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Visualization and Interaction Techniques of the Visual Metadata Browser VisMeB

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Abstract: This paper will present a new visual information retrieval system for metadata and the interaction techniques of the new system. The abundance of information we get while analyzing search results of an arbitrary query has to be channeled. This can be done by different visualizations and filter techniques. We use a Scatterplot in combination with a so called SuperTable to support the process of finding relevant information in an intuitive yet multifunctional way. Visual filters and the interaction between the visualizations play an important role. By examples from a web and a movie database search features are demonstrated.

Key Words: Visual Information Retrieval, Metadata Visualization, Interaction Techniques, Scatterplot, SuperTable, VisMeB
Category: Information System Applications

1 Introduction

Many information visualization tools are restricted to a specific domain. For example, a web search engine like Google is used to find information in the world wide web. But there will be another tool to search for information in a database. VisMeB is able to handle these situations as well. There is no restriction to a specific domain. The testdomains so far were the World Wide Web, a database for geo-metadata and a movie database. The pictures below will show application scenarios using metadata of webdocuments and movies.
This paper presents our main ideas developing a visual information retrieval system named VisMeB (*Visual Metadata Browser*), using different visualizations and interaction techniques. It is developed in the framework of the EC-funded project INVISIP[1]. After this introduction, [Section 2] will summarize the development stage of the system. An introduction to the SuperTable + Scatterplot idea will be given as well as a short overview of usability study results and its consequences. [Section 3] will focus on the different visualization and interaction techniques we used, combining the two visualizations SuperTable and Scatterplot. In [Section 4] the related work that has influenced our own will be presented. Conclusions and outlook are given in [Section 5].

[1]INVISIP – Information Visualization for Site Planning, funded by EC, 5th Framework of the IST Program, Project No. IST-2000-29640, www.invisip.de

2 VisMeB - The Visual Metadata Browser

Two visualizations dominate the global appearance of our system: The SuperTable and the ScatterPlot. They unify the typically used result list of a search engine like Google with unique combinations of visualizations. The user has the opportunity to obtain a quick overview of the result set as a whole and explore relevant objects step by step. Through brushing and linking we can achieve synchronized visualizations. Two SuperTable versions are implemented, a Level- and a GranularityTable. A visual configurator, a browser view to show the documents' content and a query preview function complete the system.

The SuperTable itself consists of a combination of different visualizations. Barcharts, tilebars, and colored highlighted text are a couple of those. A more complete set of used visualizations can be seen in [Fig. 1], showing the SuperTable in the GranularityTable version. In this case the barcharts represent the relevance of single keywords, corresponding to the colors used in the legend (located in the upper left corner). But other numerical values like "Size in kB" can be mapped onto the bars, too. The tilebar view (Fig. 1, second row from bottom) is a schematic representation of the text, dividing it in segments (row in the tilebar grid) and highlighting the occurrence of keywords (e.g. here the words "City" in blue and "travel" in lightgreen).

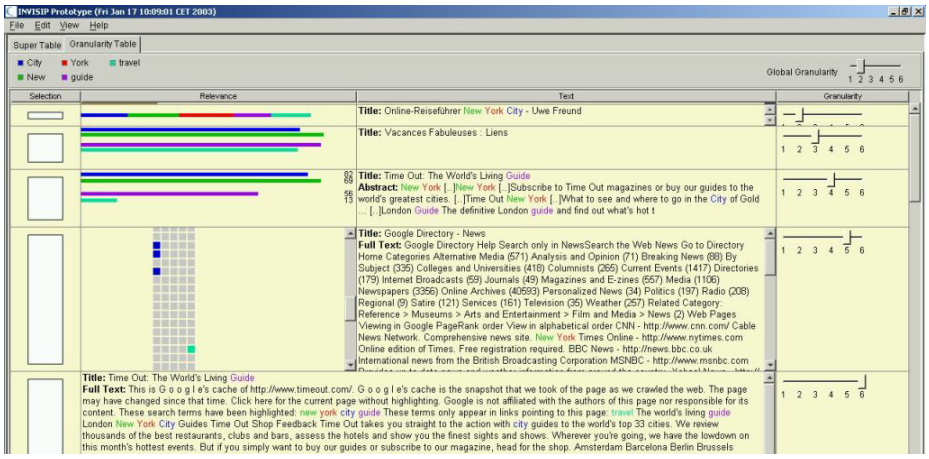


Figure 1: SuperTable realized as GranularityTable and its visualizations

Two design variants of the SuperTable were developed to find the most appropriate way to support the user finding relevant information. The idea behind those versions is a level concept which enables the user to change the depth of information he is interested in. The first level offers an overview of all documents, the last level shows the document itself. In between you find different levels increasing their amount of information from the first to the last level [see Fig. 1]. We named this drill-down functionality "Focus of Interest".

The first of those design variants is called *LevelTable* [see Fig. 2]. Every metadata has its own column, but not all metadata are visible in every level. One special example is the "Relevance Curve" [Fig. 2, fourth column from the right]. It represents the docu-

ment as a whole, whereas the width reflects the document's length. Important text passages are marked by vertical bars whose height illustrates the factor of importance. This metadata can only be seen in level 3. In return the "Language" or "Document Type" columns disappear in this stage. In the LevelTable, global buttons [Fig.2, upper right corner] are used to change levels. Pressing a button moves the documents in a body to the corresponding level.

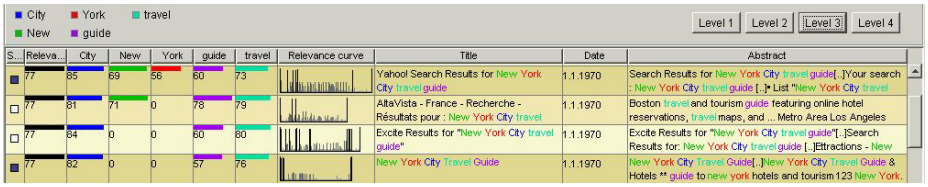


Figure 2: The SuperTable realized as LevelTable

The second design variant named *GranularityTable* [see Fig. 1] differs slightly from the LevelTable. Instead of buttons for level altering sliders are used to change from one level to another. The number of levels differs as well as you can choose between six . Only four columns are used to show all the information: selection, visualization, text, and granularity. The visualization as well as the text column change their display from level to level, always giving more information than the previous level. In this version it is possible to move single rows to another stage, not only the documents in a body.

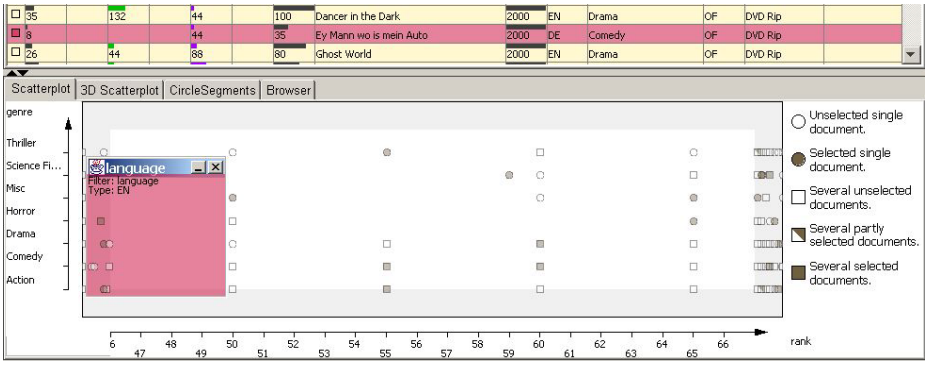


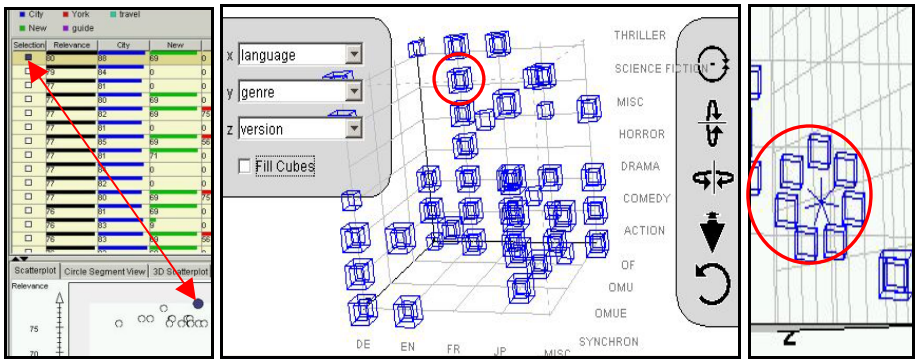
Figure 3: The Scatterplot, using a distortion technique and a Movable Filter

The ScatterPlot [see Fig. 3] is a twodimensional coordinate system enhanced by the possiblity to allocate the x- and y-axis with every kind of metadata used in the current context. It eases a comparison of document properties, for example document date, size or relevance. Using different colors for the datapoints adds another dimension to allow a faster perception of important facts as well as the usage of tooltips. Additional features like visual filters or distortion techniques are presented in [Section 3].
In the context of the INVISIP project, two evaluations (n=8; user tests with expert users from the expected INVISIP target user group and n=31; using an online questionnaire) were made in october 2002 with both SuperTable versions, implemented as clickable html-prototypes. Overall feedback was very positive, but

clickable html-prototypes. Overall feedback was very positive, but the limited interaction between SuperTable and Scatterplot (partially dependent on using html) was one major criticism, that led us to the interaction techniques described below. The fact that analytic working test users preferred the LevelTable version whereas browsing-oriented users more likely chose the GranularityTable strengthens us to enhance both variants in future. A detailed evaluation report is given in [Limbach et al. 2003]

3 Visualization and Interaction Techniques

Using a combination of SuperTable+Scatterplot enables the user to get a general idea of the entire result set as well as the possibility to explore interesting documents in detail. To reach this goal both visualizations are synchronized, using *brushing and linking*. This means that for example filtering out objects in the ScatterPlot leads to the display of only the corresponding objects in the SuperTable, or marking rows in the SuperTable marks the respective datapoints in the ScatterPlot [see Fig. 4a].
The Movable Filter [see Fig. 3], influenced by [Fishkin, Stone 1995], available in the ScatterPlot, effects on the SuperTable as well and provides the opportunity to filter out documents temporary (like a non-english movie shown in [Fig. 3]). Moreover, it is possible to use different lenses simultaneously what made it necessary to add half-transparent lensecolors. If objects are filtered out by the lense, the background of the corresponding objects in the table changes to the lensecolor [see Fig. 3].



(a) *(b)* *(c)*

Figure 4: Selection of objects in ScatterPlot and SuperTable (a), 3D-Scatterplot with opened (b) and closed MDP (c) (see red circles)

Zooming to a cloud of points has the same effect in the SuperTable as filtering out points by a global filter: only the zoomed objects are visible in the table.
In this context another technique is used to support the user not to lose the track of things – *focus and context* using distortion. A lightgrey frame surrounding the white main area of the ScatterPlot represents this context area [see Fig. 3]. Zoomed objects stay in the focussed center while remaining points are mapped to the lightgrey edge, keeping the same relative but compressed distance to another. Distortion in x and y direction makes it possible to display all datapoints in a correct proportion.

Apart from the 2D-ScatterPlot a 3D-ScatterPlot was realized [see Fig. 4b]. Here datapoints are visualized as 3-dimensional cubes. Using a light grid in the background for limitation and better orientation emphasizes the 3D effect. We are able to rotate the whole Scatterplot, zoom in a special area and select one or more datapoints using the mouse or the navigation arrows to the rightof the 3D-ScatterPlot. An empirical evaluation is planned to discover the advantages and disadvantages of the 3D compared to the 2D version.
Special attention was directed to the problem of datapoint overlapping in the ScatterPlot. Frequently, objects own the same metadata of specific characteristics (like the same size or language) what leads to the same position in the drawing area. Therefore we introduced a new glyph, the so called *Multi Data Point* or *MDP* to point this fact out to the user. [Fig. 3b] shows the 3-dimensional version, visualized as two interlocked cubes. At 2 dimensions, the circles are replaced by squares that are partially or fully color filled to indicate if some or all underlying datapoints are selected. If the user moves the mouse over these MDPs, the current glyph disappears and all base datapoints are positioned (ordered by an internal arbitrary numeration) on a radial arrangement around the center [see Fig. 4c]. Tooltips are available again for the single datapoints. Thereby, overlapping objects can be displayed and analyzed separately. Too many datapoints building a MDP can cause problems if they lead to a radius that would burst the available space or to a very small distance between different radial arranged points which makes it impossible to carry out a separate analysis. A possible solution is the use of an animation. The datapoints circle in an orbital path around the center of the MDP comparable to the rapid serial visual presentation [see Spence 2001]. Direction and speed can be varied. Details of the item being actually in the foreground normally shown by tooltips can be seen in a special text area.

4 Related Work

The primary system this work is based on has been influenced by many different systems. The SuperTable idea, explained in detail in [Klein, Mueller, Reiterer, Eibl 2002], was inspired by multifocal approaches using focus-plus-context techniques as can be found in a number of tabular data representations. Interactive tables like the Table Lens [Rao, Card 1994] or Focus [Spenke, Beilken, Berlage 1996] are typical examples. In both systems textual and graphical data representations are used simultaneously. The TileBars trace back to the work of [Hearst 1995]. The ScatterPlot has been influenced by different systems as well. Examples are visual information seeking systems like Envision [Nowell, France, Hix et al. 1996] or xFIND [Andrews et al. 2001] to name just a few. The *Movable Filter* was influenced by the idea of *moveable filters* by [Fishkin, Stone 1995]. Synchronisation of SuperTable and ScatterPlot via brushing and linking was inspired by the work of [North, Shneiderman 2000].

5 Conclusion and Outlook

The advantage of the presented system is its variety of visualizations used to support the user in his search process. New possibilities are given to find the most appropriate data for the current task in an environment users are accustomed to. The evaluation

proved that we are on the right way. A highly sophisticated data model enables us to adapt the system to a wide range of fields like stock market, medical data mining or geodata infrastructure. The browser view only used to show a single document so far will be extended by a thumbnail view giving the possibility to display and compare more than one document at the same time. *Panning and zooming* is another technique we want to introduce to the ScatterPlot to expand its feasability.

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