MAPPING THE VICTOR-SPACE –AN APPROACH TO ENHANCE NAVIGATION IN A COOPERATIVE KNOWLEDGE PLATFORM

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Abstract

The visualisation of spatial data as well as data that can be linked to spatial locations has become hugely popular on the Internet. On the basis of the ViCToR-Spaces platform, this paper explores a way to map a cooperative learning and research management system consisting of data that has originally no spatial meaning or relation. Assuming that the virtual objects can be arranged spatially in a sensible way to form a recognisable knowledge landscape, one of the major challenges we face is how this landscape can be represented as an interactive map. Furthermore, as the platform is community-driven, another challenge is the landscape creation process itself, which will be carried out by the user community. The map is intended to replace the traditional hierarchical navigation within the domain of the platform.

1. Introduction

Everyday web navigation is generally facilitated by showing the users a choice of next steps they can take. The most important tools therefore are hyperlinks which take us one step further, sometimes right to our destination, and of course search engines that deliver also a list of hyperlinks and hence a collection of possible next steps. Everyone has in some way adapted to this kind of navigation on the Internet and developed their own preferred navigational methods. Considering the size of cyberspace, i. e. the number of active URLs and the amount of content, these tools perform by all means astonishingly well. But the problem is that users always have to *remember a path* when navigating e. g. through "familiar territory", i. e. sites you visit more than once or plan to request again later. Bookmarks cannot solve this problem satisfactorily, especially because you cannot take them with you from computer to computer, rather, they are saved within the browser application used on a single computer. Conventional cyberspace navigation interfaces have to compromise between displaying an unwieldy number of links at the same time to reduce the number of steps, and requiring long paths to reduce the number of possibilities per step. The number $\mathbf{S}$ of required steps as a function of the number $\mathbf{N}$ of possible destinations is at least $\mathbf{S = O(\log_d N)}$, where $\mathbf{d}$ is the number of links presented per step. Typically the problem of providing an overview of a large number $\mathbf{d}$, e. g. $\mathbf{d > 10}$ links is dealt with by imposing a hierarchical structure of drop-down menus or lists of sibling nodes in a tree. The nodes are usually represented by a short textual name or description of their content. Those nodes, which do not represent final destinations but rather more detailed overviews, have to describe a common way to differentiate their own child nodes from others.

But the problem of remembering a path is also a very natural one. Human users basically need more than one step because they can only deal with a limited number of items at one glance. Especially in a situation, where the user has some knowledge of the site, they tend not to read the link, but to remember its general look and position. Even if they have not clicked on it before, they will remember its description from former visits to its sibling node. Empirical experiments show that most people can determine the number of up to four similar items without really counting them. This implies that a reasonable number of links to be differentiated in a quick, one-step decision should generally not greatly exceed four (Henderson & Card 1986; Roth, 1997). For further information on this complex of problems see Ware's extensive explanations on visual-manual control loops (Ware 2000, p. 336 et sqq.).

In everyday normal life we are familiar with using maps for navigation and orientation purposes. Maps quickly answer questions about where you are at the moment, where you can go to and how you can go there (and back) and provide an overview of the surrounding environment (Gloor, 1997). These in fact are exactly the same questions one asks when navigating through the Internet (Fleming, 1998, p. 5). Maps are principally intended to be "abstractions of the world that are more useful than looking at reality itself" (Peterson 2007, p. 64). It is also argued that "[a]bstraction in maps is a useful and necessary form of lying" (ibid.) and it is abstraction that helps to show only what is necessary to show. So maps are selective. They do not and cannot display all there is to know about any given section of the represented environment. Now some people may insist they do not want to be shown *lies*. But then again, what in fact are the results of any search engine also only showing a small selection of *reality*?

In this paper we describe our approach to collaboratively mapping the ViCToR-Spaces, a knowledge platform and learning management system currently under development at

Technische Universität Berlin (Cikic, et al., 2006). This platform, aimed at *vi*rtual *c*ooperation in *t*eaching and *r*esearch is focussed primarily on mathematics, the natural sciences and engineering. It makes use of a room metaphor (Greenberg & Roseman 2003) adopted from FernUniversität Hagen's CURE platform (CURE website, 2007) which is the core system on which the ViCToR-Spaces developments are based. Unfortunately the data in the ViCToR-Spaces platform has no spatial location as the platform has no underlying physical model. But assuming we did have such a model—what fantastic opportunities to create navigation interfaces would be presented to us by modern cartographic technologies! As the ViCToR platform is community-driven, users should also be able to determine the form the map should take, to actively build and create the knowledge landscape.

In section 2, related work and the existing tools are briefly described and discussed. The visual grammar, i. e. the map elements, is discussed in section 3, the map visualisation itself in section 4. A closer look at the various preconditions to be fulfilled is taken in section 5. Section 6 then explains in detail how rooms are positioned as part of the room creation process. Finally, the paper will conclude with an outlook on our future work.

2. Related work

When relating our vision of a map of rooms to existing technologies, we see that this relation is of a dual kind: it is on the one hand a map *in* the internet, as it appears as a hypertext document displaying a spatial distribution, and on the other hand it is a map *of* the internet, as it abstracts the content of a domain.

2.1 Maps *in* the internet

Recent decades have seen some progress in using graphics to visualise information that has spatial meaning. The technical term for this is "geovisualization", which Unwin defines as "the exploratory analysis by graphics of data in which their spatial location is used as an important and necessary part of the analysis." (Unwin 2008, p. xi). Cartography as the map-making discipline is in the middle of a technical revolution and is being more and more democratised. Users are becoming increasingly involved - they not only love to have access to maps - as demonstrated for instance by the great success of *Google maps* (Google maps website), but seem moreover to greatly enjoy the newly available ways of mapping their own data, e. g. photos, or of editing existing map data.

In geovisualisation, the map elements are representations of spatial objects. Be it cities, streets or mortality rates in *GIS* applications, *Google Maps* or *OpenStreetMap* (OpenStreetMap website, 2008), or be it virtual items and avatars in game worlds such as *Second Life* (Second Life website, 2003) - what they have in common is that the distribution itself is precisely ***not*** a symbol, but a more or less true projection of an underlying physical model. Furthermore, since the domain itself claims to be a virtual environment and thus competes among attractive competitors, a certain responsiveness is demanded and a certain target-language, namely common map-reading practices, has to be used. Luckily, in an era of open programming, this can be done approximately in terms of functionality (see sections 3and 4). So for the technical design of the mapping service (see 5.2), we refer to standards and paradigms in (web) cartography (Cartwright, 2007; Geroimenko & Chen 2005; Google maps website; Slocum, 1999).

2.2 Maps *of* the internet

Being an abstraction of a to-be-structured domain there remains the question of *what* the spatial object to be mapped is. The idea of drawing spatial overviews of web content is actually not completely new, as already stated by Dodge & Kitchin (2001, p. 80): "Almost immediately [when the Web began to grow exponentially], one of the key problems was trying to navigate efficiently and to search for particular pieces of information both within and across websites. Not unsurprisingly in both cases, a key strategy has been to explore and adopt spatializations as navigation tools, alongside keyword search tools and navigation bars."

In *semantic maps* the location is used as a symbol for non-spatial information. Non-formal taxonomies are already widely used in web applications for product classification (e. g. *Amazon*) or web-directories (e. g. *Yahoo, Open Directory Project (ODP)*). Taxonomies are also used in semantic web standards such as *RDF* and *Topic Maps* (Fluit, et al., 2005).

Because the resulting maps are too schematic to provide an attractive and intuitive environment, too unstable to be recognisable, and because we have the option of harvesting user community's intelligence, we do *not* refer to such artificial intelligence methods. See (Dodge & Kitchin 2001) for examples of artificial maps of cyberspace.

2.3 Current navigation in ViCToR

The core innovative feature of the ViCToR-Spaces platform is a "room" metaphor. After login, a user chooses to enter one of the existing rooms where he becomes aware of other present users. All the learning objects like scripts, shared documents, virtual laboratories, chats etc. are contained in those rooms. This means that access to the content is bound to the access to certain venues, which in turn is ruled by the possession of virtual keys. Before the introduction of the knowledge landscape, the set rooms was structured hierarchically. Rooms were contained in rooms. While this makes sense conceptually, it turned out that very soon, with growing room numbers, the navigation became complicated, an overview was not possible, and the lost-in-cyberspace phenomenon began to undermine the acceptance of the whole platform.

3. Representation of the rooms

The design of the map, i. e. its visual grammar, should be as clear as possible and as differentiated as necessary. The user navigating outside of the rooms will wish to gather information about room content and room types as well as recognise relationships between rooms at a glance.

Each single room created can be regarded as a container that can be filled with various sorts of content (Cikic, et al., 2008a). Whether this consists of communication tools such as a chat function, a shared whiteboard or a forum, different types of documents, image files and videos, virtual laboratories and remote experiments – it is the content that makes one room different from (or similar to) another. But nevertheless it should still be the person who has created the room who decides on the room's purpose. Is this room going to host a virtual laboratory? Is this room related to other existing rooms? Who should have access to the room?

As the ViCToR-Spaces platform serves education and research scenarios in the natural sciences and engineering, the following room types are suggested:

- Lecture
- Tutorial
- Factory (room used for group work)
- Warehouse
- Virtual laboratory
- Remote experiment
- Additional material and information
- Archive

On the map, each room type is presented by assigned symbols. As the rooms have no outside size, i. e. no own volume by nature, these symbols also mark the addresses (coordinates) of room entities (Cikic, et al. 2008b). Further map elements are required to visualise the different possible connections between rooms. This is similar to different kinds of streets on a normal geographical map. The complete collection of map elements is provided as a library of SVG vector graphic icons. Other metadata (such as room name, date of creation, name of room architect, and so on) is also available based on the room builders' input during the room construction process. As all metadata is available in a standardised XML format and can therefore be used directly as input for visual design (Geroimenko & Chen 2005), it can be translated to different shapes, colours, symbol sizes, et cetera.

4. Visualisation

A visualisation is described by Young & Munro (1999, p. 343) as a "collection or configuration of individual representations (and other information) which comprise a higher level component." This also describes our map. Assuming that structures of clusters and geometrically grouped rooms will arise, users navigating through the map will be able to orientate by visual features and the stable layout of the map itself (the rooms are usually used over a longer period – throughout a semester or longer – thus users will easily recognise the map from one visit to the next).

The resulting structure of distance and neighbourhood is potentially very significant. Users will be able to expect that rooms lying close to another have more in common than those rooms lying far away from each other. We refer here to the set of *Gestalt laws* that have been formulated by the German group generally known as the Gestalt School of Psychology (Ware 2000, p. 203 et sqq.). Proximity especially when combined with connectedness makes possible a very expressive and meaningful grouping of symbols. As mentioned in the previous section, further principles to be considered include shape, colour and size.

Users do not have to narrow their focus immediately to a precise area but can first home in on a larger region. A "close up" on a group of potential next steps does not have to entail the loss of one's sense of orientation in the map as a whole. The map is zoomable, hence even overlapping symbols will move further apart the closer the user zooms.

5. Preconditions

There are some technical prerequisites to be taken into account – the following components must be implemented:

5.1 Persistent data structure

The informational basis of the landscape is naturally a unique "location" attribute to the "rooms" table in the server's relational database. Since the data type of this attribute establishes the microstructure of the space in which the landscape is created, special attention must be paid to this. But the technical details are not further explored in this paper.

5.2 Mapping Service

The webserver must answer to relevant http requests with a dynamically generated map document. The source of this document is the "rooms" table in the database, but further parameters are processed in each mapping process. First of all, the request contains a definition of a rectangular extract of the landscape, which defines a certain subset of rooms to be displayed and also gives the scale. Other filtering specifications can be specified such as "hide private rooms". Furthermore the output can be affected by the session context, namely individual user preferences and browsing history.

The resulting map document is an interactive hypertext made up of *SVG*, *JavaScript* as well as *A*synchronous *Ja*vaScript and *X*ML (*AJAX*) technology. It allows zooming, panning, mouseover effects and - most importantly - direct access to individual rooms by mouseclick. Quasi-standard technology as described in (Cartwright, et al., eds., 2007) has been adopted in the design of the interaction features.

5.3 Landscape-editing interface (wiki-style)

A dialogue for the positioning of the room must be added to the existing interface for the creation of new rooms. Of course the map of the existing landscape is used to pick a free pair of coordinates in an appropriate vicinity. This is described in more detail in section 6.

5.4 Moderation and editorial issues

Whenever a certain room gains some importance, the surrounding area becomes "popular". While on the one hand this is actually a desirable process, since it supports clustering and is certainly necessary for the evolution of a meaningful landscape, we must on the other hand provide the administrators and/or the user community with ways to take action against misuse. An initial technical measure could be to define regions of exclusive access. Requests from unauthorised users to locate a room in such a region would have to be preceded by a decision-making process among the user community or – if possible – by the region's "inhabitants". As the ViCToR-Spaces platform is a living entity in which registered users can at any time add, delete or move rooms, it is the user community that will discuss best practice and solve incidental conflicts cooperatively. Discrete intervention, based on as few rules and paradigms as possible, is essential to sustain the evolutionary nature of the whole knowledge building process.

6. The room positioning process

In order to avoid rooms being distributed arbitrarily, the graphical interface for creating and locating the rooms is to be very thoroughly designed. Each user who constructs a room faces the challenge of finding a *good*, or in fact *optimal* place for it. They are allowed to choose the relative position of the room, but this is by no means a trivial process. When thinking in terms of proximity, what exactly does "closely related" mean? The content of different rooms may be closely related; the constructors of different rooms may be closely related (e. g. both working at the same university); the functionality of different rooms might assume a close relationship (e. g. three tutorials on the same lecture).

The following figure illustrates room positioning within the room creation process.

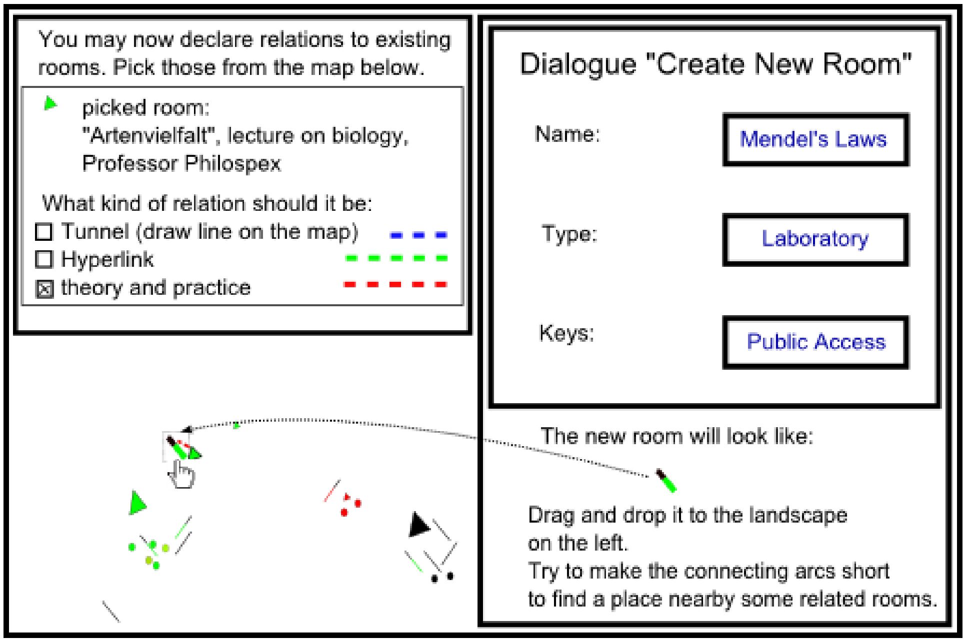

Figure 1. In this example a professor has added a virtual laboratory on a special subject to the platform. By drag and drop he positions it next to another, already existing room, which contains his lecture on that subject. Every laboratory appears as diagonal bar, where every triangle represents a lecture (see section 3). Together the rooms become part of a cluster, that form an overall scientific discipline.

The whole procedure of positioning a room is kept very simple so room constructors understand easily and intuitively what to do without impairing their creativity.

7. Conclusion & Outlook

Paul Kahn, one of the most knowledgeable people in the nascent field of website mapping, commented: “I think website mapping is bouncing back and forth between two poles: it is absolutely necessary and it is impossible.” (Kahn, 2001, p. 80). However, the field of digital design is still advancing rapidly, which prompts us to explore the field further making use of current methods. We may have a certain crucial advantage nowadays over earlier researchers and developers in this field: We don't have to spatialise existing information, but rather can let each single entity be positioned by the one person, that knows it best – its creator.

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