Analysing Data Trough Visualizations in a Web-based Trade Fair System

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ABSTRACT

The enormous amount of data available on the web must be adequately exploited by company managers in order to improve their business. An important role is played by various techniques that are capable of extracting useful information. Our approach exploits visualization techniques. In this paper we present 2D and 3D visualizations that are used in a web-based system that supports the organization and management of trade fairs. We show how the main users of the system, namely fair organisers and companies that participate in the fair either as exhibitors or visitors, take advantage of the available visual tools in their business activities.

1. INTRODUCTION

The evolving requests of the market and the increasing competitiveness force companies to support their business plans with structures capable to give the company managers the possibility to make decision in a rapid and more effective way. The expression Business Intelligence groups all disciplines aiming at providing decision support by transforming the information stored in huge distributed databases into knowledge useful to optimise the company processes as well as the customer relationships. Business Intelligence refers to concepts and methodologies for providing information to managers in a way that makes them able to take decisions for their business activities.

People get their knowledge from their education, their experiences, and their cultural context. The enormous amount of data easily accessible by the current technology provides information that integrates into peoples' knowledge. Presenting in appropriate ways information that can be extracted from various repositories enhances the possibilities of human beings to make decisions for performing their daily activities. Advances in information visualization offer promising techniques for presenting knowledge structures and for permitting explorative analyses of the data to allow users to extract the appropriate knowledge to support their business activities [2, 3, 7, 8].

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Knowledge visualization has various interpretations depending on the authors [5, 4]; in [5], knowledge visualization is defined as the visual explication of conceptual knowledge. It is based on understanding the domain knowledge, applying cognitive principles, encoding salient features graphically by exploiting the visual parameters. It is considered the intersection of three main areas that are cognitive science, graphic design, and information graphics. The cognitive science helps understanding the cognitive processes underlying perception, categorization, visual reasoning, communication, creativity, and motivation. The graphic design exploits the rich legacy of the knowledge and techniques developed in art and illustration. Finally, information graphics refers to the various graphs and diagrams visualizing quantitative information.

Several systems have been developed that address knowledge visualization issues, such as selecting appropriate similarity metrics and displaying high-dimensional structures. Often, visual representations are used to identify single elements in a large knowledge base and also to show explicit relationships between elements. The great advantage of visual representations comes from their capability of shifting load from the user's cognitive system to the perceptual system. Indeed, information needs to be visualized in an information space in order to be retrieved by users. This visualization can either be carried out by the users in their own mind, in which case it is essentially the users' conceptualisation of that information, or it could be accomplished by the system, in which case the visualization is generated on the display screen, thus reducing the user's cognitive load.

In this paper we present a selection of visualization tools available in the FAIRWIS system. They have been designed and developed in order to present in appropriate ways information extracted from the system repository, thus allowing the main actors of the trade fair domain to better exploit the extracted knowledge for improving their business activities [1]. The paper has the following organization: Section 2 briefly describes the FAIRWIS system. Section 3 and 4 illustrate the visualization tool used in FAIRWIS. Finally, Section 5 provides the conclusions.

2. THE FAIRWIS SYSTEM

Project and development of FAIRWIS (trade FAIR Web-based Information Services) have been funded by EU. The

objective of the system is to offer on-line innovative services to support the business processes of real trade fairs as well as to provide information services to main actors in the fair business organised in web-based virtual fairs. Up to now, information media for supporting trade fair events has been primarily paper-based. Booklets, flyers, maps, etc. are usually the means used to exchange information. Recently, Web sites have been created to provide information both on trade fair events and on companies participating in these fairs. However, these data are usually static and not organised in an integrated, homogeneous and comprehensive way.

In FAIRWIS, the whole concept of trade fairs is transferred into an electronic form, and visualisation techniques, including virtual reality environments, are used in order to provide "reality" feelings to the users of trade fair information systems, to allow the users to grasp the knowledge stored in the database, and improve human-computer interaction. The possibilities of on-line marketing analysis are also unusual in current fair web sites. FAIRWIS primarily addresses three types of users: fair organisers, exhibitors, and professional visitors, i.e., people who visit the fair for business reasons rather than for fun. Data analysis functionalities aim at providing a valuable help to these users in the different phases of the decision making processes they may undergo to improve their own business.

In this paper, we illustrate selected important functionalities of FAIRWIS, namely navigation among virtual reality representations of the fair, and visualization and easy access to the data stored in FAIRWIS database, which include data about companies involved in the fair. We will refer to activities strictly related to the fair, such as stand planning, and also to marketing activities that can be carried out even beyond the fair. For example, company managers can be interested to access the data stored in the FAIRWIS database in order to retrieve a set of companies of interest. Once an appropriate set has been identified, they can use names and addresses of these companies to start a specific marketing campaign. The system FAIRWIS provides a module that allows them to compose e-mail messages. These messages will be sent to all companies previously identified for the campaign.

3. VISUALIZING DATA FOR ACTIVITIES WITHIN THE FAIR

Within the FAIRWIS system, the graphical engine permits to dynamically generate databased 3D visualizations. The aim of such visualizations is not only to provide a map of the fair, but, actually, to support important activities of the users, such as booking, stand planning, etc.

In the process of perceiving information spaces, 3D display methods can be usefully adopted for managing large sets of objects because they take advantage of natural human skills for spatial perception, orientation and spatial memories [9]. 3D visualizations enable making the screen space "larger" and "denser" [10], since a bigger amount of information objects can be arranged on the same screen space. 3D space naturally provides a mean to organise data and control the complexity; objects located far from the current user's position appear smaller and obscured, whereas close objects reveal details, concealing other distant objects. Simply by moving in space, users get information, or zoom into details, quickly accessing information.

The 3D environment is intended to become an emancipated element of the graphical user interface supporting users in all their important business activities. The upcoming scenarios on navigation support and stand planning illustrate possible uses of interactive 3D information visualization in business applications within the domain of trade fair business.

3.1 Navigation Support

Users highly depend on proper maps of the exhibition in order to orient themselves. Nowadays these maps come printed on paper and mostly show the immobile layout of the fair venue and the functions of its entities like, e.g., parking places, entries or bistros. Other maps visualize the arrangement of thematic areas on the location. Only a few maps display the location of single exhibitors in the halls and on the outer areas. FAIRWIS provides not merely for a better map of the fair venue but for significant representation of the exhibition. This functionality supports real fair events, showing the user, in a well-directed way, where specific items are found in the fair venue and how they are organised in the overall context.

Let us assume a professional visitor with a special interest in exhibitors coming from Spain. The exhibitor catalogue is structured by exhibitor name and geographical region. FAIRWIS offers to browse the catalogue according to these categories. For the geographical index, sensitive images allow to select the region from a graphical image map. As a result of this browsing activity, the user arrives at a set of exhibitors from a specific country. The traditional FAIRWIS user interface displays this result set in text list format using standard web pages (see upper part of Figure 1). The textual result list comes with links that invoke 3D visualization showing the location of their stands on the fair venue. Links attached to an exhibitor highlight this single exhibitor's stand within the 3D visualization; links attached to a group of exhibitors highlight all corresponding stands within the 3D visualization (lower part of Figure 1). The virtual worlds built up are hierarchically structured. For the fair domain the levels are (i) fair ground, (ii) hall or outer area, (iii) stand, and (iv) product. When exploring the visualization, the user is always situated at one of these hierarchy levels. Only the elements of the current and the next lower level are displayed, e.g. one hall and all its stands, as shown in Figure 1. Clicking on a stand, the user moves into a specific branch one level deeper in the hierarchy, the visualization is updated and the user can now inspect that part. For updating the scene, the graphical engine either manipulates the current scene or switches to another scene. Users can also maneuver up in the hierarchy again. Clicking on a stand lets users enter the virtual stand of the exhibitor, if this 3D model exists.

3.2 Stand Planning Support

During the fair preparation, exhibitors need to shape and organize their appearance at the event. Typically, they first book stand space of a specific size. The exact location of that stand is negotiated between the fair organiser and the exhibitor during the planning phase. The organiser, respon-

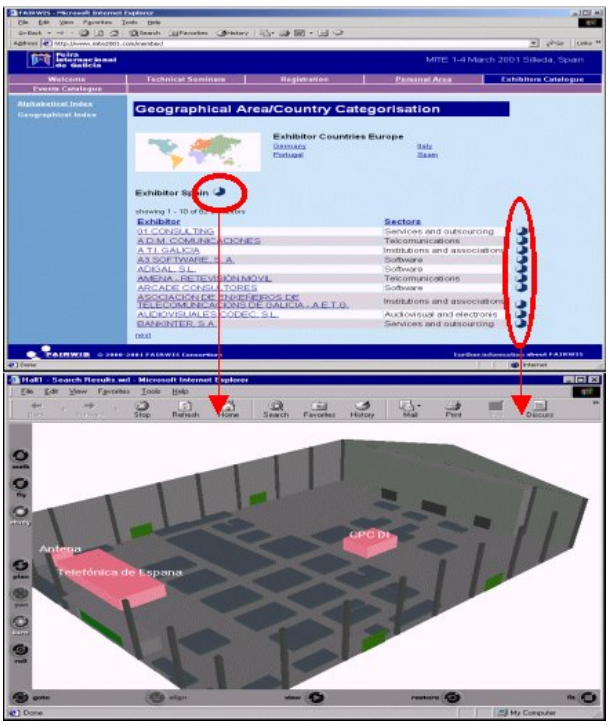

Figure 1: Example of stand location visualization.

sible for the overall set-up, structures halls and outer areas on the fair venue and proposes spots.

For stand selling, FAIRWIS displays the current status of the fair venue space assignment within a 3D virtual representation of the actual physical fair location. Spaces already assigned to other fair participants are displayed as occupied. Additional information can be visually encoded: areas on the fair venue dedicated to a specific topic are indicated as coloured planes and the prize of offered spots is proportional to the displayed height of stand locations. Side by side, FAIRWIS lists stand properties in a text area.

Let us assume an exhibitor organizing his fair stand. Calling the FAIRWIS stand planning function, he can recall his current individual space order and alternative stand locations proposed by the fair organiser. Whereas the 2D interface lists exact detailed information, the 3D environment is most suitable to instantly grasp the surrounding of stand locations and compare their prizes. As another benefit, the look of the designed stand can be evaluated within the virtual environment, given that the exhibitor did provide the 3D model. By point & click on the 3D environment, the exhibitor can reserve a space. The stand identification number, name, or coordinates, respectively, are fed into the space planning function of the FAIRWIS core system.

4. VISUALIZING DATA FOR ACTIVITIES BEYOND THE FAIR

We illustrate a FAIRWIS module that provides support for a variety of analyses of the stored data. This module exploits visualization techniques in order to give users the possibility to quickly understand the content and the structure of the

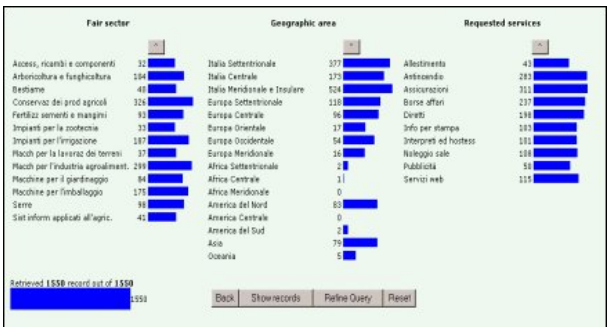

Figure 2: Example of query preview for a fair on agriculture.

database.

We use what Shneiderman calls *visual-information-seeking mantra*: "overview first, zoom and filter, then details on demands" [12]. The overview allows the user to grasp the content of the application and its distribution across the different attributes. Users typically have interest in some portion of a collection, and they need tools to enable them to control the zoom focus and the zoom factor. Users may also want to filter out uninteresting items, so that they can quickly focus on item of interest via zoom. Once a few dozen of items are obtained, it should be easy to browse the details about the group or individual items. The usual approach is to simply click on an item to get a pop-up window with values of each attribute.

The visualization module we developed provides users with rapid overviews of information about exhibitors and visitor companies, stored in the fair database, in order to perform appropriate data analysis. The overview shows the data distribution along selected major attributes. Then, we use dynamic queries and query previews to filter data and support efficient query formulation [11].

Query previews provide the possibility of easily getting preliminary information about data interesting for the user, making visible the problems or gaps in the metadata that are undetectable with traditional form fill-in interfaces. In this way, the user may rapidly eliminate undesired datasets and also preview the size of the result set to avoid the so-called zero-hit queries, i.e., queries that provide an empty set as result.

In order to see how the module works, let us refer to this scenario: the organiser of the fair on agriculture wants to perform a segmentation of the exhibitors at last edition of the fair. Let us suppose that the organiser wants to find out which were the most requested services at the fair, which companies requested them, and so on. The objective of the organizer is to increase the fair income by selling more services. Therefore he is interested in selecting company segments for starting appropriate marketing campaign promoting the fair services. In order to help the user (in this case the organiser) in his analysis, the system is able to visualize an overview in which data are visualized along some major attributes. The user is first asked to select three major attributes among those considered in the database. Let us

suppose that the user selects *Fair sector*, *Geographic area*, and *Requested services*, the resulting overview is shown in Figure 2.

The user immediately gets a lot of information, for example no company comes from Central America ("America Centrale" in Figure 2) so that it is useless to perform any further query with Central America as geographic area since it will return an empty data set. The user also sees that 17 exhibitors come from East Europe ("Europa Orientale"), and so on. The interface allows the user to perform data previews, for example, by clicking on the value North Europe ("Europa Settentrionale"), only the records with this attribute value are selected and the number of retrieved data is updated consequently. More specifically, as result of this query, the 118 records of companies coming from North Europe will be selected and the bar at the bottom left of Figure 2 will be update to show 118 out of 1550 records. The values of attributes *Fair sector* and *Requested services* will also be updated to indicate only the values relative to the selected 118 companies. The user might need to further reduce the selected data set. In this case, the system permits to refine the query in order to reduce the set of selected data. Due to lack of space, we cannot describe this functionality. Once a list of the desired records is retrieved, details on a specific record can be obtained by clicking on it, opening up a window with all the available information.

Fair organizers and company managers may use the data analysis functionality described to retrieve companies with specific characteristics within the underlying database. For marketing campaigns via the Internet, eligible users can write personalized e-mails and address them to companies that have been identified as members of specific company segments.

5. CONCLUSIONS

The work we presented refers to the EU funded FAIRWIS project, whose aim is supporting the organisation and management of trade fairs. We described how visual representations are used to identify single elements in a large database and also to show explicit relationships between elements. We presented some scenarios in the domain of trade fairs, showing how 3D and 2D techniques can be exploited for web-based business applications.

It is worth mentioning that the visualization framework used in FAIRWIS is easily adaptable to other contexts by providing a 3D model of the fair venue and other metadata about companies participating in the fair.

The visualization framework, and the overall FAIRWIS project, have been developed by following a user-centred methodology [6]. Special attention has been devoted to system usability that has been evaluated with different methods, also observing users interacting with evolving prototypes. Users have also appreciated very much the capability of these tools in generating knowledge from the stored data, thus providing a great support in their business activities.

6. ACKNOWLEDGMENTS

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