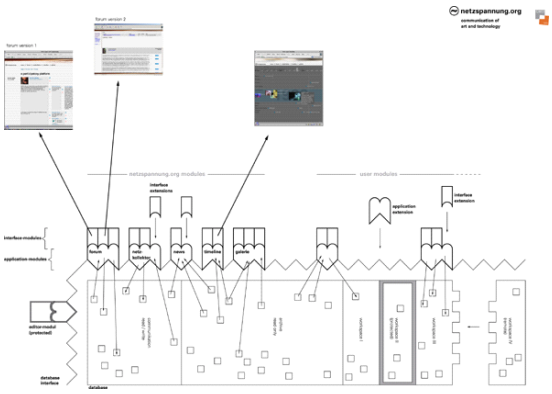

netzspannung.org

an internet media lab for knowledge discovery in mixed realities

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Abstract

The MARS Exploratory Media Lab at the Fraunhofer Institute for Media Communication is developing a model for an online media laboratory as Competence Centre for digital art, culture and technology . To this end, the Internet platform netzspannung.org is being developed as an open distributed toolbox for knowledge discovery and experimentation with networked media spaces accompanied by community information channels and media strategies connecting processes in virtual space with real places. The first online demonstrator of netzspannung.org explores the creation of an architecture for visualising and exploring the interrelations between media art, culture, science and technology.

Keywords: Mixed Reality, Knowledge Discovery, Semantic Web, Media Art, Experimental Media Spaces, Distributed Systems, Cultural Archives, Awareness, Collaborative Knowledge Spaces

Project URL:
http://netzspannung.org

1. Introduction

The goal of the development of netzspanung.org is an architecture for making visible the interrelations between media art, science and technology. In order to realise this we are exploring the extension of the common notion of web platforms as means of presenting and sharing information towards the model of an online media laboratory.

Under the notion of an online media laboratory we understand a web-based platform, which combines tools for contextualization of information into a collaborative knowledge space with tools for active experimentation with networked media spaces. This takes into account the fact that the use of the Web for creation and distribution of information in different professional communities (e.g. art, science, technology) is today perhaps the most significant example of mixed realities: the contents of the Web represent a myriad of different perceptions of "realities", of "knowledge about" and "representations of the world", expressed as networked constructs combining different media (text, image, video, 3D, mobile communications etc.) and often as a result of a collaborative process.

Such a highly mediatized situation of communicating and constructing knowledge requires new models for discovering contexts and relationships and for understanding how meaning is encoded in complex structures of networked media. In our opinion, this concern cannot be met with the "old" model of a passive user with arbitrarily "intelligent" technologies. Rather, what becomes of crucial importance is

tools that enable (empower) the user to explore his own ways and construct his own models for dealing with the situation.

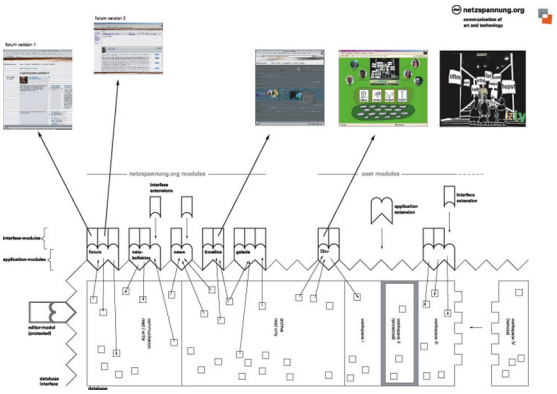

Fig. 1. netzspannung.org architecture

In this context, a crucial point of our approach is that the web platform itself is built as a toolbox of individual modules, which can be modified and extended by the user and employed for realisation of his own projects beyond predefined functionalities. Strategies are required for designing web-platforms not merely as information access points but as tools for acquiring competence of underlying technologies. The challenge here is how to design systems that make the technical structures underlying their functionalities manageable at different levels of technical expertise, without hiding them.

On the one hand, such an approach can be loosely related to historical precedents such as the experiences of MUD/MOO architectures for online communities and learning environments [Curtis94] [Bruck95] [Hay97] [Novak96]. On the other hand, it can be related to artistic strategies for exploring new forms of experimental media spaces for collaborative learning and communication through community engagement and intervention in public spaces [VGTV89] [Iden90] [Kiasma99] [Legr01].

In this context, this paper presents the realisation of the netzspannung.org platform as an open toolbox for knowledge discovery and experimentation with networked media spaces consisting of following modules:

Dynamic archive adaptor for user-oriented semantic integration of online archives (Section 2.1).

Knowledge map system for visualisation and exploration of contexts and relationships in collaborative information spaces (Section 2.2)

Mobile Unit and i2tv system for experimenting with media architectures connecting real and virtual spaces to new modalities of perceiving people, spaces and information (Section 3).

Framework for building distributed user-extendable systems (Section 4).

Public information channels and media strategies for community building through collaborative mapping of the current media culture landscape (Section 5).

2. Exploring contexts and relationships: timelines, clusters, knowledge maps

We relate the notion of knowledge discovery [Fayy96] to tools for analysis and contextualization of existing information flows on the Internet. The goal is to provide tools for exploring how knowledge is represented, created and communicated between different professional communities.

The first step we take in addressing these issues is to develop a model for connecting existing archives and collections of artistic works and scientific research, into a collaborative knowledge map based on semantic relationships.

The two basic elements of our model are the following:

[1] a knowledge map system for visualising and exploring contexts and relationships in collaborative information spaces

[2] a dynamic archive adaptor for user-oriented semantic integration of different online archives and databases in real-time.

The goal is to provide a tool with which users can explore possible relations between information usually isolated in separate archives of different communities in the fields of media art, research and technology. This is intended both as a tool for professionals in the field of digital culture and technology (artists, researchers, designers, curators, journalists) as well as a public information interface.

In developing the prototype we first focus on knowledge structures represented in common databases of artistic works (archives of media art festivals such as EMAF, Medienkunstpreis, Ars Electronica) and research projects (such as the ACM Digital Library). The concrete prototype is based on two different netzspannung.org information pools: the submissions of the cast01 conference and the competition digital sparks. In the next step the involvement of concrete partners from both art and research is planned, in order to produce a real-world demonstrator connecting different archives that can be publicly accessed.

At this stage we also deliberately disregard the knowledge transfer that happens through explicit communication channels such as Email and newsgroups and mailing lists [Sack00] [Schwa00] but the developed model can be easily extended to incorporate also such semi-structured information sources. Figure 2 depicts such a generalised model of netzspannung.org as a Semantic Web [W3C] browser.

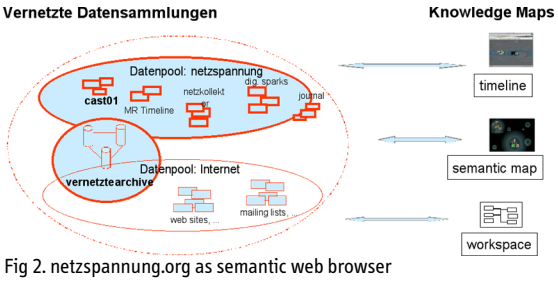

Fig 2. netzspannung.org as semantic web browser

2.1. Connecting archives and heterogeneous information flows

There are two main obstacles to contextualize information coming from different data sources on the Internet:

[1] Much of the information is accessible only as unstructured or semi-structured information (Web pages, mails etc.)

[2] Different databases employ different data structures for encoding the semantics of information.

[3] Different database systems employ different interfaces for communicating with the database server.

Previous work on resolving these issues in integrating heterogeneous data sources includes [Arens96] [Berg98] [Levy96] [Bay97] [Fang94] [Chri00]. A typical approach is to develop a normalisation process for mapping local name constants of different data sources via a system of global name domains (meta domains) organised in different hierarchical levels. This is also the approach of the current Dublin Core initiative that aims at developing domain-specific normalisation processes for different professional communities as a basis for the realisation of the Semantic Web vision [W3C].

The challenge is to enable semantic integration of heterogeneous data sources at run-time, where information has to be extracted from and mapped between different data structures that are unknown to the system in advance. The XML-suite of technologies for exchanging machine-understandable information about the semantic encoding of data structures provides the standard for addressing this challenge.

Applying the meta-data normalisation procedure approach to netzspannung.org is difficult as the goal is to integrate data sources from different professional communities. A typical user of netzspannung.org is interested in discovering intersections between his own field of profession and fields that are not an everyday part of his professional environment. Hence, the problem of data-integration has to be treated from a dynamic user-context perspective: the same data fields will often be assigned different meanings depending upon which user in which context is attempting to access and compare information from different data sources. To deal with this problem we are developing a dynamic adaptor for user-oriented semantic integration of online archives.

As a first step we are implementing a real-time online tool, which enables the user to specify the desired semantic mapping between two different data structures at the moment in which he is formulating a particular search query. On one hand this is a relatively straightforward practical solution for the users. On the other hand, the real-world deployment of such a solution will provide us with a large set of empirical data about patterns of user behaviour and developed mappings. In the next step we investigate possible methods for automatic semantic mapping between cross-domain data based on the experience with the real-time manual mapper model. Particularly promising seems the combination of the basic elements of the normalisation procedure with statistical and heuristical methods from information retrieval and machine learning [Cohen00].

The technological realisation of both the real-time manual mapping tool and the automatic mapping model is based on the netzspannung virtual storage module (Section 4.) that supports different protocols (XML on http, CORBA and SOAP) for connecting heterogenous databases into a common data pool. The final implementation of the dynamic archive adapter will complement the functionalities of the automatic mapping by the system with on-the-fly adaptation by the user.

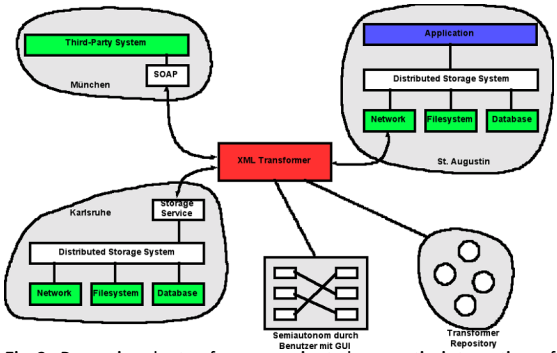

Fig 3. Dynamic adaptor for user-oriented semantic integration of online archives

2.2. The knowledge map system: a tool for thought

On top of this infrastructure the knowledge map system for analysis and contextualisation of information collections is implemented. This system addresses two goals:

[1] an information browser displaying information constellations in a way that provides insight in possible semantic relationships between individual items,

[2] a tool for active creation of new knowledge structures based on users' personal interpretations of relationships in the given information pool.

The architecture of the knowledge map system addressing these requirements is depicted in Fig 4. The current realisation implements two basic interfaces for contextualization, navigation and re-structuring :

[1] The Timeline - time-based contextualization of information categorised in different thematic areas,

[2] The Semantic Map - information-clustering based on a system-generated analysis of semantic relationships.

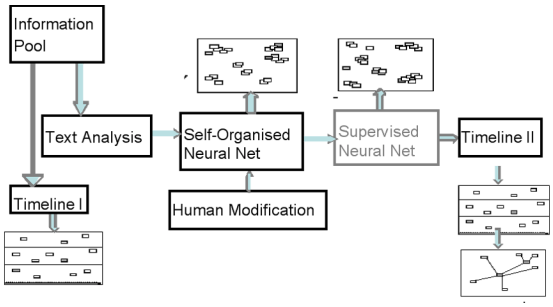

Fig. 4 Architecture of the knowledge map system

2.3. Timeline

The Timeline interface allows a time-based contextualization of information from different data sources, as long as all information items are mapped to a common categorisation scheme . To this end the Timeline interface combines the time axis with parallel display of different thematic categories. This allows implicit insight into possible relationships between historical development of different fields.

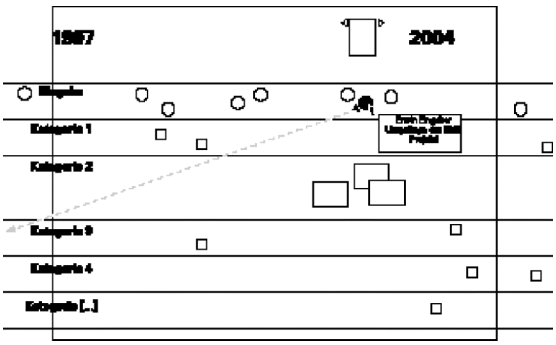

Fig. 5. The Timeline principle

The supported interaction levels include Overview Mode, Detail Mode and Context Mode. The Overview Mode provides a dynamically resizable time-window while the Context Mode (Fig. 6) accomodates the possibilities for investigating explicit cross-category references between individual items (manual grouping or common keywords).

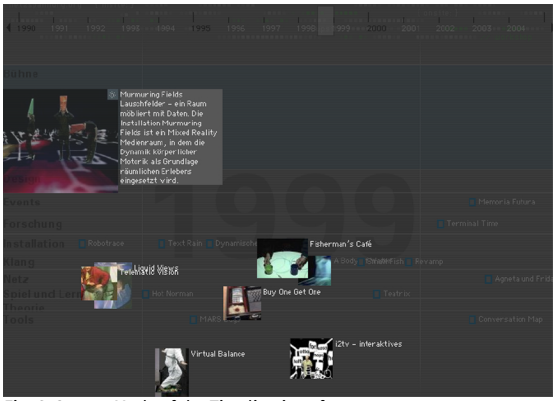

Fig. 6. ContextMode of the Timeline interface

2.4. Semantic Map

In contrast to the Timeline principle, which is based on using firmly defined categories, the Semantic Map is based on the generation of clusters of semantically related content. The basis for this is the combination of text-analysis with Kohonen's self-organised neural network [Lin91][Kohonen00]. In order to encode semantic properties of each information item we employ the vector space model. Numeric vectors are assigned to each text based on text-vectorisation techniques such as word frequency and inverse document frequency (IDFxTF) with stemming, stopword-list filtering and random projection. As a result vectors describing the relevance that the occurrence of individual words has for each text processed are formed .

These high-dimensional vectors (several thousand components) are passed to the Kohonen Map which maps high-dimensional input onto a two dimensional map. As the vectors encode semantic properties of texts the map will position semantically correlated texts close to each other. The information describing the distribution of items and the measure of "semantic similarity" between both individual items and groups of items (clusters) provides the basis for the visualisation developed in the Semantic Map interface (Fig 7).

The basic difference between this and other work on semantic clustering [Lin91] [Kohonen00] [Sack00] is that others employ the resulting cluster map primarily as an information retrieval interface. In our approach the map is a basis for constructing a "tool for thought": a tool for active creation of new knowledge structures. The system-generated information clustering is only a basis to be restructured by the users based on their personal interpretations of relationships implied by the clustering. The requirement for the machine-based "encoding of semantics" is that it creates a constellation that inspires and provokes the users' active investigation of possible knowledge structures that can be constructed from the given information pool.

2.4.1. Visualising relationships

By displaying the distribution of all items and their grouping in semantically related clusters the Overview Mode of the interface gives a quick, general impression of the information pool. The semantic space of each cluster is described by a number of keywords (Fig 7). One kind of keywords is extracted from the data records as entered by the user, while the other is generated by the server side text-analysis.

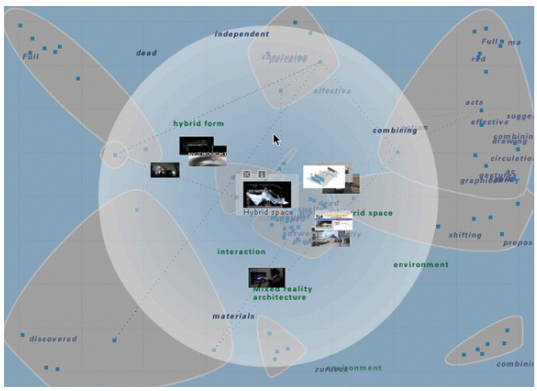

Fig. 7. Screenshot of the Semantic Map Interface

This comparison of computer-generated and human-generated keywords supports the users' interpretation of the "validity" of the information constellation generated by the system. As the computer-generated keywords represent the most significant words for a given item, this also allows an insight into the functioning of the system. Instead of merely navigating a computer generated information space, the user can confront the most significant parameters of the system-based clustering with the distribution of parameters (manual keywords) assigned by the human authors of the information. As noted in [Herl00] this kind of feedback is usually missing in existing approaches to knowledge discovery.

A detailed investigation of the relationships in the presented information space is supported by the Zoom Mode,which displays a set of objects within a given semantic distance from a selected object. Keeping the visual distance between the objects in direct proportion to their semantic similarity allows the user to develop a more accurate impression of possible relationships between an individual object and its "semantic neighbours".

2.4.2. Creating new structures

The possibilities for the user to restructure the map generated by the system have been prototypically realised by the possibility to drag items around and create new clusters, as well as by the possibility to assign labels to clusters, according to one's personal judgment. At the time being this

results only in achange to the visual representation, which can be saved as a new map. Since the original surface structure of the map is derived from the neural network, the network itself should be adapted in a supervised training process to reflect the user's changes.

This would allow the user to create a personalised structure on which new entries can be automatically mapped and thereby dynamically contextualised from the user's personal point of view. This has been foreseen in the overall architecture of the knowledge map system (Fig. 4) but is not implemented at this point. Another element to be included in the further development is the subjective experience of the user. The evaluation of navigation paths of different users can be incorporated as an additional parameter influencing the structuring and visualisation of the information constellations.

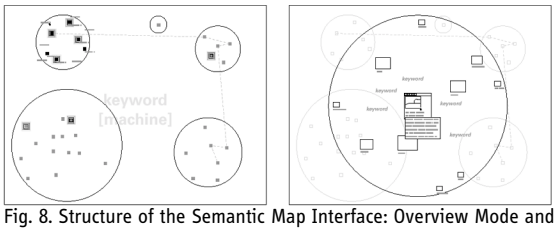

Fig. 8. Structure of the Semantic Map Interface: Overview Mode and Zoom Mode

2.5. Interface for connected archives

The purpose of the described Semantic Map approach is twofold:

[1] On the one hand, the system-generated semantic categorisation (clustering) provides a point of departure for discovering possible relationships that normally might not be perceived by the human user (due to personal bias, lack of cross-disciplinary knowledge etc.).

[2] On the other hand the Semantic Map is one possible solution to the problem of adjusting different categorisation systems as found in different archives. In effect, semantic clustering creates a new "categorisation" that is based on the joint information content, rather than on fixed, predefined categories. This is especially important in the case of information coming from different thematic fields where the difference between the thematic categories often makes direct comparison between them unfeasible.

Since the knowledge map system is intended as a general purpose interface for exploring the possible interrelationships between information items, the categorisation generated by the semantic map can also be displayed in the Timeline interface. In this way the user can combine the two different modalities of contextualising information – the loose semantic structuring of the semantic map, and the time-based arrangement of fixed categorisation of the timeline – in order to discover and visualise possible meanings and relationships in the given information pool.

The described combination of methods for semantic structuring of content and interfaces for navigation and generation of new content provides the foundation of an expandable contextualization system. By applying this to the information pool created by netzspannung.org we aim at providing a tool for exploring how artistic production, scientific research and technological development intersect with each other.

3. Interfaces for networked media spaces: Mobile Unit and i2tv

With the ever more pervasive Internet, mobile communications and wearable computing, the notion of Mixed Reality becomes an ever present everyday experience. With the growing sophistication of underlying technologies the question of what it means to live, play and work in a world shaped by and perceived through digital media, networks and architectures of real and virtual space, becomes more and more elusive.

In this context, experimenting with networked media environments that connect real and virtual spaces becomes the only way of understanding the significance and implication of underlying technologies for everyday life and human experience. But, while a number of open source tools for production of networked multimedia scenarios exist, they suffer from two main problems:

- most of them require a critical threshold of prior technical knowledge and experience, and
- individual tools are difficult to interconnect without extensive programming adaptation.

In this context, we see as a particular challenge the development of tools, which combine different technological elements and make the underlying technical structures manageable at different levels of expertise.

At the same time, developing such concepts and staging such experiments requires not only online media but also equipment and the ability to configure the spatial setting on-site. This includes both the staging of media elements such as projections, displays and interfaces, as well as embedding the accompanying hardware systems for broadcast, streaming and audio-visual equipment.

This has been the motivation for the following two modules of the netzspannung.org platform: (1) the mobile unit for realisation of multimedia environments, and (2) the i2tv system for live media productions and networked scenarios integrating Internet participants with participants on-site.

3.1. Mobile Unit

The basic goal of the Mobile Unit is to provide a fully-fledged networked multimedia environment which can be set up in any space without a direct Internet connection. This environment should enable people to display, edit and broadcast broadband multimedia information. It should be mobile and modular so as to adapt to different spatial conditions and functionalities needed for a given application scenario. To achieve this, the development of the Mobile Unit comprises two distinct but strongly interrelated parts: (1) the technological configuration and (2) the product design for spatial configuration of hardware elements [Stra01a].

The technological set-up of the Mobile Unit comprises a set of different network, multimedia and presentation components, integrated in a logical multimedia system organised in a simple three-layer modular structure (Fig. 9). The unit can be used for video/audio streaming, multimedia-based presentations or as a connectivity tool.

The central technological part is media streaming. This is an area, which for professional use demands very good knowledge of network architecture and protocols, video and audio compression techniques, standards and operating systems. The whole area of distributed multimedia systems is a prerogative for professional streaming media developers and users. On the other hand, technical changes and

improvements in mobile computing have brought us to the point where almost every single user can experiment with basic streaming functionality. The problem that still remains is making professional-level streaming more user-friendly for professional scenarios as well as accessible to inexperienced users.

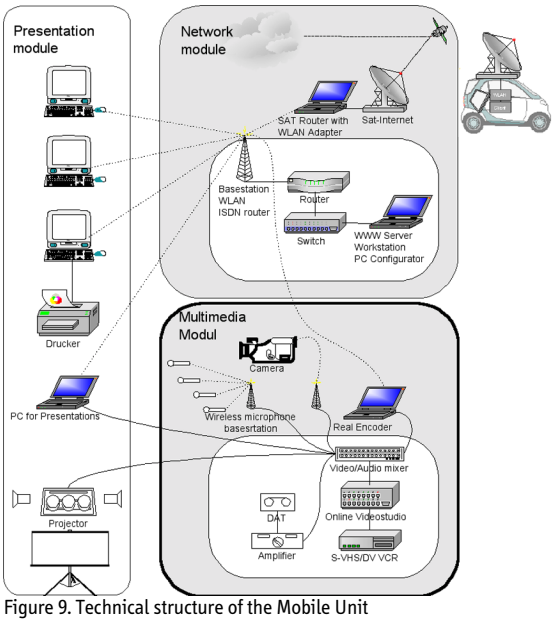

Figure 9. Technical structure of the Mobile Unit

3.2.1. Application: Streaming

In this context, an essential element of the mobile unit is the streaming module that offers an intuitive control tool for integrating diverse encoding and streaming hardware and software components. At present it is based on a dual Pentium, Windows 2000 Professional PC with the following extensions and services:

- MPEG-1/MPEG-2 network broadcast hardware encoder (Minerva VNP-201),
- ViewCast Osprey video capture cards
- RealMedia, Windows Media and QuickTime encoding plug-ins.

This combination implements an "all-in-one" encoder with a web interface for managing customised audio/video profiles and controlling the delivery of streams to the streaming server. The media server is based on Kasenna MediaBase software, which supports creation of multi-format video description files. This means that the media server can dynamically select the appropriate delivery stream based on a client request. It further supports live video storage during the encoding process as well as both unicast and multicast streaming of high-quality (MPEG-2) video.

The described configuration provides a flexible environment for providing and managing a dynamically scalable range of streaming quality: from common 28.8k modem RealMedia streams to high-bandwidth MPEG-2 streaming.

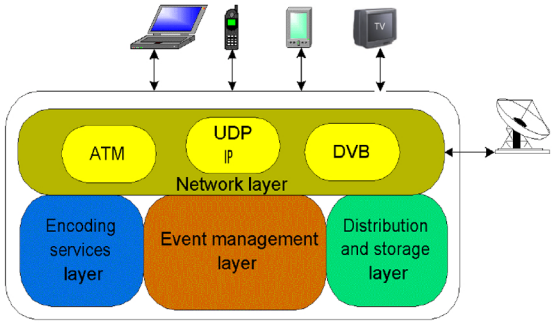

Fig. 10. Structure of the streaming module

This in turn enables on-line users of netzspannung.org to use CAT-Enc as a streaming tool for generating their own streams and distributing them over the netzspannung.org streaming server using TCP/IP or some other protocol, without need for some special streaming knowledge. In other words, this is the infrastructural basis for experiments with live on-line events integrating several or many (multicast) participants.

3.2.2. Application: Mixed Reality Lounge

In conjunction with the eMUSE system [Stra99] the mobile unit enables the realisation of different Mixed Reality configurations independently of the given physical location. An example is a Mixed Reality Lounge setting configured as an interactive playground connecting real and virtual space (Fig. 11).

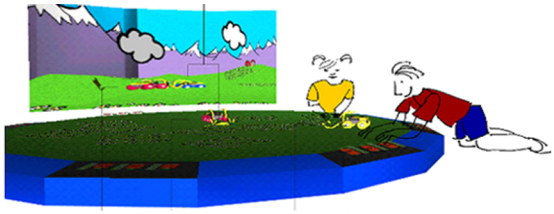

Fig. 11. Mixed Reality playground scenario enabled by the Mobile Unit

3.2. i2tv (interactive Internet-TV)

The i2tv (interactive Internet-TV) system [Novak01b] extends the streaming features of the Mobile Unit by providing a complete toolkit that enables the realisation of live media productions and networked scenarios integrating Internet participants with participants on site. To this end it implements a modular architecture that integrates Internet-based multi-user interaction and awareness with broadcast technologies such as Internet streaming and Virtual Studio, and with technologies for Mixed Reality in shared physical space.

The i2tv system consists out of the following parts:

- MOO server – platform for networked multi-user environments [MOO][Curtis94],
- RealServer – platform for streaming video over Internet [Real],
- e-MUSE – system for multi-user interaction in a combination of shared physical and virtual space [Stra99],
- 3DK Virtual Studio – distributed Virtual Studio system [Vonol99][DMP],
- eMOOSE – interface layer connecting individual elements of the i2tv system.
- Display and input devices – Web browser, handhelds, free body interfaces.

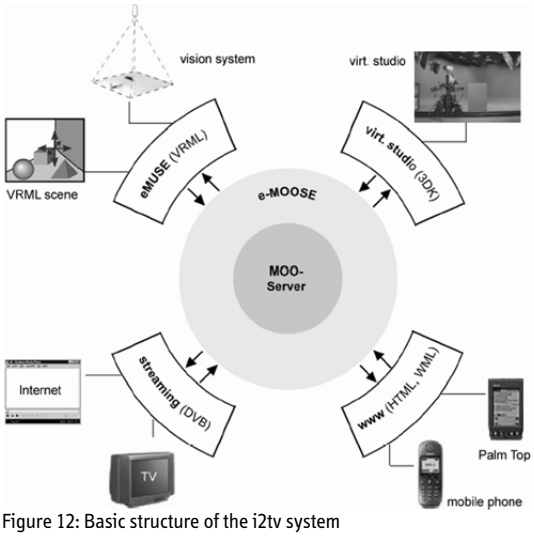

Figure 12: Basic structure of the i2tv system

The particular challenge addressed by i2tv is the creation of an environment in which Internet participants and local audience become equal partners, despite their different situations (on-line, on-site). It enables scenarios in which the audience, both local and on the Internet, can not only follow the event, but also actively shape it, using text, image, live audio or video. To this end, scalable channels for representation of users' presence and a range of interaction channels are supported, such as moderated chat (public and private channels), streaming audio/video, text annotations to live video (video notes), 3D content creation in Virtual Studio, and movement and content creation in shared 3D space.

The application possibilities of the i2tv system have been demonstrated in two public trials: 1) The extension of the historical format of public discussion into a Mixed Reality situation at the Memoria Futura Symposium [Novak01], and 2) the staging of the "Ottos Mops" sound poem of Ernst Jandl, as a distributed poetry play and Mixed Reality television game, making on-line participants active producers of new content and an integral part of the situation on-site [Novak01].

The Memoria Futura demonstration was realised by integrating a group of invited experts2 into the discussion on-site as Internet participants through the minimal version of the i2TV system combining Internet streaming, text interaction and digital TV broadcast via satellite.

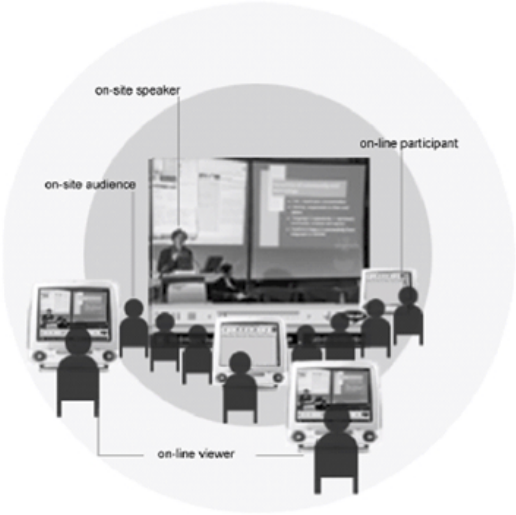

Figure 13: Layers of participation in the i2tv trial at Memoria Futura Symposium

Staging "Ottos Mops" in i2tv demonstrates a prototype for a Mixed Reality television game. Ernst Jandl's phonetic poem "Ottos Mops" is split into single words as a starting point for a collaborative word-sound collage. Participants on-site, in Internet cafés or outside in the streets are equipped with a mobile phone, palmtop, PC or touch screen, in order to send their word fragments of the poem into the Virtual Studio at FhG. The moderator in the studio plays a conductor who binds the incoming words of the networked audience into a new phonetic poem.

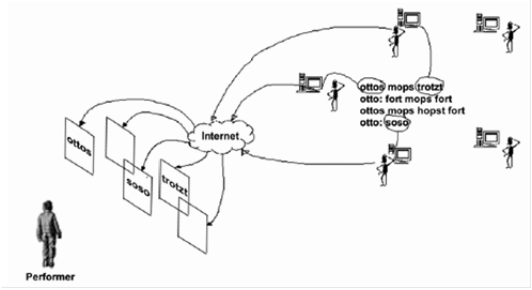

Figure 14: Basic concept "Ottos Mops" distributed poetry play in i2tv.

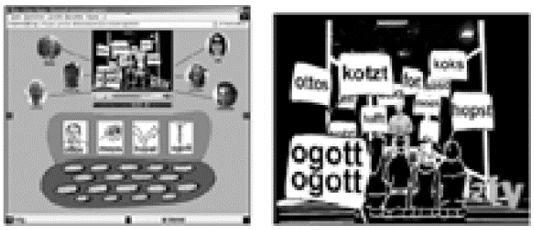

Figure 15. "Ottos Mops" i2tv interface and medial staging in Virtual Studio

These two i2tv applications investigate the specific factors of situations that integrate networked participants in real-space events and explore how the combination of broadcast technologies with interactive media channels of the Internet can develop new forms of cultural spaces based on Mixed Realities.

4. The toolbox principle: distributed, user-extendable system architecture

The underlying basis of the described modules of netzspannung.org is an open, user-extendable distributed system architecture. The challenge is to build a system, which not only deals with different user requirements in a heterogeneous environment of the Internet but also enables the users to modify and extend the system with new functionalities, data archives and interfaces, at different levels of expertise.

The developed system architecture realises a framework for Internet-based distributed systems with decentralised application management and dynamic integration of heterogeneous data sources, distributed services and user-defined modules.

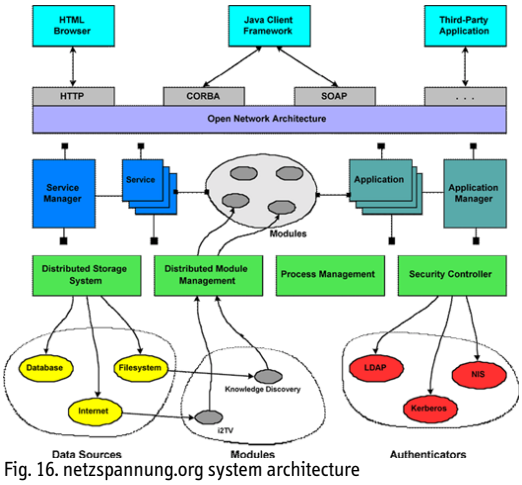

Fig. 16. netzspannung.org system architecture

This framework enables the modelling of a transparent data-pool consisting of both structured and unstructured data sources (heterogeneous databases, file-systems, websites etc.). A basic model for the distribution of applications provides the foundation for decentralised management of application elements while an event notification service implements a basis for shared workspaces and information awareness. These functionalities are supported by the following modules:

Distributed Module Management (DMM)

Transparent integration of system functionalities is enabled by dynamic location and loading of modules, and resolution of their dependencies. Modules can be located anywhere on the Internet and accessed transparently as though they are stored locally on the machine.

Virtual Storage System (VSS)

An open storage interface and data abstraction layer enable transparent access to heterogeneous data sources, without regard to where and how the data is stored. Different applications can share the same data archives, even when they span over different storage types like object-oriented and relational databases, XML repositories and network connections.

Open Network Architecture (ONA)

A protocol abstraction layer supports the implementation of networked systems not only in a Client-Server-Architecture, but also in a Domain-based architecture or within a P2P network. This enables concurrent use of different network protocols (e.g. CORBA, SOAP) as well as individual selection based on the needs of a given application.

Distributed Server Framework (DSF)

Though netzspannung.org does not want to instruct how the implementation of server or client nodes must be designed, it provides a ready-to-go framework, for distributed server implementations. The framework is a basis for extension by custom modules and provides both runtime and developer support. The C++ release is accompanied with a Java version, that comes with Java Servlet, Java Server Pages (JSP) and Extended Server Pages (XSP) support.

Java Client Framework (JCF)

A community platform which requires only a native HTML browser, can be accessed by most Internet users without installing additional software portions. But for more dynamic interfaces, active clients are needed. For this purpose, we provide a Java Client Framework, able to run in a browser window and needing only a Java Plugin for execution. Additional software packages can be loaded from the server and extend the client with the needed functionality.

5. Information channels and media strategies for community building

In order to build up a community based on the productive possibilities of the described web-platform netzspannung.org, the toolbox principle needs to be accompanied by appropriate information channels and media strategies connecting activities in real and virtual space. In the first on-line demonstrator this aspect is supported by the netzkollektor as the public input channel and the workspace as personal space for individual configuration of the platform. Furthermore the cast01 conference and the digital sparks student competition are media strategies for community building and mapping the current space of media culture. In addition, pilot projects with individual artists and institution are an integral part of the development of the platform and demonstrate its "real-world" application for realisation of artistic projects.

6. Conclusions

In this paper we have described a model for an online media lab as a web-based distributed toolbox for knowledge discovery and networked media spaces. This is accompanied by community information channels and media strategies connecting processes in virtual space with real places.

The developed knowledge discovery tools include a dynamic adapter for on-the-fly connection of existing archives and collections into a collaborative knowledge map based on semantic relationships between descriptions of artistic works and scientific and technological research. The Timeline and Semantic Map interfaces support visualisation and exploration of contexts and relationships in such collaborative information pools.

The first prototype of this system is put in use as the web-platform (netzspannung.org) for a developing online competence centre for digital art, culture and technology. The integration of the developed system with a public input channel (netzkollektor) and media strategies (cast01 conference & competition digital sparks) demonstrate the deployment of developed models in a real-world context. This online strategy is complemented with the Mobile Unit and the i2tv system for events connecting real and virtual space.

The goal of this demonstration deployment is to explore the building up of a professional community based on tools for construction and semantic exploration of a collaborative knowledge space in connection with real space events based on Mixed Reality scenarios. In this way we have created an

experimental setting for empirical investigation of the convergence of the approaches of knowledge discovery and mixed reality into an architecture connecting social/ knowledge processes in real and virtual spaces.

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