The LeMO Project – Development of an Internet Multimedia Information System of 20th Century German History : Aims and Results

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ABSTRACT
The aim of the LeMO project was to create a multimedia information system on 20th century German history in the Internet. This work was carried out in a joint project by the German Historical Museum in Berlin, the Haus der Geschichte of the Federal Republic of Germany in Bonn and the Fraunhofer Institute for Software and Systems Engineering ISST in Berlin.

The LeMO system provides various options for accessing its information. With the need to make cultural content attractive to young people in mind, 3D environments have been developed for each period of 20th century history. These presentations constitute a different way of looking at history. Visitors navigate through 3D spaces to the various museum exhibits and can request further multimedia information on historical events (text, images, audio and video material).

Access to specific content is also provided via different search capabilities, including a metadata-based search engine. The architecture of the LeMO system is based on Internet technologies (including VRML, HTML, streaming audio/video). This paper describes the aims, concepts, implementations and results of the LeMO project.

By the end of 2000, 31 3D environments and over 5000 multimedia web pages covering various periods, topics, chronicles and biographies from German history had been developed for the virtual exhibition (www.dhm.de/lemo or www.hdg.de/lemo).

From 1997-2000 LeMO was a project of the DFN-Verein (Association for the Promotion of a German Research Network) with financial support from Deutsche Telekom T-Nova Berkom GmbH (1997–1998) and the Federal Ministry of Education and Research (1999–2000).

KEYWORDS: Internet, information

system, multimedia, 3D worlds, German history

INTRODUCTION

LeMO is a joint project by the German Historical Museum (DHM) in Berlin, the Haus der Geschichte of the Federal Republic of Germany (HdG) in Bonn and the Fraunhofer Institute for Software and Systems Engineering (ISST) in Berlin to develop a multimedia information system on 20th century German history in the Internet (*www.dhm.de/lemo or www.hdg.de/lemo*). LeMO is an acronym for **Le**bendiges virtuelles **M**useum **O**nline (dynamic, virtual museum online) and is an attempt to find new ways of presenting historical content [1] [6].

The LeMO system goes far beyond the usual online presentations of historical content. Its special features include 3D VRML worlds where users are offered new playful forms of access to museum content.

The development of the project started in January 1997. Exactly two years later, the virtual exhibition was officially opened and made accessible via the Internet.

LeMO was a joint project involving computer scientists, designers, museum experts and historians. This ensures that the requirements made on the project were not of a purely technical nature but were also influenced by the content, the concept and the design of the exhibition. This co-operation between different disciplines was a special feature of the project.

From 1997 through 2000 LeMO was a project of the DFN-Verein (Association for the Promotion of a German Research Network) [8] with financial support from Deutsche Telekom T-Nova Berkom GmbH (1997 – 1998) and the Federal Ministry of Education and Research (1999 –2000). Today LeMO is financed by the museums.

This paper begins by describing the basic situation when the project started in 1997. Then the requirements, concepts, system architecture and technical implementation are presented. We conclude with a summary of experience (especial target groups) gained since the exhibition went online

BASIC SITUATION

The DHM owns about 700,000 objects, the HdG about 250,000. Only a small number of these can be shown to the public in permanent exhibitions, and not all those interested in history have the opportunity to visit the museums in Berlin and Bonn. As the majority of the objects are included in the museum's own databases and are thus already available in digital form, it makes sense to make them publicly available via the Internet. Since 1995, thousands of objects have been accessible via this media (see *www.dhm.de or www.hdg.de*).

In order to offer visitors more than just access to an object database, the idea of the LeMO project in the initial phase was to supply the objects together with detailed information and present them as part of a virtual exhibition, with acceptance to be tested by both historical museums. To ensure a necessary minimum of content representation, LeMO was restricted to the history of the 20th century, with the aim of featuring the whole spectrum of items, guided by objects as well as by film and sound material. With the need to make cultural content attractive to young people in mind, three-dimensional environments were developed for each period of 20th century history. These presentations constitute a different way of looking at

history.

The museums wanted to exhibit their objects to the general public via the Internet, for the Fraunhofer ISST it was most important to test various multimedia technologies like streaming video and three-dimensional worlds in the Internet.

LeMO is supported by the DFN-Verein, which aimed to test LeMO as a pilot project for its high-speed network B-WiN, based on ATM technology with a transmission capacity of up to 155 MBit/s. B-WiN provides high-speed access to other European networks, to the USA and to the still relatively low-bandwidth Internet. LeMO's concept and architecture thus consist of components supporting users with both high- and low-bandwidth network connections.

REQUIREMENTS AND CONCEPTS

The design of the LeMO system was based on both content and technical considerations:

- LeMO should be distinct from the both museums' existing online offers (object databases, websites with images and texts).
- LeMO should include broadband multimedia applications to take advantage of the bandwidth of B-WiN.
- LeMO should cover the entire spectrum of exhibits present in the museums, ranging from image material (photos, paintings, prints, etc.), printed material (books, newspaper, poster, maps, etc.), film and sound material, through to period objects (vehicles, appliances, clothing, furniture, etc).
- LeMO should not be a direct visualization of the real exhibitions at the two museums.
- LeMO should make content accessible to a broad target public. It should be fun to surf through LeMO, but it must also be possible to gain fast access to specific information.

To fulfil these requirements, we decided to offer users several interlinked types of access to the information. In addition to access via conventional HTML pages, three-dimensional VRML environments (see Section 4.2) were to be integrated in to the information system.

The virtual exhibition was designed especially for LeMO and for the media of computer and Internet. To enable direct searching for specific content, users were also to be provided with a range of search functionality.

This concept also satisfied two requirements set by the DFN-Verein and Deutsche Telekom:

- large bandwidth (needed for transmission of 3D worlds and audiovisual material)
- large quantities of content (in the interest of both museums).

To give users with narrow band Internet connections (e.g. ISDN) access to LeMO with acceptable download times, the system was designed to ensure that certain application components load without difficulty. This applies in particular to the multimedia information pages (HTML pages) with images and texts.

Content Design and Presentation of Historical Periods

For this project, the 20th century was divided into nine periods, forming the basis for content structuring in both the 3D VRML environments and HTML pages:

- Wilhelmine Germany (from 1900 -

1914)
- World War I (1914 - 1918)
- Weimar Republic (1918 - 1933)
- National Socialism (1933 - 1939)
- World War II and the Holocaust (1939 - 1945)
- Postwar Years (1945 - 1949)
- Divided Germany (1949 - 1989)
- German Unity (1989 / 1990)
- Approaches to the Present (since 1990)

This allows both a general overview and further details on specific themes, giving insights into the century from a range of angles. The German Historical Museum presents history from the turn of the century through the end of World War II, with the Haus der Geschichte covering the period from the end of WW2 to the present day.

LeMO offers users the choice between three points of entry: (1) VRML allows links between historical objects to be established visually in 3D dimensional space. (2) Illustrated texts, digital videos and sounds, supplementary biographies and chronicles can be viewed on HTML pages. At the more detailed level, the architecture of the VRML worlds varies considerably,

Fig. 1: 3D environment "World War I"

giving each period a characteristic representation. (3) For fast, direct access, various search functions are available.

The attempt to visualize metaphors as 3D environments as a site for the presentation of history constitutes a new approach to online information presentation. For the period of World War I, the historians chose a quote from Erich Maria Remarque: "The front is a cage". Correspondingly, this section of LeMO appears as a three-dimensional cage, giving a strong impression of this hopeless, no-way-out situation (Fig. 1). The individual sections of the grille are used in three ways: As frames for photographs from the war, as a surface for key words, and as entrances to

further 3D worlds and HTML pages dealing in more detail with topics such as art, everyday life and war propaganda.

The world of the immediate postwar period presents itself to viewers as a free-floating, ruined, patched together with massive metal components, rising above a bombed-out urban landscape. On a territory under allied control, stylized architectural elements give access to individual environments on culture, politics and the economy (Fig. 2).

Forum

In addition to the virtual exhibition, the LeMO system also offers a forum for active user participation. In the "collective memory", visitors can enter accounts of their experiences, interviews or even entire biographies. The forum thus supplements the actual exhibition with further information from private individuals. Surveys, quizzes or image puzzles on historical themes are provided each week under the title "Questions of Time".

To introduce users to the exhibition, guided tours are offered in the form of videos or directly within the VRML worlds.

Other interactive forums (e.g. discussion forums on historical topics) were deliberately omitted, as LeMO is intended as an information system.

Navigation Structure

Figure 3 shows the call and navigation structure of the LeMO system. Starting from the homepage (*www.dhm.de/lemo* or *www.hdg.de/lemo*) users arrive at the overview. From here, they can switch directly to the historical periods in 3D (VRML) or 2D (HTML). The 3D

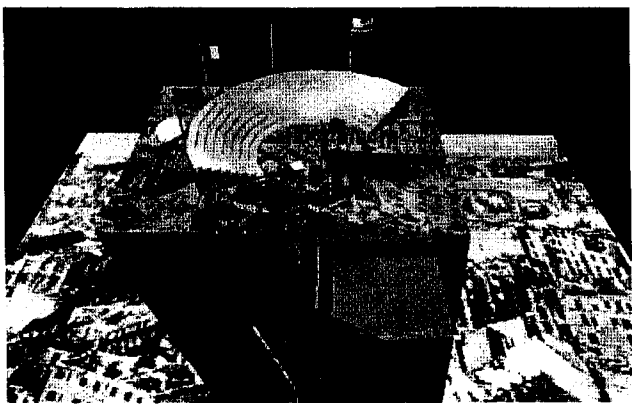

Fig. 2: 3D world "Postwar Years"

worlds are linked to the HTML pages. From within the period environments or webpages, further worlds and webpages with more detailed information can be accessed (including chronicles, biographies, videos, sound material). Using the navigation bar on every web page, users can switch to the previous or the following period, or return to the overview. The search functions and forums are also located on the overview page.

ARCHITECTURE AND TECHNICAL IMPLEMENTATION

The LeMO project uses Internet technology only. This ensures that every visitor with access to the Internet and the WWW can enjoy a virtual trip through history. The special quality of LeMO consists in the combination and integration of a wide range of multimedia web technologies to form an Internet information system. It features the following components [5] [7]:

- Virtual Reality Modeling Language (VRML) to display three-dimensional rooms
- HTML, Javascript and Java to create HTML pages
- Streaming audio/video to transfer data to users in real time without the waiting caused by lengthy download procedures.

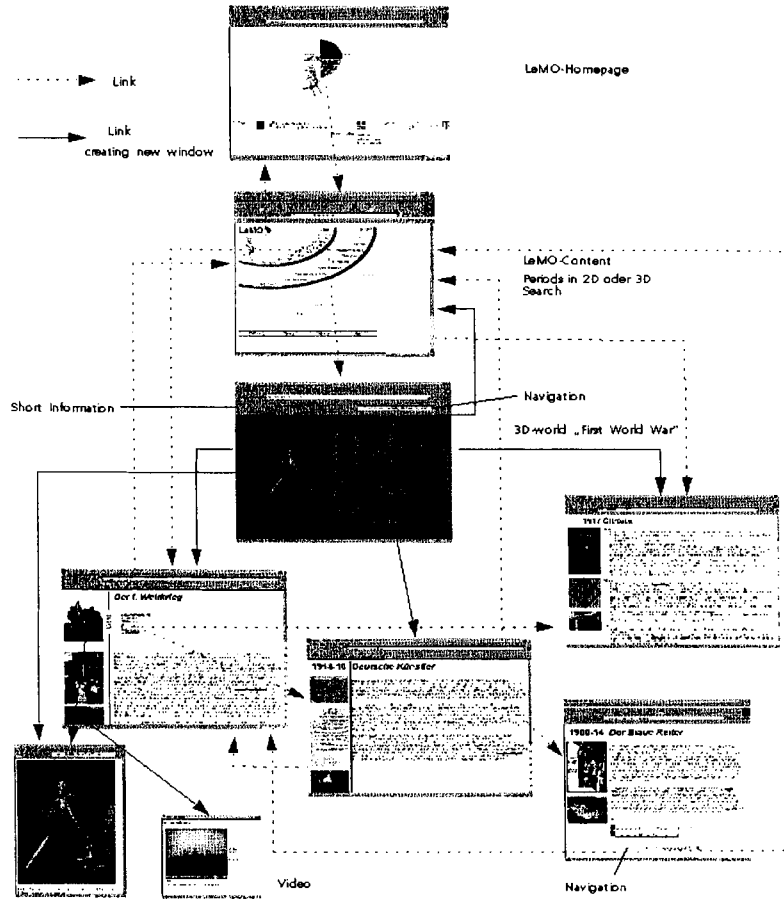

Fig. 3: Structure of VRML and HTML pages

Architecture

The basis of the LeMO architecture builds on the network side of the DFN-Verein B-WiN high-speed network with a transmission capacity of up to 155 MegaBit/s. B-WiN provides access to other networks. The LeMO architecture thus consists of components supporting users with both low and high bandwidth Internet connections. Some of the VRML worlds were developed especially for B-WiN: When such environments are loaded via ISDN or modem connections, longer download times must be reckoned with.

The LeMO architecture (fig. 4) centers on the various servers used to provide LeMO's services:

- WWW server to manage HTML pages and VRML worlds
- LeMO meta-database server as the basis for the metadata search engine

- Video/audio server for direct playout of video/audio files using streaming technology

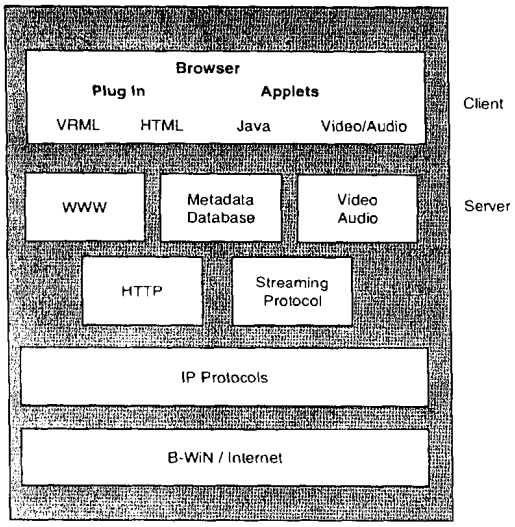

Fig. 4: Architecture of the LeMO system

To use LeMO, visitors require a standard, commercially available multimedia PC with Internet access, using a web browser as a client application. Once freely available plug-ins have been installed (Cosmo Player for VRML, Real Player G2 for video/audio), a web browser can be used to navigate through VRML rooms and receive streaming audio/video.

All server-side services are provided via powerful Unix servers at the two museums.

VRML

The LeMO project uses the current VRML standard 2.0 which enables interactive navigation in three-dimensional space [2]. VRML is a description language like HTML for the development of 3D worlds in the Internet.

The architecture of the above-mentioned VRML worlds was designed from scratch and does not correspond to existing rooms or exhibition spaces at the DHM or HdG. It is based on quotations (see 3.1) [1] [5].

For performance reasons, the VRML period rooms were created using simple geometrical objects (planes, cubes, cylinders).

The objects on display in the VRML spaces are from both museums. Photographs of the objects are either scanned or taken from the museums' object databases. Each image then forms the surface of a simple element (planes, cubes, cylinders) and is placed within the appropriate VRML period environment

Fig. 5 is a snapshot from the period room "Wilhelmine Germany (1900-1914)".This room contains 40 exhibits. Using compression techniques, the storage volume for these images is still 7 MB. Large virtual exhibition spaces thus require the user to have high bandwidth if the 3D environments are to be loaded in an acceptable time. The distinction must be made clear between data transmission and the subsequent computing of the virtual environment. Once loading via the Internet is complete, the delay before the environment appears on the screen depends on the speed and performance of the individual local computer. The speed of navigation similarly depends on individual performance parameters. A fast computer gives the user a smoother journey through 3D environments.

One problem with VRML environments is their file size. The larger the environment, the greater the demands on PC and bandwidth. For this reason, the LeMO project is also developing smaller VRML environments. Instead of designing one large room with many exhibits for each period, some of the periods are broken down into several smaller worlds.

This concept is linked to another of the project's aims. In order to differentiate the virtual exhibition from traditional museum structures - where visitors pass through rooms and view exhibits - the VRML environments also include interactive components, such as slide shows or animations, beyond which further events are to be found.

The VRML space shown in Fig. 5 is very close to the structure of a real museum room. But in order to experiment with the possibilities of the VRML/Internet

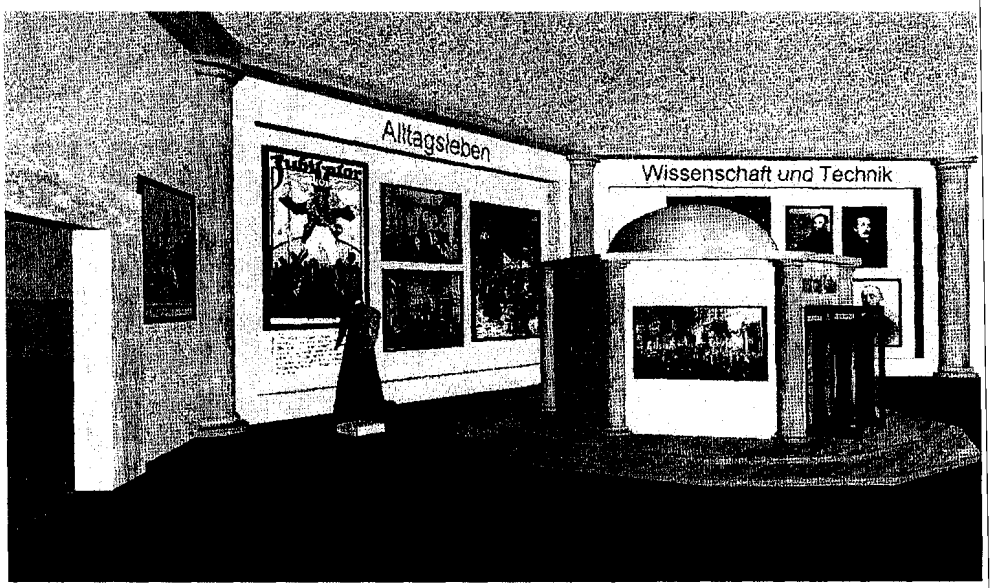

Fig. 5: 3D world "Wilhelmine Germany"

medium, other rooms are given different architectures. Thus, for example, the VRML space on World War I (see fig. 1) is without gravity. Users cannot be sure whether they are on the floor, the ceiling or one of the walls.

Streaming Video

The LeMO exhibition makes a large amount of archive film material available via the Internet. The videos are transmitted using streaming video technology.

The technical possibilities for video transmission via the Internet have improved a great deal in recent years. The state of the art in this field is streaming video, which allows video data to be transmitted via the network in real time and displayed immediately, instead of having to download the complete file before viewing can start.

Both video-on-demand and live broadcasting of events and news programs can now be implemented with relative ease in satisfactory quality. This is due in part to the increased speed of PCs and modems on the receiving end and to the faster data transfer rates resulting from the development of networks. However, the most important developments in video transmission came in the software field with new transfer protocols and video compression techniques.

For the LeMO project, a server-based approach was chosen, using the Real video server [9].

The advantage compared to a purely WWW-based approach is that a higher quality of video transmission can be assured. As the number of clients increases, a web-server soon becomes overloaded, whereas video servers are specially designed to serve larger numbers of clients.

Search

Visitors looking for something specific in LeMO have three search options:

1. Archive

In the archive, the content is indexed by category (biographies, chronicles, maps, videos, etc.) in alphabetical order.

2. Full-text search engine

The full-text search engine searches texts for search terms. If "Adenauer" is entered as a search term, the search engine returns all the HTML pages containing the name.

3. Metadata search engine

For detailed searching, a metadata-based search machine was developed. For each searchable object, content descriptions were written (metadata). These permit a more detailed search with more accurate results than full-text searches. It was implemented using the MeBro framework (metadata-based brokerage) developed at the Fraunhofer ISST [4] [5].

In this way, searches can be run on specific categories, subcategories, persons, periods, places and keywords, with unlimited combinations of search queries.

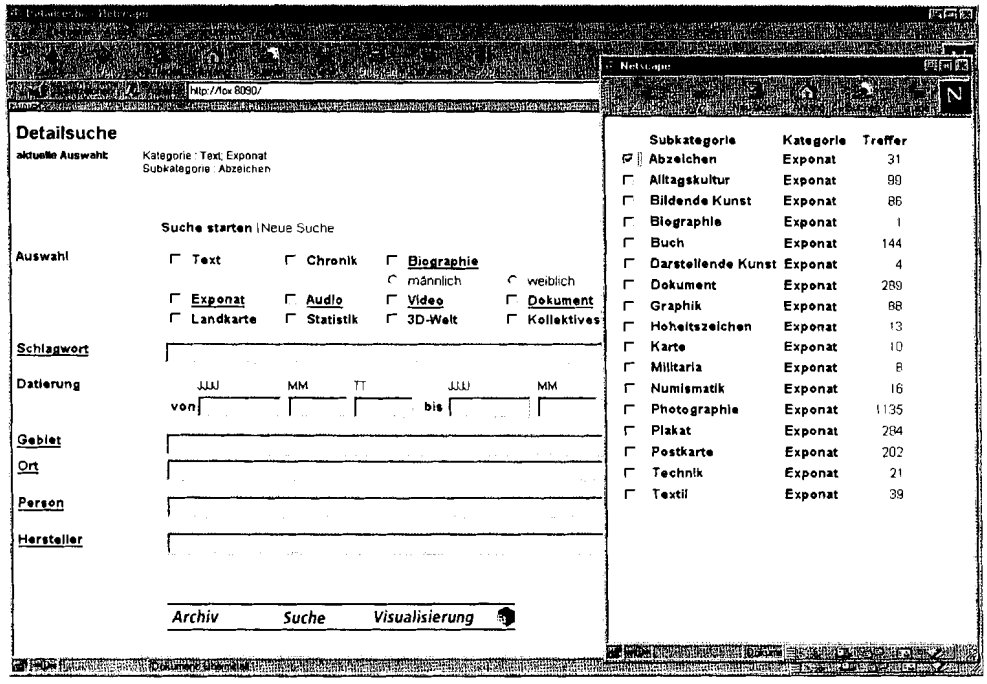

Fig. 6: Interface of the metadata search engine

The search machine's web interface (fig. 6) enables convenient searching. Users are given active guidance during the search process, with a choice of selection criteria and hit forecast for all search parameters, e.g. a list of all keywords.

Metadata must be supplied by those who provide/create resources (in the case of LeMO, this means the historians). Metadata consists of special "tags" which are inserted into the source code of the HTML pages. The pages are then scanned for these tags by a special program, the so-called metacrawler. To make them accessible to the search engine, the metadata acquired in this way must then be stored in a database. The corresponding LeMO data model was developed by museum staff in cooperation with the Fraunhofer ISST.

As the LeMO system is subject to continual development, with constant addition of new documents and HTML pages and modification of existing material, the database has to be brought up to date from time to time. To do this, the program described above is run at regular intervals.

The LeMO data model was mapped to the "Dublin Core" [3] metadata standard, which is used by libraries, archives and museums around the world. This means that LeMO content can be found by all Internet search engines worldwide which support HTML tags or Dublin Core. The following excerpt shows metadata (LeMO data model and Dublin Core) embedded in a HTML page:

```
<!DOCTYPE html

  PUBLIC "-//W3C//DTD
  XHTML 1.0 Strict//EN"

  "DTD/xhtml1-strict.dtd">

<html
xmlns="http://www.w3.org/199
9/xhtml" lang="de">

.....

<head>

<!-- Generated on Wed Oct 04
15:18:01 GMT+02:00 2000 -->

<title>Nachkriegsjahre</title>

.....

<meta                    content="Haus der
name="organization"      Geschichte der
                         Bundesrepublik
                         Deutschland, Bonn">

<meta name="author"      content="LeMO">

<meta name="language"    content="de">

<meta name="keywords"    content="Nachkriegs
                         zeit, Kriegsende,
                         Besatzung, alliierte
                         Besatzung,
                         Milit&auml;rverwalt
                         ung">

<meta name="category"    content="Text">

<meta name="dating"      content="1945-
                         1949">

<meta name="place"       content="Besatzungs
                         zonen">

<meta name="person"      content="">

<meta                    content="http://www.
name="DC.Identifier"     hdg.de/lemo/
                         html/Nachkriegsjahre
                         /index.html">

<meta name="DC.Title"    content="Nachkriegsj
                         ahre">

<meta name="DC.Creator"  content="LeMO">

<meta                    content="Haus der
name="DC.Publisher"      Geschichte der
                         Bundesrepublik
                         Deutschland, Bonn">

<meta name="DC.Rights"   content="http://www.
                         hdg.de/lemo/
                         copy.html">

<meta                    content="de">
name="DC.Language"

<meta name="DC.Subject"  content="Nachkriegs
                         zeit">

<meta name="DC.Subject"  content="Kriegsende
                         ">

<meta name="DC.Subject"  content="Besatzung"
                         >

<meta name="DC.Subject"  content="alliierte
                         Besatzung">

<meta name="DC.Subject"  content="Milit&auml
                         ;rverwaltung">

<meta                    content="1945"
name="DC.Coverage"       type="Dating.Beginn
                         ing">

<meta                    content="1949"
name="DC.Coverage"       type="Dating.Ending
                         ">

<meta                    content="Besatzungs
name="DC.Coverage"       zonen"
                         type="place">
```

<meta name= "DC.Relation.IsPartOf" content="http://www.hdg.de/lemo">

<meta name= "DC.Relation.References" content="http://www.hdg.de/lemo/objekte/pict/Nachkriegsjahre_photoGrosseDrei/index.html">

<meta name= "DC.Relation.References" content="http://www.hdg.de/lemo/objekte/pict/Nachkriegsjahre_plakat26MillionenTote/index.html">

<meta name= "DC.Relation.References" content="http://www.hdg.de/lemo/objekte/pict/Nachkriegsjahre_plakatDurchDieStrassenBettlernGleich/index.html">

<meta name= "DC.Relation.References" content="http://www.hdg.de/lemo/objekte/pict/Nachkriegsjahre_filmplakatDieMoerderSindUnterUns/index.html">

<meta name= "DC.Relation.References" content="http://www.hdg.de/lemo/objekte/pict/Nachkriegsjahre_plakatERPMarshallPlan/index.html">

The results of the detailed search can also be displayed as a 3D space, giving a helpful visualization of content links between different items [10].

LEMO TARGET GROUPS

Those who work with museums are well aware that "museum visitors" is not a homogeneous category. Different visitor groups have different levels of education and interest. Compared to visitors at a real museum, the majority of virtual exhibition visitors are generally younger and they own a PC with Internet access. At the moment, about 250,000 pages a month are called up by 50,000 users, nearly half of them from abroad. About 50 percent of LeMO users are referred to our project by a search engine while looking online for specific information. Because of the fact that a great number of people become acquainted with the DHM and the HdG by our virtual and not by a real exhibition, LeMO raises the publicity of both museums involved enormously. A high number of LeMO users visit the multimedia web pages of the DHM and HdG as well. Entries in visitors books and conversations in the museums show us that quite a lot of museum visitors are encouraged by LeMO and the Internet presence of the DHM and the HdG to visit real exhibitions. Many questions to LeMO by email also show a general interest in both historical museums with their exhibitions and offers. Especially school and university students visit LeMO in order to prepare tests and reports.

To support the use of LeMO in schools directly, LeMO was tested in seven selected schools in Germany in the school year 1999/2000. In close co-operation with teachers, analysis was carried out to find ways of using LeMO in history lessons and to ascertain the extent to which it meets the required standards for school teaching. The teachers at the schools involved reported on their experience with LeMO in several workshops. According to these findings, preparation and presentation of history lessons is much easier with the help of a modern multimedia information system. Pupils

and teachers as well as other LeMO users are especially fascinated by the multimedia imparting of history realized by LeMO and the high number of historical objects. Younger pupils preferred the video and audio files followed by the 3D worlds. Older pupils suggested to include more authentic texts. An opinion poll at the schools involved revealed that LeMO deepens the historical knowledge of the vast majority of the pupils. Because of its hyperlinked structure, LeMO has the advantage of explaining historical connections in a much more graphical way than books. This boosts levels of motivation and achievement at school among both teachers and students. The restricted disposal of the 3D environments and the streaming videos and audios without having the necessary bandwidth is criticized by many LeMO users. However, LeMO corresponds with the character of a pilot project using a technology being perhaps standard in a few years. The cooperating schools also experimented with different network connections (128 Kbit/s ISDN, ADSL, 2 Mbit/s B-WiN). A 2 Mbit/s connection is more than enough, but is not yet generally available in schools and homes. In future, ADSL technology promises to give these user groups increased bandwidth Internet access. The aims of the LeMO project for the years to come include pushing for greater use in schools and extending the LeMO server to include a learning portal for history teaching with special content for teachers and students.

In addition to this, projects within regular lessons or in extracurricular groups create and contribute content for the interactive applications. Students acquire their own articles for the "collective memory". Most of the articles are interviews with grandparents or other older people about their experiences in former periods of German history. The "oral history" contributions are presented to a general public via the "collective memory" on the LeMO server. This also promotes the "learning by publishing" effect.

But of course, the "collective memory" is not only open to school students. Growing numbers of older people are also seizing the opportunity to submit articles about their eventful lives.

RESULTS AND CONCLUSION

LeMO is much more than a virtual exhibition in the Internet. In the space of four years, the project has developed an extensive multimedia information system on 20th century German history which is constantly growing. Since the virtual exhibition was opened in January 1999, the number of people using LeMO increased continually. At the moment, about 250,000 pages a month are called up by 50,000 users. The LeMO project now includes 100 chronicles, more than 750 biographies about the most important German and European persons of the 20th century, about 100 sets of statistics, 200 videos, more than 200 audio files, and countless pages with detailed information on various themes of German history. The user has access to 5,000 multimedia HTML pages and 31 three-dimensional environments, the whole data set amounts to 2 GigaByte. "Guided tours" are available as introductions to every period. As well as being one of the most visited websites on the servers of both historical museums, the quantity and quality of historical information on offer make LeMO unique nationally and internationally, and it already has an established reputation.

Nevertheless, an information system like

LeMO is never completely finished. It has to be updated continually, as the chronicles and biographies of living persons must be updated and the text pages adjusted to reflect the latest state of research.

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