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iMapping Wikis— Towards a Graphical Environment for Semantic Knowledge Management

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Abstract. iMapping is a visual technique for structuring information objects. It is based on research in the fields of visual mapping techniques, Information Visualisation and cognitive psychology. iMapping uses a Zooming User Interface to facilitate navigation and to help users maintain an overview in the knowledge space. An iMap is comparable to a large whiteboard where wiki-pages can be positioned like post-its but also nested into each other. Augmenting Wikis by providing spatial browsing and zooming facilities makes it easier to structure content in an intuitive way. Especially semantic wikis, which typically contain more fine-grained content, and stress the structure between information items, can benefit from a graphical approach like iMapping, that allows to display multiple such items and multiple wiki-pages in one view. This paper describes the iMapping approach in general, and briefly how it will be applied as a rich client front-end to the SemWiki engine.

1 Introduction

Wikis have proven to be useful devices to easily store and manage structured information, and are also increasingly being used for Personal Knowledge Management. Semantic technologies however have not found widespread use so far. Using wikis to also author formal (semantic) knowledge structures seems a promising approach. However for these semantic technologies to be widely used, it is crucial that they are very easy to author and that they do not constrict the user in his work. Also hypertext research has shown, that users often get "lost in hyperspace" when browsing complex hypermedia without additional navigational help [1].

When semantically formalised knowledge structures are being used, content typically becomes more fine grained and the content structure, i.e. the relations between objects gain importance. This stresses the need for user interfaces that facilitate navigating and authoring such structures without loosing orientation. Nowadays' ontology editors appear to be too complicated for every-day lightweight use. Outside the wiki and semantics world however, exist quite a number ot visual mapping techniques (like Mind-Maps, Concept Maps and others), that provide easy ways to rather intuitively structure fine grained bits of information.

iMapping is a new visual mapping approach based on Zooming User Interfaces, that tries to combine the strengths of several established mapping techniques and go beyond them. It is meant to support easy informal note taking as well as semi- and fully formalized knowledge engineering in the same powerful yet easy-to-use environment.

An iMap is like a large pin board, where wiki pages can be spatially arranged thus enabling users to gain visual overview over several wiki pages at once. Besides classical browsing, an iMapping-enabled wiki can be navigated by zooming through. We believe that the iMapping approach may well facilitate the use of wikis-especially when they go semantic.

2 Background

Since external knowledge repositories like wikis usually represent human knowledge and are maintained by humans, it appears sensible to make the UI as cognitively adequate as possible, to enhance the link between mental and external models. Unlike text, diagrammatic knowledge representations carry a structural analogy to the content they represent. In other words: A diagram's structure looks similar to the structure it is about. A map of Europe looks somehow like Europe from above. A flow-chart depicts the structure of a process. A text doesn't—It takes a longer way in the user's mind until it can be related to the user's mental model [2]. Enabling users to spatially arrange information items allows the creation of such diagrammatic depictions that give an intuitive overview over a subject matter. This is the very basis of iMapping.

2.1 Related Work

Microcontent Some Wikis, like e.g. SnipSnap [1], already allow including other wiki pages in a page so, instead of having to follow a link, the user can see the target page inline. This is a first step into the direction of microcontent ("content that conveys one primary idea or concept [and] is accessible through a single definitive URL" [2]), which is useful to avoid redundancies, because most pieces of information are relevant in different contexts. In the same way, pages can be nested into other pages in an iMap. This leads to a different conceptualisation of what a wiki page is: many pages will just be little snippets of text, while other pages will mainly *contain* such snippets or other resources, thus functioning as aggregators.

Semantic Desktops and Wikis One of the first Semantic Desktop systems, that lets the user freely specify semantic relations between typed information items on a topic maps basis, is **DeepaMehta** [3]. It provides a graph-based UI in a thin client. Once an item (or relation) has been specified (in a topic map),

[1] see `http://snipsnap.org`
[2] see `http://en.wikipedia.org/wiki/Microcontent`

DeepaMehta keeps it in a background repository on the server independent from whether they are still part of an actual topic map. This separation between the structural model and visual model makes sense, also for iMapping, because it allows multiple (visual) instances of an item to be used in different contexts or locationsmuch like hard links in a Unix file system. Some Semantic Wikis like **SemWiki** [4] work in a similar way, but browser based and without a graphical UI. Others, like SemperWiki [5], are made for local, personal use only and feature an optimized WYSIWYG UI [3].

Visual Mapping Techniques Visual mapping techniques are methods to graphically represent knowledge structures. Most of them have been developed as paper-based techniques for brainstorming, learning facilitation, outlining or to elicit knowledge structures. Some of them have proven to be very useful in Personal Knowledge Management, especially for tasks like gathering and structuring ideas and acquiring an overview on a certain domain. For an overview on visual mapping techniques, their cognitive psychological background and an evaluation of some existing techniques and tools, see [6]. In brief, all of these mapping techniques are quite helpful for some purposes but have constraint paradigms that make them useless for others.

Mind-Maps for example, provide an easy-to-understand tree-like structure useful for outlining a topic or sorting items. But it is suitable to depict the relational structure between items.

Concept Maps on the other hand have a graph-based structure that emphasizes these relations. But they are not as easy to handle, because explicitly specifying all these relations is too laborious e.g. for a fast gathering of keywords.

"Spatial Hypertext" is yet another approach. The basic idea is to view a self-contained hypertext (like a wiki is) from an overview perspective, drilling down to single pages (which tend towards microcontent). However the Spatial Hypertext paradigm expressly abandons the concept of explicitly stating relations between objects and uses spatial positioning as the basic structure. To fuzzily relate two objects, they are simply placed near to each other, but maybe not quite as near as to a third object. This allows for so-called "constructive ambiguity" [7] and is a very intuitive way to deal with vague relations and orders. While Spatial Hypertext in its pure form is not suitable to author formal knowledge structures like needed in semantic wikis, the general approach may well be used to augment them as a surface.

Zooming User Interfaces An early research prototype using a zooming approach was Pad and its successsor **Pad++**, both developed in Maryland [4]. It has been used in various applications and also as a web browser capable of showing the viewed web pages and their link-structure from a birds view. In a study

[3] For more information on Semantic Desktop systems in general, see `http://semanticdesktop.org`

[4] see `http://www.cs.umd.edu/hcil/pad++/`

where participants had to perform browsing tasks in order to answer some questions, subjects using Pad++ were 23% faster than those using Netscape [8]. This shows that using large zoomable information surfaces are well-suited hypertext front-ends. The work on Pad++ has later yielded its successors "Jazz" and finally **"Piccolo"**, a toolkit that supports the development of 2D structured graphics programs, in general, and Zoomable User Interfaces, in particular Piccolo [5].

A Semantic Desktop system whos UI is deeply based on zooming is **MentalSky** [6]. It uses machine-learning methods to semantically classify existing resources into clusters that can be browsed by zooming through and restructured with drag-and-drop interaction. MentalSky is currently in a prototype state of development. It strongly differs from an iMapping based semantic wiki in the respect, that it is constraint to managing external resources (like files, pictures, web-links, etc.) but is not made for authoring content neither in plain text nor in a formal way.

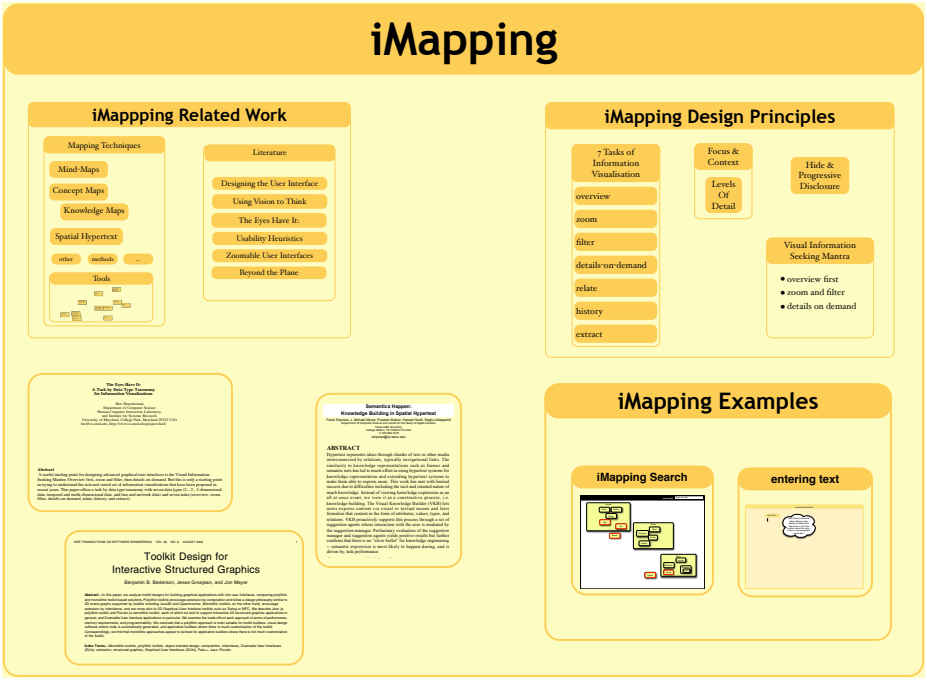

Fig. 1. An example iMap showing three expanded text pages and several sub-maps with collapsed items.

[5] see `http://www.cs.umd.edu/hcil/piccolo/`

[6] see `http://mentalsky.net/` and `http://cognitivetools.net/tiki-index.php?page=MentalSky`

3 Design

iMapping tries to combine the advantages of all the above approaches:

- basic wiki functionality (collaborative editing, easy linking, backlinks etc.)
- visual knowledge representations with structural analogy to content
- easy hierarchical overall topology
- facility for graph-based relation mapping
- support for formal semantic statements
- allowing constructive ambiguity
- provide overview by integrating context and detail through zooming

Basic Hierarchy The basis of the iMapping paradigm is a large two-dimensional surface, where items can be freely placed. In a wiki context, these items mainly correspond to wiki pages. Because these items can contain other items, it is encouraged to use microcontent rather than long unstructured texts. Whereas in Mind-Maps or other tree-like diagrams the lower hierarchies branch towards the outside from a central point, in an iMap hierarchy goes down into deeply nested nodes that can be zoomed into (see Figure 1). Like explained above, there can be multiple visual instances of one and the same information object, because it may be relevant in different contexts.

Other Content Instead of a wiki (text-) page, a node could also contain things like a picture or other structured objects. It can basically be seen as an inline link to any resource for which a display method is known. Even inter-wiki or other remote content could be included inline like that.

Levels of Detail Because some information objects (like most text-pages) are rather hard to recognise when they are scaled down to thumbnail size, the nodes should have at least two possible states: open and closed, which could also be seen as expanded / collapsed or being outside / inside the node. Switching between these states is done either manually per click or can take place automatically, depending on how large the object is displayed. This method is also sometimes referred to as "semantic zooming". A wiki page could be represented by its name in collapsed state and with its content in expanded mode. A more structured article could show his title only from a distance, when zoomed larger also some additional information like authors and date and when zoomed to reasonable size, fade over to the full content. Structuring content in the ABCDE format[7], facilitates such semantic zooming.

[7] see `http://wiki.ontoworld.org/wiki/ABCDEF`

Link Structure On the one hand, giving an overview to the structure and relations between information items is one of the main benefits of the iMapping approach. On the other hand, just drawing arrows for every link or even every semantic relation and backlinks to any other item would result in a complete mess sometimes referred to as the "spaghetti syndrome". The idea in iMapping is, to not show any relations by default, and only make them visible on demand (see Figure 2). This could be a subtle interaction like mouse-over or something more explicitdepending on user settings or a mode.

Not only naming or even typing links but graphically drawing them between objects in a concept map (node-and-link) style would go even further beyond common wiki functionality. However it is a common and well-evaluated technique that is useful for depicting and authoring relations between information items. Such links have of course to stay permanently visible. In the same way, it is possible to semantically interrelate items by simply drawing links between them, which can than be typed. If this is done using auto-completion, reuse of existing relation types is fostered.

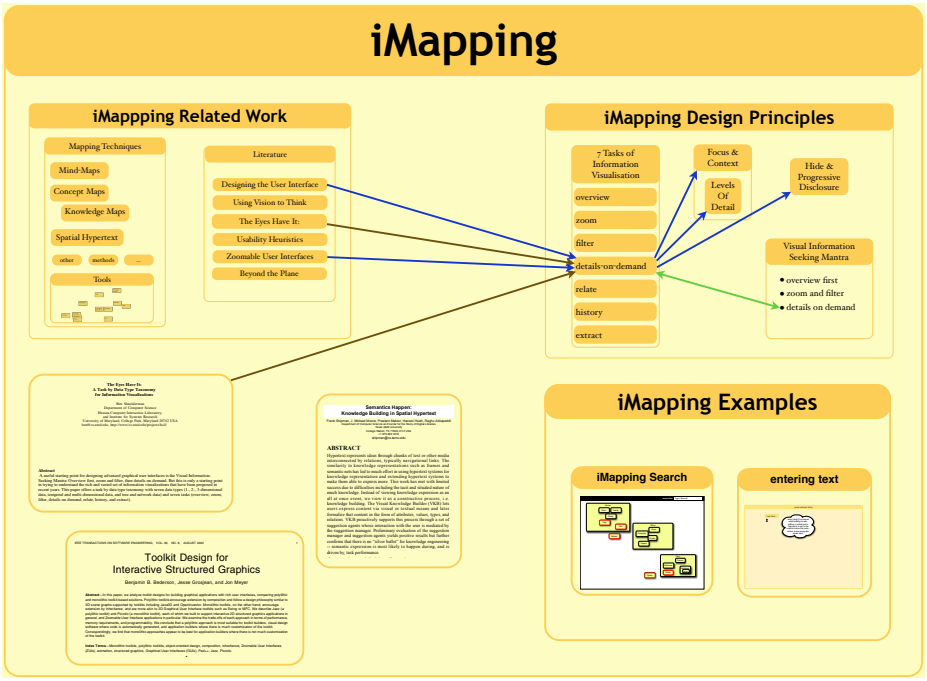

Fig. 2. The same iMap but with link-structure of one item made visible.

To sum up, this makes three structurally different ways of interrelating items in an iMapping environment:

- wiki-style text-links
  (linking from a particular text position to another item)
- nesting items into another
  (including the link target inline at a specified position)
- linking on an item level
  (stating a relation between two objects)

Each of these can be mere navigational links or carry formal semantics, if specified.

4 Discussion

Whether the iMapping approach will be successful, user studies and time will have to tell. It is a concept so far. A first prototype environment is under development and might be available by mid 2006. While our implementation is based on a java client to take advantage of the Piccolo framework (s. above), a flash- or SVG+AJAX-based version would allow browser-based usage, which would come closer to common wiki use.

Also, since the iMapping approach was initially designed for personal use, there might be unforeseen difficulties when used in a collaborative setting, like most wikis are. For example, there could be dissent on how items should be spatially arranged. But hopefully, like it is common in wiki culture, over time layouts will converge to a structure that finds consensus. Another approach would be to use personal profiles to let users make their personalised spatial arrangements of the content. The better the content and its structure represented using defined semantics, the easier it is to separate it from its visual appearance and to syndicate it to other applications.

5 Outlook

Wikis have started as very simple content management systems and many engines have grown immensely feature-rich by now. The step to semantic wikis is very promising and could give the realisation of the Semantic Web a significant boost. But it surely doesnt make these wikis easier to use. Focussing on user interaction and cognitive ergonomics will be an important point, if semantic wikis are to become widely used whether collaboratively or for personal knowledge management. In the Open Source Social-Semantic-Desktop Project Nepomuk[8], a first iMapping Wiki is being developed, and anticipated to become available during 2007. It will then become part of a more comprehensive knowledge workbench integrating Semantic Desktop functionalities like application integration, and semantic search with a distributed p2p-based collaboration environment.

[8] see `http://Nepomuk.semanticdesktop.org`

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