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Shared Spaces on the World Wide Web**

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Merz: Creating Personal and Shared Spaces on the World Wide Web

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Abstract: Merz is an environment which supports knowledge work, personal information management and collaboration on the WWW. As a user gathers information by browsing and querying, a local database of metadata is built, serving as a basis for creating Merzbaus: visual representations of documents and links. The user interface is characterised by filtering and semantic zooming. Instead of having to classify objects into hierarchies and folders, users can successively add keywords to the metadata records for objects and links and create multiple, filtered views of information. Categorised objects can be moved to parallel, more organised Merzbaus, e.g., corresponding to specific projects. Users can personalise Merzbaus by rearranging icons, creating links, and by entering hand-written marks. Collaboration is supported by means of publishing Merzbaus to a WWW-MOO server for other users to access. Merz is implemented in JAVA.

Introduction

Merz is a new kind of user environment for the WWW, which supports personal information management, knowledge work, and collaboration. Merz is being developed on Sun workstations, using the JAVA multiple-platform language [Sun 1996]. Collaboration in Merz is implemented using MOO-technology [Curtis 1991].

As a tool for personal information management and knowledge work, Merz primarily addresses usability problems like information overload, disorientation, and difficulties in organising information, which are common in hypermedia systems [Nielsen 1995]. In Merz, the key approach to helping users overcome these problems is by visualisation of information. This is not an uncommon approach. However, Merz is unique in three respects, first, that users can personalise visualisations, e.g., by laying out node and link elements by hand and by adding hand-written annotations, drawings and marks, second, that users have access to multiple views of information, e.g., by rapidly and seamlessly changing metaphors and semantic filters, third, that gradual organisation of information is supported, as opposed to having to immediately organise it into hierarchical structures. The emphasis on such personal, creative and dynamic aspects of visualisation motivated the use of the concepts "Merz" and "Merzbau", which were borrowed from the German artist Kurt Schwitters [Schmalenbach 1967]. A Merzbau is a construction put together of bits and pieces found in the world (see [Merz] below).

As a tool for collaboration Merz is aimed at situations where groups need to share visualisations, access other groupmembers' annotations, follow their trails through information, and collaboratively develop information structures. Merzbaus can be shared with other users for them to explore, modify and return to the

originator. Thus, the collaborative aspects of Merz support building information structures at a conceptual, "project-organising" level, rather than, e.g., the more common collaborative creation of hypermedia documents.

Below we give a simple example of Merz, followed by an overview of previous, related work, a description of the current status of the implementation, and some future development and research issues. An earlier version of Merz has been described in [Lenman and See 1995]

Merz example

A simple Merzbau and a preliminary user interface is illustrated in [Fig. 1]. A similar, JAVA demo is available on the WWW [Merz 1996]. The circles represent HTML-documents and the light grey lines represent hyper-links embedded as HREF tags in the documents. New documents are added, e.g., by browsing the WWW. Embedded links are automatically extracted and represented, e.g., as the circular patterns in [Fig. 1].

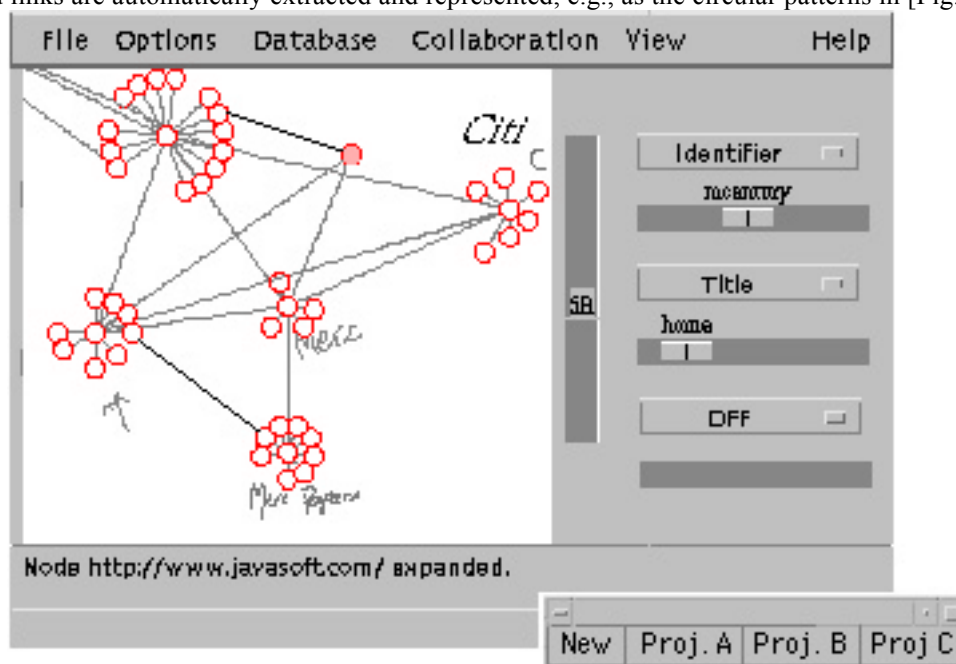


Fig. 1 A Merzbau and a preliminary user interface

Zoom and pan are primary interface operations. The vertical slider to the left of the window indicates the current zoom-level, and can be used to control the zoom directly. However, the main method for zooming and panning is by means of the mouse in combination with different keys. Double-clicking on an object gives access to various actions: viewing the object itself with a WWW-browser, annotating, editing, removing the visual representation of the object from the Merzbau, etc. Different kinds of objects support different actions.

In [Fig. 1] the user has entered some personal notes and marks by drawing directly in the space. Also, two links (dark grey) have been drawn between objects by the user, to indicate a relation. The nature of the relation can be specified in annotations or keywords, which are stored in the metadata record for the link.

The horizontal sliders to the right in [Fig. 1] control filters, based on semantic characteristics of objects. What sliders represent can be selected from a menu, accessible from the slider. In [Fig. 1], a single object which has "mcentury" in the identifier and "home" in the title matches the filter and is highlighted. Filters tuned to, e.g., different projects a user is working on, can be saved and restored.

The metaphor by which a Merzbau is viewed can be changed, e.g., to an ordered list of file names instead of a spatial view, depending on the task at hand. In [Fig. 1] the metaphor is very simple: objects on a 2D surface. As understanding of information pieces grows they can be represented in parallel, more organised Merzbaus, e.g. corresponding to specific projects, concepts, or ideas.

Lastly, Merzbaus can be shared with other users by exporting (or importing) them by means of the "collaboration" menu. Shared Merzbaus can be modified and re-exported, e.g., as part of work within a project-group.

Background and related work

Merz

Kurt Schwitters (1894-1947), who invented Merz in 1919, was a writer, publisher, artist, designer, architect, ad-man, and performer. Merz served Schwitters as a quasi-brand name linking together his paintings, poems, plays, sculptures, and architectural constructions: "The word Merz denotes essentially the combination, for artistic purposes, of all conceivable materials, and technically, the principle of the equal evaluation of the individual materials. A perambulator wheel, wire-netting, string and cotton wool, are factors having equal rights with paint." [Schwitters 1919]

The WWW promises, but does not today provide this kind of suppleness, this capability to work freely with heterogeneous materials, if not for artistic purposes, for purposes of gaining and developing knowledge. As a set of tools designed to help individuals better organise, integrate, and understand the heterogeneous materials of cyberspace, the Merz application is not so much an aid to efficiency, but to coherence. It is a tool to deal with conditions of unbounded proliferation of elements -uncatalogable in principle- which exists already on the WWW.

The discovery of new relationships between things that Merz aims to support, and that is implicit in Schwitters' Merz principle, bears a close resemblance to the concept of "abduction", by the philosopher C. S. Peirce [Buchler 1955]. Neither a deduction from formal premises, nor an induction of general rules from instances, abduction can be understood as the logic of creativity. To our knowledge there is only one other Web based research project, the Mental World Browser, which starts from similar concerns [Kubota 1996]. Another similar project, although not concerned with the Web, aims at developing computer tools that support engineers in articulation of unstructured, nebulous, fragmented ideas that are typical during certain phases of creative activities [Hori 1993].

Knowledge work

Three particular characteristics describe knowledge work: annotation and note-taking, spatial layout and manipulation of information pieces, and the difficulty to enter information into classification schemes before it has been understood. In note-taking, the personalisation that results from personal marks and annotations seem to be important for the creative process of understanding. Thus, computer tools should be aimed at capturing and reproducing the appearance of marks and notes rather than at interpreting them [Kidd 1994].

Other researchers have also observed that knowledge workers use physical space as temporary holding patterns for information pieces they cannot yet categorise or decide how they might use. They often prefer to deal with information by creating physical piles of paper, rather than immediately categorising it into specific folders [Mander, Salomon and Wong 1992]. Even when we find it difficult to classify items, or to express how or why they are interconnected, we are often able to meaningfully arrange them in space [Marshall and Shipman 1995].

Thus, computer tools should not force users to classify information in order to store it for later use. Making sense out of information is a process; annotation, manipulation of information items, and experimenting with spatial arrangements are important activities in this process. Although it might seem self-evident that information cannot be classified until it is understood, most current systems require exactly this: users are provided only with an hierarchical file system, which requires immediate labelling if information is to be stored meaningfully. In contrast, Merz is specifically aimed at supporting personalisation, spatial manipulation and deferred, gradual classification of information.

Visualisation

Using spatial models and metaphors for accessing and managing large repositories of information is not a new idea. The history of visualisation is a long one [Tufte 1990] [Rieber 1995], and in human-computer interfaces spatial metaphors have been used extensively. There are numerous examples of visualisation of large scale file systems and libraries, e.g., the recent work at Xerox PARC [Robertson, Card and Mackinlay 1993]. Visualisation of the WWW is also common, e.g., the Navigational View Builder [Mukherjea and Foley 1995], Hyper-G [Andrews, Kappe and Maurer 1995], and HyperSpace [Wood, Drew, Beale and Hendley 1995]. There are also recent developments towards 3D visualisation on the WWW, as reflected in the VRML standard and applications [Pesce 1995]. However, the approach to visualisation in Merz is different, because it emphasises not visualisation per se, but that different users require different views of information, depending on

preferences, circumstances and tasks, and that changing the view should be user-controlled, rapid and seamless.

In Merz the main components of a view are semantic zoom, filter, and metaphor. Semantic zoom refers to how much detail about the content is revealed. For example, depending on the scale at which the content is viewed, an item or a link can be represented by an icon, a title, a summary, or the full page, e.g., as rendered by a standard Web browser. The main purpose is to close the gap between navigational views and close views, thus avoiding the phenomenon of being "lost in hyperspace". [Waterworth and Chignell 1991]. E.g., while reading a document, a user only needs to quickly zoom out for reorientation, and then zoom back in, or pan and zoom to a different document. An earlier, advanced development using this principle is Pad++ [Bederson, Stead and Hollan 1994].

The filter component of a view refers to what content is shown. For example, a user could choose to see only documents related to "scientific visualisation". All other information in the view could be filtered out completely, or shown in a dimmed rendition. Such a mechanism supports working with information in flat information structures, as an alternative to, or in parallel with a hierarchical organisation. The background to this approach is Shneiderman's Dynamic Queries [Shneiderman 1994] and the recent development IVEE [Ahlberg and Wistrand 1995].

Metaphor refers to the frame of reference which is used to present information to the user. A variety of metaphors can be applied to organise the same selection of information. For example, a collection of information objects can be viewed as an alphabetical list, as folders and subfolders in a desktop metaphor, or as places, villages, and houses in a 3-D virtual world. The purpose of using metaphors is to reduce complexity in organising information and to aid the user's memory by exploiting prior knowledge from different domains [Carrol, Mack and Kellogg 1988]. However, forcing a single, detailed metaphor can be both counterproductive and cumbersome, and restrict inventiveness and creativity [Waterworth and Chignell 1989]. In Merz, users can choose to view information organised by different metaphors, depending on the task at hand.

The Merz application

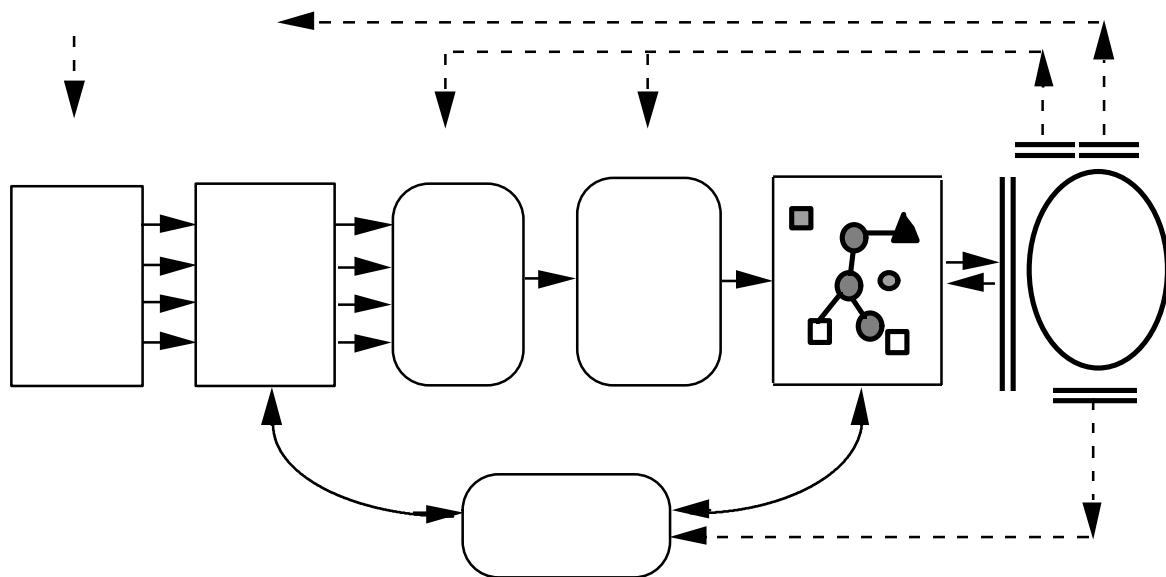


Fig. 2 Overview of the main components in the Merz implementation. Parallel, double-width lines indicate user interfaces.

The structure of Merz, which is implemented as a JAVA application, is shown in [Fig. 2]. Information is brought into Merz by browsing or querying the WWW, or by automatic processes, "agents". However, the latter aspect has not yet been implemented. Accessing a new information item (a world-object) creates a database record, a proxy, which holds metadata about the object in a local database, maintained for each user. This database is central to the Merz environment, both for supporting visualisation and for the collaborative aspects. The base fields of proxies conform to the Dublin Core Set [Godby and Miller 1996], such as title, kind of object, address, keywords, geographic location, etc. There are also additional fields, e.g., to hold keywords

and annotations that a user might add. There are four kinds of proxies: proxies for world-objects, proxies for links, proxies for user-created marks, and proxies for Merzbau.

When an HTML-document that contains embedded links is accessed, it is automatically parsed, and a separate proxy for each link is created. Thus, in Merz links are bi-directional and treated as first-class objects, which can be given keywords and annotated, as can any other object.

A Merzbau proxy holds references to user-created collections of world-objects, which themselves have proxies in the database. Merzbau proxies also have one or many associated view specifications, which in the current implementation are stored as separate files, and which hold information about how the Merzbau should be visualised.

Proxies (world-objects) are represented to the user through a filtering process, which selects information from the database according to criteria specified by the user. Information from the filter is passed to a visualisation process, which assigns representations to the selected information within the framework of a metaphor, according to some rules of assignment. The resulting view is in most cases visual, but currently we are also working on auditory representations of information. Parallel representations are possible, e.g., different windows can show different views onto the same Merzbau.

Collaboration

In the current phase of the project it was most straightforward to implement collaboration through a central server. This server had to be internet compliant, allow user registration and password protection, permit user group assignments, support document protection and archiving, and it had to be fully programmable and sufficiently flexible to permit modifications and additions. We choose to use a variant of Lambda MOO [Curtis 1991]. Members of the Merz software team had previously developed WWW - MOO software, e.g., [Virtual Film Festival 1995], based on the hypertext extensions to Lambda MOO [Meyer, Blair & Hader 1995].

MOO's are object-oriented databases which include a rich collection of primitives, object-classes, and functions ("verbs") applicable to multi-user, networked collaboration. The integration of MOO technology with the WWW through HTML declarations permits complex hyper-media sites to be constructed. For the Merz project, however, a different scheme was required. First, the PERL routines which provide Web - MOO correspondence had to be replaced with JAVA applications. Second, the MOO would not provide interactive on-line services for users but, rather, would remain on-line transparently once the user had made a valid connection. After such a connection, a user may "put" a Merzbau, identified by a unique name, into the MOO. Any other authorized user attached to the server can then retrieve the Merzbau by name, and start making changes to it. Thus, the MOO functions as a background database server for the storage, archiving and retrieval of Merzbau's.

Each Merzbau is identified by a unique name and is owned by a unique user. Named Merzbau's and users are, in fact, uniquely numbered objects in the MOO database and can be accessed by any of the MOO procedures. Ownership privileges are assigned to objects according to the privileges of the user. That is, if user N has group access to all the Merzbaus submitted by users A, B, and C, then N will be able to "get" the Merzbau, i.e., the Merzbau proxy and all its associated proxies and view specification(s). If user N re-submits this Merzbau it will be stored by a new name and assigned new privileges. A very simple scheme exists to format the client-side Merzbau data into an ASCII stream of name-value pairs. Companion client-side and server routines have been implemented in JAVA which manage the connections and the put and get routines.

Thus, at the current stage, several users can put, get, modify, and re-put Merzbaus as new objects in a secure, fully protected database. The sequencing of requests and read/write accesses are handled by the MOO core software. While Lambda MOO databases were not initially designed for tasks of this nature, all of the criteria listed earlier were realized using this novel combination of JAVA and lambda MOO.

Future developments

There still remains some work concerning the basic JAVA application, especially with regard to aspects of visualisation which involve metaphors. Another concern is the user interface: the existing interface is only a point of departure for the interface development, which will take place through rapid prototyping and formal usability testing.

Adding autonomous processes to aid search and monitoring of content on the WWW is a next step. Some preliminary work in this respect has been carried out concerning the use of neural networks, and how the user should communicate with such processes in a visualisation environment. Another, ongoing line of

development concerns the previously mentioned "sonification" of information: using sound to convey meaning [PennycookBreder and Dawkins 1996].

The system for collaboration implemented to date will be extended to also permit direct person-to-person communication. This will include many of the standard features of the Web - MOO, as well as real-time audio conferencing using low-bandwidth speech codec systems such as TrueSpeech [DSP Group 1996]. A further initiative will be to replace the central MOO server with a distributed, client-based system. This development is necessary to fullyrealise the kind of seamless collaboration we have in mind for users of Merz.

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