The Interactive Stardinates – Design Considerations

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ABSTRACT
We describe an interactive Information Visualization (InfoVis) technique called the "Interactive Stardinates". One main focus was to analyze and integrate the users' interactions into the design of the user interface. These users' interactions are classified in respect to the objects, which are manipulated. Currently, we are developing a tool that offers multiple views on the same data by using four different InfoVis techniques. The development of the Stardinates is done in close cooperation with two psychologists applying our tool to evaluate a clinical study of anorectic girls. Moreover, user studies, especially Ethnographic studies will prove the efficiency and applicability of the Stardinates.

Keywords
Interactive Information Visualization, cognition, design issues

THESIS RESEARCH SUMMARY
Information Visualization (InfoVis) is the use of computer-supported, interactive, visual representations of abstract data in order to facilitate cognition. The goal of InfoVis is to promote a more intuitive and deeper level of understanding of the data by using graphical representations such as Glyphs (compare InfoBug [7]) or other techniques [3]. We introduce the concept of the interactive Stardinates.

The Stardinates
The Stardinates are an interactive InfoVis technique, which combines the strengths of Parallel Coordinates [8] with the advantages of Glyphs. The name results from a compound of "Star" and "Coordinates" because the axes are arranged in a circle. Thus, the visualization looks like a star. The user can arrange four up to about twenty axes within one instance of the Stardinates. Each axis represents one attribute of the data thus every data record is visualized by a line (record line) along the corresponding data points. In contrast to Star plots [4] this technique can display many records within one instance. Like Glyphs a number of instances of the Stardinates are displayed side by side. This enables the user to visualize highly structured and multidimensional data. We think that the principles of the Gestalt laws [1] are a good starting point to create intuitively understandable visualizations. Therefore, the shapes of the Stardinates offer some advantages over Parallel Coordinates. Moreover, they can handle more complex data especially time-dependent data whereas the visualization does not look complex. However, our hypotheses about the perception of the Stardinates and their abilities and functionality have to be proven by user studies.

To mention one possible application we name the visualization of patient records in medicine. If the user wants to focus on temporal patterns and compare patients at the same time, she or he generates one instance of the Stardinates for every important day in the patients' history whereas every record line of one instance represents one patient. The user can compare the patients according to their therapeutic progress easily. Figure 1 depicts an example with a data set of five patients and three days based on five medical attributes. Patient A is highlighted.

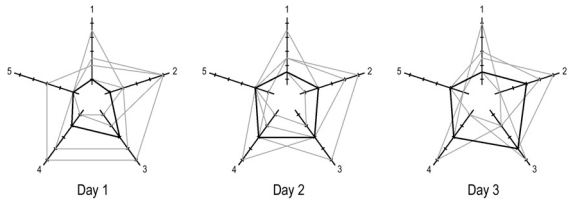

Fig. 1: Sketch of the Stardinates, axis 1: values range from 10 to 18; axes 2 – 4: values range from 1 to 5, always starting at the inner point of the scale.

There are several other fields of application, e.g., financial and business data, process visualization, industrial product engineering, environmental pollution, etc.

In InfoVis three different types of investigation techniques are distinguished: Presentation, exploration, and analysis. We focus on exploration and analysis. Exploration means that the user manipulates the visualization in order to get new insights into the data under investigation. In contrast to the process of analysis she or he has no concrete

hypotheses to prove. In both, exploration and analysis, interaction plays a very important role. Static visualization techniques could be suitable for presentations. Anyhow, InfoVis becomes more interesting if exploration is supported by direct interaction techniques. Therefore, we want to put the Stardinates interaction techniques in concrete terms in order to draw some conclusions for the design of the user interface. The Stardinates are a hybrid visualization technique combining geometric and glyph-based visualization with Focus + Context techniques [10].

Interactive Visualization

A variety of more general frameworks and taxonomies exist [6, 11]. Our approach for classifying interaction on visual representations is oriented on the objects of interaction. We think this is a good basis for both, the implementation and the concept of the user interface. The user could manipulate the axes, the record line, and an instance of the Stardinates or all Stardinates at once. The manipulation of one object could cause manipulations of the dependent objects. Examples for manipulating an axis are: Selecting an attribute of the data base and associating it with an axis; Adding or excluding attributes respectively the corresponding axis; Arranging axes; Changing the orientation of an axis; Defining the scales; Using the axis as a slider in order to filter data records. Manipulating a record line means: Highlighting by moving the courser over it in order to see the details; Highlighting or fading out one or more record lines by filtering; Linking and Brushing (selecting record lines in one instance causes the highlighting of corresponding record lines in the other instances automatically); Comparing with a reference star (standard values of a record line); Filtering based on the distance to a reference star; Comparing with the flat star. The flat star corresponds to a straight line of the Parallel Coordinates. This feature eases the recognition of straight lines within the Stardinates. Every manipulation of an axis results in mutations of record lines. Examples for handling an instance of the Stardinates are: Magnifying; Zooming out. Settings of the Stardinates are: Associating an attribute of the data base, e.g. date, patient id, etc; Changing the order or alignment; Specifying the size; Selecting the color of axes and record lines. These are the user interactions we consider to be crucial. Nevertheless, this list is not complete. To find out more details we need to do user studies. Ethnographic studies offer adequate opportunities – both, to facilitate program development and to evaluate the usability and efficiency. We are convinced that visualizations should be user-oriented and task-specific. Therefore, we need to investigate and describe the users and their tasks. Currently, we are working on a tool called LinkVis [9], which provides the user with multiple views on the same data by using four different InfoVis techniques, particularly, Chernoff faces [5], Parallel Coordinates, Scatter Plots, and the Stardinates. The user can select the most suitable technique or in multiple view mode two techniques in order to compare the visualizations. We assume that multi-view techniques offer enormous potentials to gain more insight into the data under investigation and to support the exploration and analysis tasks. In close cooperation with two psychologists we apply our tool to medical data in order to evaluate a clinical study of anorectic girls. “Linking and Brushing” and highlighting features enable the user to focus on details but do not lose the context.

Design Considerations

Interaction should be directly and combined with immediate respond because this gives the user the experience of exploring the data. Therefore, fast graphic and data base technologies are needed. We prefer the mouse courser as pointing device for handling the objects. The objects mentioned above need suitable features to support the manipulation processes adequately. Based on the users’ interactions the interface should be both, functional and simple. Applying psychology to design [2] cognition becomes a significant aspect of design decisions.

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