DeepaMehta – A Semantic Desktop

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Abstract. DeepaMehta is an open source semantic desktop application based on the Topic Maps standard. It's conceptualization and especially the UI have been guided by findings of cognitive psychology, in order to provide a cognitively adequate working environment for knowledge workers of all kind. It uses a graph visualization similar to concept maps. DeepaMehta aims to evolve nowadays' separated desktop applications into an integrated workspace, enabling the user to organize, describe, relate, edit and use almost any information objects.

Introduction In this paper we present the Topic-Map-centric semantic desktop environment "DeepaMehta". First we state some psychological requirements for personal knowledge management (PKM). Then we describe the UI concepts and their realisation via the Topic Map metaphor. We conclude with a brief evaluation based on psychological criteria.

Psychological Requirements It should be the main goal of any knowledge management software, to facilitate *creation, externalisation, and (re)construction of knowledge*. Since there is evidence, that conceptual human knowledge is actually stored in an associative way, comparable to semantic networks [1], it appears sensible to provide the knowledge worker with a UI, where contents are displayed, managed, created, and refined in such an associative manner (i. e. items together with their relations to other items), that enables the construction of semantic networks—like *concept maps* [2, 3] do, as well as their more formal derivatives *knowledge maps*[4].

Mapping Techniques[3] allow the knowledge worker to use his natural sense of spatial orientation wich easily distinguishes spatial positions and layouts (also in a plane) to gain orientation in his *knowledge space*. Research in cognitive and instructional psychology has shown, that the use of concept-map-like techniques can have various positive effects on learning and problem solving—i. e. knowledge generation and -use [5, 4, 6].

[3] In this article the term "mapping" is used as coined in the domain of instructional psychology, i. e. in the sense of *creating and using visual knowledge representations* called "maps" like mind-maps, concept maps etc.

A major goal of user interaction design—especially in hypermedia—is to keep *cognitive overhead* as low as possible. This is "the additional effort and concentration necessary to maintain several tasks or trails at one time" [7]. Because human working memory and thus capacity for conscious processing are quite limited[8], we should avoid wasting it to secondary tasks like worrying about saving files, dealing with layout and formatting or regaining orientation in the information environment while writing the actual content.

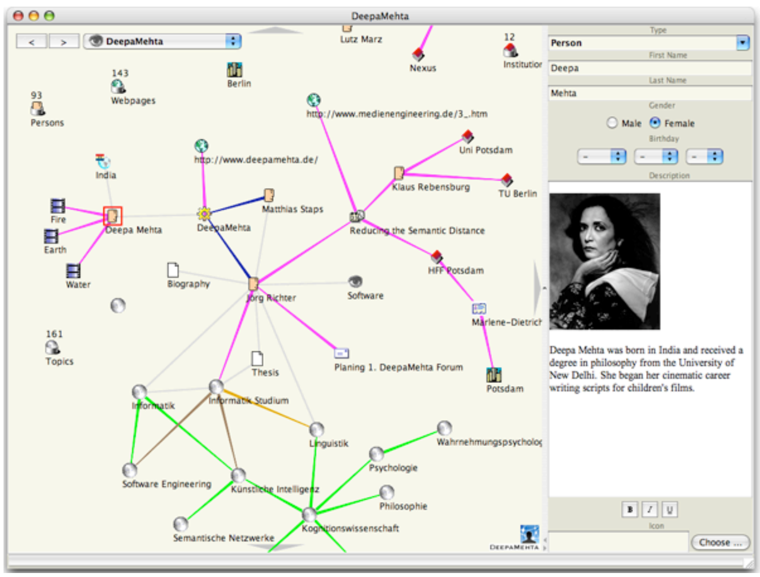

Fig. 1. A Topic Map (typical DeepaMehta working screen)

Design The design of DeepaMehta is centered around the model of *Topic Maps*. Topic maps are a human-oriented approach to encode knowledge and meta knowledge (knowledge about knowledge). Topic maps consist of *topics*, *associations* and *occurrences*. In the semantic web, this relates to *resources*, *relations* and *instances*. Topic maps form a self-describing type system, much like RDF schema. We assume some familiarity with Topic Maps and refer the reader to ISO standard 13250 [9] and RDF [10].

DeepaMehta is an application framework with a Topic-Map-based UI (see fig. 1), the design of which has been guided by findings in cognitive psychology. Information of any kind as well as the relations between information items can be displayed and edited in the same space. The user is no longer confronted with files and programs. There are no overlapping windows, no menu bars and no dialog boxes. Topic Maps are individual views on interconnected contents. An application in this context is a collection of topic types, for which specialised and generic commands are executable by the user (e. g. what's related, hide, retype, delete).

A Cognitively Adequate User Interface One of the most obvious problems in current desktop user interfaces is that of context switching. Users currently have to switch applications for every sub-task. Each switch presents a completely new interface to the user, even if the underlying concepts are the same: An address used within a text document is *conceptually* not much different from *the same address* used in an email. Today's desktop UIs are application-oriented, not data- or task-oriented. DeepaMehta gives the user **stable views**, letting him focus on the task itself, without leaving the work-context: In one and the same view the user can read an e-mail, link it to an existing topic, attach a note to it, search for related media, save the search results, make semantic statements and spatially arrange all these items on the screen. And he will later allways find his workspace exactly as he left it.

Browsing the web is easy. Figuring out later where one has been is not that easy. A browser history is merely time-based (1) and offers no means to attach any kind of additional information (2). Even worse, after a fixed time interval, the history is usually erased automatically (3). If not, it becomes so large that it is virtually impossible to handle (4). Additionally, the browser history contains no information about other resources accessed than web pages (5). Bookmarks sometimes do offer an annotation feature, but problems (4) and (5) still remain. Maintaining bookmarks in a way they remain usable requires quite some additional effort compared to mere web browsing. DeepaMehta offers **constructive browsing** as a solution: Each resource visited (be it a web page or something else) is represented as a topic in the current workspace. Each new topic is placed right next to the preceding one. The user can conveniently move these newly created topics around to other places in his workspace, which is always visible. Now, surfing the web or accessing other resources automatically creates a map of viewed objects. Even searches and search results are represented in the same consistant fashion. This spatially arranged map visualises a work process better then a list of named URLs and it is persitant, automatically saved and fully navigable.

Most traditional applications have a fixed set of objects they can deal with. The DeepaMehta **type system is extensible**. The user can construct new topic and relation types on the fly in the same UI, using a set of very few built-in topic types like *topic type*, *assoc. type*, *property*, *prop. value*, *data source*, *search*, *map*, and *workspace*. New topic types can be used instantly and serve as the basis for the UI. Even user management is done using the topic map concept (users are represented as topics, with relations to groups and shared workspaces).

DeepaMehta is realised with a **service oriented architecture** (SOA) offering many communication and integration options. It features a thin client, a web interface and a set of desktop adapters. Data can be stored in several back-ends, exported to XTM or PDF or even shared via SOAP web services. Each topic type can be provided with it's own java class, to give it unique functionality.

For **collaboration**, users can share their workspace (topics, topic types and maps) with others, so they can use it e. g. in the web interface relying on the integrated access control system and central synchronisation server.

Evaluation The DeepaMehta architecture defines a **new application model** and gives developers a framework to design DeepaMehta-applications. Such applications are easy to maintain as the business logic resides on the server. Also a range of interaction front-ends is offered: a thin client, web front-end and even a PDA interface[4]. The thin client framework provides a solid framework for many kinds of interaction clients. A more up-to-date user interface is planned.

This flexibility enabled the successful deployment of several commercial sites in a variety of domains[5], among which are two eLearning projects and the award-winning geographic information system "Kiezatlas". For consultants, a competence analysis tool was implemented. A third project acts as an information management system for modern and contemporary artwork.

In order to evaluate the innovative **user interface**, we checked[6] it against a set of criteria set up to evaluate visual mapping tools for personal knowledge management from a cognitive psychological point of view [6].

- *Free Placing* an item on the canvas is possible.
- *Free Relations*: Stating relations between items in DeepaMehta is possible in all degrees of formality (unlinked nodes, unlabeled links, labelled links, typed links)
- Every item can be given an *Annotation* in natural language.
- The most useful way to deal with complexity and clarify the macro structure of a domain, is to use *clustering* [11, 8]. DeepaMehta offers only *visual* grouping within a single map but also the ability to create sub-maps.
- For brainstorming, too many mouse-clicks are currently required and creating new items without leaving the keyboard is not possible at all. The *cognitive overhead* should be reduced for standard tasks.
- The *detail and context problem* [7, 12] is tackled in DeepaMehta by splitting the screen and showing the user always both the actual content (property pane, right hand side) and the context information (topic pane, left hand side). The interlinked topic-view always displays all related items, while the property pane can be navigated classically by traversing links or editing property values.

DeepaMehta's UI and interaction paradigm takes a consequent approach of minimalist design, where only relevant controls are shown. As this differs from common interfaces, it requires some initial time to get acquainted.

Providing zooming capability and a grouping feature would surely increase its utility, especially for the use of larger and more complex maps.

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[4] Download at `http://www.deepamehta.de/docs/deepamobil.html`

[5] `http://www.kiezatlas.de`, `http://artfacts.net`

[6] Due to space limitations, the more detailed and elaborate evaluation can only be found in the long version of this paper

Conclusion Wether DeepaMehta will succeed in replacing nowadays standard applications or not, in any case it introduces and combines several quite promising innovative approaches to personal knowledge management and user interface design. Without a bloated interface it offers many useful features well-thought-through.

As is common for prototypes, usability is still improvable, however it becomes clear that DeepaMehta beares a high potential, combining the advantages of visual mapping techniques and semantically specified topic maps. Furthermore it offers a solid and web service enabled back-end for collaborative creation and use of knowledge bases ranging from informal collections of notes to fully fledged ontologies. And it has allready proven it's utility in several production-status commercial projects.

It is a networked environment for personal ontology-based management of unified knowledge.

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[7] see `http://knowledgeweb.semanticweb.org`