture. We consider that ability to make these gestural uses of orientation may be important to preserve on a table-top display.

Acknowledgements

This research was supported in part by Intel Inc. and National Sciences and Engineering Research Council of Canada (NSERC).

References

1. Hancock, M. S. (2001). A Feed Forward Neural Network for Determining a User’s Location. *Simon Fraser University Technical Report TR 2001-2*.
2. Shen, C., Beardsley, P., Lesh, N., and Moghaddam, B. (2001). Personal Digital Historian: User Interface Design. *Extended Abstracts of CHI’01*, pp. 29-30.

3. Tandler, P., Prante, T., Müller-Tomfelde, C., Streitz, N.A., Steinmetz, R. (2001). ConnecTables: Dynamic Coupling of Displays for the Flexible Creation of Shared Workspaces. Proc. of UIST'01, pp. 11-20.
4. Tang, J. Listing, Drawing and Gesturing in Design: A study of the use of shared workspaces by design teams. Research Report SDL-89-3, Xerox Palo Alto Research Center, Palo Alto, California.

Biographies

Sheelagh Carpendale is an assistant professor in the Department of Computer Science at the University of Calgary. Though her current professional focus is computing science she has a background in both arts and sciences. She initially opted for fine arts, studying at Sheridan College, School of Design and Emily Carr, Institute of Art and Design. For ten years she worked professionally in the arts, teaching 3D arts at Humber College and was involved in establishing the Harbourfront Arts Centre at York Quay, in Toronto. Subsequently she has reconnected with her interests in math and science and completed her BSc and PhD in Computing Science at Simon Fraser University. She has found the combined visual arts and computing science background invaluable in her research.

Russell Kruger is pursuing his MSc in Computer Science at the University of Calgary under the supervision of Dr. Sheelagh Carpendale. As part of his undergraduate honours thesis, he designed and empirically evaluated a tabletop display known as the e-Table. Work on the e-Table involved the research goal of understanding the design space of physical and electronic tables. In particular, the focus was on articulating foundational issues that describe the unique characteristics of tables and what people can do with them. From this, several key areas of interest emerged, including horizontal orientation, and collaborative issues.