Publ. in: ITS '10 ACM International Conference on Interactive Tabletops and Surfaces, pp. 263-264, doi>10.1145/1936652.1936707

ScatterTouch: A Multi Touch Rubber Sheet Scatter Plot Visualization for Co-Located Data Exploration

Mathias Heilig, Stephan Huber, Mischa Demarmels, and Harald Reiterer
University of Konstanz
Workgroup Human-Computer Interaction
Universitätsstraße 10
78457 Konstanz, Germany
{mathias.heilig, stephan.huber, mischa.demarmels, harald.reiterer}@uni-konstanz.de

ABSTRACT
This paper introduces a touch-sensitive two-dimensional scatter plot visualization, to explore and analyze movie data. The design focuses on the ability to work co-located with several users. These are able to create several focus regions through distortion techniques triggered by multi touch gestures. Furthermore, the introduced visualization is an example how promising concepts from InfoVis research can be transferred onto multi touch tables in order to offer more natural interaction.

ACM Classification: H5.2 [Information interfaces and presentation]: User Interfaces. - Graphical user interfaces.

General terms: Design, Human Factors

Keywords: Visualization, Tabletop, Fisheye Distortion

INTRODUCTION
In the last decades the InfoVis research community introduced a lot of promising visualization concepts, for example to explore and analyze complex information spaces. Most of these concepts are designed for single users that use desktop PCs, operated by keyboard and mouse. However, social activities like discussion or consultation are very important aspects during information work [1]. Until now, visualization concepts that support co-located collaboration and thus offer possibilities to execute social activities are rare.

SYSTEM CHARACTERISTICS
In this paper we introduce a the ScatterTouch system that is designed for co-located exploration of data. To democratize the interaction between multiple users, we decided to use a multi touch table (see figure 1). This technology is blended with a scatter plot visualization into a novel concept.

In the basic setting objects, represented by a visual thumbnail, are projected on a two-dimensional scatter plot. To showcase the ScatterTouch, movie data is used. The axes are assigned with the attributes "production year" and "rating"[1]. An all around labeling of the axes allows users to view and access the visualization from every side of the table. Via four semi-circular buttons (see figure 2 a), located respectively on every table edge, a flower menu can be accessed. The menu allows to change the assignment of the axes (e.g. from "production year" to "budget"), resulting in a smooth animation that repositions the movie objects.

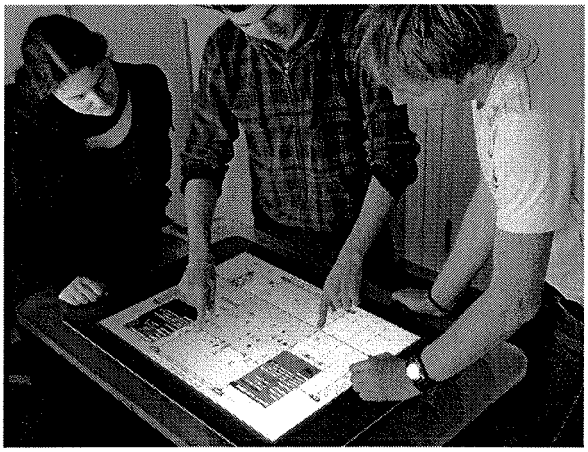

Figure 1: Three co-located working students using the ScatterTouch Visualization on a multi touch table. One student distorts the scatter plot grid to define a focus area for discussion. Two information objects are displayed up-scaled to access and compare the meta information.

Due to the fact that the grid of the scatter plot has only finite amount of space and the data points often exhibit areal concentrations in clusters, the ScatterTouch uses distortion techniques to solve this problem.

The distortion is based on a fisheye concept similar to the work introduced by Buering et al. 2006 [2]. Through the distortion of different regions of the scatter plot, it is possi-

ITS'10, November 7–10, 2010, Saarbrücken, Germany.

[1] The rating, as well as all other movie data originates from the Internet Movie Database (imdb.com)

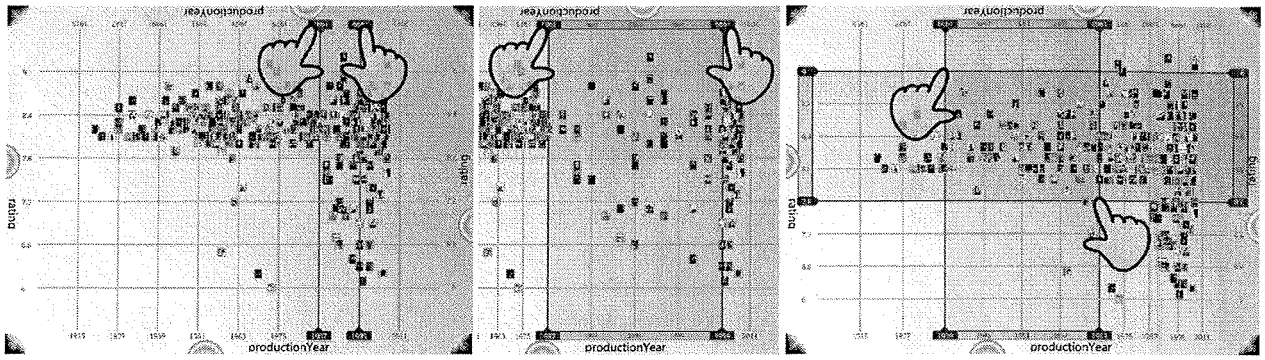

Figure 2: (a) By touching single or multiple labels or grid lines they will be activated for distortion; (b) Moving the activated lines result in a fisheye distortion; (c) A two dimensional distortion can be established by dragging two cross-points of the scatter plot grid.

ble to create a focus area that offers enough space for exploration.

In addition to the mentioned concepts, we utilize the rubber sheet interaction concept [3]. In analogy to a real-world rubber sheet users are able to stretch the grid of the scatter plot by finger gestures (see figure 2 a, b, c). By touching a grid line or label of the ScatterTouch, the grid is activated for distortion. To handle finger precision issues and to guarantee accuracy, the grid lines and labels with the lowest distance to the finger contact are activated. Moving the activated grid lines via one or two-handed spreading and pinching gestures execute the distortion of the scatter plot. During this process, the activated grid lines are virtually connected with the fingers and the grid distortion develops as smooth animation to help keeping track of the spatial arrangement of movie objects [4]. By means of the new generated display space, it is possible to fade in new, finer grained grid lines and labels. The data objects in this focus region are now untangled and users are able to explore them more precisely. As additional visual feedback, the distorted regions of the ScatterTouch are highlighted by a semi transparent layer behind the objects (see figure 2 b, c).

The traceability of the interaction steps executed by other group members is very important during collaborative work and is therefore supported through extensive visual feedback like highlighting of labels, grid lines and regions as well as smooth animation.

The grid distortion can either be accomplished in one dimension, by executing the spreading and pinching gestures on the labels (see figure 2 a, b) or in two dimensions, by executing the gestures inside of the scatter plot grid (see figure 2 c). Tapping on the highlighted area reverses the distortion, again animating the objects reorganization.

Furthermore, with the help of this distortion technique, we offer a tool to define several focus regions inside the scatter plot grid. This way, users are able to compare different regions in more detail. Besides, the users have the possibility to define individual foci.

To access detailed information of a single object, a finger tap on the visual thumbnail triggers an animated up-scaling of the object accompanied by a semantic zoom that reveals more information (see figure 1).

OUTLOOK AND CONCLUSION

This paper introduces the ScatterTouch, an interactive scatter plot visualization on a multi touch table to explore and analyze movie data in co-located collaborations. With the help of distortion techniques and natural gestures it is possible to define different foci in the scatter plot.

To improve the ScatterTouch, the gained space through the distortion could be better exploited by an automatic scaling of the movie objects according to the scatter plot grid. By means of this concept and semantic zooming, detail information of movie objects could be presented to the user without any explicit interaction. Furthermore, a user study to evaluate the ideas will be accomplished in future work.

Finally, the visualization demonstrates how multi touch technology and insights from the InfoVis research community can benefit from each other, especially in co-located work situations.

REFERENCES

1. Evans, B. M. and Chi, E. H. 2008. Towards a model of understanding social search. In Proceedings of the CSCW '08. ACM, New York, NY, 485-494.
2. Buering, T., Gerken, J., and Reiterer, H. 2006. User Interaction with Scatterplots on Small Screens - A Comparative Evaluation of Geometric-Semantic Zoom and Fisheye Distortion. *IEEE Transactions on Visualization and Computer Graphics*, 829-836.
3. Sarkar, M., Snibbe, S., Tversky, O. J., and Reiss, S. P. 1993 Stretching the Rubber Sheet: a Metaphor for Viewing Large Layouts on Small Screens. Brown University.
4. Bederson, B. B. and Boltman, A. 1999. Does Animation Help Users Build Mental Maps of Spatial Information?. In Proceedings of INFOVIS '99.