EVA Europe '99 Berlin

Conference Proceedings

Electronic Imaging & the Visual Arts

9th - 12th November 1999

GFaI
Gesellschaft zur Förderung angewandter Informatik e.V.
Society for the Promotion of Applied Computer Science

VASARI UK

Conference Proceedings

EVA Europe '99 Berlin

Electronic Imaging & the Visual Arts

The 6th EVA Berlin is the main European event in 1999
of the worldwide EVA series.

9th – 12th November 1999

at the

S|M
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State Museums of Berlin –
Prussian Cultural Heritage
at the Berliner Kulturforum

Organisers

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FOREWORD

In the last year of the millennium the astonishingly rapid technological developments in computing and telecomms have continued. The 'convergence' phenomenon is now well recognised, not only at the broad industrial sector level but also within the cultural sector as museums, Libraries, archives and other types of cultural institutions increasingly face common challenges and opportunities from the new technologies. These are global trends which Europe can and should play a leading role due to its remarkable cultural heritage and its strong efforts and capabilities in science and technology. Moreover, it is not only a question of applying the new technologies in the cultural sector since the field of cultural heritage can itself help act as a technology driver. This is illustrated by a quotation from Dominique Gonthier of the European Commission: 'ask not only what technology can do for culture, but what culture can do for technology'. This view is reflected in the inclusion for the first time of cultural heritage at a key area in the European Commission's Fifth Framework Programme (key action line III).

Ten years ago in 1990, the first EVA [Electronic Imaging & the Visual Arts] conference was held at London University moving to the National Gallery in London in 1992 for the third EVA. In 1998 the main European EVA was held in Florence and then Berlin was selected as the venue for the 10th anniversary main EVA Conference in 1999. A key issue is helping to bring together East and West European initiatives in the area of 'Culture x Technology'. EVA'99 Europe Berlin, [also the 6th EVA in Berlin] thus takes a critical position in the world wide series of EVA Conferences, which have now spread as far as Japan, Russia and the USA, as well as across Europe.

The main objective of the EVA Conferences and also of EVA'99 Europe Berlin is to provide an opportunity for the exchange of ideas, experiences and plans between people from the cultural sector, scientists and technologists from industry, universities and research institutes, as well as government.

To this end, not only results from research and development projects, but also applications will be presented. The exhibition will include a wide selection of innovative project results as well as new products and services. In particular, there will be news on the latest situation of the Fifth Framework Programme and encouragement given to help in creating new partnerships. In summary, EVA'99 Europe Berlin will be an interdisciplinary, multi-sectoral forum with local, European and international participants.

The opening keynote paper by Professor Lutz Heusinger (Marburg Photo Image Archive) will discuss practical issues on image indexing for art and architecture based on working with 1.5 million images and related cultural policy issues. Norbert Kanter (Art & Exhibition Hall, Bonn, Germany) will present a closing paper on art video content on the internet.

The first two conference days address three main issues:

- Digitising: Beginning New Media Applications including a variety of topics from large scale 2-D imaging for the internet to 3-D and wound digitisation
- Cultural Databases: Capture - maintenance - retrieval - including papers on the 'hot topic' of content based retrieval as well as museums and general applications including architectural and design
- Presentations: Multimedia projects - culture on the World Wide Web ranging from landscape art to on-line publishing and integrated multimedia systems for libraries

The EU and International Conference day begins with news and perspectives from the European Commission followed by papers and a panel on Central, East & West European national and regional initiatives. Finally, there are papers from North America and Asia, and a panel on international co-operation.

Prior to the conference on Tuesday 9th November 1999 there will be a series of tutorials on two major themes: Visitor oriented design of media projects and Digitisation strategies and creation of digital image archives.

The accompanying exhibition will have about twenty stands. Exhibitors come from as far as Rumania and the Ukraine as well as from EU countries with companies, universities and research institutes all participating.

The purely cultural side is not neglected - on the evening of Wednesday 10th November a special event 'Homage to Kandinsky' is planned, as well as guided tours of the magnificent New Art Gallery at the Kulturforum.

Our special thanks to the Prussian State Cultural Foundation for hosting EVA'99 Europe Berlin and in particular to its president, Professor Klaus-Dieter Lehmann, who will give the welcoming speech to the conference. Also many thanks to Dr Andreas Bienert and his colleagues who have worked so hard to make this 10th anniversary EVA Conference a success.

Gerd Stanke

James Hemsley

Electronic Imaging & the Visual Arts

EVA Conferences 2000 / I

EVA 2000
Berlin
Autumn

Co-organised with
GFaI Berlin

EVA 2000
Gifu, Japan
3-5 October

Co-organised with
Gifu Prefectoral Government

For Further EVA Information see VASARI UK WebSite: www.vasari.co.uk

EVA 2000
Scotland
27-29 July

Co-organised with
National Museums of Scotland & SCRAN

EVA 2000
Athens
Main European EVA Event
15-18 May

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EVA Conferences 1999 / II

EVA 2000
Florence
27-31 March

Co-organised with the ***University of Florence***

EVA'99
Berlin
November 9-12

Co-organised with
GFaI, Berlin

EVA'99
Moscow
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PICTURE INDEX OF ART AND ARCHITECTURE

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Prototype of Picture Index for Art and Architecture in the Internet: bildindex.de

1. Summary

Two world wars, the turbulent reconstruction in West Germany, and insufficient care in East Germany have caused irreparable damage to art and architecture in Germany. Many monuments have been irreversibly lost or destroyed, while others have been substantially altered, calling their authenticity into question. The federalist structure of the German state and the division of responsibility for its cultural legacy have only exacerbated the problem, making it more difficult to preserve and study the heritage of visual art in Germany than in any other country in Europe. For this reason, the development of a national picture archive of art and architecture in Germany, accessible to all at no cost in the World Wide Web, is a task of primary significance—one that can be fulfilled by building on the foundation of the "Marburger Index."

The Marburger Index is a systematic, constantly expanding preservation filming and microfiche publication of 1.3 million photographs of art and architecture in Germany. Over the last 20 years, photographs have gradually been borrowed from historic preservation agencies, museums, and libraries (Dresden, Cologne), catalogued, filmed onto microfiche in accord with the highest quality standards, and returned to their owners. This procedure alone has made it possible, both culturally-politically and economically, to develop a national picture archive on the basis of the irreplaceable historic holdings of important institutions, above all West German historic preservation agencies and two libraries in East and West Germany. This picture archive, in turn, preserves a cultural legacy that sadly no longer physically exists in Germany. About 80 % of the photographic documents, some of them dating back to the beginnings of photography, are irreplaceable due to changes that have occurred since they were taken.

Appropriately for a national picture archive of art and architecture, the reproductions in the Marburger Index are topographically organized. Within each individual location, the works of art are systematically arranged.

In recent years, new processes have made it possible to serially digitize microfiche images at a quality level usable for scholarship (2300 x 2800 pixels, 256 gray scale) for a reasonable price (95 Pfennig gross). Tests have shown that the loss of quality from photographic negative to photographic print to microfiche image to digital image is so negligible that later redigitization at a higher resolution would result in no significant gain of information. This observation would hold true even if funds were to permit the direct digitization of negatives of differing size (35 mm to 24/30) scattered throughout numerous institutions.

The digitization of the Marburger Index will make a national picture archive of art and architecture in Germany available over the Internet, accessible to all interested persons free of charge. This archive can and will be developed cooperatively by scholars in historic preservation agencies, museums, archives, university departments, and research institutes as a future-oriented example of electronic publishing.

The Deutsche Forschungsgemeinschaft (DFG [German Research Association]) has approved funding for the project (January 1, 1999 – December 31, 2001) in the amount of DM 1.93 million (DM 1.31 million for digitization, DM 300,000 for a scholar, DM 270,000 for five student assistants, and DM 50,000 for software adaptation).

2. Description of Holdings

In reaction to heavy losses in historic building substance during the rapid reconstruction of the cities after 1945, a process of reevaluation was initiated in the early 1970s. The federal states gradually began to make new historic preservation laws, while the significance of art historical documentary photography—with whose help destroyed or damaged monuments could perhaps be rebuilt or at least visually preserved for coming generations—became ever clearer. When the transfer of high-quality halftone photographs to silver-film microfiche succeeded for the first time in 1976, the time was ripe for the Marburger Index.

The Marburger Index is a preservation filming and microfiche publication of documentary photographs of art and architecture in Germany. At present, it contains 1.25 million images ranging from masterpieces in all artistic genres to applied and folk arts, from cities to villages, from cathedrals to worker settlements, from the Rhine to eastern Germany (boundaries as of 1937). With the completion of the fourth alphabetical series in 2000, the Index will comprise 1,325,000 photographs.

2.1 Origin and Quality of the Photographs

The 1,325,000 photographs collected in the Marburger Index are drawn from the following institutions:

State historic preservation agencies:	
Schleswig-Holstein (Kiel, Lübeck)	45,000
Bremen	10,000
Hamburg	20,000
Lower Saxony	50,000
Berlin	25,000
Rhineland-Palatinate	40,000
Baden-Württemberg	55,000
	245,000
Museums:	
Braunschweig, Herzog Anton Ulrich-Museum	5,000
Cologne, Römisch-Germanisches Museum	10,000
Nuremberg, Germanisches Nationalmuseum	70,000
	85,000
Picture archives:	
Berlin, Landesbildstelle	10,000
Dresden, Deutsche Fotothek	280,000
Koblenz, Landesbildstelle	5,000
Cologne, Rheinisches Bildarchiv	240,000
Marburg, Bildarchiv Foto Marburg	460,000
	995,000

As this tabular survey shows, the Marburger Index contains photographs from 15 institutions: seven state historic preservation agencies, three museums, and five picture archives.[1] Seventy-four percent of the material is drawn from the three major art-historical picture archives in Dresden, Cologne, and Marburg. This material may be described as follows:

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[1] These numbers may seem small; yet despite the interest of other institutions in contributing to the Marburger Index, it has not been logistically possible to borrow, catalogue, integrate, film, and publish more than an average of 66,000 photographs per year (in alphabetical order!).

Dresden, Sächsische Landesbibliothek – Staats- und Universitätsbibliothek

The Deutsche Fotothek, a division of the former Sächsische Landesbibliothek (State Library of Saxony), originated from the old provincial photo archive of Saxony and thus possesses valuable historic holdings for that region. After 1945, it was established as the central institution for art historical documentation of the German Democratic Republic and thus documented art and architecture in East Germany. The Deutsche Fotothek also served as the museum photo archive for the Dresdner Kunstsammlung; accordingly, the holdings in the Marburger Index drawn from this source are quite thoroughly documented.

Cologne, Kunst- und Museumsbibliothek

The Rheinisches Bildarchiv, a division of the Kunst- und Museumsbibliothek (Art and Museum Library) of the city of Cologne, was founded in 1924 by a former staff member of the Bildarchiv Foto Marburg with the intent of creating a similar archive for the Rhine region, focusing particularly on Cologne. In accord with this goal, the archive possesses a collection of old photographs of the Rhineland, some of them dating back to the beginnings of photography. The second focal point of the archive consists of photographs of the holdings of museums and exhibitions in Cologne since the 1920s.

Bildarchiv Foto Marburg of the Philipps-Universität

Since its founding in 1913, Foto Marburg has primarily photographed monuments that were threatened by decay, change, or even destruction; negatives from other archives were also purchased and integrated according to the same criteria. Typical examples include the photographs of the Ministry of Propaganda, taken in 1942–44 in preparation for reconstruction after the war, as well as thousands of new photographs taken by Foto Marburg documenting the condition of the most important architectural monuments immediately following 1945.

Secondly, Foto Marburg has sought to obtain photographs of works accessible only with difficulty (private collections, temporary exhibitions, manuscript illuminations, etc.). Thirdly, it has provided systematic photographic documentation where the administrators of portable and non-portable works of art were unable to do so. Finally, many of the photographs stem from large and small-scale research projects.[2]

Viewed as a whole, therefore, the collection of art historical documentary photographs in the Marburger Index has a certain random or fragmentary quality. Many monuments have been almost continuously documented since the 19th century, while other, no less important examples are entirely missing. The 4,000 photographs of hand-crafted Rhenish carnival medals may seem strange, while the 150 images of 19th-century artists' ateliers in Munich may elicit enthusiasm. 30,000 photographs of art and architecture in Berlin may seem too many, 10,000 of medieval manuscript illuminations far too few. These imbalances, however, can only be corrected when the Marburger Index is digitized, opening the way for expansion with the help of modern technology. In this way, a national picture archive within a distributed digital library can be created in a sensible manner, an archive containing the valuable historic holdings of institutions that have not yet been integrated into the Index as well as new (color) photographs[3] showing the current condition of the works.

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[2] The ca. 900,000 photographs of art and architecture from other European countries contained in the Bildarchiv are compiled according to the same criteria.

[3] In view of the current commercialization of German museums, museums will most certainly be interested in offering their new photographs for sale not only via their own museum servers, but also in the national picture archive.

2.2 Quality of the Microfiches

From the beginning, the preservation filming of the photographs for the Marburger Index has been performed by the firm Herrmann + Kraemer (Garmisch) with the reduction factor 24x, subject to all applicable norms and strict quality control. The master fiches were placed in storage with Herrmann + Kraemer in climate-controlled vaults immediately after completion of the silver-film copies. Although in 1976 there was as yet no thought of digitization, for the most part the filming was performed in accord with the "Requirements for Film Quality and Film Organization with a View to the Option of Film Digitization" outlined in the final report "Digitization as a Means of Preservation" of the DFG committee on digitization and preservation.[4] The high standard of quality and the consistent uniformity of the filming over a period of 20 years constitute the prerequisite for the planned digitization of microfiche images.

2.3 Organization and Identification of the Material

The original concept for the Marburger Index, approved by the Volkswagen Foundation in 1976, called for the preservation filming and publication of the estimated 500,000 photographs in the Bildarchiv Foto Marburg and the Rheinisches Bildarchiv in Cologne in accord with the topographical system of the Germany division in Marburg (see "Categorization System of the Marburger Index" of 1976 in the appendix).[5] This concept has been maintained to the present, although the first series has now been supplemented by three additional alphabetical series, requiring users to look in four different places.

The information in the Marburger Index leads from the subdivider cards (an average of one card for every ten microfiches) to carefully differentiated titles on the individual fiches, to the photographic reproductions with their subheadings and more or less detailed identification. Obligatory elements of this identification are:

- site and exact localization of the object or object part;
- designation of object as precisely as possible;
- owner, negative number, and date of photograph.

Information concerning the title of the object, artist name(s), date, material, dimensions, and the like, as well as the conditions under which it was photographed ("before/during/after restoration," "collecting point," "auction photograph," etc.), are desirable, but not always obtainable due to the differing ages and origins of the identifying captions.

On the whole, the identification of the photographs in the Marburger Index is comparable to what scholars are accustomed to finding in scholarly photo archives: unfortunately, far too much outdated and erroneous information, but sometimes also surprisingly interesting notes made by other scholars on the mounting board before filming. Almost always, however, enough information is provided to render the photographs useful for scholarship and publication—even if only with the credit "unknown private collection, reproduced in the Marburger Index Microfiche No. ...."[6]

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[4] ZfBB 44 (1997) 1, pp. 53 ff. A more detailed technical description of the fiche production is available upon request.

[5] This project was funded by DM 1.4 million from the Volkswagen Foundation, since many of the photographs in the two archives existed only as negatives and had to be printed and identified before filming. After the expiration of the five-year funding, the situation had not essentially changed; even now, essential holdings must first be prepared in this manner before filming. The achievement of the Marburger Index consists not least of all in having necessitated and facilitated this process of identification en passant and secured its continuation.

[6] An important advantage of the digitization of the Marburger Index will be that in the future, scholars will be able to communicate necessary improvements in the captions via e-mail, enabling Foto Marburg to easily incorporate them into the identification of the digital images.

2.4 Current Availability of the Marburger Index

According to statistics provided by the publisher K. G. Saur Verlag, at its height the Marburger Index had 202 subscribers in 145 locations, among them 102 institutions (59 locations) in Germany, 43 institutions (34 locations) in other European countries, 37 institutions (32 locations) in North America, and 20 institutions (20 locations) on other continents.

This dissemination of a product that appeared in 1977 at the almost prohibitive price of DM 10,000 and since then has become even larger and more expensive bears witness to widespread interest in the comprehensive documentation of art in Germany. On the other hand, it should also be noted that the Marburger Index has lost subscribers during its 20-year period of publication, so that today only 140 institutions subscribe to the microfiches. There are two possible reasons for this decline:

1. Due to its value and extent, many institutions placed the Index in their storage magazines where it was difficult to use;[7] as a result, it began to appear dispensable.
2. The supplementary expansion of the Index in four series—the only option with microfiche—and the sole COM index available for years complicated usage to the point of scaring off potential customers.

If the Marburger Index consisted of a journal with a few thousand articles, its current dissemination would suffice. Articles could be obtained with a minimum of effort from one of the libraries subscribing to the Index. But since the Index consists of a collection of 1.3 million photographs—of the sort that scholars and interested persons all over the world are always looking for but can hardly order interlibrary loan without having seen it—its availability is insufficient.

2.5 Copyrights for Photographs and Data on the Works of Art

Since its founding, the Marburger Index has consisted of a preservation filming and microfiche publication in which legal questions have played virtually no role. The copyright for the publication is held by Foto Marburg; for the first two of the four alphabetical series, it shares the copyright with the Rheinisches Bildarchiv in Cologne, for the fourth series with the Deutsche Fotothek of the Sächsische Landesbibliothek in Dresden. The name of the owner appears beneath each published photograph in the Marburger Index. Although no written contracts exist between the institutions participating in the Marburger Index, unspoken consensus requires unquestioning respect for conventional scholarly rules of behavior.

Artistic copyrights for the reproduced works of art could be disregarded since the Marburger Index is a catalogue that serves to prove the existence of the individual photographs in the various institutions. Photographic copyrights could be disregarded since without exception, they are held by the institutions that provided the photographs to the Marburger Index. Property rights for the reproduced works of art could be disregarded because they have never been asserted against the public institutions participating in the Marburger Index.

In the context of the digitization of the Marburger Index, the following rights must be considered:

1. The copyright on the Marburger Index. The two owners of copyrights for portions of the Marburger Index—the Rheinisches Bildarchiv in Cologne (1st and 2nd alphabetical series) and the Deutsche Fotothek of the Sächsische Landesbibliothek (4th alphabetical series)—are familiar with the project and have agreed to the digitization of the Marburger Index.
2. To the extent that they have been consulted, the owners of the photographs reproduced in the Marburger Index—the historic preservation agencies, museums, and archives—have agreed to digitization. The institutions that have not yet been consulted will likewise agree, for the following reasons:

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[7] To this day, many institutions still keep the Index in the boxes in which it was delivered. Almost never is it set up in a room with a reader-printer, although this is the most effective solution.

1. They will receive free copies of the picture files and thus will no longer have to themselves digitize their valuable historic holdings.
2. Foto Marburg will offer them no-cost care of their digital picture holdings (backup and migration).
3. If desired, Foto Marburg will provide them with cost-free homepages for the separate presentation of their own share of the national picture archive of art and architecture in Germany, either on their own server or that of Foto Marburg.

3. While the inclusion of reproductions of copyright-protected works is of course desirable, it is not indispensable for the national picture archive of art and architecture in Germany, intended primarily to document lost holdings and previous conditions. Accordingly, for economic reasons questionable reproductions will be digitized along with the others, but will only be integrated after clarification of whether the so-called catalogue privilege comes into effect or whether permission must be obtained from VG Bild, other copyright representatives, artists' estates, or individual artists before reproductions are shown in the World Wide Web.
4. In the event that, contrary to all previous experience, public owners of reproduced works of art demand usage fees, they will be offered the opportunity to integrate their own and usually more current photographs of their objects into the national picture archive and thus attract potential customers. Otherwise, the reproductions of their works will be removed from the picture archive—resulting in their absence from the largest image pool of its kind.

Legal questions thus represent no obstacle to digitization. To the extent that they have not yet been clarified, they can be discussed during the project, since they are not critical for the final product.

3. Goals of the Project

- The project seeks to offer a national picture archive of art and architecture in Germany in the World Wide Web, accessible free of charge to all interested persons, widely used, and susceptible to distributed expansion. It is intended to support and facilitate the research, scholarly presentation, and practical care of art and architecture.
  In accord with the performance capacity of the Internet and current graphics cards and monitors, 100 KB picture versions will be offered in gallery mode, with 700 KB versions in single picture mode. In addition, 1.6 MB picture versions will be offered upon request as individual, customized WWW pages (on the technology see below). The identification of provenience on each photograph will make it possible to order a reproducible print directly from the owner, securing direct access to the entire body of photographs with their valuable cultural-historical visual information.
- The project is intended to provide an up-to-date, efficient basis for the cooperative electronic publishing and exchange of art historical data among historic preservation agencies, museums, archives, and institutes—a process that has been initiated in recent years—as well as to reach a broad range of new users, not least of all in the schools.
- The age of digital information opens up new perspectives and functions for historical works of art, with regard not only to their aesthetic appeal, but also to their importance as historical sources and witnesses of social development. This opportunity should be utilized and art supported as an essential element of collective social memory.
- In the course of the much-invoked process of globalization, a competition for cultural identity develops not only linguistically, but in the area of visual arts as well. Thus it is appropriate to take note of American and French precedents and strive for a comparable digital presence of art and architecture in Germany.

4. Digitization of Microfiche Image Fields

Since 1976, the preservation filming and production of copies of the Marburger Index has been entrusted to the firm Herrmann + Kraemer. Although estimates have repeatedly been obtained from other sources in the interest of reducing costs, up to this point no other firm has been able to scan microfiche images at the same level of quality. Thus in the following it will be assumed that only this same firm can be commissioned to digitize the Marburger Index. (Nonetheless, the Bildarchiv has stood firm in its price negotiations with Herrmann + Kraemer and has met with at least some success.)

The digitization of the microfiche image fields by Herrmann + Kraemer—who also participated in the tests for the above-cited report by the DFG committee on digitization and preservation—is being performed in accordance with the guidelines outlined in the committee report, with one exception: despite generally valid scruples concerning this procedure, the digitization is to be performed from the master fiches, stored in the firm's vault since their creation. This procedure will prevent loss of quality due to small, not excludable weaknesses found in the copies.[8]

After completion of a comprehensive series of tests, the digitization will proceed as follows:

Scanning mode:	8 bit with 256 gray scale, digitization with 6000 dpi
Scanning resolution:	ca. 2270 x 2840 pixels
Image refinement:	unsharp masking
Storage capacity:	TIFF uncompressed ca. 6.5 MB
Indexing:	Fiche number + coordinates
Storage medium:	CD-R, Kodak Writable CD with Infoguard protective coating, 650 MB

The decision to digitize with these values and media is based on the following considerations:

1. The resulting quality will correspond to that of average reproductions in printed works. Since heretofore the latter have successfully served the needs of scholarship, the former will do so in the future as well.
2. Digitization at this level of quality will produce a catalogue of photographs which, in the long term, will adequately protect scholars from mistaken orders resulting from unclear picture interpretation.
3. Whether made aware of works through printed or digital means, in the future scholars will still require photographic prints produced by the owners of the images in accord with individual research and publication needs. Such prints continue to possess the greatest evidential value and will therefore remain indispensable for scholarship.
4. As technology continues to develop, digital "prints" in ever higher resolution will be prepared upon request and increasingly stored in those places where the negatives of the photographs are also kept. Once the lines and monitors have the capacity to convey these prints effectively, they will be made available for subscription as the highest level of quality via the projected national picture archive for art and architecture. The development of a need-based availability of high-resolution images appears more probable than the assumption of a future total digitization.

5. Cataloguing and Systematic Presentation of Visual Material

The Marburger Index reproduces the art and architecture of Germany in topographical order from Aach to Zyfflich. The works of art in each location, both portable and non-portable, are systematically organized on the basis of a simple set of rules that has been used successfully for the last 70 years.

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[8] This procedure, however, does comply with the recommendations of the committee insofar as it dispenses with one generation of images, those of the fiche copies.

The user of the Marburger Index encounters this system of organization first on the subdivider cards between the microfiches, then in their titles, next in the subheadings of individual picture fields, and finally in the pictures themselves, which present the individual objects in a systematic manner according to artist or according to type, chronology, and geographical origin (although unfortunately the corresponding descriptors are not always explicitly included in the captions). For example, where there are multiple documents of a single object—whether due to its special significance or to restoration—the detail views are arranged before filming in as meaningful and optically coherent an order as possible, enabling users to make correct interpretations even on the basis of the macro-photographs. The order established for the publication on microfiche will be adopted in the digital picture archive.

A not inconsiderable problem, but one that can be solved with technical skill, experience, and diligence, lies in the fact that due to its 20-year history, the Marburger Index consists of four alphabetical series which must now be combined into a single system within the digital picture archive. Accordingly, a light-desk station with a special program was developed, consisting of a PC with three 21-inch monitors. This set-up makes it possible to easily combine the images from four series.

The prototype for the presentation of the digital picture archive in the World Wide Web is oriented to the Shareware program ACDSee 3.0 (registration fee $30). It consists of a screen with two frames whose separating line can be shifted at will with the mouse. The first frame shows the contents of the digital picture archive in the same way in which directories and folders are shown in Windows Explorer (with the simple, but practical system of plus and minus signs as an orientation help). In the second frame, the contents of the selected directory or file will be shown in the form of a gallery of pictures with the (likewise digitized) captions. The user can thus move from place to place as in a real, systematically organized picture archive and examine folders by clicking on them (city history, city plans, city fortification, etc.).

6. The Future of the Distributed Digital Research Library

The digitization of the Marburger Index will create a national picture archive of art and architecture in Germany with a total of 1.3 million photographs. With the support of the Deutsche Forschungsgemeinschaft, this resource will be available to all interested persons **free of charge** on the World Wide Web. Such an archive has no international precedent; it is to be hoped that its cost-free accessibility will set an example for others.

The question remains as to what role the archive will play in the distributed digital research library of the future and what opportunities exist to expand and access it with increasing effectiveness. This question can be answered reliably and positively if we consider the genesis of the archive:

1977–1981 Preparation and publication of the first 500,000 photographs on microfiche, supported by DM 1.4 million from the Volkswagen Foundation. The publisher Verlag Dokumentation (later K. G. Saur) covered the cost of the preservation filming (DM 80,000 annually), production of copies (DM 140,000), and marketing. For editorial work, it paid the Bildarchiv royalties in the amount of DM 100,000 annually, without (then or at any time later) claiming a copyright. Without the contribution of the publisher, the Marburger Index would not exist; if the publisher had not renounced the copyright, negotiations would now be necessary before the Marburger Index could be digitized.

since 1981 Continuous preparation, preservation filming, and publication of an additional 800,000 photographs from various institutions, funded by the Bildarchiv and additional royalties from K. G. Saur Verlag. This funding, continuing to the present, has totaled DM 2 million. Without these royalties, the expansion of the Marburger Index would have not have been possible, and thus a basis would not have existed for additional support of the project by the Volkswagen Foundation.

1981–1983 Development of the Marburger Informations-, Dokumentations- und Administrations-Systems (MIDAS) and expansion of computerized object cataloguing for accessing reproductions in the Marburger Index (in the context of an 18-month job-creating program for five scholars).

1983–1987 Cataloguing of 50,000 objects in context of the project "Register-Herstellung zum Marburger Index" ("Production of Indexes for the Marburger Index"), supported by DM 3 million from the Volkswagen Foundation. A relational databank was set up, which, in addition to the 50,000 object documents, contains an additional 40,000 (authority) documents (terminology, persons, societies, iconography, etc.). Between 1985 and 1990, K. G. Saur Verlag published, marketed, and paid royalties for 30 indexical catalogues with a total of 200,000 pages as Computer Output on Microfiche (COM).

1990–1993 In context of the program "EDV-gestützte Katalogisierung in großen Museen" ("Computerized Cataloguing in Major Museums"), supported by DM 3 million from the Volkswagen Foundation, seven museums adopted the cataloguing system and databank as an instrument for developing their own catalogues. **A production association was formed, which has continuously expanded the databank through the exchange of information every three months since 1990.** In 1995–96, ten digitally illustrated catalogues on compact discs were published with a total of 21,000 digital reproductions. The publisher K. G. Saur Verlag paid DM 100,000 production costs and DM 100,000 royalties to the museums. Without this contribution by the publisher, the publication of the DISKUS series would not have been possible.

1991–1994 In context of the program "EDV-gestützte Inventarisation und Dokumentation des historischen Baubestands in Ostdeutschland" ("Computerized Inventory and Documentation of Historic Buildings in East Germany"), supported by DM 3.5 million from the Volkswagen Foundation, as well as a photo campaign supported by the Federal Ministry of the Interior, 100,000 new photographs were made documenting as much historical building substance as possible before the beginning of the construction boom in former East Germany. The historic preservation agencies adopted MIDAS and the databank. Due to the overwhelming practical burden of the state historic preservation agencies in the new German states, however, virtually no scholarly contributions were made to the shared databank.

since 1995 In context of the program "EDV-gestützte Dokumentation in Forschung und Lehre ausgewählter kunstgeschichtlicher Universitätsinstitute" ("Computerized Documentation in Research and Teaching in Selected University Art History Departments"), supported by DM 4 million from the Volkswagen Foundation, eight departments in Germany and six abroad have adopted MIDAS and the databank in order to participate in its expansion in the context of study projects (see the directory of participating institutions and their projects in the appendix).

Thanks to the support of the Volkswagen Foundation and the contribution of the publisher, the Marburger Index has been successively transformed from a simple **product**—a publication on microfiche—into an innovative **means of production**, an illustrated databank. The increasing involvement of various museums, archives, and institutes—which have used the illustrated databank as a means of production in a tri-monthly exchange of information—as well as the cooperation of the publisher have facilitated the continuous, uninterrupted expansion of the Marburger Index. When the current, fourth series is completed in the year 2000, subscribers will be given the opportunity to continue their subscription in the form of access to a constantly expanding illustrated databank, based in the future on a national picture archive of art and architecture in Germany, freely accessible to all.

Since in this development model, those holdings that are accessible free of charge remain the same, while those subject to payment are constantly expanding, the model may seem to contradict the goals set by the Deutsche Forschungsgemeinschaft in its efforts to promote cheaper, faster, and non-commercial exchange of scholarly information through electronic publishing by scholarly

institutions. In fact, however, the Marburger Index has long accorded with these goals and considerations in that **since its founding, the illustrated databank has been available to all interested persons at no cost as a means of production and communication, as long as those persons were willing to seriously participate in the cooperative production.** Only this fact reveals the full significance of the digitization of the Marburger Index: digitization will transform the Index as a whole[9] into a means of information and a forum for electronic publishing, available in the future to scholars everywhere at no cost.

In this light, the producers of the Marburger Index view future developments with both eagerness and trepidation. In the future, will libraries refuse to subscribe to the Marburger Index, reasoning that local departments could probably contribute at least enough to be accepted into the circle of free subscribers? Will publishers, schools, television corporations, or interested individuals, on the other hand, subscribe to the Marburger Index in order to gain free access to the foundational work with 1.3 million digital images?

Appendix: The Current State of Databank Expansion

The question arises as to why the so-called Marburger Index Databank[10] cannot constitute an element of the free national picture archive of art and architecture in Germany in the future. This decision was made for the following reasons:

1. Of the 262,000 object documents in the databank, only 93,000 refer to objects illustrated in the microfiches of the Marburger Index.
2. The 93,000 object documents relevant to the Marburger Index comprise only 10–15 % of the ca. 800,000 objects illustrated in the Marburger Index.
3. The databank, which (as stated above) is available at no cost to anyone seriously interested in participating in its expansion, is the only product that can be sold to non-participants in order to raise the funds indispensable for its expansion.

The databank currently contains the following documents:

Terminology	23,800
Chronological entities	1,200
Geographical entities	29,000
Artists and other persons	71,200
Societies (collections, workshops, etc.)	500
Iconographical objects (ICONCLASS)	31,500
Objects[11]	262,000
Exhibitions	4,400
Bibliography	18,400
Dissertations and masters' theses	26,600
	468,600

The documents of individual entities and types of entities are linked with each other in accord with the Entity Relationship Model. To name only one example, it is thus possible to inquire as to artists

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[9] Up to this point, it has not been possible to provide a free set of Marburger Index microfiches to institutions and scholars interested in cooperation.

[10] Marburger Index Databank on CD, 5th ed., Munich 1999, with 40,000 digital illustrations in thumbnail quality.

[11] The 262,000 objects consist of both simple and complex works; in the case of the latter, the parts (e.g. panels of a retable, miniatures in a manuscript, statues of a fountain, etc.) are separately accessed. If these parts are individually counted, the databank comprises 396,800 works.

who emerged from a particular school, later joined a particular artists' group, and represented a particular iconographic theme, although these indications are distributed over artist, society, iconography, and object documents in order to avoid redundancies and mistakes.

The 262,000 object documents consist of the following:

115,200 object documents developed in the Bildarchiv Foto Marburg, accessing objects reproduced on the microfiches of the Marburger Index

10,000 objects from foreign divisions (microfiche indexes from abroad)

44,700 object documents developed by cooperating museums since 1990, 14,000 of which are reproduced in the Marburger Index. Digital reproductions already exist for 38,000 objects (Kodak Photo CD).

20,000 object documents from the photo archive of the Bibliotheca Hertziana, comprising works of Italian art. Some of these works are now held in Germany and thus are illustrated in the Marburger Index; most of them, however, are located in Italy and are reproduced only in the photo archive of the Hertziana.

25,700 object documents from the photo archive of the Kunsthistorisches Institut in Florence; here the same situation exists as for the documents from the Hertziana. It is worth noting that 4,500 of these documents represent photographs from the DFG-supported special collections of the institute, developed in context of a DFG-supported project.

19,800 object documents from the Deutsches Historisches Museum. Of these, 13,400 digital reproductions are already available.

26,700 documents prepared by the Association of Thuringian Museums with the continuous support of the Bildarchiv. These are to be digitally illustrated; at this point, however, no further details have been determined.

The rest of the documents come from various other sources, above all from the Rheinisches Bildarchiv in Cologne and the projects pursued in context of the program "EDV-gestützte Dokumentation in Forschung und Lehre ausgewählter kunstgeschichtlicher Universitätsinstitute" supported by the Volkswagen Foundation, a program that will continue into the year 2000.

The databank is updated every three months. The cooperating institutions[12] deliver their data to the Bildarchiv, which in turn unifies it, establishes the necessary authority file documents (terms, geography, persons, societies, etc.), produces the new version of the databank, and delivers it within four weeks to the participating institutions. The latter integrate the data they have acquired in the meantime and continue their work with the new databank and the authority documents contained in it. In this way, the databank serves not only as the guarantor of data consistency, but also as an effective means of scholarly communication.

Whenever an institution catalogues an object for which reproductions exist in the Marburger Index, an indication of this fact is included. Hence over the years, the databank will provide ever better access to the digital picture archive of art and architecture in Germany.

Objects that could no longer be reproduced on microfiche due to the topographical-alphabetical organization of the Marburger Index have been digitally reproduced since 1995. Thus for some time already, the databank has been continuing in digital form a project that was begun on microfiche in 1977.

[translated from the German by Melissa Thorson Hause]

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12 The fact that the editorial office of the *Allgemeines Künstlerlexikon aller Zeiten und Völker* (formerly Thieme-Becker) and the ICONCLASS Research and Development Group (Utrecht/Leiden) belong to this production association ensures on the one hand the best possible source of artist-biographical information for the databank, and on the other hand makes possible worldwide communication with other ICONCLASS users and their data holdings.

INCUNABULA ON THE INTERNET – A DIGITISATION PROJECT OF THE BAYERISCHE STAATSBIBLIOTHEK

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Background and scope of the project

Incunabula, the oldest documents of printing history, are valuable, rare, often unique and mostly only accessible to the general public in occasional exhibitions. The Bayerische Staatsbibliothek owns the second largest collection of incunabula in the world after the British Library. Thanks to funding from the project Sammlung Deutscher Drucke sponsored by the Volkswagen-Stiftung, the BSB was able to add a number of valuable copies to its collection in recent years. The background for the digitisation project was the intention of all libraries participating in the project Sammlung Deutscher Drucke to make some part of their holdings accessible to the public in digital form. Projects for the presentation of collections of incunabula - predominantly on microfiche - exist already. The Bayerische Staatsbibliothek did not intend to compete with such enterprises or duplicate them and therefore concentrated on digitising the "printed book illustration of the fifteenth century" (illustrated incunabula) within the DFG-programme Retrospective Digitisation of Library Holdings. The illustrations are exclusively woodcuts of varying quality and detail. About 30% of the prints have been coloured in by hand. In the age of Dürer, the technique of woodcutting became more subtle: woodcuts show a more differentiated use of line drawing and shading, the technique of printing from several plates (line and tone plate) increased the potential for design, and woodcuts thus did not require later colouring.

The choice of illustrations followed a double intention:
- extension of indexing to an area previously neglected by libraries:
the area of images and, more specifically, image subjects
- creation of a tool for art historical research
- creation of a service for a broader public: illustrations can provide immediate access, whereas texts printed in incunables, even if they are in German, are not easily comprehensible for a general public.

The aim of digitisation was on the one hand to create master files for reproduction of the prints in order to be able to fulfil regular requests for reproductions by using the digitised image, thus avoiding further strain on the original. From the very beginning, it was also intended to provide access via the internet - in reduced quality, taking into account the standard capacities for connection and transmission.

Procedure and technical aspects of digitisation

Basically, there was a choice between two options:
Digitisation from microfilm / Ektachrome or Digitisation from the original.

No films of sufficient quality existed. In addition, the problem of potentially double shift of colour from the original to the photographic image and from the photographic image to the digital image had to be considered especially for coloured originals. After some discussion, we decided to undertake direct digitisation, which was not yet practised in libraries and museums on a large scale when the project started (1997); exceptions were the project Vaticana and Lutherhalle Wittenberg, both funded by IBM, which however did not lend themselves as models due to the framework conditions, which involved very considerable strain on the original.

As camera, we chose the Progres3012 by JenOptik (formerly Kontron), which had already been tested by a contractor who provides photographic services in routine work, not merely for the creation of individual images.

The technical parameters of the camera and the digitisation are the following:

resolution capacity of the CCD array: 3,500 x 4,500 pixels = 384 dpi on A4 scale.
36Bit colour depth, which was however reduced to 24 Bit during software processing by the scanning and image processing programme used (PhotoShop).
For originals of different sizes, a range of exchangeable optical lenses were available.
We made full use of the maximum scanning resolution, but varied colour depth according to black and white and coloured originals. Black and white woodcuts were digitised with 8 Bit, i.e. 256 scales of grey; the maximum colour depth of 36/24 Bit was only used for coloured woodcuts.

IR and UV-filtered halogen lamps were used for lighting.
The required exposure time was between 30 and 45 seconds, due to internal chip technology (movement of the CCD array). This is more than during photographic work, but was in the end regarded as acceptable by the book restorers from our Institute for Restoration of Books and Manuscripts.

A further problem when digitising books is the support for books. For the Vaticana project, the originals had been dismembered – this was unthinkable for this project, if only for reasons of costs and work involved.
In co-operation with the contractor, we decided to digitise individual pages and to use a so-called book cradle by default, which allows a book to be opened at an angle of 90°. It was necessary to employ sheets of glass to keep the original open, but no massive pressure was applied to the page or the book block. The book cradle proved suitable for the protection of bound books during this project: Even books from which several hundred scans were taken showed no damage to the spine or binding.

Digitisation was carried out in the Bayerische Staatsbibliothek (in the exhibition room for treasures in the department of manuscripts, which ensured proper height of ceiling, lack of vibration, and climatisation) with special staff who had received appropriate training for this project, but with equipment provided by the contractor (camera, lighting, support for originals, i.e. book cradle, computer workstation for scanning, second computer workstation for quality control and CD-writer).

Calibration of equipment and colour management

The camera was calibrated on the Macbeth colour chart. Every morning, before starting work, the staff carried out an new calibration by software. A colour chart with integrated scale was digitised with the original. When digitisation was done (early 1997), procedures of colour management with the creation of ICC profiles were not yet available as a standard. The lighting intensity was partly reduced in the course of the work in order to protect the originals. This caused problems and necessitated occasional follow-up editing of the images: the colour values of digitised colour chart were measured with a spectrometer, the values found were compared with the values of the digitised chart and corrected by software. The in terms of colouring very variable results of photographic reproductions of the image files by a range of contractors who themselves had no access

to the original showed further how important it is to come to an agreement on colour measuring and colour space, in order to achieve reproductions from the digitised image with correct colours.

Results of digitisation

Within a period of three months, 6,424 illustrations from 76 incunabula were digitised, ca. 30% of the images were coloured and were scanned in colour. The average number of shots was ca. 150 when digitising in scales of grey (at the end, 180 shots were achieved), and ca. 80 when digitising in colour. The reason for this difference was not so much the longer time required for scanning in colour, but the time required for follow-up editing: focussing of the image etc., which made intensive use of computing power. The sizes of files created averaged ca. 45 Megabyte for colour images (14 for grey scales). These are factors which need to be considered when undertaking high-quality digitisation. Some cameras which are currently available and achieve an even higher resolution (e.g. Picturegate by Anagramm with ca. 7,500 x 7,500 pixels) produce file sizes of 200 MB and more. When planning a project, consideration needs to be given to the adequate relation between the intention (purpose of images) and parameters for digitisation and thus to questions of economy and costs.
The estimated time depends also on the handling of the material: careful and protective treatment of valuable and ancient books and images requires time which needs to be invested in such enterprises.

Indexing of the illustrations

Only the illustrations were digitised, but access to the bibliographical data of the complete edition is required. For this, previous cataloguing work could be used: The machine-readable catalogue records of the Incunabula Short Title Catalogue (ISTC) were downloaded as the basis of the bibliographical description and loaded into a database. They were translated into German and extended by variant forms of names and titles as used in German incunabula catalogues, i.e. the incunabula catalogue of the Bayerische Staatsbibliothek. In addition, an abstract of the contents of the text and/or brief information about the place of the edition in the history of printing were composed.
The incunabula selected (the main criterion for selection was richness in or significance of illustrations) give a survey of the types of books which were illustrated in the fifteenth century. The main genres represented are secular literature in vernacular languages (prose versions of courtly romances, heroic epics, travel books), religious literature (Bible, liturgical books like plenaries, collections of saints legends), herbals and medical treatises, chronicles. The only book digitised as a whole is the Augsburg edition of the Nuremberg Chronicle written by Hartmann Schedel; here, digitisation included mere text pages.
The main work was the indexing of image subjects. With a view on international standards, which naturally have gained importance in the age of the internet and the potentially world-wide reception, we decided to undertake indexing based on the IconClass classification developed for art historical projects. IC attempts to organise potentially all objects and subjects of art in a system of 9 main classes (Religion and Magic; Nature; Human Being, Man in General; Society, Civilisation, Culture; Abstract Ideas and Concepts; History; Bible; Literature; Classical Mythology and Ancient History). This can lead to very detailed, complicated classifications. For our project, preference was given to the searchable verbal description rather than the numerical notation, which is however entered as well.
Indexing aims at providing one suitable description of the depicted scene as a whole rather than analysing its constituent parts (as it is done for projects which undertake the indexing of every individual object depicted in an image, like items of clothing, shoes, for the sake of a study of material culture).
The indexing is done using four categories: Up to two classifications from IconClass can be given. There is a field for captions transcribed from the original and another freetext field in which the indexer can enter terms not covered by the classification which ought to be searchable. An example

for this are personal names: the classification describes a scene of homage, but the incunabula text explicitly refers to emperor Maximilian.
This means that searches are integrated both on a more general level for iconographic comparison as well as more specifically. In addition, keywords from the caption can be entered in modern German form and are thus suitable for retrieval.
This kind of indexing may not allow for all imaginable queries, but offers a range of access points which can be provided within a pragmatically acceptable amount of work.

Presentation and internet service

The service aimed at offering three different types of access to the user:

- navigation in the sequence of images as printed in the individual incunable (browsing between illustrations)
- search for subjects of images, e.g. portraits of rulers, topographical views, from different printed editions
- navigation from the systematic classification to the images associated with it.

Regarding the third option it has to be said that not the complete classification was integrated into the presentation. The reason for this was that too many notations would have lacked corresponding images. The notations entered during indexing were merely traced to their root (the relevant main group), which makes it possible to link the notation to a higher level (ignoring intermediate levels) like nature or magic. Thus, the user who descends from nature only encounters notations which are in use, e.g. linked to images.

Realisation was done in several steps:
The bibliographical description and the description of subjects of images were entered into a relational database, in which the necessary connections were made between the list of images, the title data, the classification and the descriptions of individual images.
Following this, the data were exported with automatic SGML tagging according to self-designed DTDs. Two separate SGML-files were created: the SGML document "Incunabula", which contains all title data of the incunabula and the descriptions connected to individual images. In addition, there is a SGML-encoded file for the classification, which contains the main groups, the notations used and links to the relevant images of the incunabula titles.
The user can choose between the two forms at the beginning.
Naturally, the data model is more complicated than for individual images which need not to be kept in a particular sequence. In a database system, navigation by browsing between illustrations could not have been offered.
For retrieval, several search interfaces were designed which demonstrate to the user the options for combination of search terms in the form.

By digitising, indexing and processing of the incunabula illustrations, a complex tool for search and presentation of the genre was created.

At the moment, additional technical features which are in principal desirable for digitisation and the access to images cannot be offered: e.g. zooming or cutting out of details. Presentation is geared towards a use via internet browsers without further software. Other forms of processing or separate editing of individual title with CD-ROM software product which allow such kinds of reproduction can be imagined.

IMAGE PROCESSING AND UV/VIS/IR-REFLECTOGRAPHY WITH BANDPASSFILTERS. THE MAKING VISIBLE OF WASHED OR RUBBED WRITING IN MEDIEVAL MANUSCRIPTS ANALYSIS OF UNDERDRAWINGS IN BOOK PAINTING. PRESENTATION OF THE PRINTED DIGITIZED IMAGES.

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Investigations of old manuscripts and documents should be totally non-destructive. New UV/Vis/IR-reflectography techniques in combination with bandpass filters and with image processing makes it possible to distinguish inks and colour materials and can make faded or rubbed writing and underdrawings visible.

Documents and autographs in archives and libraries are not infrequently damaged (washed out and rubbed) by poor storage conditions or by the disastrous influence of fire, water etc. in the past. The paper has been damaged, the ink colours are no longer visible and the text or the images have become illegible. Especially at the beginning 20th century there was great enthusiasm for experiments in making faded inks visible through the application of chemicals which originally enhanced the script, but have since darkened and destroyed the writing support. New techniques should be totally non-destructive. A combination of different optical and electronic techniques make this possible.

The illumination of an object with light can provoke three different effects: absorption, reflection and sometimes also fluorescence. Every material has its specific characteristic; for example if the ink absorbs the light and the background reflects it, the contrast of writing and support is so different that we are able to read the text. If the ink is faded or rubbed but even the faintest traces of it remain on the surface of paper or parchment, with the use of monochromic light it is possible to find the exact wavelength where the contrast between ink and support is great enough that the script appears darker or lighter than the background. Then the script is again visible and can be read.

In the visible range (Vis) the various colors can be observed by naked eye, but in the Ultraviolett (UV) or Infrared (IR) ranges the wavelengths can be quantified only with a detector. For the UV and VIS (200 - 780nm) and for the near range of the IR (750 - 1900nm) two different videocameras (HAMAMATSU C2400-03/05) can be used. This method can be applied to analyze materials of a painting or to distinguish between inks or other drawing materials[1]. It is useful to make

[1] For the non-destructive (i.e. without any samples) analysis of colour and ink materials three other techniques are already in use: XR-diffractometry, IR-spectroscopy and colour spectroscopy, see: *Robert Fuchs*, Zerstörungsfreie Untersuchungen an mittelalterlicher Buchmalerei - eine wissenschaftliche Herausforderung. Tagungsband zum Symposium für Zerstörungsfreie Prüfung von Kunstwerken, 19./20. November 1987. Deutsche Gesellschaft für Zerstörungsfreie Prüfung e.V. Berichtsband 13, Berlin 1988, pp. 120-127.
Other techniques need samples from the original, which is very problematical from the conservational point of view: for example the RAMAN-spectroscopy, see: *Bernard Guineau, Jean Vezin*, Etude technique des peintures du manuscrit De laudibus sanctae crucis conservé à la Bibliothèque Municipale d'Amiens (Amiens 223). In: Scriptorium 46, 1, Bruxelles 1992, pp. 224-237.
The new reflectography technique allows the non-destructive 2-dimensional material analysis: *R. Fuchs, R. Mrusek, D. Oltrogge*: Spektrale Fenster zur Vergangenheit. - Ein neues Reflektographieverfahren zur Untersuchung von Buchmalerei und historischem Schriftgut, Naturwissenschaften 82.2, Heidelberg 1995, p. 68 -79, esp. p. 73, fig. 1, 2

underdrawings in book illumination visible[2] or to examine faded texts[3]. The analysis includes the ultraviolet (UV), the visible and the infrared (IR) ranges. In all cases problems can be solved by analyzing separate sections of the spectrum. To realize such a segmentation of the spectrum, bandpass filters can be applied (Fig. 1).

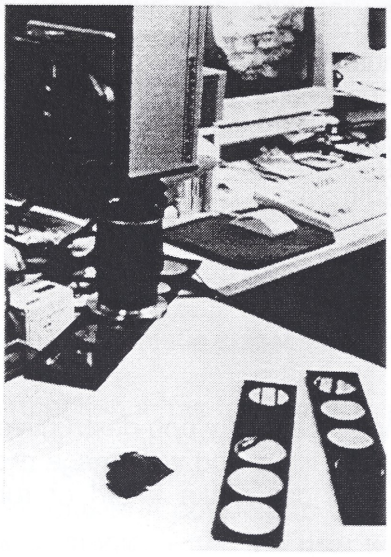

Fig. 1. Under the objective of the IR-camera a set of bandpass-filters is mounted.

1 Method

The object is illuminated with light of low intensity. Depending on the problem we use various light sources, which give access to the different parts of the spectrum. A tunable device is applied, which emits white light or alternatively monochromatic light in all ranges of Vis and in some bands of UV and IR. Barrier filters can be used to separate narrow regions of IR for illumination. For the IR, red light bulbs of the type employed in photographic laboratories are also used.

The intensity of light reflected (?) by any material will alter as a function of the wavelength. In each case where desired and disturbing effects appear simultanously, they can be separated if they show different responses to illumination by light. The images are recorded in a range from UV (>200nm) to IR (<2000nm) by using two different electronic tube cameras. We apply at least 25 optical bandpass filters to divide the spectrum of the reflected light into narrow bands of 60 to 120nm[4]. A chosen detail of an object is illuminated and recorded with different filters. This leads to a series of images. The signals are digitized and the images can be stored on a portable PC. The quality of the images can be improved by digital image processing. This method works with portable instruments, and investigations can be done outside the laboratory in museums, libraries and archives.

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2 *Robert Fuchs, Doris Oltrogge*, Naturwissenschaft und Stilkritik - Handschriften aus dem Umkreis des Registrum-Meisters. In: Kunsthistoriker, Mitteilungen des Österreichischen Kunsthistorikerverbandes, Jg. VIII (Sondernummer) 1991, p. 96-104. *Doris Oltrogge*, "Materia" und "ingenium". Beobachtungen zur Herstellung des Egbert-Codex. In: Egbert - Erzbischof von Trier. Hrg. v. F. J. Ronig unter Mitarbeit von A. Weiner und R. Heyen. [=Trierer Zeitschrift, Beiheft 18], Trier 1993, Vol. 2, p. 123-52. *Robert Fuchs, Doris Oltrogge, Ralf Mrusek*: Eine Galerie des Unsichtbaren. Spektrum der Wissenschaft, Juni 1995, p. 85 - 89. *Robert Fuchs, Doris Oltrogge*, Neue Untersuchungen an mittelalterlichen Handschriften. In: Rhythmus und Saisonalität. Akten des 5. Symposiums des Mediävistenverbandes. Hrg. P. Dilg, G. Keil, D.-R. Moser. Sigmaringen 1995, p. 327 - 345.

3 *Robert Fuchs, Ralf Mrusek, Doris Oltrogge*, Die Entstehung der Handschrift - Materialien und Maltechnik. In: Petrus von Ebulo, Liber ad honorem Augusti sive de rebus Siculis, Eine Bilderchronik der Stauferzeit aus der Burgerbibliothek Bern. (Ed. Th. Kölzer und M. Stähli), Sigmaringen 1994, p. 275 - 285. *Ralf Mrusek*, Reflections reveal faded secrets of ancient books. Opto & Laser Europe 36, Bristol 1996, p. 11.

4 *Fuchs et al.*, Spektrale Fenster (supra note 1), p. 71, Tab. 1.

2 Image Processing

The interpretation of images of ancient objects in art historical research can be assisted by a digital image processing system[5]. Thus images produced by IR cameras and optical filtering will lead to a better understanding of the manufacturing process and the history of an object, but the method has some disadvantages due to the technique. Therefore these disadvantages have to be corrected by developing the necessary software programs. The available image processing software can be used to optimize the image acquiring procedure and to improve the stored images in additional processing steps[6].

2.1 Image Acquiring

In digital image acquisition noise effects which interfere with the signal are introduced by the electronic components of the system. They have a recognizable effect, because we are working with weak signals. For illumination one has to be careful in choosing the light source. Light of lower intensity should be applied to avoid heating fragile surfaces. But the smaller the intensity of light for illumination, the smaller the response of light from the pigments and inks. That means that the light which enters the camera is already limited in intensity. In addition the optical filter process will cut only a narrow band of the whole light intensity. This weak signal which reaches the detector has to be amplified electronically. But in the same way the signal is amplified, the noise of the image acquiring system is increased. Consequently beside the signal the noise is recognizable in the resulting images. It is desirable to suppress the noise interference in advance during the acquisition process by digital image processing.

We have therefore implemented the following acquisition procedure. The electronic noise changes in time; one can thus eliminate it by storing some images in a time interval and carrying out an averaging process. To realize this process a series of up to 16 images within about 3 seconds will be acquired and the average of these images shows a reduction of the signal/noise ratio.

By this operation the noise in the resulting image in comparison to that in an immediately frozen (?) image can be enormously reduced. To have an idea of the amount of noise reduction, we have measured it with the Fourier transformation technique[7] and found that an average over 16 images is sufficient even for the very weak signals in the upper range of the IR-camera (1700 - 1900nm). The OPTIMAS (Ver. 6.0) software is used for this purpose. This software can be programmed and has many acquired functions. It is normally used for medical purposes for the automatic calculation of blood cell density etc.

2.2 Image Enhancement

The digital images stored on a hard disk are processed in several additional steps. The images recorded by the camera system have low contrast and need to be sharpened to enhance contours and to amplify the visibility of image details. For this purpose we use different image processing software: Optimas, ADOBE Photoshop, MGI Photosuite and ACDSee32.

In library research projects the images have to be prepared for analysis by a human expert. In contrast to industrial image processing, which is implemented in a mechanized visual system to test the quality of serial product manufacturing, we are working with unique objects. But nobody knows in advance which details should have been expected in an image. Mostly we are using interactive procedures in which an historian or art historian or a philologist has control over the successive processing steps.

In the first image processing step the contrast of an image will be increased. That do not means that the images acquired by the camera use the entire dynamic range of the image processing and

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[5] Andreas Burmester, F. Bayerer, Towards improved infrared reflectograms. Studies in Conservation 38.3, OOO 1993, p. 145 - 152.

[6] *Peter Haberäcker*, Digitale Bildverarbeitung, C. Hanser Verlag, 3. Aufl., OOO 1989. *Bernd Jähne*, Digitale Bildverarbeitung, Springer Verlag, Heidelberg 1990.

[7] Robert Fuchs, Ralf Mrusek, New Methods of Reflectography with Special Filter und Image Processing Techniques: Examination of Materials, Writings and Underdrawings, in: Optical Technologies in the Humanities, Hg. D. Dirksen, G. von Bally, Optics Within Life Sciences, OWLS IV, Berlin 1997, S. 108 - 118.

[7] E. O. Brigham, FFT - Schnelle Fouriertransformation, München/Wien 1989.

display system. Therefore the images should be scaled between the minimum and maximum of the image.
In further processing steps we use edge enhancement procedures to sharpen contours in the image. We have had good experience with unsharp mask filtering which is based on a traditional photographic technique in which a negative and the blurred positive image are combined and exposed on a high contrast film. In the software realization one is able to control how many pixels in the neighborhood of a pixel at the boundary of a contour are processed. The effect of the filter procedure is that the contrast is increased, particularly at the boundary pixels of a contour line.

2 Application in Humanities (library reseach)

2.1 Text investigation

In a number of ancient manuscripts the text has become unreadable for the naked eye. Sometimes a part of a text has been overwritten or covered to make it unreadable. Another problem is the ageing of manuscripts. The ink has corroded, washed or faded out, or the surface of the manuscript has darkened by age or dirt. Nevertheless, often different inks as well as ink and writing support (paper, parchment etc.) show different remission (reflection?) characteristics. By using bandpass filters it is possible to separate these characteristics and to show only the reflection of the ink. Thus it is possible to make unreadable texts readable once again. Fig. 2 shows a leather fragment from Elephantine, Ancient Egypt (2nd half of 5th cent.)[8], which was published as an Aramaic text, because nobody could read it[9]. The image is recorded in the range of visible light, illuminated with infrared light and recorded with a filter of 950nm so that the text can be read (Fig. 3). It is a Demotic text, and, in addition, even a palimpsest which runs transversal to the later text and informs us about a list of names was discovered[10].

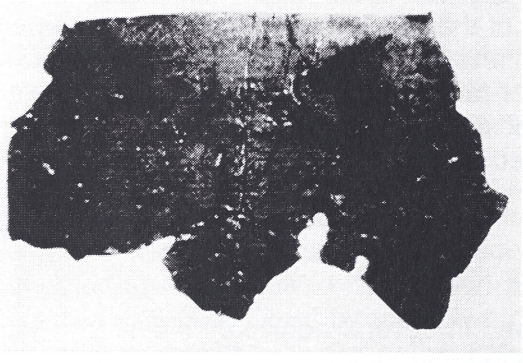

Fig. 2. Leather fragment from Elephantine 5th cent. under visible light (PMB P13443).

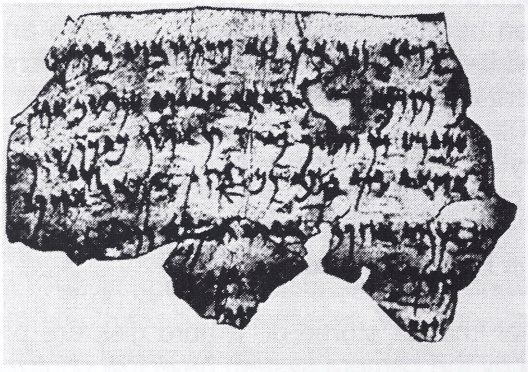

Fig. 3. Leather fragment (fig. 2) under infrared light of 950nm.

Fluorescence techniques have been used for a long time to read faded texts. The manuscript is illuminated with UV light, and the response to its stimulus is observable as emission of visible light. The UV camera makes an additional approach possible. Reflections which are not visible to the human eye can be recorded. Bandpass filters in this region suppress effects belonging to the interaction of the material with visible light. On the other hand, the time of exposure to the UV light can be considerably reduced by digital image recording (at least to 3 sec). This is important for the conservation of precious manuscripts[11].
In July 1999 we were invited to investigate the almost totally washed out manuscripts in the Archive of the Opera del Duomo in Florence. The disastrous flood of 1966 in Florence had severely damaged many manuscripts and illuminated books. 15 years later the texts of the most famous archival codices on the work of the Opera del Duomo are being transcribed and put in a database which will soon be available on Internet. But some of the books even could not be read,

[8] Pergamon Museum Berlin, P 13443
[9] *Eduard Sachau*, Aramaeische Papyrus und Ostraca, Leipzig, 1911.
[10] *Bezalel Porten*, Textbook of Aramaic Documents from Ancient Egypt, Vol. 4, Winona Lake (Ind.), in prep.
[11] *Fuchs et al.*, Spektrales Fenster (supra note 1), p. 75

even with the help of the UV fluorescent lamp. With our technique it was possible to make nearly all the texts visible, and the images were digitized and stored in the database; they too will be accessible via Internet. To get a better resolution a series of 5 images were acquired from every page. One page could therefore digitized under UV-light (366nm) within 30 sec (3 sec for each image) and was exposed very short time to the UV-light. The result was astonishing. Even on blank pages where the ink was washed out totally the reflection images can now be deciphered very easily. Digitization from film or directly from the original is normally made with white light and would in this case not have shown the text (Fig. 4). Only the acquisition with our bandpassfilter-reflectography technique made the text available for the reader.

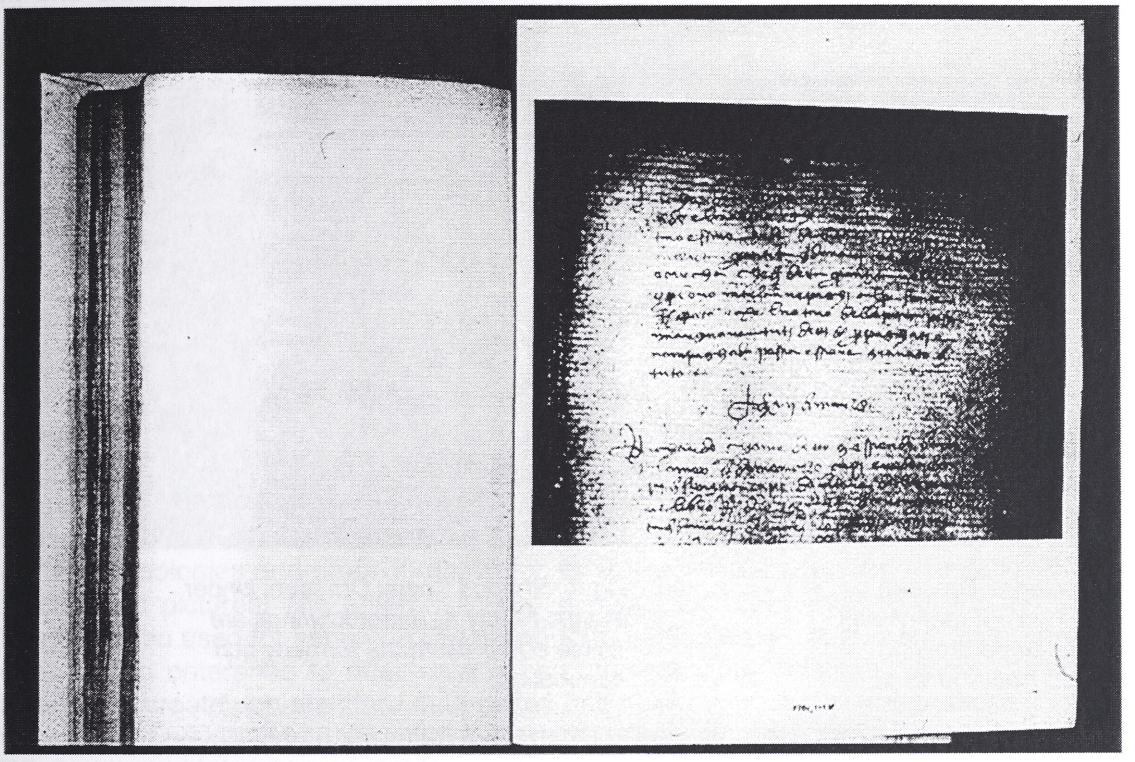

Fig. 4. Opera del Duomo Firenze, II-2-2, f. 76v. Left: original page shows the washed out text; right: print of the digitized image by reflection under 366nm.

2.2 Material analysis

The reflectography method with bandpass filters can also be used as a tool for material analysis. Different writing materials show different properties, especially in the range of IR. Application of bandpass filters will show that inks, which in a certain bandpass region absorb light in the same manner, can show differing properties in another range. As a function of the wavelength of remitted (reflected?) light the appearance of a text will change. This can be demonstrated through the images of three texts written with iron gall ink, blackthorn ink and lamp black[12]. In a similar manner a varying remission (reflection?) of different painting materials can help to analyze pigments in medieval book illumination and other paintings[13].

In comparison to common spectrometer methods, reflectography offers an additional advantage: besides information about the value of light intensity, the displayed image contains information about the local distribution (two-dimensional information) of the materials.

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[12] *Fuchs et al.*, Spektrales Fenster (supra note 1), p. 73, fig. 1.
[13] *Fuchs et al.*, Spektrales Fenster (supra note 1), p. 73, fig.2

2.3 Underdrawings

The filter technique is also a powerful tool in the examination of underdrawings. Sometimes there are considerable differences between the drawing and the completed painting[14]. Whether the drawing materials are recognizable or not on the digital image depends on the property of the materials covering the drawings. We found that in a range where certain drawing materials are observable some painting materials will become transparent, but others are impenetrable to the light in the chosen bandpass region. Therefore, multiple series of images recorded with different bandpass filters have proved useful in obtaining the most complete information on the underdrawings. In some cases different drawing materials have been used in one picture. The use of bandpass filters permits the concentration on one material in order to make it visible and the suppression of the others' effect in the digital image (Fig. 5, 6).

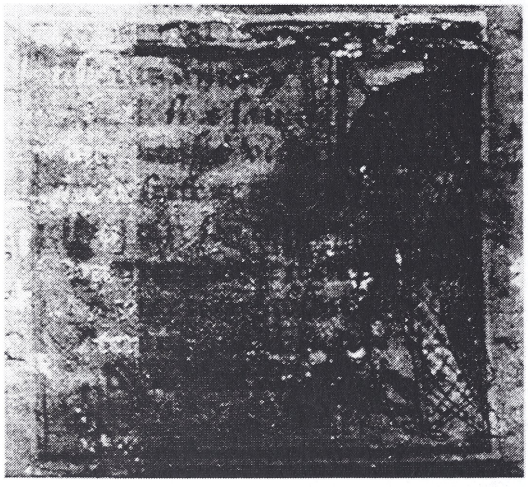

Fig. 5. Phebus Codex Dresden. The totally washed out manuscript small rests of an underdrawing can be observed from the verso.

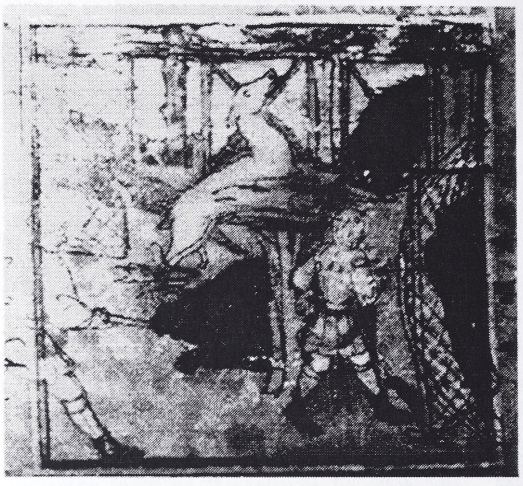

Fig. 6. Phebus Codex Dresden. Under IR-light nearly all underdrawings are visible and present the formerly rich illumination.

2.4 Exposition of text information and painting sequence of a scriptorium

The digitized images of underdrawings of reconstructed text can easily presented in demonstrations. The digitized information can be printed and calculated and enhanced with image processes, so that the presentation even on large posters is possible. For the amelioration of the resolution of a picture, a series of different images were made with a small overlapping border. An additional software program allows us to combine automatically this series of Tiff-images into a bigger picture. So even large panel paintings or book paintings can acquired and printed in a reasonable resolution. The investigation of underdrawings, painting technique and colour material permits the reconstruction of the workshop practice of a scriptorium or a master and the prints can be shown in an exposition of directly in the internet or on a CD-ROM.

Abstract:
Investigations of old manuscripts and documents should be totally non-destructive. New IR/UV/Vis-reflectography techniques, combinations of bandpass filters with image processing allows distinction amongst inks and colour materials and can make faded or rubbed writings and underdrawings visible. The digitized images can be put directly on a CD-ROM or printed in a database which also can be used in Internet or presented in an exposition.

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[14] *Fuchs et al.*, Eine Galerie (supra note 2), fig. 3, 4, 5.

"Photo-realistic visualization of objects and scenarios"

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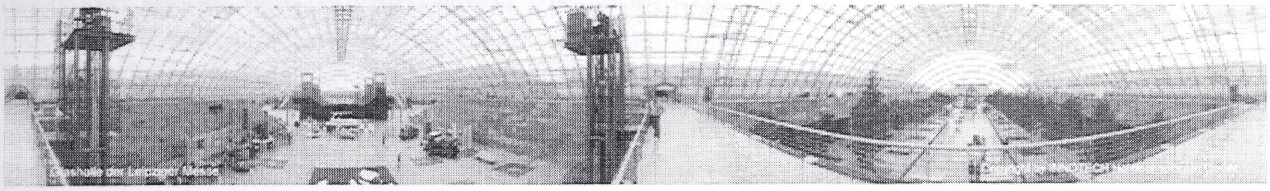


The Enterprise

Since 1992 the Innotech has itself specialised in photo-based visualization, beginning with the simple object representation before background pictures, over photo-realistic and full-scale presentation of objects before background pictures up to the movement by photo worlds. As result of its application orientated research and development activity the enterprise developed constant digital technologies and procedures, which enable a photo-based representation of objects before background pictures. The enterprise is responsible for the marketing of the innovative products. They are also used for services. The network from engineering specialists and software developers enables the enterprise to offer customized, non-standard solutions. Therefore it is at any time possible to create non-standard data bases and object libraries, to merge these into a visualization in order to develop virtual information systems. The enterprise strives to offer solutions which are PC, laptop and Internet executable.

Theses

Today close-to-reality visualizations are a lot more than only object visualizations. They actually contain the object scenario, represent it in its closer environment and show regional, if necessary also supraregional references. Therefore visualizations increasingly take over not only representative optical functions, but form the base for the structure of complex information systems and virtual communication platforms.

Independent from advancement in future, the public effective representation requires a playback quality which is common to most humans and which is shaped by film, television and video. That means that a photo-realistic representation quality must be used. For complete information the presentation of results is possible by help of the Internet, non-standard presentations on PC displays and demonstrations on large screens. In addition a duplication of individual visualization results over printed media is supported.

Solutions

In order to fulfill this requirement the following innovative technologies, developed by the Innotech Holztechnologien are at disposal:

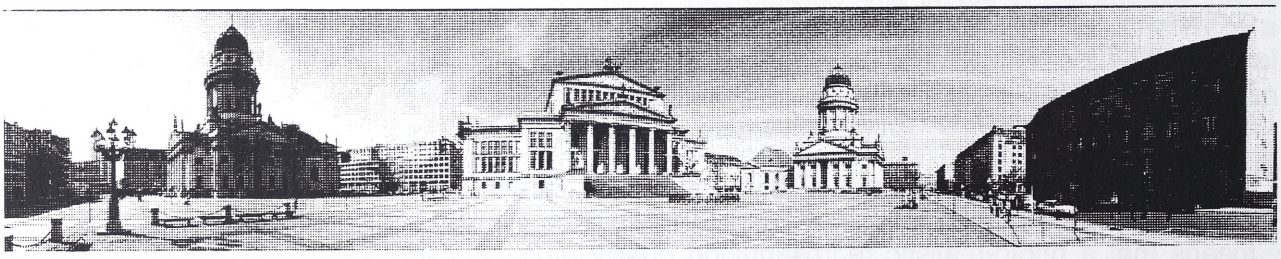
- Digital very high resolution documentation and measuring system Sasta metric (very high resolution digital rotation scanner with appropriate software modules), world-wide singular system
- Software SASTA soft for the rule-based implementation of objects before background pictures and the photo-realistic visualization of a status before the implementation, product leading the market in the area of application of the element manufacturers of Germany
- Data base on the basis of vrml for easy and interactive use of 2d and 3d objects on the basis of any reference grid (input, administration of objects, movement by virtual worlds), result of a research project, applications under http://o4.f4.fhtw-berlin.de (city model, vrml scene)
- Special softwaretools for local independent communication of several users in a virtual model

Applications

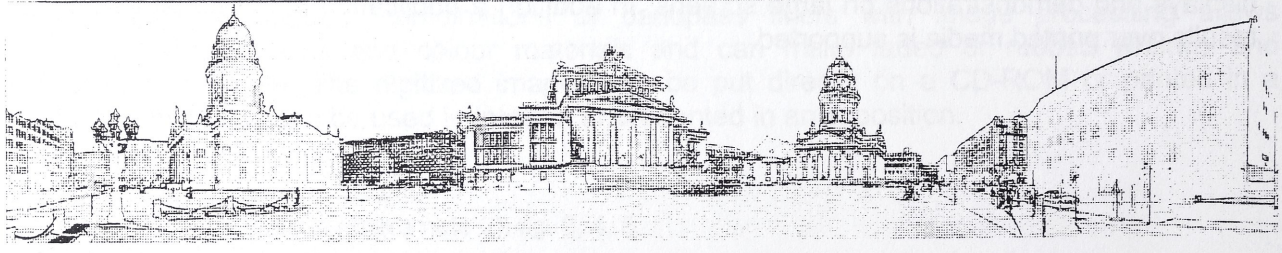
1. Digital status documentation

The digital status entry of existing scenarios such as river landscapes, workstations, silhouettes, road courses, industrial areas and harbor facilities is implemented effectively by accommodation of 0-360° panoramas (wide angles and/or round view).
These round views and panoramas are produced in a very high resolution with a special rotation camera. The image file is present immediately after the accommodation. The short accommodation duration for a digital panorama enables the daily supply of several image files. The process of the digital picture recording is arranged very effective in this way. The max. picture resolution enables enlargement up to 24 times of picture details by near zoom or a detailed view of objects far away. Thus the accommodation technique is suitable also for interesting and important objects further away. Up to 120° *Orthofotos* can be produced from the panoramas. In addition, these *Orthofotos* can be exported, the import of pictures into a panorama in order to close e.g. a building gap is also possible.

Due to their dissolution the panoramas are equally suitable for large prints and, after appropriate compression, for Internet. The image files are transferred into the .TIF format and burned on CD. Thus the graphic handling with conventional picture handling software and the transformation into an Internet suitable format are possible (.JPEG).



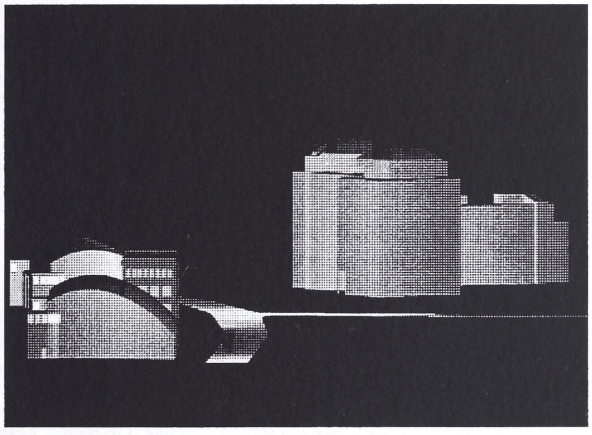
Picture 1 and 2: Gendarmenmarkt, 220° panorama and outline picture



The dissolution guarantees a sharp and very detailed playback on appropriate large canvases. The digital panoramas unfold their special attraction in presentations on large displays. With the help of picture handling software the viewer carries out the rotating motion of the camera and receives the impression of a round view.

2. Measured value production and CAD compatible object modelling

The grey tone panoramas entered with SASTA metric are suitable for the measured value production. With special software modules, which complete the accommodation system, frames and pairs of pictures can be analysed at the workstation. Space point coordinates and metric measured values can be determined. The linkage of pairs of pictures enables the full-scale modelling of existing objects. After transformation in the .DXF format a further processing in CAD systems is possible. Since pairs of pictures without delimitation can be taken, the modelling of complex scenarios is also possible. It applies: On all pairs of pictures visible objects can be analysed. The modelling method was applied so far in town construction and architecture, successfully for the bank modelling and the measured value production at with difficulty attainable objects (water level edge at bridge).

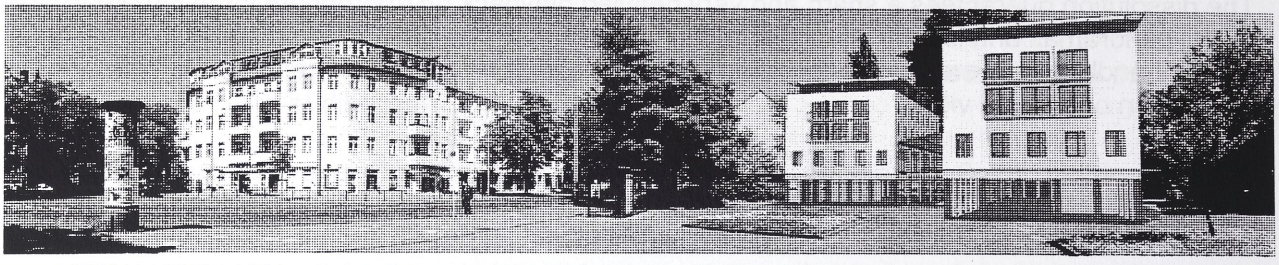


Modelling of existing buildings, Rudower Chaussee

3. Photo-realistic visualization

Several methods are available for visualization. These are:

- Production of object films: Object films enable the movement around modelled objects and the movement in the object. Object films are produced with the help of CAD based software.
- Production of panorama films: For the production of panorama films 360° panoramas are implemented on 3d objects. The high picture resolution and special software solutions enable the movement in a picture or a passing through of several pictures. Panorama films enable the movement by an environment and/or in objects. The representation takes place photo-realistically and the visualization results are very fast creatable.
- Connection of object and panorama films: To set objects in reference to an environment, the full-scale and perspectively correct object implementation before background information is necessary. Very high resolution surfaces, cut out from panoramas by SASTA metric technology are put in beforehand produced line models and placed as an object in an appropriate background panorama. The maximum dissolution guarantees a precise and detailed representation quality. Objects which were not yet built can be implemented in background panoramas. Thus a visualization of sketched objects is possible in the planned, really existing environment.



INNOTECH HT GmbH in cooperation with Barbara Mohren, architect

Additionally SASTA soft enables a full-scale and perspectively correct implementation of 2d and 3d objects before background pictures. Thus a varying of planned objects is possible in photo-realistic quality. Additionally the technology of SASTA soft enables to create new items. The photo-realistic representation quality applies not only to even surfaces such as metal, glass and plastic, but also to porous surfaces e.g. woods.

4. Data bases

For the visualization of complex scenes data bases which can administer and handle large quantities of data are necessary. Based on VRML the data base is used as navigation surface for the presentation of the visualization results in the Internet. It enables the adaptive entry of city landscapes to administer planned models and to administer data. Beside object films, animations such as picture cylinders are also representable. Furthermore the representation of detailed information to objects or to the region is possible. The data base is expandable, so that the visualization can be starting point for information systems for the promotion of economy development and marketing of a region.

A resuming development uses the virtual model as communication environment. Several users from different locations can log in over a central server and move therein. The virtual picture is completed by defined internal messages, which are fed into the model. The user is forced to react spontaneously to processes, which were released by other users. The client server development enables communication in a virtual world and animates this virtual world. The reality proximity of virtual worlds can be produced not only optically by photo-realistic modelling procedures. It is also enriched by spontaneous and defined internal messages. The technology can be used both for the simulation and monitoring of procedures. The system is tested at present by the example of a virtual driving school.

DIGITIZING AND CNC-PREMACHINING OF STONE-SCULPTURES[1]

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Today's manufacturing of sculptures, plastic arts, capitals, reliefs, ornaments etc. from natural stone is traditionally and almost exclusively done by sculptors manual work. Especially premachining of the raw stoneblock demands heavy physical work. From pre- up to finishmachining the single level-points are transfered with help of a mechanical pantograph mechanism from the original to the duplicate to be manufactured.

The ITW in co-operation with the Sächsische Sandsteinwerke Pirna has developed a CNC-machine and the technological procedure to automate the premachining of sculptures.

The original sculpture is digitized applying an optical 3D-sensor. Digitizing is possible either using an 3D-coordinate measuring machine as handling system or using the sensor as „flying" sensor. The digitized point-cloud is scaled up by an offset depending on the required allowence. From horizontal cross-section derived contour-curves are the information needed for the NC-code-generation. The functions of the CNC stone cutting machine are moving the cut-off-wheel in the right vertikal positions and cutting the contour-curves in the raw-stoneblock. After cutting all curves the remaining laminas can be easily sledged. Result is an rough-machined sculpture, which may be finish-machined by the sculptor or stone-mason.

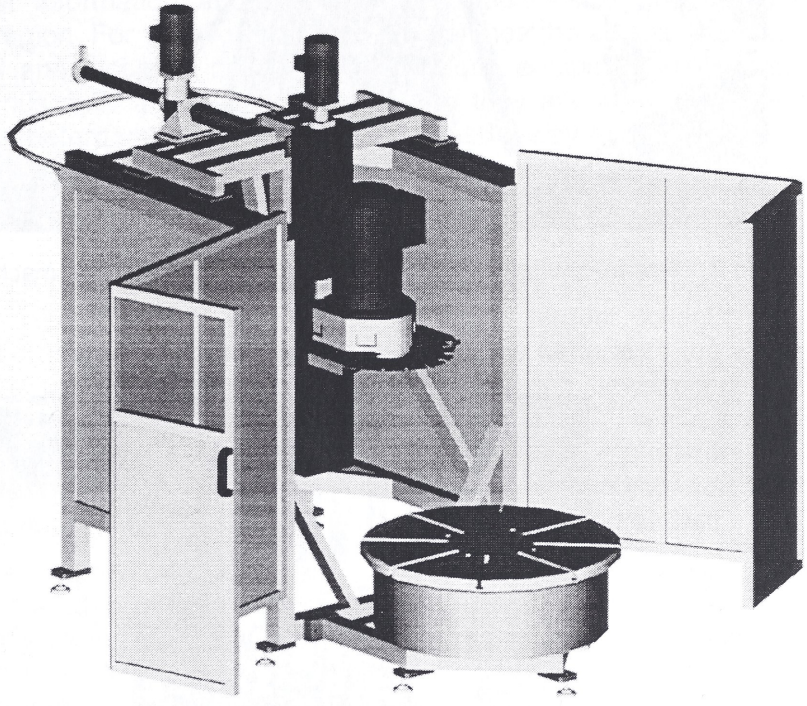

Fig 1 CNC stone cutting machine

To perform the infeed and cutting motions the CNC-stone-cutting-machine is equipped with 3 NC-axis. The contour-curves are cut by a horizontal aligned diamond cut-off wheel. The traversing-distances ranges up to 500 mm in horizontal and 1000 mm in vertical direction. Maximum blank dimensions of the stoneblock may be 1000 x 1000 x 1200 mm.

The developed CNC stone cutting machine together with the technology described was tested by the ITW under filed conditions in the Sächsische Sandsteinwerke Pirna. The expectations in saven manual work and time were proven but the sculptors challenge to make an "original copy" was preserved.

Due to the large diameter of the diamond cut-off-wheel contours including sharp bends can not be cut upt to the allowence. Further developments will respect this and use milling and/or drilling heads to improve the state of preprocessing.

[1] supported by BMWi project management agency GEWIPLAN

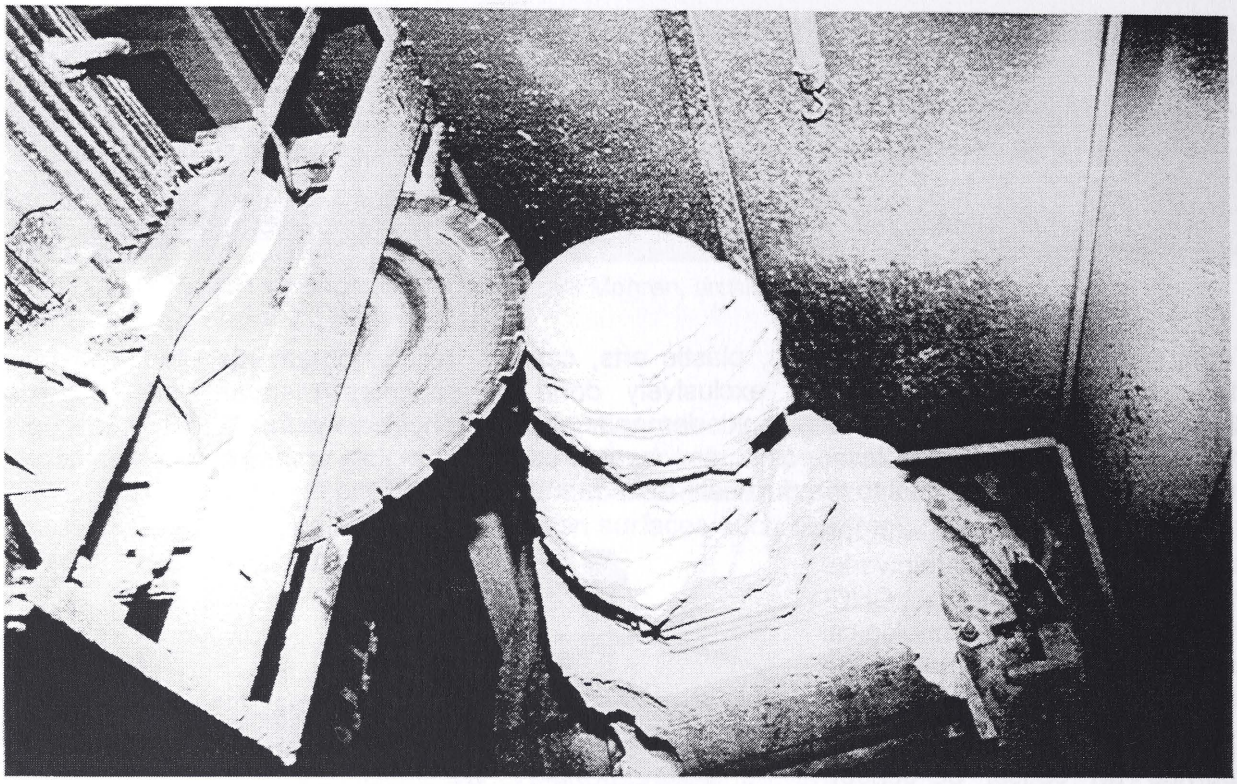

Fig 2 Pre-machining of a sculpture at a CNC stone cutting machine

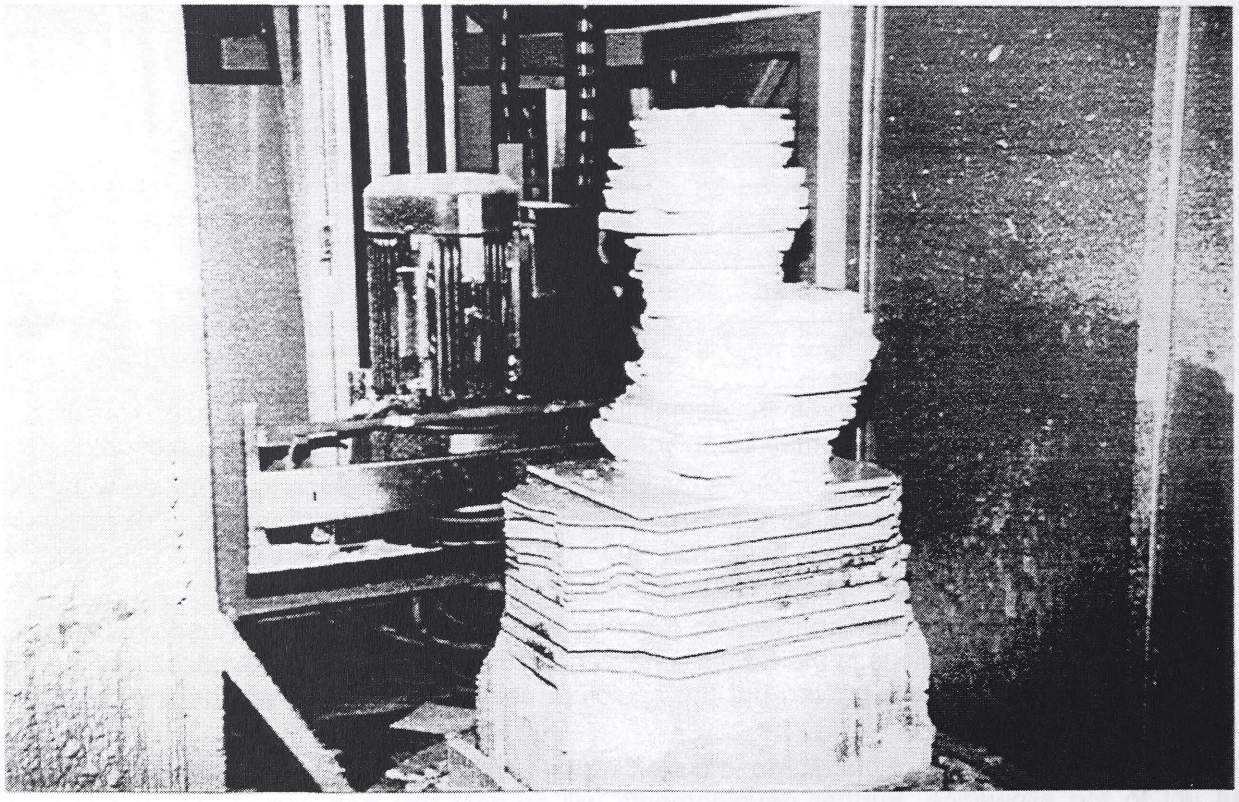

Fig 3 Pre-machined sculpture with partly cut off lamellas

MATERIALS OF ETHNOGRAPHIC EXPEDITIONS IN UKRAINE MULTIMEDIA PUBLICATION

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Results of ethnographic expeditions of the first half of the 20th century are presented on the heterogeneous carriers: phonograph cylinders, music records, travel records, photos. Their investigation allows to get the vast information about the culture, traditions of the certain population groups living in the given region. For the broad circle of researches the access to these materials is connected with practical and technical difficulties: the unique equipment for sound reproduction is needed, a lot of manuscripts are made by pencil and they are easy damaged during repeated usage. Publication of heterogeneous records in multimedia way on CDs has an importance for their storage and including in the scientific turnover. Results of number of ethnographic expeditions in Ukraine materials publication in multimedia way are presented in the report.

1. BRIEF DESCRIPTION OF COLLECTION MATERIALS

At Vernadsky National Library of Ukraine is stored one of the worldwide largest collection of Jewish musical folklore. This collection has an enormous value. Its materials generalize the work of several generations of talented researchers - folklore experts on studying Jewish musical culture of Ukraine and (in a lesser degree) Belorus - regions of considerable Jewish Diaspora with traditionally powerful centres of religious and spiritual life. Presently, this collection is a unique, the only one of its kind culture monument which shows so completely in alive sounding not only various palette of Jewish secular folklore but the richest tradition of synagogal singing as well.

The collection base make folklore expeditions materials of Petersburg Jewish Historic-Ethnographic Society in 1912-1914. The idea of expeditions carrying out belonged to S. An-sky famous Jewish writer and ethnography expert and G. Gintzburg sponsor and baron financed it. S.An-sky's colleagues in expeditions were Y. Engel music expert and composer, S. Kisselhof folklore expert, S.Yudovin artist and others.

In 1912-1913 the members of expedition visited Wolyn, Podillya and Kyiv region. They managed to record on phonograph an enormous, as to scale of that time, quantity of examples for traditional Jewish music in different genres: wordless chants (nigunim), instrumental pieces, songs, fragments of synagogal liturgies (hasanut), Jewish folklore theatrical plays (purimshpils).

After 1917 Cabinet of Musical Folklore attached to Institute of Jewish Culture in Kyiv ethnographic section continued traditions of Jewish folklore and ethnography experts whose work was interrupted by the I World War and the revolution. There was created their own independent phonograph archive attached to Cabinet and M. Beregovsky famous Jewish scientist and folklore expert stood at its source. Thanks to his efforts expeditionary works of Cabinet became planned, fixing and decoding of expeditions materials reached high scientific level. Within eyeshot of M. Beregovsky and his colleagues were both large centres of Jewish culture in Ukraine (Kyiv, Odessa) and separate characteristic seats of Jewish life in Podillya and Wolyn, west regions of Ukraine (Galychina) and Jewish agriculture colonies of the south of Ukraine (Kherson region, the Crimea).

The huge value of collection consists in safety of music and textual decodings to phonograph records, scientific comments. During the ethnographic expeditions a great quantity of photos was made.

Enormous intellectual value of this collection was not discovered until our days. Collection studying, including its materials in the scientific turnover is complicated by the fact that its materials are presented on heterogeneous carries and access to them is limited.

2. DEFINITION OF THE RESEARCH PROBLEM

The only way for physical preservation of information stored on the phonograph cylinders, in paper records and on photos is its digital rerecording onto modern carriers. The defects of phonograph cylinders (namely, difficulty with replication of recorded information, low reliability of recorded information storage because of cylinders mechanical fragility and their surface deformation while readout) were obvious including their creators as well. First attempts of information rerecording from phonograph cylinders began with appearance of gramophone records simultaneously.

During the last 25 years there were developed over 20 systems (piezoelectric and magnetoelectric) for qualitative sound reproduction from Edison phonograph cylinders. The database created by Christer Hamp (http:/home5.swipnet.se/~W-56154/phonol) contains fairly detailed information on the last years projects. The problem of developers of sound reproduction systems from phonograph cylinders consists in development of nondestructive systems of high-quality sound reproduction. This problem solving is complicated by the fact that most phonograph cylinders were already repeatedly reproduced by traditional methods based on gradual deformation of recorded relief. Therefore comparison of various methods used for sound reproduction can be incorrect after a long interval of time.

Optical methods whose noncontacting insures a full preservation and inviolability of recorded information have great potential resources in regard to nondestructive sound reproduction. However, development of methods of sound reproduction from phonograph cylinders is connected with great difficulties which don't enable to obtain qualitative sound due to high noise level connected with optical irregularity of phonograph cylinders surface [1].

We consider the best results can give combination of mechanical and optical methods in which cylinder surface profile is sounded by the elliptical stylus whose shape is close to one of sound recording and size of stylus movement is determined by the optical methods.

Many records in the handwritten part of the collection are made by pencil that also doesn't ensure their long safety: the records gradually die out. The ordinary reprint doesn't enable to save all records nuances. At present, the most suitable way of records preservation is the digital text scan method.

Presentation of phonograms, music records made by the collection collectors themselves and travel records on the same carrier will allow not only to preserve the materials of ethnographic expeditions but to include them in the scientific turnover and to open them for researchers of different countries being interested in this problem as well.

3. THE OBTAINED RESULTS

On the first stage we carried out the works on sound rerecording from phonograph cylinders [2].

Process of rerecording from phonograph cylinders onto CDs includes 3 main stages:

- digital pickup and sound track profile storage;
- computer processing of the profile signal;
- creation of CD image and information recording onto CD.

Direct works with phonograph cylinders are carried out on the first stage only. By means of slow rotation and axis supply of the cylinder its unrolling is executed. Meanwhile the sound track profile is traced by stylus of special elliptical shape to which optical element of the measuring interferometer arm is stiffly connected. The oscillations of the optical element correspond with the sound track profile, they are measured with an accuracy of 0,04mm and are recorded in the computer.

For sound reproduction the derivative velocity of sound track profile measurement is calculated. This transformed interferential signal supplied at discretization frequency of 4KHz is converted into sampling frequency of 22 kHz and all further signal computer processing is carried out at this discretization frequency.

The first stage of signal processing is the choice of optimum speed for sound reproduction achieved by changing of sampling step while its constant frequency.

Next signal operating step is the removal of pulsed hindrances and broadband noise caused by the cracks, scratches and other cylinder surface damages while its storage.

The program processing is used for pulsed hindrances (crackling, snubs) removal. Its algorithm is based on nonlinear detector reacting to the speed of signal level change.

Broadband noise is being removed by the program whose operative algorithm is based on the following operations. The spectrum of signal fragment readout from the cylinder in the free of useful signal place is measured programmly on the basis of discrete Fourier transformation. The signal is passed through this filter and the noise component of the signal is weakened.

Thus three forms of reproduced phonogrammes are prepared:

- instrumental sound;
- sound with removed impulse hindrances;
- sound with depressed broadband noise.

Then the CD image is created of these sound files in the computer by the standard methods and information is rerecorded from computer onto CD on the suitable equipment.

In association with employees of Vernadsky National Library of Ukraine we had completely rerecorded the collection of Jewish music folklore. Altogether over 1000 cylinders are rerecorded. Instrumental sound was rerecorded onto CDs after the primary processing included the choice of optimum speed for sound reproduction, removal of defects related to separate sound track damages. The total length of processed material sounding forms about 50 hours.

Parallel with sound reproduction from Edison phonograph cylinders and its rerecording onto CDs we conducted the works on Beregovsky collection catalogue working out. When appeal to the interested cylinder besides its detailed description the researcher can listen to the music composition recorded on the cylinder, get acquainted with originals of the music records. The additional information is available for some cylinders: the enlarged information on performers, on the place of phonogrramms recording. Besides textual files this additional information includes video information as well (the converted photos and sketches made during the ethnographic expeditions). The presentation disk contains information on 30 cylinders.

Full information on complete collection will be published in multimedia way during the upcoming year. The collection is expected to include several (10-12) genre CDs.

4. ACKNOWLEDGMENTS

The authors of the present paper acknowledges employees of the Institute for Information Recording of the National Academy of Sciences of Ukraine for help in phonograph cylinders rerecording, textual and graphic scanning of the materials as well as employees of the Vernadsky National Library of Ukraine for preparation of catalogue materials and textual information drawing up.

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DIRECT PLAY BACK OF NEGATIVES OF HISTORIC SOUND CYLINDERS

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Abstract

The Edison Cylinder Phonograph has been widely used since the beginning of this century to gain large amounts of sound documents on wax cylinders. It was convenient for use in fieldwork and until the early 1930s, it was the only means of recording ethnographic data acoustically. A large collection of copper negatives of these wax cylinders is hold by the Berlin Ethnographic Museum. The contents of these so called "galvanos" should be played back in the most gentle way. For this task the GFaI has developed a play back system using a combination of image processing and a mechanical sensor. The precisely measured sound track geometry is converted to acoustic signals that can be directly transferred to digital sound media. The obtainable sound quality is comparable to the then used technique of making wax copies and playing them on a cylinder phonograph. Furthermore the new method can still be applied in many cases when the making of wax copies is not feasible.

The Berlin Phonogram Archive

The Department for Ethnomusicology at the Museum for Ethnology in Berlin holds one of the largest collections of traditional music from all over the world, recorded between 1893 and 1943.

The History of the Berlin Phonogram Archive dates back to September 1900 when Carl Stumpf used an Edison phonograph to record a group of Thai musicians performing in Berlin. This was the beginning of an institution which was organisationally part of the Psychological Institute of Berlin University directed by Carl Stumpf. In 1905 the Phonogram Archive was institutionalised under Erich M von Hornbostel.

Due to von Hornbostel's international reputation and fruitful co-operation with scholars from different fields, such as scientists from social and natural sciences, colonial and missionary officers, an international collection was established. By the end of WWII the number of cylinders

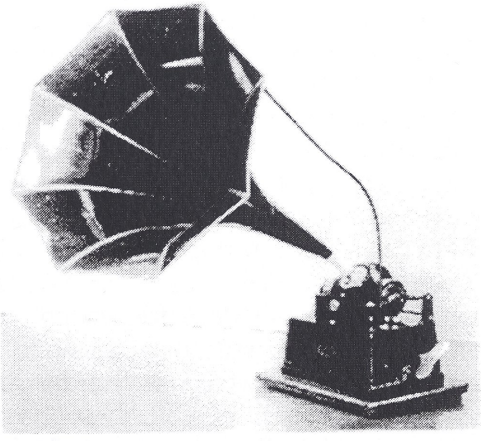

Fig. 1: Edison Phonograph

totalled more than 16,000 recordings. The geographic distribution of recordings is as follows: Africa 35.5 %, Asia 25.7 %, Australia and Oceania 11.4 %, Europe 15.5 %, America 11.7 %.

The history and the reputation of the Berlin PHA is due to Carl Stumpf and Erich M von Hornbostel, who were not only managers, but were also responsible for the scientific output of the Archive. Thus, the work of Stumpf and Hornbostel, based on the recordings of the PHA led to the foundation of a new scientific field, Comparative Musicology / Ethnomusicology.

After Stumpf's retirement in 1921 the Phonogram Archive was joined with the Staatliche Hochschule für Musik, but physically remained in its former building, the Berlin Palace. Von Hornbostel, now in an official position, continued in his mission of safeguarding traditional music in all parts of the world before it became extinct or westernised. In the 1920s and early 30s valuable collections of traditional music, mostly recorded by musicologists, entered the archive and formed the basis for regional research.

In 1933 Hornbostel left Germany, and the archive was attached to the Museum of Ethnology with Marius Schneider as director. In 1944 all the material was evacuated, but fell into the hands of the Russians who took it to Leningrad. In the Phonogram Archive of the Russian Academy of Sciences the material was copied and in 1960 handed over to East German authorities. As late as 1991 the Phonogram Archive returned to the Ethnological museum, and now more than 95 % of the pre-war holdings have been identified.

The Berlin Phonogram Archive was famous not only for its collections, but also for technical reasons. Berlin was the only Phonogram Archive which could produce copper negatives of original wax cylinders. These negatives were supposed to save the musical information for the future in the best way in original form and, at the same time, to serve as matrices for copies in unlimited number. Today, the galvano-negatives form a very valuable material, because they survived in their original form without being destroyed.

Today, an ambitious re-recording project is underway, supported by the Stiftung Preußischer Kulturbesitz and Stiftung Deutsche Klassenlotterie Berlin. A collection of CDs and a catalogue will be published hopefully by September 2000, when the hundredth anniversary of the first recordings is celebrated.

Edison Cylinders and Galvanos

Edison cylinders are about 5 cm in diameter, 10 cm in length and hollow. With grooves separated by about ¼ mm, each cylinder holds about two minutes of sound. Other sizes of diameter up to 10 cm and length up to 15 cm have also been used. The rotation speed was not standardised in the early days and was selectable between 90 and 180 rpm. The groove profile is a replica of the sound pressure during recording and has a maximum depth of about 20 µm.

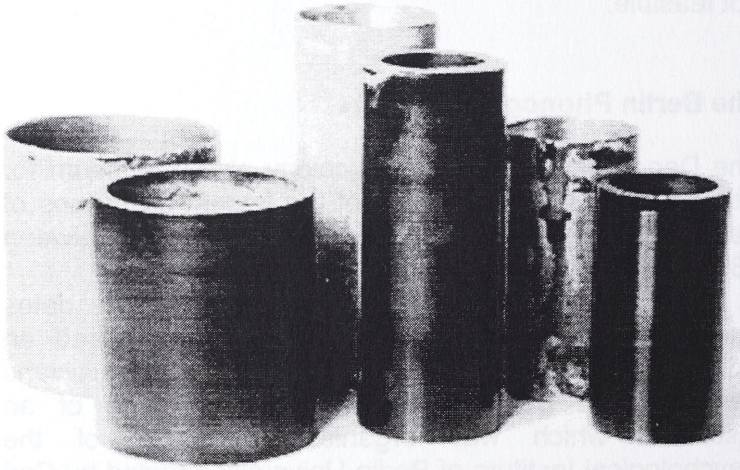

Fig. 2: Wax cylinders and copper negatives (galvanos)

Edison cylinders for sound recording are made of a special kind of wax, which is harder than the material of which candles are made [EXNER97]. Nevertheless it is soft enough so that recording by a pure mechanical device is possible. Unfortunately the process of playing back these records wears them out. The sound quality gets worse with each play back process and after about 10 play backs the record is destroyed.

In order to use records scientifically the former Berlin Phonogram Archive chose the very ingenious method of producing a copper mold of each recorded wax cylinder by means of galvanisation, resulting in so called galvanos. New wax cylinders for play back could then be cast from these molds. The wax used for casting had to have some special features in order to be able to be removed from the galvanos after cooling down.

The Direct Galvano Player

In 1996 information on how new wax cylinders were made from galvanos was not obtainable. So our idea was to regain the recorded sound directly from the galvanos. By using an endoscope, the sound tracks with their hill and dale modulation were clearly visible on the inside of galvanos and there was expectation to be able to gain the sound content of the galvanos purely by optical methods [STANKE97]. This is preferable because the sound tracks wouldn't be touched by the play back device so that any damage would be excluded.

This approach worked so far, but only with galvanos with very deep modulation where the height profile was clearly visible. Furthermore the required high frequency response hasn't been obtained with optical sound detection.

Since the optical track detection and track holding was working quite well, we tried to replace just the optical sound detection by a sensitive mechanical sensor driven by a specially shaped diamond stylus. By reducing the revolutions per minute we could use a very low force on the stylus. Combined with it's elliptic shape it has been shown that no damage is taking place to the galvanos while being played.

A specific feature of the galvanos is that the tracks are negative, i.e. consisting of ridges and not of grooves. Because of this, the stylus is not guided by the track. Consequently there must be some active tracking mechanism, which is detecting the momentary track position and holding the stylus centred in the middle of the track. In our case this is performed by a real time image processing system, using an endoscope and equipped with a CCD Camera.

The camera image is digitised by a frame grabber. The image of the laterally illuminated grooves is compared with a nominal groove image by a computer. From this calculated lateral displacement is used for following the middle of the sound track.

A galvano handling system has been built, consisting of two translation stages and one rotation stage. The rotation stage can hold galvanos from 50 to 100 mm diameter and rotate them at a selectable constant speed. A rubber belt drive is used for isolation against motor and gear vibrations. The drive uses a geared dc servo motor with incremental encoder for speed control. The first translation stage is used for following the sound track. It moves the mechanical sensor and endoscope along the galvano's rotation axis. The second translation stage is used for pressing the sensor stylus onto the inner galvano surface. Both translation stages are equipped with geared dc servo motors which can be controlled by a computer. The second translation motor can also be switched to an analogue control circuit.

The mechanical sensor consists of a plate-spring carrying a diamond stylus. While the stylus is pressed onto the sound track on the inner galvano surface the galvano is rotated at a constant slow speed. By doing this the plate-spring follows the height profile of the sound track. The sound signal is then obtained by measuring the spring displacement by means of a miniature inductive transducer (differential transformer). The sensor output is amplified and digitised with 12 bit resolution at an appropriate sampling rate. This is chosen in such a way that at the standard play back rate of CDs (44.100 kHz) the original sound pitch is obtained.

The height profile of the sound tracks consists of the sound information with relative small amplitude and a very low frequency part with often much larger amplitude, originating from deviation from ideal cylindricity and mechanical imperfections of the support. The amplitude of the interfering low frequency component exceeds the maximum sensor range. To overcome this problem, an active control mechanism has been implemented, which holds the mean vertical sensor position constant within 100 µm. A residual low frequency interference remains superimposed on the sound signal and is removed by a digital low pass filter.

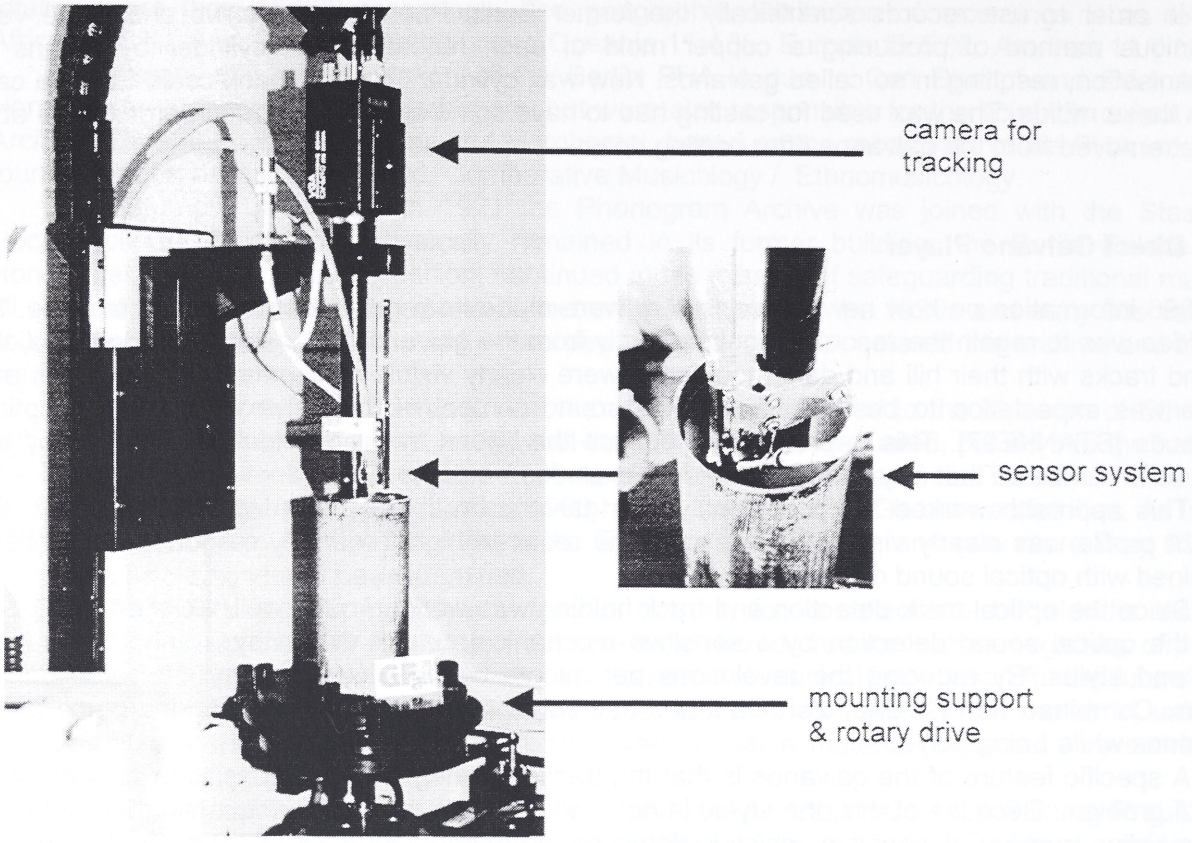

Fig. 3: System components of the direct galvano player

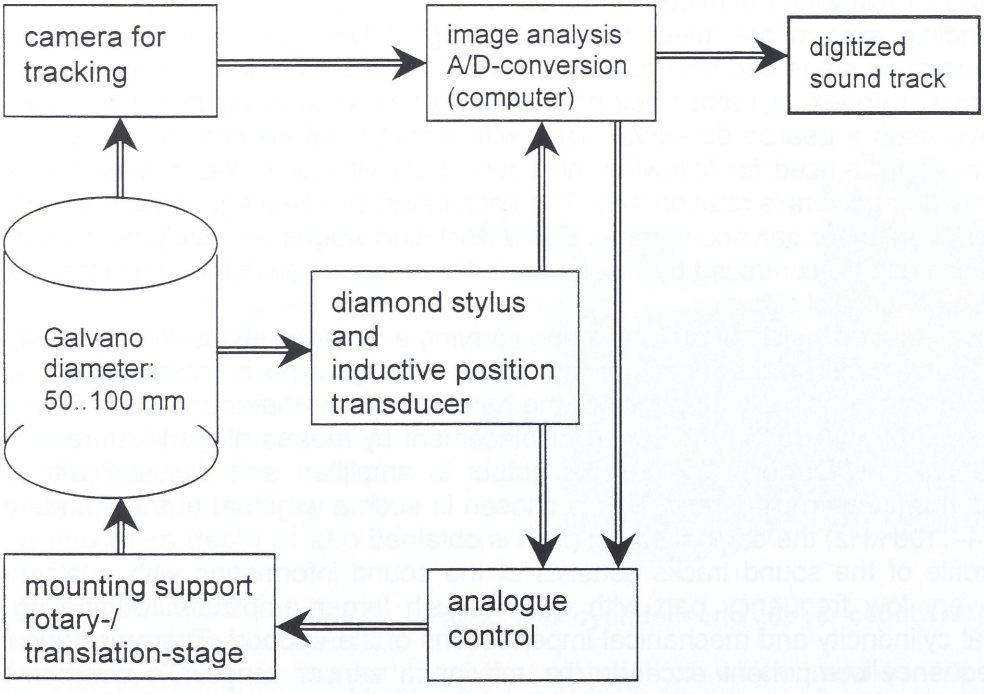

Fig. 4: Priciple of the direct galvano player

Results

Play backs made with our direct galvano player have been compared with wax copies played on a modern cylinder player. The sound quality is similar though the sound timbre is somewhat different. This has been expected due to the fact that our sensor measures absolute displacement and gives a flat frequency response like a condenser microphone, while the cylinder player used for comparison uses a dynamic cartridge which needs an equalizing amplifier to get the desired frequency response. Also the noise of the direct galvano player is somewhat higher probably induced by the friction between the diamond stylus and the copper surface.

No evidence of damage of the sound tracks by the playing process has been detected. Microscopic inspection after several play backs didn't show any differences at the used low stylus force. Also the sound quality didn't change. The obtained sound curves didn't show any erosion of the peaks.

The maximum play back speed depends on the galvano properties like visibility of tracks and deviation of the ideal cylinder. Normally 5 RPM can be used resulting in a play back time of about 80 minutes per galvano.

Due to the precise active positioning of the stylus, fragments of galvanos can be sampled and patched afterwards. This can be beneficial for re-recording of bad galvanos or galvanos made from broken wax cylinders.

Technical Data of the Galvano Player

diameter range of galvanos:	50 - 100 mm
max. length of galvanos	160 mm
playing Speed:	0.1 - 10 RPM
stylus force:	10 mN
sensor range:	150 µm
sensor resolution:	0.04 µm
sensor bandwidth:	1 kHz
frequencyresponse:	100 - 5000 Hz (depending on play back stylus)
digitising:	12 bits linear
sampling:	typ. 24 000 samples / revolution (selectable)
sampling rate of sound data:	44.100 kS/s
max. signal/noise:	40 dB (depending on galvano properties)

Acknowledgement

The development of the described direct galvano player has been funded by the Bundesministerium für Bildung und Forschung (03-ST9BER-8).

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XML/SGML TECHNOLOGY IN THE FIELD OF MEDIATING CULTURAL HERITAGE RECORDING - ARCHIVING - INFORMATION RETRIEVAL IN ORDER TO MEDIATE CULTURAL HERITAGE[1]

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Recording, archiving and retrieving information are „the" tasks carried out traditionnally by archives, libraries, museums, by information and documentation centres. The focal point of activities differs in the several institutions:

- Museums collect, record and present knowledge. They are mainly dedicated to the aspect of presentation. The exhibition, i.e. the choice of objects, the style of presentation, the program in the context of the exhibition enable the visitor to participate in the exhibition. The museum can become a meeting place as well as a place of discussion or a place of learning.
- The tasks of archives are mostly defined by law. The law defines which kind of material has to be archived as well as the space of time in order to secure the heritage. Predominant is the providence principle. Additionally selection criterias have to be defined as well the availibility for long-term use to be guaranteed.
- Libraries own unique historical collections, too, and have taken over archival functions in this sense. Libraries have focussed their activities to the field of cataloguing and making information available for research, for teaching and training. The parts of libraries, available directly to users, are usually presented in a systematic manner. Information retrieval through catalogues is possible via formal criteria as well as through subject headings and classifications.
- Documentation focusses generally to a special subject and indexes it in a extensive way (by the use of thesauri, terminology pp.) Beside bibliographical references and catalogues, which are managed by libraries and archives as well, data and facts are indexed, classified and made available.
- Scientific edition aims to prepare important works in the field of art and humanities for research, managing the texts as historical documents. Historic-critical editions meet the highest requirements by presenting a text together with the history, the delivery and the receiption of a work. Beside these criteria annotations and text variations are integrated.

All these activities have in common that they record, archive and organize the cultural heritage (of a city, of a region, of a nation, about a subject).

[1] The talk held at EVA'99 included the presentation of the CD-ROM „Kulturerbe digital". The CD-ROM is available via the German Library Institute, situated at Berlin. A email subscription form is available via the homepage of the Institute of Terminology and Applied Knowledge Research (http://www.itaw.hu-berlin.de). In order to understand the full opportunities of SGML-based publishing and visualisation the reader of the article should install the CD-ROM and explore the presentation and the retrieval facilities.

1. The concept

The independent project BIADOK_Publikation (supported by the Institute of Terminology and Applied Knowledge Research, situated at Berlin) was founded in 1996 and works in the field of XML/SGML based knowledge structuring and browser visualisation. The description and presentation of cultural objects implies the use of different kind of media: books, press clippings (articles in newspapers and journals), audiovisual material (images, films, sound documents), manuscripts, objects and facts have to be collected, analysed and presented. This manner of managing material is a vivid example for the integration of multimedia elements and the presentation of complex, multivarious linked knowledge structures. Computer based information systems in the field of culture and sciences (for example of a museum or a research institute) have some advantages in comparision with conventional ways of scientific research and publishing. It applies to the rationalization of working procedures by the online access to the permanently updated database, the shared use of information (facts, texts, pictures). Furthermore a computer based information system allows a differenciated access to the material and an improved use of the information. Such an information system offers improved services to the users (access to information by databases, profile services, pp.) and supports the marketing opportunities of the institution itself, for example to raise funds, to make the institution well known.

1.1. SGML - Standard Generalized Markup Language

The knowledge structuring bases on the ISO standard 8879 SGML (Standard Gerneralized Markup Langauge). SGML has been developed to manage, maintain and exchange complex structured technical information.

- The structue contains the logical organisation of a document. A document consists always of different logical parts. A book, for example, consists of chapters with titles, sections and subsections. A section itself consists (in any sequence) of other elements, for example lists, tables, graphics or simply text. All these parts or elements of the documents have a certain hierarchical relationship. The sections of a book are generally to be found in a chapter and therefor one hierarchical level below the chapter.
- The content of the document (document instance) comprises the text itself and - if existing - non-textual elements, e.g. graphics, images, multimedia elements, for example video tapes, sound documents can be integrated into such a document.
- The layout (style) defines the way of presentation, the way of visualisation on paper, on the screen, on CD-ROM. Style editing means the linking of structure elements to layout elements: which fonts is used for titles, lists, texts, indicates emphasis pp. ? The layout has to be separated strictly from the logical structure, it only concerns the way of presentation with regard to the readability on screen or on paper. The layout does not belong to the SGML application in a narrower sense.

A SGML application generally consists of two parts, stored together in one or separately in two or more ASCII coded files: the document type defintion (DTD) on one hand and the SGML marked document instance on the other. The document instance is characterized as marked, because the document contains beside the text „tags“, put in the text at the beginning and the end of the separate elements.

The advantages of SGML result from the features of SGML marked documents: the separation of content and context allow the platform-, software- and application independent management of data and layout. The validity, i.e. the correct element use, of the documents can be easily proved by computerbased parsing the document instance and the document type definition. SGML is software independant. That means, it is always possible to change the tools for publishing and visualisation without any compability problems. Another advantage is the fact, that the document instance only contains structural and no layout information. This means, that different styles can be linked to the same document with

regard to different purposes. This is important, if documents have to be published on different media. SGML strucutred documents can be easily adapted to further developments in the field of word processing and desk top publishing, because only the style of presentation has to be changed. The expediture for the data management is quite low: elements and elements groups can be changed or exchanged automatically, they can be deleted automatically. Restructuring and reorganising of document and text structures can be carried out quite easily on the basis of the DTD, too.

The mostly known SGML application is HTML (Hypertext Markup Language). HTML ist one special document type definition, based on the SGML standard.

1.2 XML - Extensible Markup Language

Quite new is XML, a subset of SGML. XML aims to use the attributes of SGML for processing and publishing documents on the Internet. It has been developped as intermediate stage, simplifying the use of SGML and guaranteeing the interoperability to HTML. XML can be introduced by those, who would like to deliver information through the Internet and need to go beyond the opportunities of HTML. Potential applications are electronic books, financial transactions (e-commerce), technical documentation, chemical formulars, medical information, museum catalogues, encyclopedias pp.. The main differences in comparison to SGML are:

- the definition of a character set for the XML meta language (e.g. chinese, greek, latin based)
- no minimization, i.e. start- and end-tags have to be set and can not be minimized
- restrictions in the element declaration, for the attributes, within the use of entities in comparison to SGML (no floating elements)
- the extension of linking possibilities, based on the expriences within the implementation of HTML, HyTime and TEI
- XML documents are self describing, i.e. all needed information are to be found in the header of the XML document.
- unicode as a standard feature

The consideration for one approach (SGML, XML, HTML) depends on the requirements of the planned application.

1.3 The approach

In order to develop prototype publications the following step by step process has been proved as effective and practicable. The first step is the development of a document type defintion (DTD) by modifying existant publicly accessible DTDs or by making a new one with regard to the specific requirements of the SGML application. In the second step the source data have to be converted into a a valid SGML structured document instance. Texts, images, sound and videos were integrated into the application. Afterwards the knowledge structures has to be visualised for the use and retrieval through a SGML browser. The graphical interface and the retrieval facilities depend on the publication structures and the facilities of the browser used. Elements, to be put into the table of contents for hypertext navigation, have to be defined. Beside and above this, the typographical appearence of the elements on the screen, hyperlink facilities within the document and to external documents, different styles of view to the materials have to be defined. Certain elements, for example footnotes, copyright, tables, can be hidden and revealed via icons in order to enable a comfortable use and get a clearly structured view. The user friendliness and the use of SGML structures are improved by the use of search forms. The user is able to benefit of the SGML structures without knowing them by using the search forms.

2. The CD-ROM „cultural heritage - digital"

Prototypical publications, developed within the last three years as example applications of SGML in the field of archives, libraries, museums, documentation and edition, have been put together on the CD-ROM „Kulturerbe digital". The examples of SGML based publications are presented through the DynaText 4.1 browser. The publications have been choosen in order to present different aspects of electronic publishing: the integration of multimedia elements (text, pictures and graphics, sound, film, 3-D-visualisation) and the fields of application. The CD-ROM tries to give an impression, which products can be developed on the basis of SGML in the field of documenting the arts and humanities. Two examples are presented during the talk, hold at EVA 1999.

2.1 Multimedia presentation in the museum

A find of the early middle age of Montcornet, Départment Aisne / France, was documented. An iron belt-buckle, decorated with an animal in the style of the 7th century, is almost completely conserved. Until now only one half side was restored[2]. This publication focusses on the integration of external applications. The integrated graphics have to be seen as text explication via image and enable furthermore the launch of external applications. The used image material contrasts modern methods to traditional methods. Usually impossible things, for example the multiple look to the different steps of the working process, making transparent of the unique find can be carried out by using the mouse, clicking into the image in the electronic publication. Clicking, i.e. using the mouse, starts a film viewer or a program for 3-D-visualisation, enabling the change of the perspective of the view. A personal computer with CD-ROM device realises the visualisation, a pentium III chip with 450 Mhz is sufficient for a presentation without delay. This application can be seen as a first step towards the active participation of the visitor as well as a step beyond a „traditional" presentation. The object can be turned freely around, it can be touched and enlarged.

2.2. SGML based film documentation

The film is a quite young medium. Since about hundred years stories and subjects are visualised by this way. Comparable to a play a text forms the basis, which is transfered into pictures (spoken text, action). In opposite to a theatre production a film can be copied and presented to spectators at different location at the same time. There is no direct interaction between the audience and the actors, because the film is a finished product. Film can not only be presented in the public (at the cinema), it can be seen by individuals (via television or video tape). In this case there is no (or only minimal) interaction between the spectators, implying another quality of perceiption as the perceiption in the cinema.

The centre of the film is the story. The story can be adapted of literary patterns (fiction, drama, tales), the adaption of historical events or completly fictional. The story of the „Hauptmann von Köpenick", a film by Frank Beyer and Wolfgang Kohlhaase, was adapted from the play of Carl Zuckmayer. The play of Zuckmayer based on an article of a newspaper and characterizes the German society at the beginning of the 20th century in Prussia. The film, i.e. a video tape in the VHS format, has been digitized[3] (format: MPEG 1) and combined with the electronic version of the script. Additional information of the directors script has been integrated, for example the casting list and the list of roles. Differences between the script and the realised film were marked, too. With regard to the fact, that a prototype publication is presented, only a part of the film was digitized. With minimal expense publishing on different media can be realized (Internet, CD-ROM, DVD-ROM in the near future). Besides these advantages different forms of presentation, different views of the same materials can be made available, for example the view for the film-goer (spectator) as well as the view for film researchers or a multilingual approach.

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[2] DResearch has supported us by giving the permission to integrate their application into our electronic publication.

[3] We thank the TZI of the University at Bremen for the digitization of the film with regard to our structural requirements.

Beside the aspect of archiving by digitizing other criteria have to be taken into consideration from the point of presenting films. Results of preparatory work and research to be carried out every time when someone builds up an archive or documents projects are made available together with the film and other belonging material. In doing so, existing information and film databases can be used as well as electronic newspaper archives. Furthermore new products can be developed. In addition to formal criteria (title, film director, film production firm, year of production, casting list, staff list, pp.) content oriented criteria (film subjects, themes) and technical criteria (camera positions, cutting techniques) can be marked up and made searchable. The parallel presentation of different versions of a film, the parallel presentation of comparable film subjects open new perspectives from the point of the methodology of film research as well as the perception and reception of film in general.

3. SGML based indexing

The extensive indexing of the material is the supposition to enable quick and comfortable information retrieval. Indexing enables information experts and users to find documents via different points of access: via formal aspects as the name of the author, title, subject, to get information about documents of the same author, subject - but different locations, to distinct different editions or different publication forms.

3.1. Indexing of electronic publications

In opposition to the way of indexing traditional media, which are physically available for catalgoguing, additional aspects have to be taken into consideration. In the case of electronic publication the direct transfer of bibliographical information is possible. Source herefore are the opening screen, the electronic publication itself, the accompaying material. Interfaces are needed in order to exchange the information between the parts of the information systems. Furthermore additional information is needed: the ways of access to the document, structured descriptive information to enable automated indexing. In order to guarantee the long-term use, archive information has to be stored. Archive information means the format of the original, the using and the access rights, the archiving format.

3.2 Concepts to index electronic publications

At this point it becomes evident that indexing should not be restricted to the field of structural object description (mainly alphabetical cataloguing) of electronic documents. Rather indexing has to look at the production process, because the retrieval facilities are established during the making of electronic publications. For example: the producer (author) of the pages in the WWW establishes and maintains the links, offers search forms, etc. How can electronic publications be indexed and made available in an effective way to users? One way to catalogue the electronic publication is to adapt existing data formats in the area of bibliographic description, for example by defining a field for electronic location and access. In the meantime the German MAB format (MAB = Maschine Readable Format for Libaries) was modified in this area on the basis of the American model. Another way is using the bibliographic information included in the SGML-based document structure to index the electronic publication.

To receive the relevant elements needed for alphabetical cataloguing, the DTD of the publication has to be analysed. The DTD contains the elements, their relationship (structures, hierarchies) and their frequency. Alphabetical cataloguing from the point of view of SGML is a special view to the electronic publication. This view includes only those elements, decided as being relevant for cataloguing (author, corporate source, title ...), comparable to the CIP record (Cataloguing in Publication) in printed books.

Developing this concept consequently farther on, new aspects have to be taken into consideration: SGML can be used for the management of object data. Librarian data formats and electronic library catalogues, finding aids, inventary lists pp. can be reflected in SGML

by special DTDs. Catalogue data are 'lifetime' documents, too, intended to be archived and to be retrieved in the long term. SGML-based publications offer additional facilities. Beside well-known traditional structuring elements of printed publications (for example: table of contents, index, abstract, summary, footnote, annotation) the reader has further possibilities: hypertext structures to navigate within the publication, full-text search, search in the element structure (headings, figure captions, definitions, citations) as well as the possibility to follow links to external documents. Especially the search in sections of marked text, structured on the basis of the logical and hierarchical structures of SGML, has to be emphasised. The author determines the retrieval during the genesis of producing his document. With this comfortable search facilities the principle of subject headings in the context of subject indexing mislays significance. The principle of defined terms (descriptors) will supersede the principle of subject indexing. Here the working fields of library and documentation come together.

Besides the concept of „implicit" information, included in electronic documents, which have to be filtered and selected from the elements (structures), exists the concept of „explicit" information (meta data), delivered with the document. Examples for this concept are DublinCore, intended to index HTML publications on the Internet, the TEI[4] header and the Warwick Framework in order to integrate metadata into SGML-structured publications. Using this concepts of electronic publications, the transition of the relevant elements in conformity to the categories of the data formats and rules has to be carried out „only".

4. Recording - Archiving- Information retrieval in order to intermediate cultural heritage

Archives, libraries and museums collect and deliver the cultural heritage. Computer-based indexing and information retrieval enables a better access to the material and the improved usage. Organizing and structuring the knowledge is the presumption to intermediate cultural heritage. XML- / SGML structuring ensures the longterm and multiple use of structured information. The structures can be adapted without any problems to changing technological opportunities as well as to changing users needs.

An essential advantage of XML- / SGML structuring is the distribution on different media (printing, local, LAN, WAN - including WWW -) without much additional effort. Styles have to be devloped, based on the DTD in order to get a clearly arranged view. From the point of the user the retrieval facilities play the most important role: multiple retrieval facilities can be offered because of the underlying SGML structures (full-text, Bool'ean operators, truncation, SGML-structured search) through the browser with graphical interface on the local computer, on CD-ROM and via Internet. Search forms, supporting the user's search, can be integrated. Furthermor different points of view to the knowledge basis can be realized, for example for different levels of search, different access possibilities for different users groups pp.

Beside a pure SGML-based approach mixed forms of presentation can be put into practice. HTML forms can be used to perform searches in a database and to present the results in different ways. For example the results can be presented as a list in the HTML format. Content is lost by this way of visualisation. One step beyond is a XML-/SGML based presentation of search results via HTML search forms. Instead a simple list of results the user recieves a content based presentation.

We conclude: Mediation of cultural heritage is definend from the perspetive of knowledge structuring. The mediation comprises flexibility during the process of the creation of knowledge structures as well as flexibility in the process of creating retrieval facilites with regard to the information retrieval.

[4] TEI = Text Encoding Iniative, Initiative to encode and exchange digitized texts in the field of arts and humanities.

THE SIM PROJECT - MULTIMEDIA INFORMATION SYSTEM FOR MUSEUMS

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The aim of this paper is to describe the SIM project that implements a complex collections and resource management system for museums. The solution provided in the SIM project is an extended link between information technology and cultural heritage.

The primary objective of the project has been to develop a multimedia database system as a complete professional system from concept to its first implementation at the National Art Museum of Romania, the greatest museum from our country.

The increasing capability of information systems and global communications offers many opportunities to museums and galleries and the impact of Information Technology on them is huge. That is why we have developed a museum information system offering comprehensive collection management support, based on the team's dedication to museum systems since 1986.

The focus in the project was on the following:

- Integration of museum standards, like Spectrum and LASSI, and domestic standardization bodies results and experience, like those of the Information Center for Culture and Heritage (CIMEC).

  Having in view the compliance with museum standards the developed database system is easy to customize to various museums.

- The use of powerful tools and techniques, like database CASE tools, in order to build a robust, consistent and easy to re-generate multimedia database system.

  We have chosen powerful and complex tools to assist and support the business interviewing, the system analysis and design and to generate first-cut applications.

- The integration of networking facilities supported by means of Intranet, Internet and Web applications.

  The concept is to use a HTTP server to deliver the content of the database to a World-Wide-Web. The Web applications query and retrieve the database for local users on the Intranet and for remote users on the Internet, as well.

  The purpose of the database published on Internet is not only for worldwide public interested in the museum's collections but also for the museum's remote

collaborators. In the last case the database access is wider and password protected and the communication and database data exchange is provided through secured links.

New technologies, architectures and access methods, like the three layers architecture, network-centric applications with the support of powerful servers for database connectivity were implemented in order to promote interactivity and information dissemination.

- The close work with end-users from the Romanian National Art Museum, exploring and developing their requirements, using a fast prototype for first step system analysis and sharing with them the latest software and hardware advances as their technological needs change.

  Future system implementations concern other Romanian museums like the Peasant's Museum, the National History Museum or smaller museums like the Literature Museum.

- Future developments concern the search and retrieval of very large text from the database system. Museum and art techniques description (restoration, preservation, etc.) are required to be stored, searched and retrieved by the museum specialists. Art technical dictionary and thesaurus will be also built related to the database system.

  Another future facility is to store and manage video and sound within the multimedia database system as, for example, filmed restoration procedures and techniques.

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CONCEPTION AND DEVELOPMENT OF A DATABASE SYSTEM FOR ART AND CULTURAL PROPERTIES

KuKuG („**Ku**nst und **Ku**ltur**g**ut")

KuKuG is a co-operative venture of:

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mediacube Berlin, IT-Service

For a number of years museums, cultural heritage offices, transportation firms, gallery owners, curators, restaurateurs, universities and academies have been attempting to create a registration system for art and cultural properties, whether archaeological fragments, architectonic collections or modern art.

There are a large number of study groups, committees, organisations and individuals already concerned with updating conventional methods of registration (file-card boxes, lists, sketches, projector slides etc.) to the digital age. Their work has already yielded very fruitful and useful databases.

The problem here, however, is that, while these databases generally function very well within individual areas, they all require software and hardware that is not universally available. An additional drawback is that, although these applications can be used for research purposes, they cannot be updated or modified by the user. A substantial number can only be used by the creator due to the absence of clear instructions for other users. In most cases, the databases are non-transferable and data exchange is either not possible or requires considerable technical and organisational input.

On the other hand, it is now very easy to create high-resolution digital images, store and edit two and three dimensional objects or spaces; data can be compressed and stored for later access on existing databases and thesauri via Internet.

KuKuG therefore intends to develop a standard type for all generally accessible 'organisational' (title, dimensions, owner etc.) data to allow data to be transferred within a limited circle of persons in an internal group or via the Internet. For these purposes **KuKuG** employs software and hardware systems that are available to every computer user.

The realisation and processing of complex projects in the organisational area of the art and culture sector will become considerably easier. Procedures and processes are optimised and displayed clearly, and communication for those involved – even extending beyond continents – will be of a quality in keeping with the digital age.

The aim is to design a database management system that is not tailor-made to just one particular institution, but can instead be employed independent of platform and apparatus. A system of this kind is urgently required in a large number of museums, cultural heritage offices and other institutions.

KuKuG covers the following:

- Directory of works and artists / Inventory / Bibliographies / Location / History / Museums
- Scientific research in various European archives
- Thesaurus for materials and techniques with links external dat
- Integrated picture database with link to external databases
- Interface for catalogue text and layout
- Conservation / Restoration protocols
  Detailed documentation of condition, action taken and all working procedures executed
- Administration: scheduling and exhibition planning / Loans / Packaging / Transportation / Insurance / Depot management / Transportation firms etc.
- Storage of printed documents (certifications, correspondence) / Photographic and film archive

Employment over a range of different areas depends on a modular system (for partial operation), straightforward application (user-friendly layout), a list of synonyms (for pure text documents), running text for individual documents, complete document research and research according to certain criteria, intranet and Internet capability and an online service: maintenance, updates, back-ups, information pool.

Every authorised user has access to the area assigned for him. He can enter information and make inquiries. All information is transferred electronically via the Internet. Any data entered by the user can be stored in the central **KuKuG** database and be authorised for both general and restricted use – for example through a defined project group.

In combining completely different areas of the art and culture sector, **KuKuG** will provide unprecedented levels of quality and efficiency.

The **KuKuG** project has the purpose to be a practical and non-commercial tool on a very high standard for any institution or private person dealing with art and cultural properties in a professional way.

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CONTENT-BASED RETRIEVAL OF DIGITAL ARCHIVES USING STATISTICAL OBJECT MODELING TECHNIQUES

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Abstract

The efficient archival and retrieval of digitized images is a demanding task due to e.g. the increasing popularity of digital imaging and the emerging application of image databases in various areas. Apart from technical databases, digital image archives are used as commercial product catalogs or in art galleries and historical museums. This paper presents two experimental image retrieval systems, both using a statistical framework which allows a flexible matching of shapes as well as the possibility to integrate features from different visual cues such as shape, color and – in future – texture in an integrated way. The first system applies the "query by user sketch" paradigm rather than the commonly used "query by example" method and is able to retrieve images from archives of isolated objects. Our experimental database consists of 120 color-images of common objects such as light-bulbs, hands, forks, etc. Although our experimental system has been evaluated on this database, the system can due to automatic learning capabilities easily be adapted to art or historical databases containing isolated objects. Examples for archives of isolated objects in this context are e.g. sculptures, *Readymades* or ancient objects of historical importance. A second experimental system described in this paper deals with the retrieval of historical watermarks, where those images are retrieved which contain user defined details. This watermark retrieval system uses the same statistical framework as the first system (so called Hidden Markov Models), which again leads to a deformation tolerant behavior, but applies a two-dimensional variant which fits more naturally to images.

1 Introduction

By far the largest image archive available is the World Wide Web (WWW), which contains images taken from all areas ranging from digitized paintings to cartoons. In order to efficiently retrieve pictorial data from very large databases, such as e.g. the WWW, content based methods are an attractive alternative to the traditionally used method of manual textual indexing. Text-based retrieval of images requires a time consuming and thus expensive manual indexing of the entire database. Furthermore, the query may lead to inaccurate retrieval results, if the query text does not match any of the stored keywords, due to different interpretations of the image contents. Moreover, the use of textual queries is not intuitive for humans and many users demand man-machine interfaces such as computer mouse or digitizer boards, rather than keyboards. In order to overcome these limitations of textual queries, two experimental systems which allow a content-based access to image libraries are presented in the following sections.

2 Retrieval by Sketch

Content-based retrieval by sketch allows a user to search an image database intuitively by applying simple drawings. By specifying the shape of an object by a sketch, it is often much easier to retrieve a

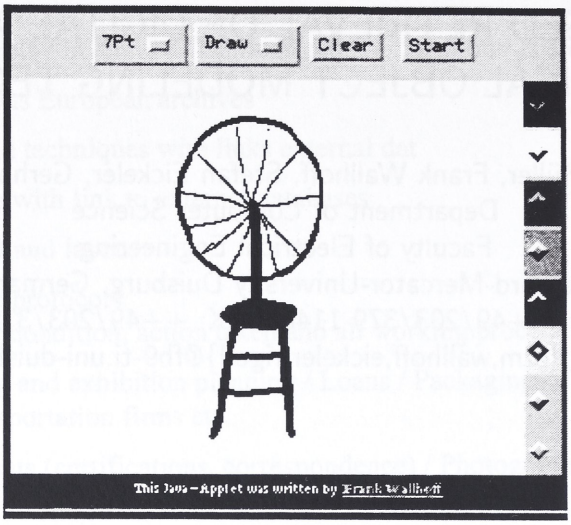

Figure 1: Java applet for presenting query sketches to our image retrieval system. This rough sketch could be used in order to retrieve an image of Marcel Duchamp's *Readymade* "The Bicycle Wheel".

specific object. It is for example possible to express height to width ratios or complex forms, which is quite difficult to express using a textual query. Imagine a textual description of the shape shown in Fig. 1, where a rough sketch of M. Duchamp's *Readymade* "The Bicycle Wheel" is shown. The sketch has been drawn using the WWW interface of our experimental retrieval system, which can be found at `http://www.fb9-ti.uni-duisburg/demos/query.html`. Note that although it would be possible to retrieve e.g. sculptures, the system currently retrieves images of common objects such as light-bulbs, forks, etc. Due to automatic learning capabilities, the system can be adapted to different databases. The Figs. 2 and 3 illustrate the polar sampling of a shape or sketch (feature extraction) and a diagram of the statistical model (Hidden Markov Model), respectively. The Hidden Markov Model (HMM) is used in order to represent the shape. HMMs are widely used in speech recognition, where they proved to be highly flexible and are able to deal with variations in pronunciation as well as (talking-)speed (see [7] for details). More recently, these models became also popular in online handwriting recognition (see e.g. [6]). In this research area the elastic matching capabilities are needed in order to deal with the large variations in the handwriting of even a single person. The examples given above demonstrate the usability of HMMs for the elastic matching of patterns and thus these models can be applied to the image retrieval by sketch. The polar sampling step illustrated in Fig. 2 generates the important features from an object and those features are used to train an individual HMM for every element in the database. Note that a very detailed explanation of the training procedure for HMMs in given by Rabiner in [7]. The particular topology of the

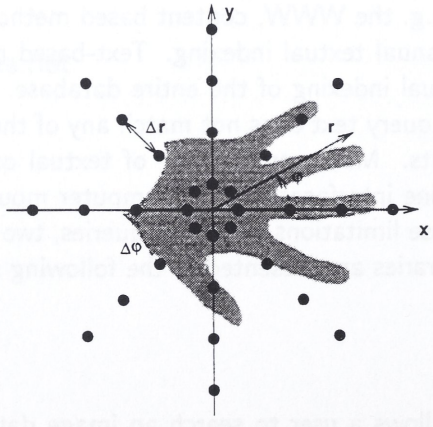

Figure 2: Polar sampling raster

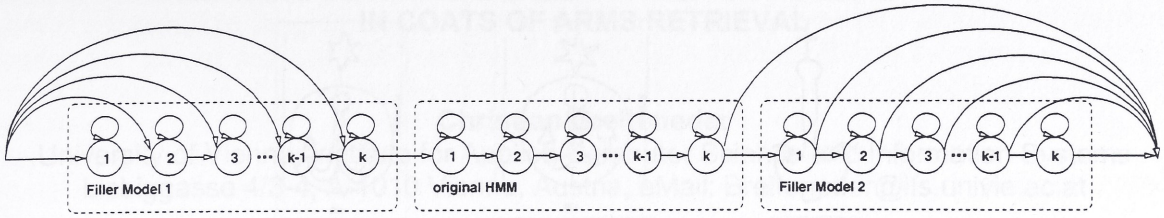

Figure 3: HMM structure for the modeling of shapes

HMM shown in Fig. 2 has mainly been chosen in order to achieve the desired rotation invariance. Rotation, scaling and translation are those affine transformations which, by definition, do not change the shape of an object. Detailed explanations about the applied feature extraction and statistical modeling techniques can be found in [2, 5]. The HMM-framework allows the use of different visual cues such as shape and color in an integrated way. In order to generate the color features, the sampling as illustrated in Fig. 2 is performed for each of the RGB-channels. Fig. 4 presents some results achieved with our system, where in every row the query-sketch is shown first, followed by those four images (out of 120) with the highest similarity measure (see also [3]).

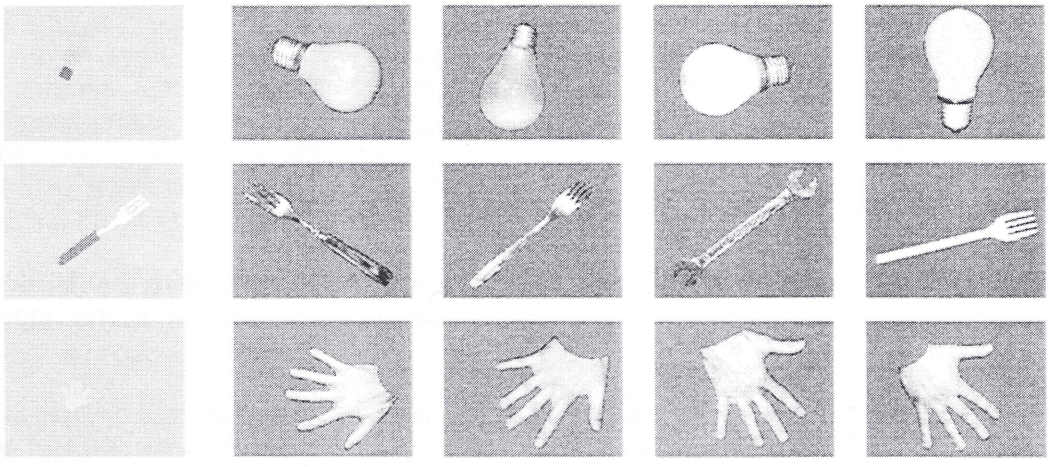

Figure 4: Query sketches and retrieved images

3 Finding details in historical watermark images

The second approach presented in this paper aims to retrieve historical watermark images [8] containing certain details, such as e.g. anchors, eagles, hands, etc., even in cases where the query shape is embedded in e.g. hatching or is connected to other parts in the image. The query-shape is represented by a two-dimensional statistical model (P2D-HMM) rather than a one-dimensional model as shown in Fig. 3 and is surrounded by so-called *filler states* which generate the remaining part of the image. This leads to an integrated approach which assigns probability scores to the elements of the archive and also locates the query shape in the database images. P2D-HMMs have been introduced by Kuo and Agazzi in [1]. Fig. 5 illustrates a query result, where the query shape (anchor) is shown in the upper left corner followed by those eight images (out of 50) with the highest similarity score (ordered left to right and top to bottom, with decreasing score). A detailed description of the system can be found in [4], however note that in [4] the system is evaluated on an engineering drawing database.

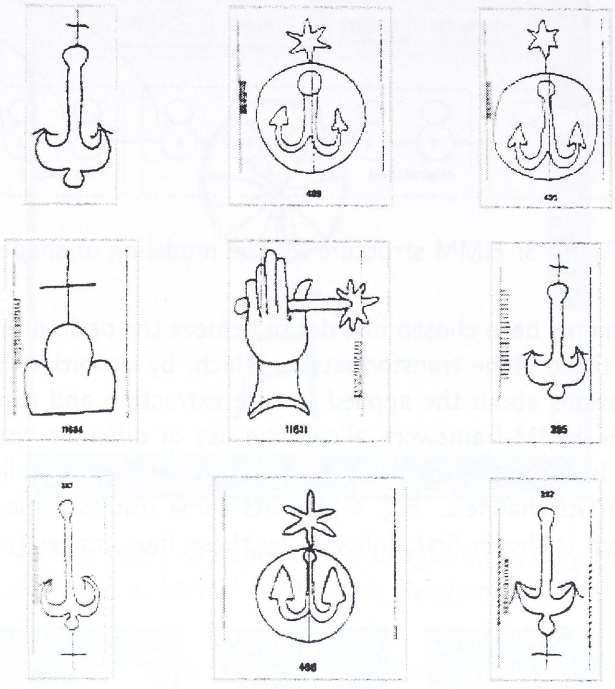

Figure 5: Retrieval of watermark images

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MERGING IMAGE FEATURES BY SELF ORGANIZING MAPS IN COATS OF ARMS RETRIEVAL

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1. Introduction

Images - even synthetic images – fequently contain a high number of different features. Many general purpose feature extraction functions exist for color, texture and shape [4][6][12] and content-based image retrieval (CBIR) systems like QBIC [5] or Virage [1] use them simultaneously to enhance performance. Usually, an independent query for each feature is initiated and results are composed by a linear combination of weighted distance values. This process is called *merging* [16]. Merging involves two major problems:

1. Some authors [15] argue that some feature classes are not linearly-related and merging therefore would not represent a suitable combination algorithm. In [15] a multi-layer neural network is proposed instead.

2. Most common, weights have to be provided by the user. In some systems weights are fixed to certain values but most systems ask the user for his or her preference. The authors of [15] argue, that the "specification of weights imposes a big burdon on the user, as it requires the user to have a comprehensive knowledge of the low level feature representations used in the retrieval system, which is normally not the case."

This paper adresses a solution for the second problem in the domain of coats of arms retrieval. We implemented a model for the automatic estimation of weights by self organizing maps (SOM). Up to now, SOMs - although a very popular technique in many research areas - have hardly been used in image retrieval applications: In [14] tree structured SOMs are employed to index and search image databases and in [6] SOMs are suggested for the creation of an iconic index. We think that SOMs can be helpful in many areas of content-based image retrieval and plan to use them for the automatic generation of query models (see section 2).

The meaning of the term "feature" varies in different papers on content-based image retrieval. The term is used, first, to describe objects in an image. In this paper we we will use the term *object* (*sub-image*) for this purpose. Second, to denote a function extracting properties of an image. Here we will use *feature extraction function*. Third, to describe a common property of an image or sub-image. We will use *feature* in this sense. In query processing we use *search image* for the example image for which the user wants to obtain similar images from the database. An image which is compared to the search image is called a *candidate image* in our terminology.

The paper is organized as follows: In section 2 query models [2] are introduced. Section 3 comprises the central part of this paper and discusses how merging is performed and how the weighting algorithm works. In section 4 the test environment and the test results are presented. Section 5 summarizes and rounds up the paper in a short conclusion.

2. Query models

We define similarity in our CBIR system by so-called *query models*. A query model is a list of tuples of the form: feature extraction function, distance function, threshold and weight. The threshold is the maximum allowed distance between an image in the database and the query image. The size of the result set is determined by the thresholds of all elements of a query model and not - as common in other retrival approches (e.g. [5]) - by an absolute number. In other words, every element in a query model eliminates some images that cannot be part of the result set any more (e.g., due to minimal distance values for other features). Therefore the threshold is an important part of the similarity definition. Table 1 gives an example of a query model. In the first step the color histogram of every image is compared to the color histogram of the search image. For images with a distance value lower than 0.5 it is determined whether they are symmetrical to their x-axis. Images satisfying also the second condition will be returned as the query result.

No.	Feature extraction function	Distance function	Max. threshold value
1	Color histogram	Euclidean distance	0.5
2	X-axis symmetry	Given? yes / no	0

The idea behind query models is the filtering of an image set through a set of consecutive sieves (Figure 1). Each element of the query model reduces the initial image set until only those images are left that are most similar to the search image.

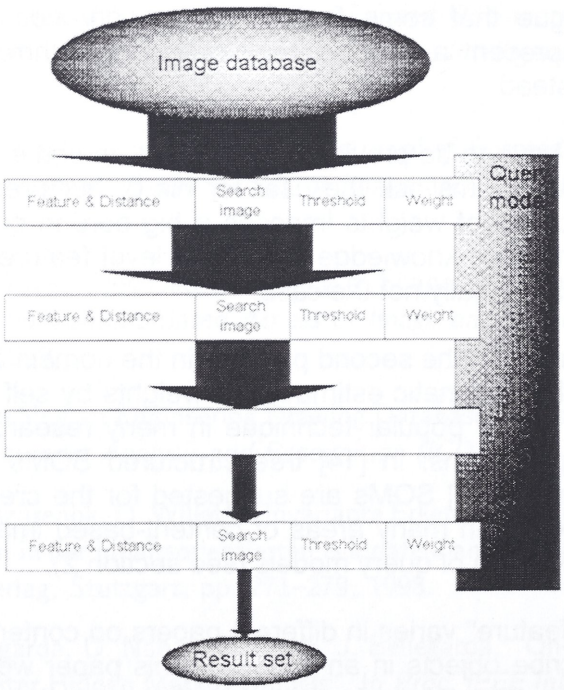

Figure 1: Image filtering

One of the advantages of employing query models is the possibility to optimize the performance by using those features first that have a faster to compute feature function and eliminate a larger group of images. For example, for our coats of arms database we usually apply a simple feature counting the number of significant colors together with a color histogram. This fast to compute

feature reduces the image set at least to half of its original size and improves the overall performance considerably.

From a different point of view, query models can be seen as representations of clusters within the image database (Figure 2). A query model defines the properties of the corresponding image cluster. We shall see in section 4 that images of coats of arms are indeed grouped in such clusters. The next section shows how clusters can be exploited in an automated weighting algorithm.

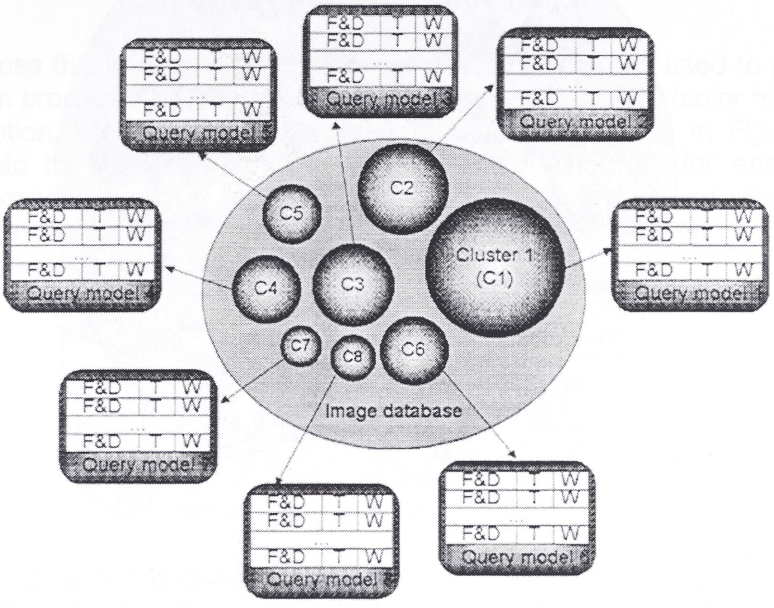

Figure 2: Clusters and query models

3. Merging of features through self organizing maps

This section describes how merging is performed and how suitable weights can be computed. In addition, we present some of the feature extraction functions. The results of feature extraction functions are composed into feature vectors that are used in the SOM ([13]) calculation.

Usually, (e.g., in [5]), when using multiple features for an image query, the result set is ordered by the weighted sum of the distance values (position value). The position value for each database object is defined by equation 1:

$$Position\ value_{Object} = \sum_{i=1}^{F} w_i d_i$$

In this formula F is the number of features, w_i the weight for feature i and d_i the distance value between the query object and the database object for feature i. This evaluation method assumes that all distance functions are standardized on the same range (in our case the interval [0,1]). Actually, a distance function is a measure for *dis-similarity*, that's why the distance between a search image and a candidate image should be small for important features but may be greater for less important ones. The weights should help to order the result set. The most similar image should be next to the query image and less similar ones should be placed at a greater distance. Therefore important features should have higher weights than less important ones to "punish" a greater distance for an important feature by a greater value for the product of distance and weight.

If we would not use thresholds to limit the range of possible distance values, it could be possible that images appear in the result set that are similar in most aspects of the defined query model but not similar in some of them. Then it would be the task of the weighting process to order images at

the end of the result set. This could hardly be achieved by the linear weighting method described above. It follows that using thresholds shifts the importance of the weighting algorithm from an essential part of a retrieval system to a more or less cosmetic operation.

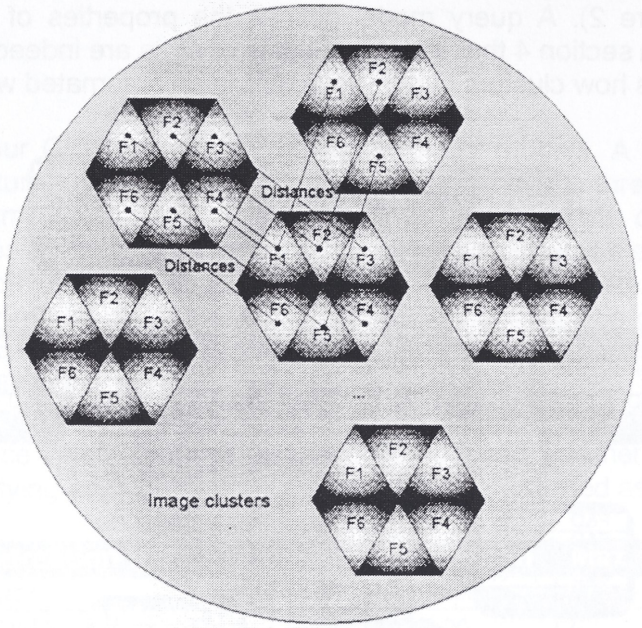

Figure 3: Clustered image space

Our idea is to cluster the image database and to use the contribution of each feature for the cluster structure for the selection of suitable weights. Clustering was performed by a self organizing map. The weight of a feature is calculated as the sum of distances (of the feature) between the cluster that contains the search image and all neighboring clusters. Figure 3 shows a clustered image space where six features (F1 - F6) are used. The weighting algorithm consists of the following steps:

1. Clustering of image database
   For each image in the coats of arms database [3] all features are calculated. Then the various feature vectors are exported, merged into a single vector (representing one image) and normalized. The normalized vectors of all images are fed into the map calculation algorithm in SOM-PAK ([13]) which produces a map with hexagonal layout. This means that each cluster has (max.) six neighbors. A cluster is represented by a feature vector pointing to its center.

2. Calculation of weights
   First, the cluster to which the search image belongs is identified and the weights for all features calculated (distance between search image and neighboring clusters). We experimented with two different approaches depicted in Figure 4: the distance between search image cluster and neighboring clusters (1) and the distance between the search image itself and neighboring clusters (2). We found in our tests that the first method is clearly better than the second one. Therefore the results in section 5 are computed by method 1. For the distance calculation itself the Euclidean distance was used.

3. Application of weights
   In the test environment weights are used as proportions; for example, for a query model with two features the pair of weights (2, 1) equals the pair (4, 2). Two different approaches were tested for the application of weights: the distance of a feature to all neighbors (1) and the reciprocal value of the sum of distances of all other features in the query model (2). Again, tests have shown that the first method is at least as good as the (more complicated) second one. We therefore used only the first method for the tests discussed in section 4.

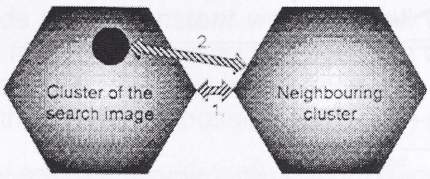

Figure 4: Weight calculation methods

We would like to close this section with some remarks on the features used to gain the vectors for the SOM calculation process. Besides the ones discussed in [2] and [3] (color histogram, symmetry features, segmentation, etc.) we used combined features as the one in Figure 5. This feature divides a shield into its elements and calculates a color histogram for each sub-region. The distance function analyzes whether two images have the same layout and returns 1 otherwise. In case of the same layout for each region the Euclidean distance between the two histograms is calculated and the average value returned.

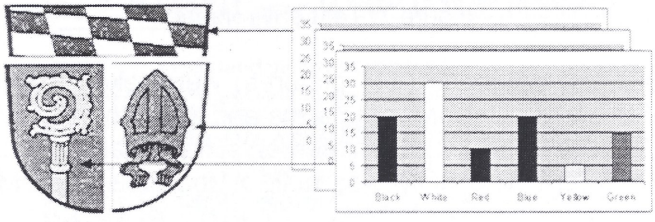

Figure 5: Combined segmentation and color histogram feature

Another feature uses the various symmetry features to find all symmetries in a given image (see Figure 6). The distance function for this feature examines whether two images share all or at least some symmetries. A third feature uses our object feature ([3], [18]) to determine the complexity of an image. The complexity is defined by the number of objects in an image, the number of edges and mean and variance of the length of the edges and the angle between them.

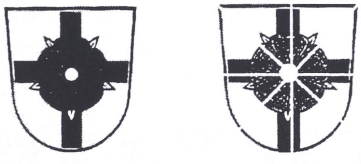

Figure 6: Symmetry description feature

4. Test environment and results

The test environment uses the IBM QBIC system [5] [8] as a kernel. Among its advantages is an easy to use C++-API and input filters for many image formats. The kernel was extended by a practical web-interface (a perl CGI-script), a search engine for query models (similar to QbQBE), the possibility to define thresholds and to limit the result size accordingly and some C-libraries for vectorization, object evaluation, etc. Features were programmed as C++-classes. Figure 7 depicts the test environment:

The web interface consists of a query section for the definition of query models and two picture sections (to show the search results in weighted and not weighted ordering). The interface was derived from our standard GUI for database queries [3] and optimized for the evaluation of weighting algorithms. A typical screenshot of the interface is given in Figure 9.

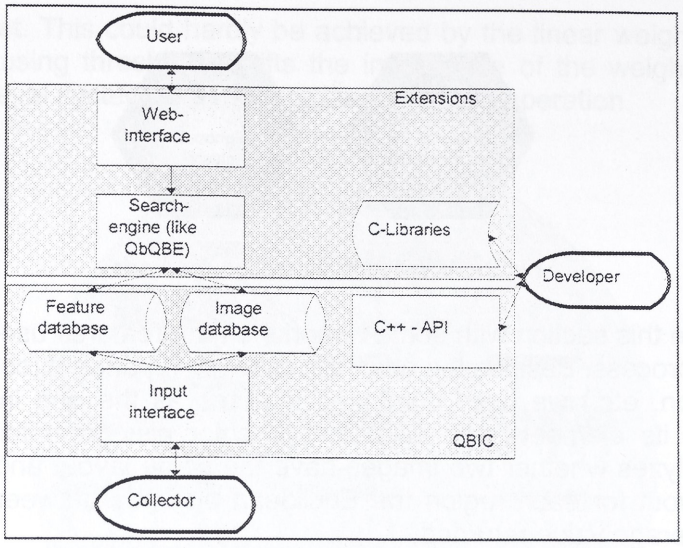

Figure 7: Test environment

The coats of arms of our test database (444 pictures) were taken from a heraldry server in the Netherlands [9]. Most of them are German civic arms and show the shield only. For each image 16 features resulting in a feature vector with 58 elements were calculated. All feature values were normalized to the interval [0,10]. The SOM was built by the tools in SOM-PAK (see [13]) with the following parameters:

Parameter	Value
Grid type	hexagonal
Map dimensions	8 x 6 bins
Neighbourhood kernel	bubble

For this small map it did not seem necessary to use the "gaussian" neighborhood kernel (see [13]). During the test session 50 tests with 550000 learning steps per test where performed. The average quantization error (see [13]) for the best solution was 7.466932. Each bin of the chosen map contains between 2 and 30 images. A typical bin is depicted in Figure 8. The cluster consists of images with similar color histograms, no field division and average complexity.



Figure 8: Typical image cluster

Verification was performed by the following steps: First, for each test query the five best images out of the first 12 result images were chosen. Second, for each of these images and the two

weighting methods the distance from the actual position to the ideal position was calculated (error sum). The two weighting methods were: *constant weights*: - all weights are equal (1) and *SOM weights*: - all weights are derived from a SOM using the algorithm described in the previous section (2). Finally, the performance is calculated. The performance of a weighting method is defined as the ratio of actual error sum and the maximum possible error sum (in our case: 45).

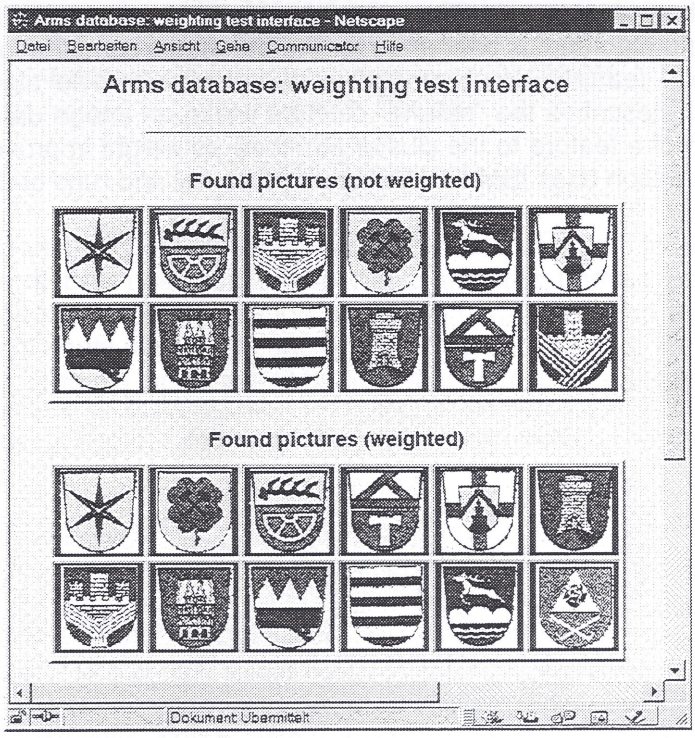

Figure 9: Screenshot of the weighting GUI

Figure 9 shows a typical screenshot of the weighting interface (developed specifically for the verification process). The first image is the search image. The query model consisted of two features: symmetry over the y-axis and similar low complexity. The latter was judged to be more important by the weighting algorithm and images with lower complexity were ordered ahead of more similar ones. It should be noticed that in this example the query model has not the purpose to describe similarity as perceived by humans.

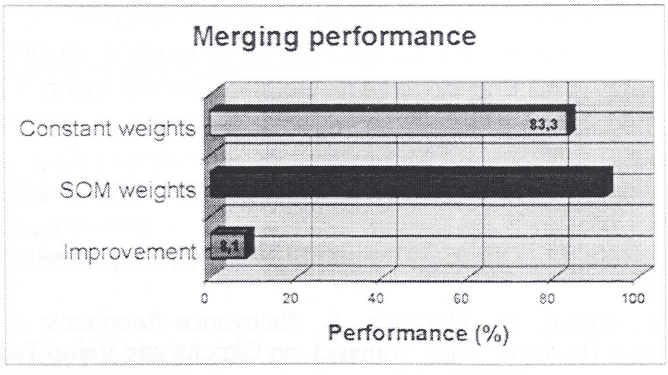

Figure 10: Weighting performance

Figure 10 shows the performance results for both methods: The performance of the SOM weights method is about 92% resulting in an improvement over constant weights of more than 8%. It is important to keep in mind that these values can only be compared by the verification algorithm we are employing. If we looked at the first twenty instead of the first twelve images the performance

would probably be lower. However, the performance of the constant weights method in this case would be lower too and the improvement still significant.

6. Conclusion

This paper shows how merging by linear combination of weighted distance values can be performed. A weighting algorithm is presented for the automatic computation of suitable weights for image features. These features are arranged in query models. The algorithm bases on a self organizing map which describes the "natural" clusters within an image database. We showed that using the contribution of a feature to the cluster structure as weight improves the ordering of query results. The implementation uses IBM QBIC system as kernel and runs under LINUX.

One of the main goals of the project is the automatic generation of query models. For this purpose we have implemented several algorithms for feature selection and threshold definition. These algorithms use the self organizing map described above and expert knowledge to derive the most suitable query model for a search image. It will be one of the next steps to tune and evaluate these algorithms and compare the results to those gained by a domain expert.

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THE DIGITAL ARCHIV FOR DESIGN, ART AND ARCHITECTURE

SUMMARY OF THE RESEARCH PROJECT OF THE DESIGN DEPARTMENT

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The aim of these project is to form a data base digital picture archive for both historical and contemporary comparative discourse in the area of design and design history, as well as history of architecture and of art.

It should be integrated as a permanent component of the didactic teaching and learning medium of the Design Department. This data archive should in addition be included in the Hochschule network or in the Internet thus being available for all teachers and students of Hochschule Anhalt, and is therefore a useful, supplementary addition to teaching and learning material on all Campuses. Appearing in the Internet, it will raise the profile of Hochschule Anhalt as an internationally respected location for innovative technical applications and media design.

The collection, collating and digitising of these documentary materials into the areas of Graphic Design, Product Design, Media Design, History of Design, History of Art and of Architecture as well as Technical History were important aspects of the research projects.

This led to close co-operation between the departments of Design, Architecture and Computer Science as well as with several business concerns, other College institutions, Museums and Archives - the first positive outcome. This interdisciplinary co-operation both archived and advanced the research projects in an ideal way. First cooperations with the Archive of the formerly „Hochschule für Gestaltung (HfG)“ in Ulm and the „Department for Information Resource Management and Computing Centre“ of the University of Ulm were realized.

1. Names and Departments of the Applicants

In co-operation with

Prof. Dr. Stuhr (Architecture Department)
Prof. Neubert (Design Department)
Dr. Paulussen (Design Department)
Prof. Dr. Worzyk (Informatics Department)

2. Subject of the Research Project

Development and commissioning of a data base digital picture archive for both historical and contemporary comparative discourse in the area of Design and Design History, as well as History of Architecture and of Art.

3. Scientific objectives

I. Investigation and comparative analysis of data base systems

This first stage of the work is aimed at the basic determination as to what extent a data base is useful for this purpose of application, and which reference projects could give some clue to it.

The speed in getting access to the data base plays a specific role in this work. In addition, its usability in the network system of the Hochschule should be archived.

Since the beginning of 1998, Dr. Paulußen has been working on this project as a Research Assistant. First of all, he looked for orientation in the technical framing conditions and the needs analysis of the technical equipment necessary for this research project, as e.g. data base server, work terminal, software, slide scanner, as well as the mass memory required for archiving. Meanwhile, this needs analysis has been completed so that the necessary hardware and software can be.

II. Multi-platform analysis of different kinds of files

Considering the future option to integrate multimedia documents too, it should be investigated how different kinds of files (picture, text, sound documents and films) are archived and how they can be downloaded.

III. Development of the data base architecture / retrieval function

A functioning organisational structure is the basis for any work with the content of a data base. In this sphere of work, the opportunities given by the technical development together with the content-related structuring of this digital data base archive should be investigated and implemented. Text and picture retrieval have to be urgently provided here.

IV. Collection, structuring and preparation of the picture material needed to cover the intended areas

This field of work covers the archiving component of collecting, collating and digitising of the documentary material into the areas of Graphic Design, Product Design, Media Design, History of Design, History of Art and of Architecture as well as Technical History. This shall be acquired by an interdisciplinary co-operation between the Architecture and Design Departments and also with several institutes, museums and archives.

V. User-friendly visualisation of the archive structure

A subdivision of all existing and expected contents, which the user will understand and recognise, is a basic prerequisite, above all for interdisciplinary utilisation at all campuses.

The aim is to find the criteria for arranging the different contextual elements. This field of work is intended to determine which search principles and kinds of visualisation can refer, in a didactically differentiated way, to the contextual dependencies of the interwoven topics of History of Design, Architecture, Art and Culture.

5. Brief description of the project

The aim of this research project is to create a digital archive.

The structuring of the archive is based on an investigation of contextual elements, which is continued by a collection of historical and contemporary picture and text material in the areas of Graphic Design, Product Design, Media Design, History of Design, History of Art and of Architecture, and History of Engineering.
Furthermore the context relevant for art and culture should be demonstrated by appropriate documents and related to historical events.

During this 36-month research project, a digital archive should be created which could be used in networks and which covers all functions permitting a user-friendly administration of its content. Considering the access in all campuses it should be investigated how the data base can be

structured so that it can also be effectively utilised in future. The concept to prepare should therefore provide a structural standard, first of all, which is then filled with contextual elements.
In the run of the project, an inquiry and search mode should be developed which on the one hand provides a focused and user-friendly access, and also permits a search for catchwords on the basis of different contextual elements.

The data base should be established as an open system with the existing contextual elements being completed and new contents integrated into it, after this research project has been successfully finished.

6. First results

In cooperation with the department of computer science of our Hochschule we have developed in a student diploma projekt a relational data base with FileMaker. With the help of a CGI-Software called „Lasso" we could beyond that created a first prototype in the Internet, where serveral search modes and the use of the data base can be tested.

In a seminar at the department of design students have build different interfaces for the digital archiv. They dealed with the visualization of the data base content. One student realized a timeline with a „lanscape of works", which gives an interesting view on the works of one person. It is written in JAVA, so that one can test the functionality with a Internet-Browser.

The „Department for Information Resource Management and Computing Centre" of the University of Ulm develop on the basis of the „IBM Digital Library" a multifunctional search tool, which allows users of the digital archiv to organize and save the choosed informations. On a virtual slide-desk one can drag the pictures to use them in a lecture and save them for the students. They should have the possibility to consult those informations and search for context informations in the digital archiv. The digital archiv will be therefore a central tool for Distance Learning and the basis of a new teaching in Design and Art-History.

You can find our prototypes on our Internet-Site at:

http://www.des.hs-anhalt.de/Digitales Archiv/

For more information please contact: paulussen@des.hs-anhalt.de

SEVEN HILLS. IMAGES AND SIGNS OF THE 21ST CENTURY

AN EXHIBITION OF THE BERLINER FESTSPIELE GMBH FOR THE MILLENNIUM 2000 IN THE MARTIN-GROPIUS-BAU

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The exhibition "Seven Hills. Images and Signs of the 21st Century", the central event in Berlin on the occasion of the millennium, will be shown in the Martin-Gropius-Bau from May 14 to October 29, 2000. General organiser is the Berliner Festspiele GmbH. The exhibit is divided into seven topics: "Nucleus", "Jungle", "Cosmos", "Civilisation", "Faith", "Knowledge" and "Dream". The exhibition will explore the promise of the modern age through a vibrant balance of edification and diversion, of science and art, of a reconsideration of cultural history and visions of the future. A perspective for the future, formulated in the future perfect: What will, what could have come of our time, when this millennium will have merged into the flow of all past cultural history?

Seven designers will give each of the seven categories its own characteristic appearance: Ken Adam, the film architect and Academy Award winner who mounted the design of several James Bond movies and Stanley Kubrick's "Dr. Strangelove", turns his attention to "Nucleus"; stage designer Tina Kitzing tackles the "Jungle"; Charles Wilp, the creator of legendary advertising campaigns in the 1960s ("Africola") and since then occupied as ARTronaut - an artist in the state of weightlessness - recreates the "Cosmos"; the visionary New York architect Lebbeus Woods outlines an ominous scenario for the "Civilisation" of tomorrow; Gerrit Grigoleit and Lars Gräbner deconstruct the pantheon of world religions for the topic of "Faith"; Edouard Bannwart, specialist for "media environments", disentangles the magazines of "Knowledge" and enables communication through the global flow of data; and finally, Kazuko Watanabe, director and stage designer, turns her talent for colourful and playful composition to the creation of "Dream" spaces.

The exhibition is multimedial - but "multimedia" doesn't mean only screens and keyboards. It addresses all of the visitor's senses: the intense interactivity of the media installations is juxtaposed with the abstract observation of medieval manuscripts displayed in protective glass cabinets; modern digital visualisation techniques of natural science with the traditional forms of chart, model and specimen; computer-animated reality on gigantic projection screens with the haptic evidence of history from the past two thousand years; the collective, joint attention paid to the medial exhibits with the silent, individual dialogue with a work of art. The new media in the exhibition serve on the one hand to form networks between objects and installations, pictures and texts in order to provide visitors with an individual approach to the topics. On the other hand, the new media, as essential processors in the modern sciences, are themselves an object of consideration. And they provide new metaphors for natural processes, the abstract visualisation of which can only be generated by the processes themselves: the aesthetic potential that lies in the natural sciences is of no less interest to the exhibition than their artistic transformation through "electronic art". Although it is not possible to depict the exhibition in its entirety here, a few examples should serve to illustrate the strategies of visualisation that it undertakes.

The section called "Nucleus" in the central atrium of the Martin-Gropius-Bau deals with the precipitous development of certain natural sciences since the beginning of the 20th century. The search for "nuclei" and the smallest particles of matter in the most advanced areas of research in physics, brain research, genetics and geology is the prerequisite for an increasing thirst for

knowledge, for the question of the interaction of the particles within the system, and thus the functioning of the system itself. This approach, of course, would be futile if it weren't for the breakneck development of computer technology. Intelligent machines have taken over an essential part of the research work, whereby it is often the case that the smaller the particles are, the greater the technological effort needed to examine them.

It is therefore only natural that the "Nucleus" section utilises the modern media. Major points of reference for visitors will be reproductions of large scientific instruments or theatrical stagings of scientific research projects. An example of this is the "Brain Cinema", which demonstrates neuronal processes in the brain. It is in the form of an oversized concave skullcap, the inner side of which serves as a projection surface - not only for the usual states of neuronal excitation, but also for extreme states such as an epileptic fit or an apoplectic stroke. The quantity of pixels on the skullcap corresponds to the synapses in the human brain so that the processes can be depicted as accurately as possible. Visitors can activate these processes.

In the "Nucleus" section, as in the other areas of the exhibition as well, there will be a mixture of installations, objects and pictures on display. This is in order to illustrate important aspects of present-day research on the one hand, but also to reflect both their origins with respect to the history of science and the artistic positions taken in the respective topics. This combination should draw attention to the correspondence, but also the contradictions between natural science and art, and at the same time achieve "didactic" effects.

In general the new media are used in the following forms: * as digital projections with DPL projectors (Digital Light Processing), * as films in the form of VD projections (Video on Demand), * as video display terminals at "Points of Information" where visitors can call up specific information and images, * as display terminals of the installations that have direct online access to research institutes and receive the latest data from them, * in the form of robots - humanoids, little dogs, industrial robots - that combine media technology and natural movements and illustrate a kind of playful communication between man and machine in a co-ordinated reaction to the outside world.

The "Jungle" section, despite its title which deliberately arouses the usual expectations, is devoted to nature beyond Nature and relies on a concept of nature that does not define itself in opposition to Culture as the true habitat of mankind. The collection, classification and preservation of nature by man is the focal point of the display - from herbarium to gene pool. The title-giving "Jungle" is only present in the form of a synthetic construct of odours, sounds and artificial organisms, in the mechanical animals made by Jim Whiting, or in the sculptures created by Jean Fabre out of beetles. Two media installations allow visitors to confront the topic actively: PICO SCAN by Christa Sommerer and Laurent Mignonneau and "Kali interactive" by the Milan group F.a.b.r.i.c.a.t.o.r.s. In the case of PICO SCAN visitors can scan their own body and thus create virtual organisms that can be seen on five plasma monitors. These artificial beings can communicate with one another. When one visitor touches another, says the artist, "then 'his' organisms immigrate to the monitor of the other visitor and propagate with them: this creates more and more baby organisms that represent a genetic mixture of their parent organisms. In some cases the organisms of different visitors are not compatible, however. Then the two organism populations will attempt to attack each other, whereby each of them can try to protect 'his own' organisms."

"Kali interactive" refers to the Hindu goddess Kali who stands for birth and death in Nature. By means of sensors labelled with icons and secured to the arms of a goddess pictured in the monitor, visitors can navigate through virtual spaces on large screens where they can see vivid pictures of life and death in nature, classified according to the topics "Man Destroys Nature", "Nature Destroys Man", "Man and Nature Co-exist", and "Kali as a Metaphor for the Jungle". If one gets very close to the fearsome goddess Kali, one can follow, with the help of a trackball device, a vision of the future reflected in her eyes, behind which liquid crystal monitors are hidden.

In the "Knowledge" section a plexiglass wall appears to float through the exhibition rooms, thus symbolising Pierre Teilhard de Chardin's famous metaphor for modern communication, the "cosmic membrane". Like the electromagnetic field that surrounds the Earth and, through its technological

availability, "lets every individual be present - actively and passively - on all the seas and continents at the same time," this room-high installation serves as an optical extension of the objects in the exhibition: a projection screen on which a look into the future or into the past can be made virtually. The interaction sought between historical realities and the projection screen is illustrated below by means of two examples.

The theme room "Library of Eternity", which leads us from the storage places of knowledge in antiquity to the future virtual museum of world cultures, is ruled by Athena Parthenos, the goddess of wisdom and understanding, an antique marble statue from the reading room of the library of Pergamum (Berlin, Graeco-Roman Collection, 2nd century BC). The library of Pergamum, an important centre of intellectual life and research, stands in the exhibition for the storage and generation of knowledge in ancient times, not least of all because due to a lack of Egyptian papyrus a method was developed to write on specially treated animal skins - parchment, as it was known - which counted among the most important vehicles of written knowledge until the invention of paper. The medial extension of the authentic and colossal Athena figure represents a virtual stroll through the Acropolis of Pergamum. Starting at the huge altar of Zeus, the so-called "Pergamum Altar", the way leads uphill to the Athena temple and ends there with a visit to the library. Entering the reading room one sees the location where the Athena statue originally stood, together with the reconstructed architecture of the room and its furnishings. The reconstructions will be carried out in co-operation with the staff of the Berlin Graeco-Roman Collection, which will take over and expand the database after the exhibition is finished.

In the theme room "Celestial Strains", which is devoted to the notation and cataloguing of sounds, the oldest sound documents in the world are presented. The phonograph developed by Thomas A. Edison made it possible for the first time to store sounds for repeated reproduction. This "fixing" of sounds provided an opportunity to systematically study non-European music which had not been set down in notes. The exhibition will show such phonographs and sound cylinders from the phonogram archive of the department of music ethnology of the Museum für Völkerkunde in Berlin, which contains one of the largest and most important recording archives in the world. Such examples taken from cultures having almost exclusively oral traditions are of inestimable documentary value because the chains of oral tradition have largely been destroyed. In some cases the cylinders that were deformed through transportation or rendered unusable through frequent playing have been restored with the aid of special techniques.

At the same time the multimedial installation on the "cosmic membrane", the "Map of World Music", will allow visitors to select and listen to some 70 to 100 examples of tones from different musical regions. Many of these musical samples will be illustrated by examples of photographs and films from those times. After the exhibition is finished this data will again provide the museum with a base of material which it can further augment.

The last section of the exhibition, "Dream", is dedicated to human subjectivity. The forms of expression that the arts have found for the senses, the passions, dreaming and playful creativity are juxtaposed with related research efforts in the natural sciences, particularly the neurosciences. The room called "Nose-It-All" is just one example of this section. It emphasises the "power of the nose" - subversive in our visual age and dissonant in the concert of the senses. The significance of smell and odours in cultural history, in religious cults and in medicine will be depicted by means of baroque allegories of the senses, incense burners and fragrance vials from antiquity to the present. The centre of attraction, however, is the media installation "Smell and Memory", which is being created in co-operation between the animation filmmaker Heinz Busert, the multimedia producer Professor Eku Wand and the Institute for Neurobiology at the Free University Berlin under the direction of Professor Randolf Menzel. The feat of memory of honey bees in recognising nourishing flowers is to be duplicated in the form of a computer game - not least of all by means of so-called "Glomeruli" pictures, which serve in research to mark neuronal processes by colours. If this relationship is not familiar, such data images from inside the bee can be observed for the pure delight of viewing: as serial works of artistless art, works of unexpected aesthetic fascination.

VISUALIZING UNCERTAINTY IN VIRTUAL RECONSTRUCTIONS

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The virtual reconstruction of lost buildings as means of recreating lost cultural heritage has become a strongly growing field of application for computer graphics [1]. Research results of historians and archeologists are used by computer scientists to create computer models as base for visualizations. Typically, off-the-shelf software is employed that allows generating images with the quality of photographs (see, for example, Figure 1).

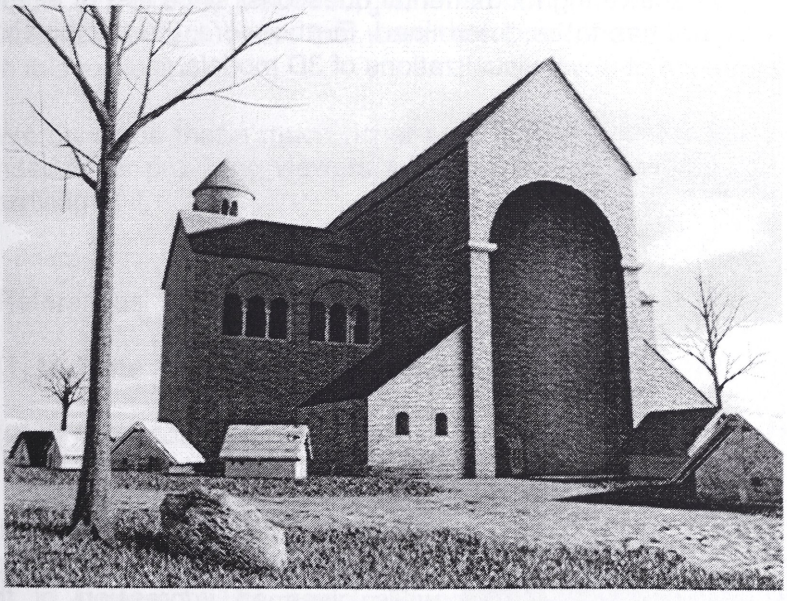

Figure 1: A photorealistic image of the virtual reconstruction of the area around the Kaiserpfalz of Magdeburg, rendered with a standard 3D rendering tool (original image in color).

Although this method can be used to illustrate to an audience how certain buildings may have looked like, this practice is subject to a number of fundamental problems. For non-experts, it is striking how carefully specialists are in choosing the words to describe their excavation findings or interpretations. Often verbalizations like "These findings suggest that this could have been a [...]"

are used. But these cautious statements—conveying uncertainties or even speculations—are represented as proven facts in computer models that are used to create visual materials. The wary character of the verbal messages is lost. A photorealistic image always bears the danger of being taken for reality and making a viewer believe too strongly in that specific visualization. The images settle in the viewer's mind, pretending a certainty that does not exist to this extent.

A new field in computer graphics, the so-called "non-photorealistic rendering," offers promising alternatives that aim at avoiding those unintentional visual fixations [2]. Non-photorealistic visualizations (like the one shown in Figure 2) provide scientists with methods to handle uncertain knowledge in computer models. Here, attributes describing reasons or alternatives can be stored along with the usual geometric data. From this data, visualizations can be generated that are honest with respect to the degree of certainty, the reasons, and the alternatives.



Figure 2: A sketch-like rendition of the reconstructed building. Here, the same 3D model as in the previous image is used, but the "sketchy" character of the line drawing proposes a preliminary design state. This type of image does not pretend that the expert knows exactly how the building has looked like in the 10th century.

Especially in the discussion process between experts it becomes obvious that a photorealistic graphic with too much detail distracts from answering fundamental questions, since first of all in a reconstruction the building's overall structure has to be determined. Furthermore, the combination of different techniques enables the generation of novel visualizations of 3D models.

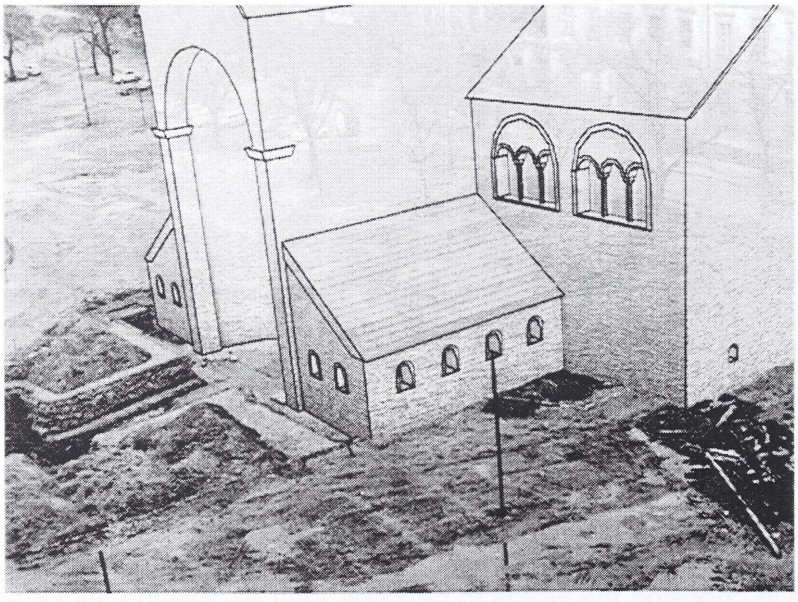

Figure 3: The visualization of the reconstruction over its foundation walls gives an impression of the former position and appearance of the building.

In Figure 3, several techniques were applied to illustrate the fact that the uncertainty of a reconstruction increases with growing distance from the ground: the further away we get from the excavation basis, the more insecure is the reconstruction. In order to visualize this increasing uncertainty, a fading photorealistic image (depicting the assumed appearance of the building) and a line drawing (maintaining the overall shape) were combined in this picture to visualize the building in question above its excavated foundation walls. Based on a photography of the excavation site, the camera positions of the rendered images were adjusted to match the original position of the photographer. Eventually, these three were combined to visualize the reconstruction in its original location. With the aid of AncientVis (see Figure 4), a system which is proposed in [3], we can render images with less detail, using techniques for emphasizing and deemphasizing, and we can reuse and develop the 3D model, thus undergoing a constant refinement.

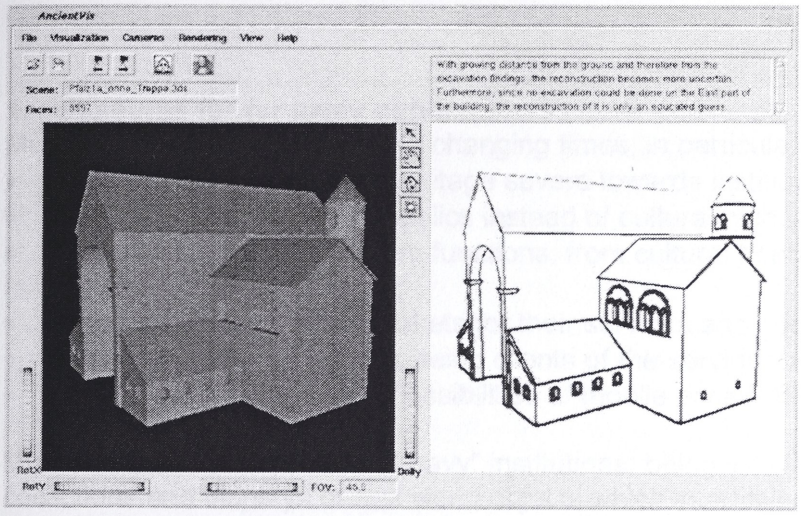

Figure: 4: A screenshot of the prototypical system AncientVis, which allows to generate sketch-like renditions of arbitrary 3D models. It is possible to specify certain illustrative features such as fading line styles that indicate uncertainty.

These techniques emerged from the work on the virtual reconstruction of the "Kaiserpfalz zu Magdeburg", a collaboration between the *Institut für Simulation und Graphik* and the *Kulturhistorisches Museum Magdeburg*. The reconstruction will be presented as part of the exhibition "Otto der Große, Magdeburg und Europa" in the year 2001 in the museum. Several different visualization techniques that were developed throughout the reconstruction process will be applied in this exhibition.

We conclude that a much richer selection of visualization and interaction techniques is ultimately needed for providing viewers a "fair" picture of a virtual reconstruction and the difficult process of arriving at it.

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MUSEUMS AND WWW: BETWEEN VISIT INFORMATION AND VIRTUAL EXHIBITION

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1. Museums for far away publics

Museums are forced to adapt to changing times, in particular in respect to

- develop from "European" heritage savers towards institutions for intercultural communication
- reach broad and popular publics instead of cultural high level minority groups
- fulfil a multiplicity of different functions, from cultural heritage to all aspects of popular leisure activities
- think of their publics as markets for their services and commodities
- understand their visitors as being clients of the serving musuem
- meet people´s increasing possibilities of mobile accessibility.

Museums have always been "heavy" institutions: being located at a specific venue with all their collections and displays of real world objects which in addition very often are unique. Museums have to be visited physically as a filled space. Of course, they always have been trying to reach out of this place - by travelling curators, objects and exhibitions, by publications, by merchandises. The new communication technologies - Internet, CD-ROM - not only offer new possibilities for being present in the communicative worlds, but they establish a pressure on every institution to make use of them. Whoever wants to count for something in the "information society" has to make use of the new technologies.

But although there is a kind of hysteria forcing everybody to make use of the new technologies, there are some serious questions rather open, like

- What are the publics which make use of these technologies? So far they still are minority fractions in Germany and we know rather little about them.
- What could be effected within these publics by making use of the technologies? We do not know very much about the ways people use these technologies, their motivations of usage, the effects to be effected by usage of the technologies.
- Will the efforts of making use of the technologies by museums - in the framework of their increasingly restricted budget lines - be met by respective gains? The usage of the technologies not only requires computers, software and network traffic expenses but needs personnel whose required skills do not belong to the traditional skills of museum personnel.
- Which aims should museums follow in using these technologies - prevent their traditional publics to change to other media (realistic), attract new target groups which so far have not been to museums (optimistic), consider the new technologies as new media offering a complete new way of presentation of the idea of "museum" (virutal).
- And how will people react to offerings from museums reaching out from their fixed venue into the new cyberworlds? Should museums become a part of these worlds or a counterpart against them?

Some of these questions are studied by a research project on the potentials of usage of museums outreach representation through new media (Internet, CD-ROM) which is jointly undertaken by the work unit information science of the Institute for Mass Communication and Communication Science of Free University Berlin and the Institute for Museum Studies of the State Museums of Berlin - Prussian Heritage and being financed by Stiftung Volkswagen. The research programme covers several smaller empirical studies and should lead to a representative survey in late 1999 on museums visitors and users of these new technologies This paper outlines some of the results of first stages of research and some assumptions for further research. The presentation at the conference should provide some more details of research that are available then.

2. What do we know about Internet users in Germany?

Since its introduction in 1993 the number of Internet participants has been constantly growing. In Germany it went up from about 300.000 users in January 1993 to about 5 to 6 millions in 1999. In the very beginning of online research the „typical" Internet user was a young employed male person between 20 and 39 years old with at least some college experience or highschool degree. In the meantime these characteristics are gradually softening and other user groups become more and more important.

- There is more variety concerning the age of the users, i.e. the number of youngsters as well as elder persons is continually increasing.
- Although users continue to be predominantly male, the number of female users - especially young females - is rapidly increasing within the last four years. (The W3B-Survey indicates for autumn 1995 6,2 % female users, for autumn 1997 12,2% and in 1998 15,5%.)
- Users with high education and high income still are in the majority, however the quantity of persons with lower levels of education and income clearly is augmenting.

The following table gives an impression about the present quantities concerning gender and age of Internet users, based on two highly reputed surveys.

	W3B-Survey 1998	ARD/ZDF-Survey 1998
Gender		
male	84,5 %	72 %
female	15,5 %	28 %
Age		
14-19	7,5 %	11 %
20-29	35,3 %	29 %
30-39	31,0 %	34 %
40-49	15,5 %	17 %
50 and elder	10,7 %	9 %

About 40% of the users are novices, i.e. they have started on the Internet resp. on WWW only in the past 6 to 12 months. Due to different research categories within the studies it is rather difficult to gain results about how long Internet sessions normally take but one can say that online facilities are used between 2 and 10 hours per week.

Online users are eager for knowledge and news but also for communication. Internet is regarded to serve both, information and entertainment resp. infotainment and edutainment. The attention given to the net is as well due to professional as for private reasons. Most of the respondants report that they seek problem solving information, want to be informed about actual trends and are curious about what the Internet offers. However, not all of the facilities the Internet offers, are requested in the same way. WWW and E-mail are for the majority of the users the most favorite services. No other technologies come close to them. Newsgroups and even more chats are especially accepted by young resp. very young users. Online shopping is due to open security and privacy questions still seen as dispensable.

There are four significant types of users:

- **pioneers**, i.e. mainly young men working in computer branches, forming the technical avantgarde;
- **members of the postmodern society**, i.e. intellectual, liberal mainly male users who regard themselves as global media users;
- **curious people**, i.e. novices with only little experience, high number of women;
- **pessimists**, i.e. people having a negative attitude to new online media.

3. Internet usage in Internet Cafés

In the past 5 years online users have been rather well examined by nearly innumberable online and offline surveys worldwide. We know quite well about general demographics, technological equipment, Internet behaviour and so on but we still know very few about the relation of museums and Internet and even less about visitors of museum homepages.
Due to the small personal and financial capacities of the project, it was necessary to find a way to meet and identify online users without big efforts and costs. Most of the online users have access to the Internet either at home or at their working place. However, another opportunity to get access to the web are Internet Cafés. Therefore the project initiated a small survey about Internet behaviour in general and especially concerning museums. The qualitative interviews were supported by a questionnaire. 90 web users participated in the survey. Questions were asked on the following aereas:

- General Demographics
- Web and Internet Usage
- Leisure Interests and Media Usage
- Opinions on Internet
- Opinions on Museums in Internet and Museums in general.

Most of the demographic results match with those raised by other studies:

- More than two third of the users are in the 20 to 40 age range.
- The gender ratio is between 50 : 50 and 70 (male) : 30 (female), depending on the location.
- The users mainly have high education levels.
- Apart from the WWW most of the participants use E-Mail. Chats are used by about 25%, newsgroups are rarely used.

As to the special access situation we found out that in most of the cafés regular guests are dominating. Many of them also have further access possibilities but like to meet with friends in the cafés. To stay in the cafés therefore is not only to go into the web but very often is also a chance to meet people, to enjoy the atmosphere, to play around etc. Especially for young people the Internet cafés are more or less meeting points for different purposes. These results are in clear contrast to some people's anxiety according to which new media will diminish social contacts. Social isolation in front of the personal computer at home doesn't take place, at least not according to what the web users in the cafés told us.

Another cliché whereafter many online users spend most of their session time surfing from one web site to another either could not be verified. In fact, there are only few participants using the net without any idea of what they want to do or where they want to go. If so, they are very young or novices in the web. The majority of the users seek information about educational institutions, local authorities, jobs, literature, travels and finances and stay (and pay) for 30 minutes up to 2 hours.

Definitely the biggest surprise of the survey was not even that about two third of the participants (!) are museum visitors. Still more surprising was the opinion that for most of them no web site could ever substitute the museum visit in situ. Most participants would appreciate to find museums in the

Internet especially with basic information about opening hours, actual exhibitions, events etc. but museums should not try to be too pedagogic.

At least three different types of users could be identified:

- pragmatic users i.e. high education level, seeking for special information or services;
- net hoppers i.e. under the age of 20, mostly female, participating in chat groups, regarding the Internet to be fashionable;
- experts i.e. mostly male, online freaks using nearly daily all kinds of online services, regarding the Internet as indispensable.

4. Users of Museum Websites

What do we know about users of museum websites? Currently not very much. Some 100-200 museums in Germany are offering websites, from some twenty of them data of their statistics about usage have been collected (mainly for January 1999). Usage statistics usually are computations based on the logfiles. Since most of the servers used different software the statistics software differed not only in what is counted but even in how counted features are named and defined. Therefore usage statistics on this basis could not be compared very intensively. They perhaps help the personnel operating the server and even they can provide some indicators how heavy the website or some of its parts are used but they provide relatively small information about who and how. At least some evaluations point into the following directions:

- Websites of German museums are visited mainly from visitors who know the URL, that means most visits are related to frequent visitors which already include the URL in the bookmarks. Only up to 25% of the visits are following links from search services, regional information systems, technical turn-around sites or museum turn-around sites. Regarding the last ones, there are two major institutions so far: dhm.de and webmuseen.de.
- Museum websites in Germany with high frequencies of visits should be visited by some thousand people a day, but most of the museums should have frequencies much more below 500 visitors a day.
- At least half of the visitors of websites of German museums are located on a German host. This differs substantially from UK where 90% of the visitors came from North America.
- Museums websites are visited during the week more frequently during the workdays (in particular Thursday), least frequently on Saturday.
- Due to the fact, that the majority of users is located in Germany the least frequent visiting times are 0-8 o´clock.

The project recently has mounted an online questionnaire in order to find out something more qualitative data about users of museum websites (or at least users of the Internet who are at least that interested in museums that they might fill in a museum relatied questionnaire (http://www.museum.fu-berlin.de/) . There has been a similar activity in form of a master´s thesis by Rachel Reynolds in 1997 in England. Although the results may be a little bit outdated (due to enormous developments in the Internet audiences) und not comparable to our approach some experiences might be still of interest:

- The large majority of respondents wanted to see online exhibitions.
- 3-D and live video was only expected by the large majority of children and adolescents, but images would be expected by most of all. Most respondents wanted to have a search engine for selection within the website.
- About two third of the respondetns did not want to have details on the museum staff and their expertise.
- Museum and Internet audiences in the UK are quite similar in their socio-economic classification.

The study indicates that Internet users are quite similar to museum users, that Internet users do not want to get background information before a visit but that they want to obtain information they would not have access to in the real visit, and that websites are unlikely to to lead to real visits.

1. Perspectives of Virtual Museums

Some first searches on the topic "virtual museum" in Germany seem to support some of these findings. A search was conducted in August 1999 using a meta-searchmachine and found more than 100 websites which to some extent relate themselves to the idea of a virtual museum. A first evaluation showed that the interpretation of "virtual musuem" is quite different and may be grouped into three different approaches:

- the museum-oriented approach, that means websites which related themselves to the traditional idea of museums. The largest fraction within this group were real virtual museums, that means offerings within the Web that only exist there - but with many of the features of real museums inclusing systematic presentation, guided visits, changing exhibitions, special galleries etc. Another subgroup are special exhibitions within the Web that do not relate to real exhibitions. They are somehow similar to private collections, that are not accessible for the public in real world but are presented now in the Web. The representation of real museums by a virtual presence (that means in a way that is self-sufficient) was very rare.
- the actor-centered approach, where individual actors present themselves and call that a museum. This is very popular in connection with projects of schools within the Internet or with some of the people using the Web for self-representation. But even some commercial institutions appear as virtual museums.
- the art-oriented approach, which appears either as a gallery of virtual or network art (that means art that is only existing within the net) or as a gallery-like representation of a recent artist and his or her artworks.

This indicates at least that there seem to be two quite different approaches to museum outreach in the Web: On one hand the representation of the museums and some museum-related information in the Web. This is the large majority of museums websites, where the Web is used more or less as a new information source about the museum. This service could become restricted to those museums visitors which are capable of technology use and are planning museum visits (this could be a rather small target group).

On the other hand there is a strong tendency of Internet usage to build up virtual worlds which only have loose connections to real world museums, collections or phenomena. They tend to form a new medium which is unique for the Web and which is of serious interest to real world museums

- The diversity of approaches to establish something new on the Web using the concept of "museum" indicates at least two new developments: 1. "museum" is looked at as a positive concept which people like to adopt for their expressional approaches, it does not appear in these contexts as something traditional, dusty, old-fashinoned. 2. This use indicates that at least these fractions miss something in real world museums which they now try to establish in the web. Real world museums perhaps have to think about possiblities to add something to their real world to attract this fraction which seems to be rather museum-oriented (or give up that fraction).
- These developments could become dangerous to museums in at least two respects: 1. The concept "museum" may become trivialized by being used for self-representation (and not for the representation of cultural heritage). 2. The more non-museum-museums become established on the net (and some of them are really good) the relation between museum and the heavyness of its objects may disappear in the minds at least of the cybernauts - although they perhaps seem to have a lot of features which are similar to traditional museums visitors. That means that perhaps real world museums have to try to relate themselves to all kinds of virtual museums in order to keep this relation present.

To find out what people who are interested in museums and the web think about some of these questions a discussion group in form of a specific mailing list has been started.

THE USE OF THE INTERNET FOR THE PUBLIC RELATIONS AND PRESS WORK OF THE STAATLICHE MUSEEN ZU BERLIN - PREUßISCHER KULTURBESITZ

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As well as the classic tasks of museums, those of collecting, keeping and recording, they also have an educational task to fulfill with the presentation of their collections. The mediation of knowledge and culture, the leading to seeing and discovering, that is, in the broader sense, the task of prime importance of museum educational theory. It is on the agenda to employ the educational potential of the museums in a more targetted way. For this reason, museum educationalists are trying to "save" the museum's treasures, adapted in different ways, for different target groups. Museum objects need the necessary mediation in order to be brought closer to the public.

The office for press and public affairs, as well as the museums, is responsible for the education and public relations work of the state museums, Museum educationalists plan, organise and design the museum's educational offers and projects for the, in total, seventeen collections for the public. In order for these offers to be accepted they have to reach every single one. Thus the educational content must be advertised in diverse ways. For this reason, the public relations work and educational work are setting up one entity.
Public relations work as an instrument of communication, comprises of the planning, organisation, implementation and control of the activities, so as to successfully attract the chosen target groups to the content of the museums. As well as the classic forms of advertising, (printed media, radio, television, posters, flyers...) advertising within the arena of the new media, particularly in the Internet, plays a special role. The Internet can support the press and publicity work of the museums in a useful way. As well as information which is accesible for everyone, special offers should also be made available for specific target groups, for example journalists.
In the Internet, mediation, education and advertising can be brought together well.The advantage is that a direct communication can also develop in the area of education.

Internet: http://www.smb.spk-berlin.de
Targets and target groups

It is the aim of the public relations and educational work of the museums to also find an adequate form in the modern information media like the Internet. The rich museum permanence offers a wealth of content which could be gradually prepared for the Internet according to the desired target group. It is an important aim to develop an editorially controlled information system with various information areas and interactive contributions in order to be able to manage and actualise the system over a long period.

The chance exists, based on the current WWW sites, to also use the medium over and above the pure information, entertainment, research and publication medium, for further areas of the museum's work. In the long term the system must offer the possibility of the integration of content, which connects different areas (e.g. libraries, archives, museums). Interdisciplinary relations between the collections could be made available, material for the preparation and evaluation of museum visits prepared and data bases offered. Therein lies a great potential which offers advantages both for the SMPK and for many users. A useful deployment of multimedia technology cannot be acheived by the tautologiacal depiction of the museum in the digital sphere. We do not want a virtual museum, but to wake the interests of the visitors and entice them into the museum.

It was the aim of the present Internet presence to provide a basic offer, that can be built upon, with information on the collections. A general platform was to be created for the different museums which belong to the state museums of Berlin. The historic connections of the museums should be clarified. At the same time it must be discernible which museums and establishments belong to the state museums. That is why the sites resemble each other both structurally and in content. (However, at the moment this is not yet a matter of the homepage of the respective museums! They are planned for the additional extension.)

The present Internet sites of Staatliche Museen zu Berlin were conceived in the broader sense for those generally interested, that means not aesthetically modelled museum visitors, but for those interested in art and culture from around the world, tourists to Berlin, travel groups, magazine publishers, teachers and pupils. The additional planning schedules sites for journalists, pupils of different classes, teachers and students. The homepages of the separate collections must also be developed so that the curators can use it, above all the academic communication.

Within the additional development, a comprehensive offer of museum educational content will be prepared which is suitable for the internet. There is a chance of employing the educational potential of the museums in a more targetted way, in the sphere of a museum educational net with different parts and also more general themes. The academic acquirement of multimedia museum educational information systems is specifically orientated towards the viewable collections of the Staatliche Museen zu Berlin. The museum educational theory of the office for press and publicity of the Staatliche Museen zu Berlin - Preußischer Kulturbesitz has also operated for a long time with the popular academic preparation of collection areas and research results, as well as the preparation of teaching material. Due to this work of the SMPK extensive material already exists which is aimed towards multimedia conversion. The quantity of current exhibits, documents, historical film and tape recordings, models, cards, plans and photo documentatio, the copyright of the majority of which are at the SMPK, form the foundation of the project.
The project is planned as an independent system from the WWW-sites of the SMPK. It will have its own Internet address and appearance (CD/CI). In the features which have already been produced, a contact with the museum's educational contents is indicated as an example and a possible transplantation of the museum's educational net is referred to.

In order to offer the users a clear choice of different possibilities, the information for the particular target groups in different areas must be accesible. This requires an organisation and structuring of contents, a forward looking strucural diagram must be drawn up. (Bad information structures frustrate the users and has a lasting effect on the opinion of the institution.) A well thought through construction of the navigation systems and linking up of the sites, a socalled metaconcept, has therefore, a positive efect on the user and retrospectively on the reputation of the museum. Some Internet users search for information in a structured way, that means they know what they are looking for, others on the other hand, surf the net and stumble rather by chance on sites and linger when the offer seems particularly attractive. Also due to content, logistical and structural reasons, it does not make sense to offer standard information areas, as this would soon lead to confusion and chaos. The data and information which is to be mediated must be caliberated for different areas, that means the paths of information range from short information, to longer texts as well as to essays for downloading.

Press and public relations work

A structured press campaign can decisively support the public relation work. The prerequisite for a successful press campaign is a press hand-out orientated towards the medium as well as a carefully aimed use of press announcements. In order to achieve a high press response to the internet entrance of the SMPK, a subtly differentiated use of different forms of communication is planned.
As well as an online press hand-out which refers to the most recent changes and the contents of the site, is the sending out of a press portfolio with extensive information and material on the internet entrance in its preparatory phase. In this way the compiling of press material will be specially prepared for the various target groups of the newspapers and magazines.

In order to raise the awareness levels of the sites and to symbolise the integration between the public relations work and the internet entry, it makes sense to put the internet addresses on posters, flyers, press announcemnents, writing paper and business cards. This form of integration of digital and analogue communication means, permits an integral communication with the target groups.
A catchy internet address (or even several) should be introduced next to the current address for marketing reasons and for the purpose of advertising. This can extensively increase the number of visitors if employed and aimed as advertising (e.g. advertising on buses, posters and ads).
Mouth-to-mouth propaganda is also used in the marketing area as an effective instrument of communication, as with this is also the possibility of the opening up of target groups, who will not be immediately addressed through the measures of advertising and the press. For this reason the internet addresses should be easy to remember and above all communicable (also by telephone).

The registration of different internet addresses, which because of their naming are directly referred to the museums, also increase the number of visitors, especially as many internet users find their way to their desired site firstly by the trial and error path and only access after three or four failed attempts on the search engine.

The sending of interactive postcards in the internet is a special measure specifically for advertising. This form of advertising is specifically aimed at the internet user. It especially offers itself within the framework of exhibitions of which features are constructed. The motif of the postcard refers to the exhibition and can be sent to every user who has a familiar Email address. This advertising measure also enables the opening up of secondary target groups, who possibly only become aware of the state museums through the postcard on the internet site. The purpose of this postcard is left up to every user, the advertising message will be passed on by the motif.

Summary

Based on a wideranging area of responsibility, the internet offers the possibility of a subtly differentiated and sensitive discussion not only with the contents, but also with the corresponding target groups. The internet is above all a medium of publication, which carries the work of the museum to the outside world, as well as a medium of information and research. Links between the collections could be created which would otherwise not be apparent. The broad spectrum of the possibilities of using the internet as a supporting means for the press and public relations becomes clear from the diversity of interaction.

Finally some points to summarize:

- The organisation and use of the press system in the internet entrance of the SMPK as well as the specific advertising means for special exhibitions in the online area could effectively support the work of the press and public relations.
- The internet offer as an instrument of public relation work enables a dialogue with the users thereby acheiving a a high level of feedback.
- A museum educational net in the intenet could make an important contribution to the education and public relations work of the Staatliche Museen zu Berlin and altogether to the society of information in Berlin.
- Multimedia applications are a further useful and wide educational supplement to the present adaptation of the context of the original, i.e. in the classical sense of the museum. A sensible use of the interactive multimedia applications can put the art works in a vivid context and help the visit to the museum become a "successful experience."
- Multimedia which goes with the museum makes sense in particular where works of art require an integration in their original context and where media up until now has not been sufficient to depict the context vividly and all-embracingly.
- Museums must provide new modern technology and the internet and bear in mind the expectations of the visitors.
- The internet offers the user a lot of information quickly and cheaply and can in this way attract new visitors to the museums.

THE LEMO PROJECT - DEVELOPING A VIRTUAL EXHIBITION OF 20TH CENTURY GERMAN HISTORY

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1. Introduction

Cultural institutions are among those now making increasing use of the World Wide Web as a medium for information services. Many museums use the WWW to publicize exhibitions or to show items from their collections. However, most of these presentations consist of little more than scanned photographs with accompanying text.

The LeMO project ('Lebendiges virtuelles Museum Online', dynamic virtual museum online) is adding a new dimension to the Internet presence of two historical museums (www.dhm.de/lemo or www.hdg.de/lemo or www.isst.fhg.de/~lemo). In cooperation with the Fraunhofer Institute for Software and Systems Engineering ISST, the German Historical Museum (DHM) in Berlin and the Haus der Geschichte of the Federal Republic of Germany (HdG) in Bonn are developing multimedia applications for the Internet. LeMO is a project of the DFN Verein (Association for the Promotion of a German Research Network) and in the year 1997-1998 it received funding from the Deutsche Telekom Berkom GmbH. Visitors are offered both a textual and an intuitive approach to history. Three-dimensional environments designed using the VRML programming language (Virtual Reality Modeling Language) form a virtual tour through 20th century German history: animations and museum exhibits (images, graphics, photos, historical artifacts, audio documents) combine to give a many-facetted picture of German history. By clicking on the individual objects displayed, users can open windows containing additional multimedia HTML pages. These pages give information on individual historical periods and topics, chronicles and biographies, supplemented by film and sound recordings. Both access to the virtual exhibition and browsing of additional information are possible either via conventional HTML pages or three-dimensional VRML environments.

In the follow-up project LeMO+, the functionality of the virtual exhibition is to be extended. Users are to be offered a metadata-based search machine and the use of LeMO is to be tested in schools.

LeMO is a joint project involving computer scientists, historians and designers. This means that in addition to the technical and content requirements, key issues arise in the course of the conceptual and design process. This close cooperation between different disciplines is a special feature of the project.

2. Designing Content and Representing Historical Periods

In the virtual exhibition, 20th century German history is broken down into nine distinct periods:

- **Wilhelmine Germany** (1900-1914)
  1900 is given merely as a rough starting date, as it doesn't correspond to any specific historical event. As there is a separate section on the First World War, this period ends in 1914.
- **First World War (1914-1918)**
- **Weimar Republic (1918-1933)**
  This period is divided into three phases:
  - revolution and roots of the republic (1918/19-1923)
  - stabilization (1923-1929)
  - crisis and end of the Weimar Republic (1929-1933)
- **National Socialist Regime (1933-1939)**
  This period begins on the day the National Socialists came to power, January 30th 1933.
- **Second World War and Holocaust (1939-1945)**

As for the other sections, the periods after 1945 deal with the history of Germany as a whole. The Federal Republic and the Democratic Republic were not divided into two separate sections, since the history of one German state is inconceivable without the other.

The German question is a central issue of the years between 1945 and 1990, with the historical dividing lines 1949, 1989 and reunification on October 3rd 1990. These dates shape the corresponding periods in the exhibition:

- **Post War Years (1945-1949)**
  Ending with the founding of the Federal Republic and the GDR
- **Divided Germany (1949-1989)**
  Deals with the entire period during which Germany was divided. For better orientation, this period is divided into four sub-periods:
  - reconstruction in east and west (1949-1955)
  - high point of the cold war (1955-1963)
  - continuity and change (1963-1974)
  - new challenges (1974-1989)
- **German Unification (1989/90)**
  Deals with the developments in the East leading to change in many countries including Germany, focuses on the altered situation in East Germany after the fall of the wall, and shows the stages which eventually led to the reunification agreement.
- **Paths into the Present (since 1990)**
  Gives an outlook on the present and the future of unified Germany.

The same breakdown applies to HTML pages and VRML environments alike. In this way, a general overview is offered in addition to more detailed information, encouraging an understanding of the century's history from different perspectives. The DHM covers the periods from the turn of the century to the end of the Second World War, the HdG covers the remaining periods through to the present day.

LeMO offers users a choice between two different types of access: while VRML allows historical objects to be related to one another in space, HTML pages are used to provide illustrated information texts, digitized videos and sounds, supplementary biographies and chronicles. To optimize navigation, the HTML pages are all based on a uniform layout standard. At the more detailed level, the VRML environments have very different architectures, giving a characteristic representation of each period.

To implement the various periods as VRML environments, an overall concept was developed for LeMO consisting of a set of geometrical figures which are combined in various ways to symbolize the different periods. These abstract symbols are situated in a "time tunnel" with direct access to the various periods.

The presentation for the period of Wilhelmine Germany resembles a real museum. A bust of Kaiser Wilhelm II stands in the center of the octagonal room. Around him – on pedestals and on the walls – historical objects are presented relating to subjects such as home and foreign policy, everyday life, etc. The room contains a pavilion showing art of the period. Through the wall directly opposite the entrance, visitors can catch a virtual glimpse of the environment dealing with the First World War.

In his novel "All Quiet on the Western Front", Erich Maria Remarque writes, "The front is a cage". The architecture for the environment dealing with the First World War – a room with barred walls – is a visual interpretation of this quotation (see Figure 1). The resulting niches are used in three ways: as frames for war photographs, as background for key words and as doors to other environments dealing in detail with subjects such as art, everyday life and war propaganda.

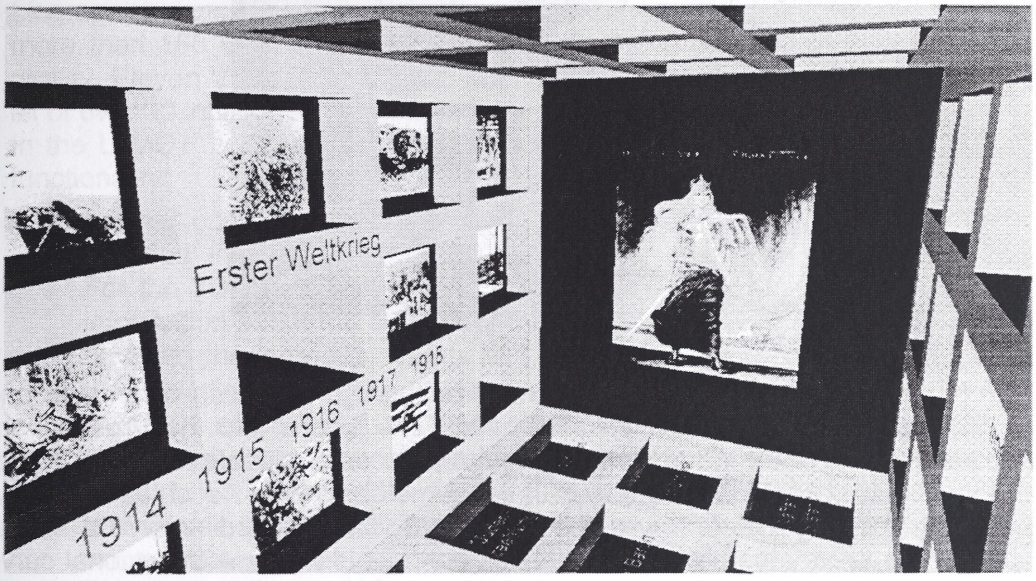

Figure 1: Three-dimensional cage room for the period "First World War"

The period of the Weimar Republic is portrayed as "a world of building blocks". Simple geometrical forms are combined in an environment where each shape belongs to a specific topic. Beginning with the revolution of 1918/19, symbolized by chaotically scattered cubes which obstruct the view, visitors move into a more ordered environment symbolizing the National Assembly of 1919. In the phase of stabilization, the environment is increasingly colorful with more different shapes. Visitors pass through a city of cones, pillars, pyramids etc. providing information on topics including everyday life, science and research, and industry.

The three dimensional schematic interpretation of the 1919 constitution offers additional details of domestic issues. A virtual book shop offers access to literature of the period.

Whereas the environments dealing with the Weimar Republic use the German black-red-gold tricolor flag as their background, the swastika flag is used for the National Socialist period. This environment is a three-dimensional room in which visitors can move about, but there is no way of getting an overview, the visitor is always within. The black swastika is used to exhibit items from the NS regime. The white circle contains elements relating to resistance and exile. And the red surrounding area deals with the reaction from abroad.

The design for the period rooms covering the Second World War and the Holocaust will either be very closely related to that of the NS Regime or actually embedded within it.

The period of the "Post War Years" consists of stylized architectural elements arranged in an empty landscape.

Due to its size, the "Divided Germany" period is broken down into four sub-periods. The years of "Reconstruction" are symbolized by scaffolding, the "Cold War" by anti-tank barricades, "Continuity

and Change" is symbolized by a version of Escher's staircase (see Figure 2) and the "New Challenges" section is grouped around a structure resembling a launch pad.

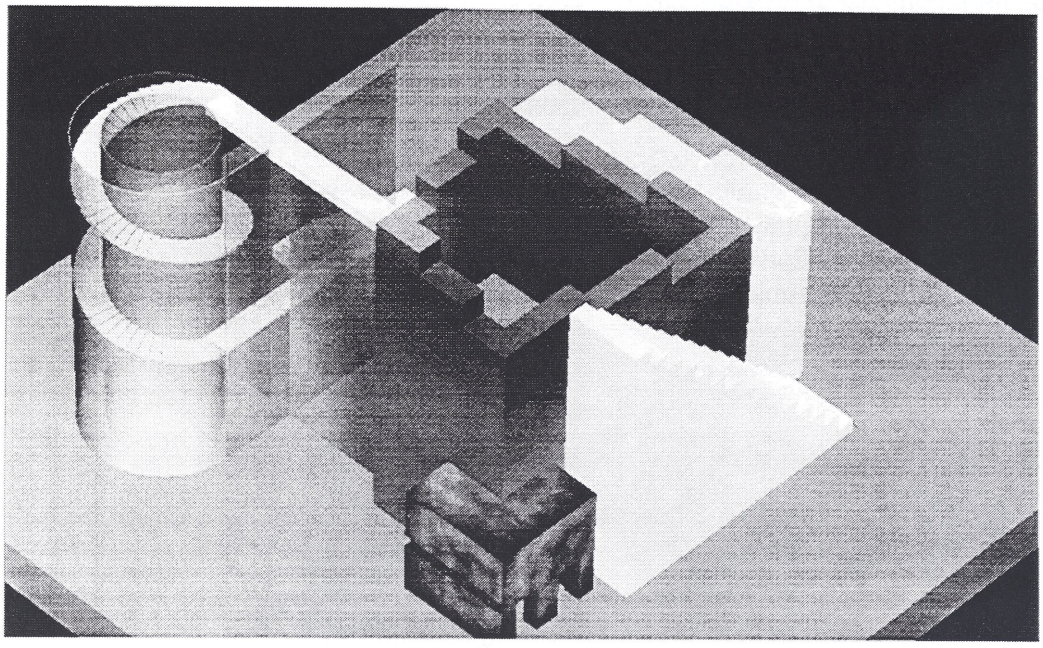

Figure 2: Escher staircase for the period of "Continuity and Change"

In the environment representing "German Unity", visitors pass through a divided colonnade and then break through the wall to enter a round, columned hall. The "Paths into the Present" are organized round a rotating model of the world symbolizing the process of globalization. For easier understanding, individual fields occurring repeatedly with the same basic form - such as economy, culture and the process of coming to terms with the National Socialist period – have a similar design in each case. For the economy, the common design element is a three-dimensional curve representing a comparison of fluctuations in industrial production per capita between east and west for the period in question. For the process of dealing with Nazi history, a walk-in cube with dark metallic surfaces is used. And for culture, the design is based on a representative painting or poster, combined with a building typical of the period, such as a makeshift theatre for the post-war years or a 1950s cinema.

3. Technical Basis and Systems Architecture

The LeMO project is based exclusively on Internet technologies[1]. This ensures that anyone with Internet/WWW access can take a virtual walk through history. What makes LeMO special is the combination and integration of a wide variety of multimedia web technologies to form an Internet information system. The following components were used:

- Virtual Reality Modeling Language (VRML) for 3D environments,
- HTML, Javascript and Java for web pages
- streaming audio/video for real-time data transfer to the user to avoid excessive download times.

On the network side, the LeMO architecture is based on the DFN-Verein's high bandwidth network B-WiN with a maximum transfer capacity of 155 MBit/s and access to further networks. The LeMO architecture therefore consists of components which support broadband users as well as those with low bandwidth network access. Some of the VRML environments were designed specially for B-WiN, resulting in long download times for users connected via ISDN or modem.

[1] Lutz Nentwig, Sonia Manhart, Andreas Kampa, Andreas Wendt, Dr. Burkhard Asmuss, Wolfgang Röhrig, Thomas Schneemelcher, *Bringing Museums to the Web: An Architecture for a Virtual Exhibition,* Inet'98, Geneva, 21 – 24 July 1998, http://www.isst.fhg.de/~lemo/inet/index.htm

On the user side, the system requirements are a multimedia computer with Internet access with a WWW browser running as a client application. By installing freely available plug-ins[2], a WWW browser can be used to navigate VRML environments and receive streaming audio/video. Users whose computers are too slow to visit the 3D exhibition rooms can always view the HTML pages with sound and video material, which is no problem even at a data transfer rate of 28 KBit/s.

4. Summary and Outlook

In two years of project work, LeMO has developed into a comprehensive multimedia information system. LeMO was officially launched and went online in January 1999[3].

To date, over 4000 HTML pages have been created including over 1000 texts on individual periods, general topics and specific subjects, over 2500 images with accompanying text, over 700 biographies, and 99 chronicles. In addition, over 100 sound documents have been digitized and more than 160 videos have been stored on the LeMO server, each at three different levels of quality. Eleven VRML worlds have been developed for the various historical periods, consisting in all of over 30 individual VRML environments.
In the LeMO+[4] follow-up project, this information system is being extended to include additional functionality:

- Further content and functionality is being added to the LeMO system to make it a "well rounded" information system offering a range of options for accessing German history.
  For the 3D environments, spoken "Guided Tours" have been developed, providing general information about the content of the rooms in question. The guide also gives tips for how to navigate the individual worlds and where and how access can be gained to other areas of the exhibition (e.g. rooms dealing with other themes or periods).
  A LeMO+ search engine is being developed to help visitors access specific information within the virtual exhibition. For all searchable objects, brief descriptions are prepared ("meta-data"), which enable detailed searches to be carried out for more accurate results than a full-text search of all LeMO web pages with a search engine such as AltaVista or Yahoo. This will eventually result in a meta-database of LeMO content.
- It is hoped that LeMO+ users will participate actively in debate on German history. To encourage this, various interactive applications are being developed, from a questionnaire on German history through to the creation of a "collective memory", where visitors can contribute experiences, interviews and even their life stories.
- To make LeMO+ particularly useful for schools, cooperative projects are to take place with selected schools in Berlin and Bonn. In close cooperation with teaching staff, the use of LeMO+ in lessons will be tested. In addition, pupils are to help fill the interactive applications with content either in regular school time or as part of extracurricular activities. During its pilot phase, the "collective memory" will be accessible to schools only.

LeMO+ makes "experiencing history" possible in a new medium. Representative objects and imaginative design combine to offer a trip through 100 years of German history. The complexity and quality of this virtual exhibition make it the only one of its kind in the Internet. This virtual world is not intended as a substitute for real exhibitions, but rather as an appetizer for visits to museums. Instead of imitating reality, the project team have succeeded in their aim of exploiting the full potential of the Web as a medium to develop a new form of exhibition.

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2 Plug-In for VRML: Cosmo Player, Plug-In für Video/Audio: RealPlayer
3 http://www.dhm.de/lemo or http://www.hdg.de/lemo

4 LeMO+ is funded through the DFN-Verein with financial support from the German Federal Ministry for Education and Research (BMBF).

KNOWLEDGE DISSEMINATION THROUGH DIGITAL MEDIA IN MUSEUMS AND EXHIBITIONS

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Introduction

Knowledge dissemination through digital media in museums and exhibitions – that is the title of this contribution. We will refer to the strategies of dissemination and the development of digital media. It is important to mention that all the applications we will talk about have the visitor of an exhibition in mind as a prospective user, not the expert.

Before starting with some remarks on dissemination strategies, it is important to mention that the "old and honourable exhibits", which are the assets of each museum, should always be the focal point of all our endeavours to present information relating to them. I think, dissemination is therefore always a process of reconstructing relations between the exhibit and the original context it once has been part of.

By presenting some of the projects "märzdesign" has carried out, I want to point out three different strategies which have turned out to be useful, even with differing aims.

"1848" – has a databank-solution in the back-ground. These applications make sense with the presentation of optional knowledge.

In this case it is the origin, the biography and the political orientation of the about 800 members of the Paulskirchen-Parliament in 1848 in Frankfurt/M.

There are three ways to get information on these members:

1. On their places of origin by use of a map of the German States
2. On their names by use of an index
3. By activating filters like "profession" or "political orientation" the selection can be reduced right from the start.

In this application the idea of context orientation does not play an important rôle. Links are only possible if the databank has a hyper-textual structure and enables unlimited relations – this kind of structure is known from the Internet.

The accumulation of knowledge is structured by the interaction between the user and the computer. The users become co-authors: by finding-out reasonable links themselves they extract the information they are searching for.

Therefore dissemination strategies based on data-banks are only possible if one of these conditions apply:

1. The user has the necessary background-knowledge enabling an orientation in such a structure or
2. There are only reduced options, like the "1848"-application, so the user will hardly ever get on a wrong track.

"Picture Gallery, Berlin" – as a second type of dissemination strategy I want to present an "exhibit-oriented" application. This is a specific way of presenting objects of art. In deviating from the traditional mono-graphical approach the objects are presented and analysed regarding the historical background at the time of their creation.

First a selected painting is described from its visual impression including phenomena typical for that time and style (e.g. "madonna" in the context of early Netherlands paintings).

This is followed by a selection of short presentations relating to the themes and motives of the picture in connection with their cultural, artistic and historical context (e.g. "function" or "perspective" of the picture).

It is obvious to imagine that by this kind of application also technical objects, historical objects of every-day-life or objects of natural science can be presented in meaningful contexts. Due to the high effort the development of this type of application necessitates, the presented exhibits should be a typical example. Exhibit and digital application, both take part in the presentation of fundamental contexts pointed out in an inductive approach. The user's intrinsic interest is a prerequisite to make use of this type of application, which offers a cognitive approach leading far beyond the meaning of the single exhibit.

The Classical Antiquties application – the third strategy is narrative in character. Background knowledge or information which are difficult to show in an exhibition are presented in short sequences. Integrated into these sequences are images of objects shown in that exhibition. In contrast to the previous applications the approach is more deductive – from the presentation of the contexts the user is led to the exhibits around him.

As an example for this more narrative type we present the application produced for the Antikensammlung (Classical Antiquities) Berlin.

The topic "Housing in Antiquity" describes the way of living in the residential area of a Greek city in the 4th century BC; the objects illustrating that topic are mostly exhibits from the exhibition.

Another example from that application demonstrates the rather complicated process of painting and burning ceramics in antiquity. The use of cinematographic techniques of presenting this process, enabled by digital technology, is especially impressive in this sequence.

The development of applications

This part will give you some more detailed information on the production of the "Classical Antiquities" (Antikensammlung) application.

The following refers to multimedia applications of the narrative type, like that one in the Antikensammlung. But I think many of the aspects I will discuss also refer to the other types of multimedia applications in museums as pointed out in the first part.

When talking about multimedia applications in museums exhibitions two points have to be kept in mind.

First: a multimedia application in a museum is only one part of a whole set of information media and therefore only one part of a whole integrated system.

And secondly, the best place to present information in an exhibition is to have it where it is needed by the visitor, in the vicinity of the related objects.

Some remarks on the set of information media we have at hand when planning an exhibition. There are

- object labels, collective informative texts referring to several objects and informative texts on the wall
- printed information sheets for the use of visitors, short guides and catalogues
- audio information systems
- audio-visual systems like multi-image shows, videos and multimedia applications.

The advantage in making use of such a well developed system becomes obvious if you think of the specific advantages each of these segments has. An informative text on the wall can be short and well structured if the more elaborate information can be placed in the printed information sheets or the short guide. The audio information can be more like a radio play, including a more emotional approach to the objects, if the essential information is already presented in the text information.

To make use of the whole system of information media in an exhibition necessarily leads to redundancy of information, which is, after all, not a bad thing – as long as it isn't boring. That is what theories of learning tell us.

Placing information media close to the point where it is needed by visitors means integrating multimedia applications into the exhibition area and not presenting it in a room adjacent to the exhibition or even separated from the exhibition area as it is frequently practised nowadays.

Before I mention some more general points let me describe an "info-station" as we have called the place of presentation in the exhibition of Classical Antiquities in the Altes Museum, Berlin. There are three info-stations having the same general design characteristics as the whole exhibition – they are areas a little separated from the originals:

Users are sitting on a bench, about 2 meters away from the 37inch screen, they can turn their heads and see the originals. The screen is integrated into a large wall, which keeps the daylight away coming through the windows behind the screen. In line with the middle of the screen there is a console mounted to the bench with the user interface. The loudspeakers are installed overhead the users, the volume is adjustable within pre-set limits.

Some guidelines for developing multimedia applications for museums

Multimedia applications should be a supplement to exhibitions - not a substitute

When using narrative multimedia applications the users have already seen parts of the exhibition, they must not be convinced to visit the exhibition by presenting parts of it. Contexts should be presented, the objects once have been part of, details of the objects could be pointed out, or technical aspects of manufacturing these objects could be presented.

Visitor's time should not be wasted but used to the optimum

Every minute visitors are sitting in front of the screen feeling bored is wasted time, even if are only staying because they think the application will become more interesting any second. An application should try to keep the balance between offering good edutainment and leaving users enough time for looking at the original objects. Therefore multimedia applications presented in an exhibition will not have that much depth of information.

The way of presenting the multimedia information can stimulate communication between users

Workstations with 15 or 17 inch screens can only be used by one or two persons simultaniously, that might produce the feeling of isolation, especially when the visiting group has more than two persons. That was one of the reasons for choosing a 37-inch screen for the presentation; six to eight persons can sit in an info-station – only one can control the programme through the user interface. A situation demanding communication if users want to participate in the selection – and it works.

User's curiosity should be stimulated

Curiosity is one of the behavioural dimensions users need to make full use of the multimedia application. The application itself should foster it and should offer ample opportunity to use it. Install different ways of navigation leading to the same screen, avoid a description how to navigate, let users find out their way.

According to one of the latest surveys an overall average of 38% of the German population has interest in trying out technical novelties, this interest raises with better education and is especially well developed in the group 14 to 29 years of age, decreasing continually with age.

Take into account the expected visitors

To be honest, we don't know very much about the visitors of our museums but the little we know we can make use of. We do know that visitors of a collection of Classical Antiquities - apart from school-classes which normally have booked a guided tour - usually are from the higher age-group and that they are well-educated. For the installation of a multimedia application this means, that a large majority of visitors are not very experienced computer users. For the museum of Classical antiquities we have therefore chosen a user situation which comes close to the private use of TV rather than the use of a computer system.

Appropriate interactivity

High interactivity is often enough thought to be an essential feature of multimedia applications. For the sake of high interactivity information is frequently broken up into very small pieces, leaving behind only fragments of a chain of arguments or isolated steps of a complicated production process. Appropriate interactivity would keep the chain of arguments uninterrupted as well as the various steps of a production process. On the other hand, a very simple form of interactivity should always be possible: the chance to change to another contents or to leave the application at all.

No extensive reading texts on the screens

One of the frequent solutions for the sound-problem is to replace spoken commentary by reading texts. Since text-files don't need large storage capacity you can sometimes have complete books on the screen. Since reading speed of individuals varies considerably and reading texts have to be much more formal than spoken texts, I think that this is a bad solution for the sound problem.
Another argument against reading texts: proof-reading is usually done with a print-out and not on screen. There isn't any reason to expect it differently from users of a multimedia application.

You cannot do without recorded comment and sound

The more senses are involved in the acquisition of information the better it is retained. It is not only the commentary, but also the sound which can support a series of images or evoke certain associations in the mind of the user. If an application is installed in an exhibition room, it is important to have a technical solution which doesn't bother the other visitors too much. We have installed the loudspeakers above the users, the volume is individually adjustable within pre-set limits – and we are quite happy with it.

Find a user interface as simple as possible

About one third of the German population uses a computer either in the office or at home. The use of computers however decreases with age, in the age-group "60 and above" we only have 2% of computer-users. Museums have to take into account that far more than two thirds of their visitors are non-users regarding computers. If we don't want to build a barrier in the use of multimedia applications, the user interface must be as simple as possible.
After some research and some tests we have decided to use a modified trackball and a "go" button. Furthermore we decided to avoid any written instruction on the user interface but to install a help button.

Navigational structure must be easy to understand, the screen design should be clear

All three info-stations in the exhibition have identical screen-design and navigational structure. At any time the user can go back to the start-screen or can change to another topic directly. In any of the three info-stations the start-screen lists the topics available in that particular station and in addition the topics available in the other stations.

Contents-centred design of each topic

I think this is the most important point of all. In the application for the Classical Antiquities we have developed each topic contents-centred – there is no principle how a topic is presented except the one that users always get an introduction after they have clicked on a topic. It kills interest very rapidly if a users can imagine how the next topic will be approached without having ever seen it before.

Evaluation

We hope to have our first results of the evaluation available by the time of the EVA conference in Berlin.

STRATEGIES OF KNOWLEDGE TRANSFER IN INTERACTIVE MEDIA

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A deluge of new information is produced. The discourse, the mise en scène, the documentation, the communication are transdisciplinary, interdisciplinary, intermedial, hypermedial and gear together. They form a multifunctional network of informations, medias and communicational structures. The museum is going to change from a content pool to a content provider. The depository and knowledge about the objects become transparent. This is one side.
On the other side the value of information disappears. As there is no time to reflect on information and to discern its relevance, we are producing endless, register everything and are captured by the Tarantula of information technology. The accumulation of information with the aim of comprehensiveness but without a sense of the whole may be imposing, but it leads us nowhere. Technological developments are such that artists, registrars, curators, researchers and visitors alike get carried away.

Interactivity can bridge this gap. Interactive multi-media technology would enable people to obtain comprehensive information on the creation, occasion, materialization, function and original presentation of the museum objcts, as well as reactions and documentations, the work set against the technical background, society, life in general and scientific discourse.

Each item of information has its *raison d'être* in terms of instructiveness. It makes little sense to feed more and more data into the computer, creating a collection of dead material, useless classifications and senseless information. Documentation is interpretation. This means, that registrars, curators and the visitors are responsible for the value of information. We need a discussion about the boundaries and possibilities. By defining the boundaries, the questions and the contents, working with information technology becomes useful for everyone. We have to realize that all collecting, researching, educating and conserving has no sense, if the actual egoistic thinking of our consumer society precipitates the collapse of humanity, culture and civilisation.

The museum makes an important contribution to humanity. We all have the duty to lead our visitors and users to a critical seeing and understanding of culture, art, science and reality. Critical seeing is distinctive seeing.

The main question is not how can we transfer the content of our database managementsystems to our colleagues or visitors?
The main question is how can we learn again to communicate together and with the following generations?
This is one of the main tasks of museum policy at the beginning of the 21st century.
Interactivity is en vogue and it could be the solution.
But how interactive is the interactivity really?
Often, interactivity is just a possibility to choose between different one-way-solutions. In that kind of sense, interactivity is not interaction, that means an equivalent interrelation in a sociologic sense or an active dialogue between the user and the system.

A first example:
An interactive drama, named "continue", made by the german artist **Dieter Kiessling**.

For me, it's a masterpiece of digital art, a masterpiece like Duchamp's urinal from 1913 for example.

At first there is a freedom of selection for the user, let's call it »the multiple choice of digital one way streets«. You can choose between "quit", that means »leave the system« or "continue", that means enjoy yourself.
But from one moment to the next your decision by free will is killing by the system.
The interactivity is going to get purely accidental and is no longer applicable.
The user becomes helpless and learns the truth and the real possibilities to act in interactive systems.
Interactivity could be also activity by creative action, this contains both, the intention to participate in creativity, that means a joyful collaboration and to be inconsistent with the system, that means confrontation. Real interactivity grows out of the actuality of action. This is productivity which leads to the creation of reality and the meaning of perception.

There are a lot of other suggestions:
What is the real benefit of the using multimedia technology and database management systems in museums in proportion to the expenditure?
How does computer technology engage the objects and the museum?
How does the visitor handle the experience of electronic reproductions and originals?
What about the aura of the original?
When becomes the reproduction of a reproduction into an original again?
How interactive is the interactivity really?
Do the registrars, visitors know something about the change of perception using computer technology in the museums?
The question of the medium is rarely of interest nowadays. Interactivity can produce a specific relation to reality. Traditional categories are no longer valid, even though they continue to exist. Other special fields, such as genetic engineering, cybernetics, artificial intelligence, cyberspace, as well as ecology, sociology and politics are introduced.

A second example:
Vienna Walk Demo is an interactive movie, based on 16mm film (DVD-ROM on MPEG 2; the demo on CD-ROM is based on Sørenson Quicktime with a length of 2 hours)
It is realised with Hypervideoengine, a new tool which combines the possibilities of digital film, hypermedia and www. Hypervideoengine is written in Macromedia Director Lingo and is using Xtras of the Brasilian Company Tabulareia.

Vienna Walk Demo is
a prototype of a DVD-ROM about Vienna
a dynamic encyclopedia
a new dimension of
knowledge transfer for cultural heritage
strategies for cross cultural and life long learning
publicity and marketing of a city
cooperation between culture, science, technology and economy
intelligent tele- and online shopping and ecommerce
real interactivity
definition the semantics of digital film
a futuristic pilotapplication and applied research in hypermedia and hypervideo

The contents of Vienna Walk Demo:
A virtual institution has planned to get an encyclopedia of the values of an european capital city. 3 agents have to fulfil their missions. They have 24 hours. They have chosen Vienna.
Tatjana: »What is luxury? Where can I buy goods? Where is the economical power?«
Pauline: »What is culture? What is art? Why do people go into museums?«
Tomo: »Where are the energetic and spiritual centres of the city?«

The agents bring you to the specific locations. With Tatjana you can stay at the famous Hotel Imperial and buy diamonds at a jeweller via online-shopping. Pauline will show you the cultural highlights at the Ringstraße, where you can order tickets for the next Zauberflöte at the opera if you want. Furthermore Pauline will discuss the purpose of art with a natural scientist in the Museum of applied Art. Tomo will find the places the energy is flowing in Vienna, e.g. Centre for Nature Spirits.
To learn more about the city, you have the chance to follow the skater on his run and meet inhabitants of Vienna. They will give you their own view about the city and you can contact them via email.
With the map you have the possibility to find all those places.

Vienna Walk Demo
concepted and realized by Science Wonder Productions (www.swp.org)
after an idea of Michael Perin Wogenburg
filmed by Oliver Kartak and fishfilm
supported by the Austrian Ministries of Science and Transport, of Economical Affairs, Kunstsektion of the Federal Chancellor Office and the City of Vienna

The relation between virtuality and reality has changed.
The traditional understanding of chronology disappears. Technological development and the media combine past, presence and future. The world becomes a museum. Knowledge Transfer means to create a base for the perception of the richness of our world. Not the dead facts, but the

Nowadays, one of the main tasks of the museum is to critically deal with the possibilities of electronic reproductions. The meaning and importance of museums are changing in the age of digital revolution. Notwithstanding its present main functions as an arthouse cinema, tourist attraction and boutique, the museum is still an institution of enlightenment in the classic sense, a "school of senses", and, now more than ever, it is obliged to guide the visitor toward critical viewing and experience.

The museum of the next century have
- to find his position in the community, his specific digital corporate identity,
- to be a constructive counterpart to the deluge of reproductive media images, and
- it will also have to consider itself an interactive transmitter actively influencing the opening of electronic "elbow spaces" and the creation of new visual codes.
- to learn that it is responsible for the truth of the informations it gives
and that it is the only controller of knowledge in a community of pleasure, fun and entertainment.

C.V.

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publications (selection):

- structures and strategies in art and museum management. tendencies of professionalism, ed. by D. Rothauer & H. Kraemer, Vienna, 1996.
- the semantic change in art museums. positions and visions to art exhibition, documentation, communication, ed. by H. Kraemer & H. John, Nuremberg, 1998.

in preparation:

- museuminformatics, digital collections and the consequences, Vienna, 1999
- digital euphoria? knowledge transfer in art, culture and technology, 2000

EVALUATION OF THE LOTSENSYSTEM OF THE BERLIN STATE MUSEUMS (SMPK)

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1 Description of the "Lotsensystem"

The "Lotsensystem" is a self guided, networked visitor information system, generated for the "Staatliche Museen zu Berlin, Preußischer Kulturbesitz (SMPK)", one of the largest unifications of culture in the world. The system includes all kinds of information about 5 of the museums of the Kulturforum. All image and text information are directly generated by an image and text database. This guarantees that only up-to-date information is presented to the visitors. A content management system enables the SMPK to easily update the system.

1.1 Objective

The objective of the Lotsensystem was to offer a large number of different information to various types of visitors. It should inform about the different collections of the SMPK. Its main idea was to present an overview of all collections and main-locations of the SMPK in Berlin. The system should give its visitors impulses and supports for the museum visit. Besides basic information, like opening hours, admission fees, and public transport, the system gives hints on special exhibitions and events.

1.2 Characteristics

The system consists of 9 terminals which are connected via wireless-Ethernet with a database sever. The extensive content management system was built with Microsoft Access and is installed on workstations of employees of the SMPK, which are connected via Ethernet to the Linux server. The user front end is programmed with Macromedia Director and offers substantial information with the help of images, text and audio material – combined in a pleasant and varied way. Besides optical claims - easy handling was in the foreground, to attract even visitors with little experiences of Multi-Media systems and to make them curious.

1.3 Introductory

To get an idea of how the visitors of the Kulturforum like the "Lotsensystem" and if the objectives of this project could be implemented, the user questioning of MUMMS (Measuring the Usability of Multi-Media Software) was carried out at the suggestion of the Berlin State Museum. The Human Factors Research Group of University College Cork, Cork, Ireland (HFRG) already carried out surveys concerning Multi-Media-systems of the Berlin State Museum.

2 The Questioning

2.1 Description

A user questionnaire is a standard way of getting end user reactions to a piece of software: such questionnaires are used quite widely in consumer research.
The MUMMS questionnaire is being developed in response to the rapidly changing patterns and technology of computing today. Multi-media computer products are establishing themselves as part of the market, and it is becoming necessary to develop ways in which these products can be assessed for quality of use by the end users themselves. MUMMS is their appreciation of the quality of a computer application.
The questionnaires contained a number of questions to each of the following points:

- attractiveness
- control
- efficiency
- helpfulness
- learnability
- excitement

The visitor had to give marks on each question from 1 (I totally agree) up to 5 (I totally disagree).

2.2 Realization

The questioning was carried out during two weeks in June 1999 directly in the Kulturforum, where visitors, who used one of the terminals were asked to fill in the MUMMS-questionnaires. 51 persons did so - consulted by a LuraTech employee. The questionnaires were sent for analysis to the Human Factors Research Group of University College Cork, Cork, Ireland (HFRG), and the result reached LuraTech and the SMPK in October.

2.3 Result of Analysis

	Attractiveness	Control	Efficiency	Helpfulness	Learnability	Excitement
Average	64.35	57.30	57.99	59.52	63.52	61.40
Median	66.93	58.25	58.25	60.42	64.76	62.59
Standard Dev	11.27	12.07	11.01	10.49	8.99	11.98
SE Mean	2.74	2.74	2.74	2.74	2.74	2.74
Max	86.46	81.50	77.78	79.95	75.61	82.12
Min	38.72	32.20	36.55	34.38	40.89	32.20
N	51.00	51.00	51.00	51.00	51.00	51.00

3 Summary

The questionnaires show that the system is attractive and enjoyable, pleasant to use, and users regard it as a welcome change. The controllability of the system is not high, but users remark it is easy to navigate through as it helps the users find what they are looking for.
The system is easy to learn to use and simple enough not to be forgotten. Its main excitement is vivid images.
Users find the system attractive visually and very different to the normal gallery guides. Interactivity is very much appreciated.

EVALUATION OF THE USE OF POI SYSTEMS IN THE GERMAN SALT MUSEUM

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The number of multimedia and hypermedia applications in museums is rapidly increasing. Most applications are point-of-information systems presenting additional information on artefacts which are shown in the museum or offering background knowledge on subjects covered by the museum. Publications dealing with such applications are often bare descriptions of contents, technical realisations or user interfaces. There are rather few studies dealing with use and acceptance of such systems by visitors.

In order to decide whether hypermedia applications should be installed museums have to regard costs and benefits: does the rather expensive development of a special application pay in the sense of making the museum more attractive to visitors? Attractivness, in turn, is the question of usability and acceptance of the application. Therefore evaluation studies which have to deal with ergonomical, didactical, and psychological questions are necessary.

1 Evaluation of POI Systems

Evaluation of computer applications normally starts from the tasks of the users. In POI Systems there is no such given task. Goals and intentions of the users are made up by themselves. Therefore evaluation of POI systems has to concentrate on the questions of what users really do with the system and how they assess it. Methods which are to be used for this purpose must not be expensive in order to provide a reasonable relation between costs for evaluation and benefits for POI applications in the museum.

Subjective methods like questionnaires and interviews are important, because acceptance of the system is a crucial factor. Both questionnaires and interviews can be used to find out the users' assessment of usability, information contents, and design of the system. While questionnaires need rather no personnel for distribution and few for evaluation, interviews require a higher amount of personnel. Thus interviews are often too expensive. On the other hand, questionnaires which are filled in without supervision are not fully reliable.

Objective methods like observations and logfile recordings are best for studying the users' behaviour. However, observations usually require additional personnel and thus are too expensive. Logfile recording reqires no additional work. If format and content of logfile records are designed in such a way that evaluation can be done automatically or half automatically, this methods offers a very good relation between the work which has to be invested and the answers which can be obtained.

Other methods of evaluation like guide-oriented judgements by experts or experimental methods are either not appropriate or too expensive. Therefore evaluation of POI systems in museums should mainly rely on logfile recording in combination with questionnaires. Additional observation may be useful. At the German Salt Museum we tried to find out how POI systems can be evaluated with minimized efforts.

2 POI Applications in the German Salt Museum

2.2 Salt. A hypermedia presentation of the German Salt Museum

This application provides information about salt minerals (origin, formation, structure, appearance, occurrences etc.). It is divided in 3 parts each of which is subdivided in 3 chapters. Each chapter contains between 2 and 48 pages with a total of 107. Each page contains a text on the right which is illustrated by a photograph, a diagram, or an animation on the left (Fig. 1).

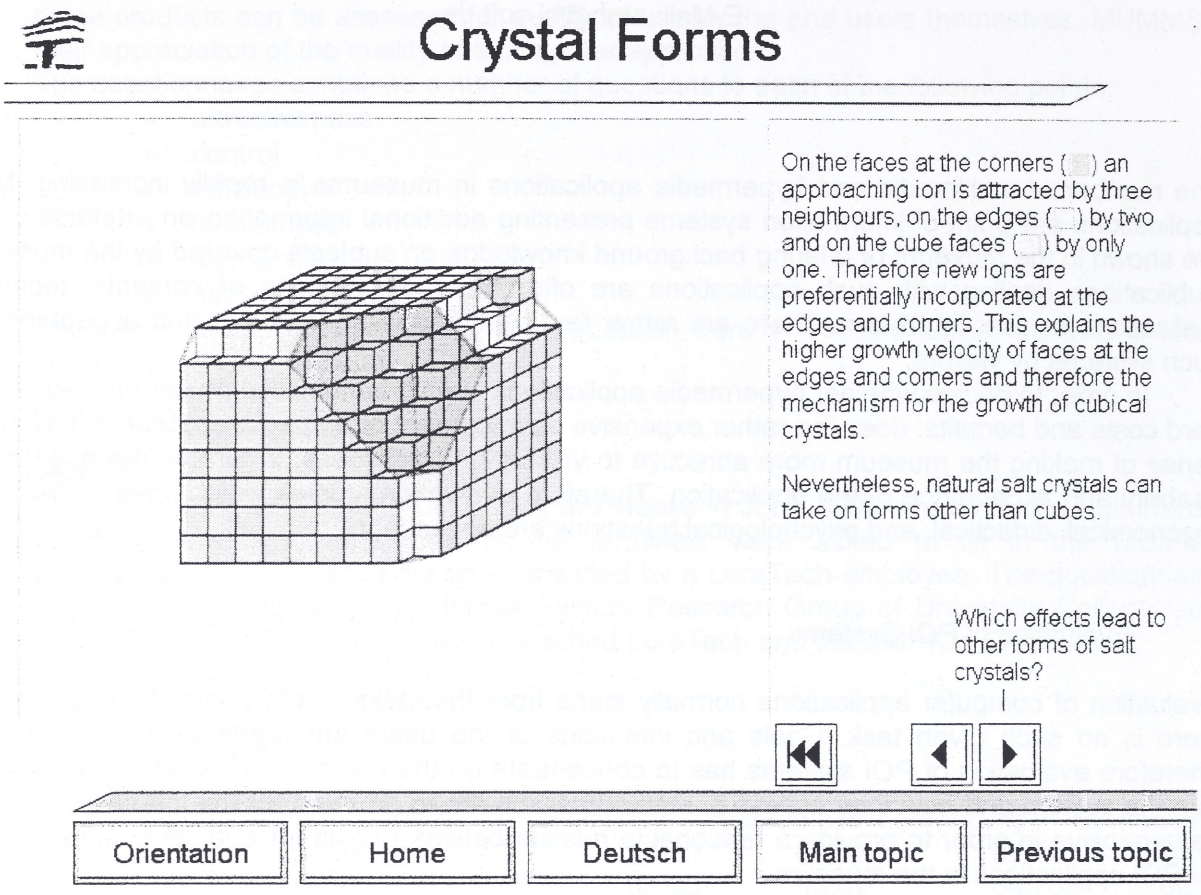

Fig. 1. Screen page of application "Salt."

Selection of chapters is done hierarchically in two steps. Pages can be displayed in seqential order within chapters or by following one of about 65 hyperlinks. Standard controls at the lower part of the screen allow to restart the system, to display a map of contents, to select between German and English language and to go one step up or one step back. The application is controlled by a trackball. It is designed in such a way that a touchscreen could be used either.

2.1 Lüneburg - a large city around 1600

This application provides information about the development of the city , about economical, social, and cultural life within the city, and about remarkable buildings and places based on a map from 1574. There are three different views of the map (overview, full view, zoom view for details). 35 pages of information about the city as a whole belong to the overview, 73 pages of information about buildings and places to the zoom view. Each page contains the map or a zoomed part of it on the left and a text field on the right. (Fig. 2)

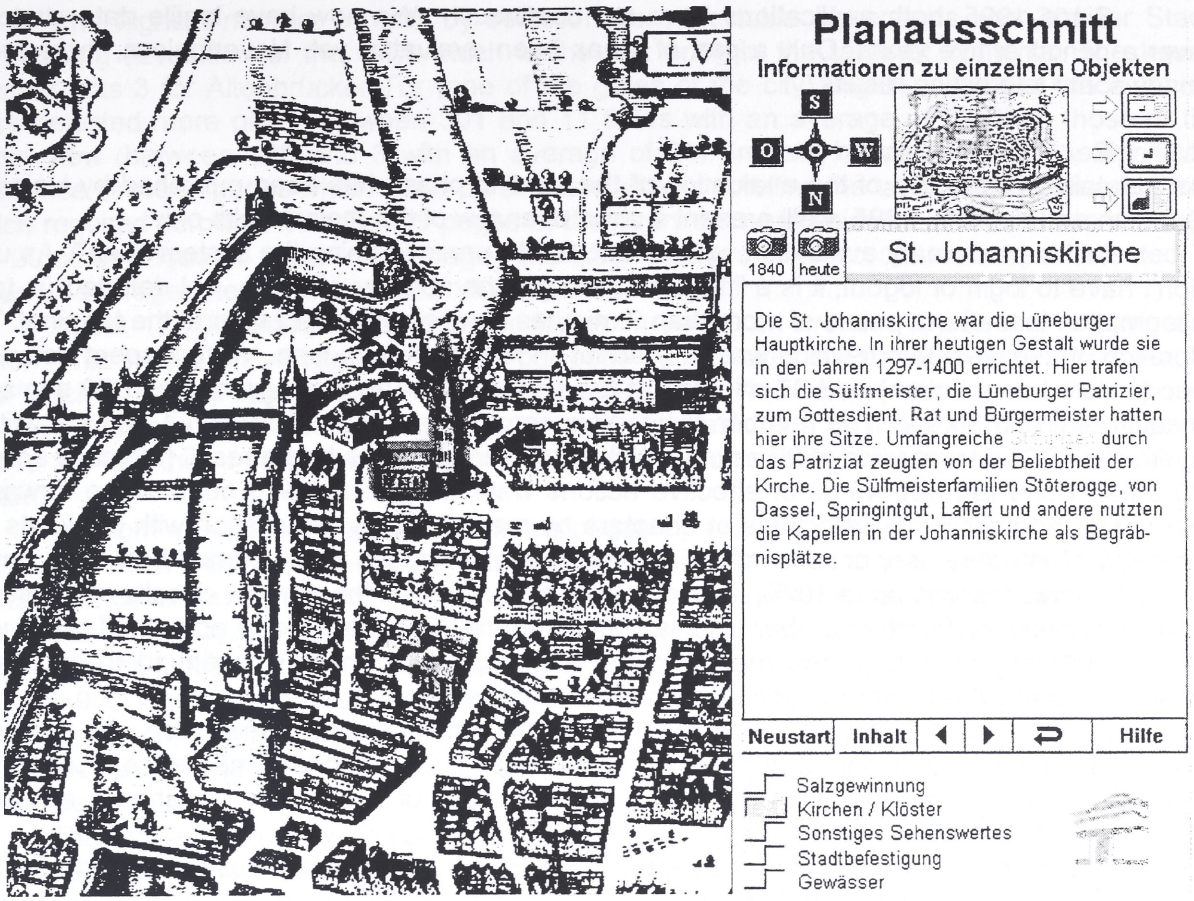

Fig. 2. Screen page of application "Lüneburg" in zoom view.

All pages can be called up by selection from a hierarchical table of contents. It is possible to change between pages by buttons following sequential order (next / previous) or by hotwords (hypertext links). There are about 280 of such hyperlinks plus about 80 hotwords which display additional information in popup boxes. In zoom view objects on the map can be clicked upon in order to display the text belonging to an object. Many pages contain buttons for the display of pictures (about 50), and some of the pictures carry buttons for tracks of sound like church bells or organs (about 10). The application is controlled by a trackball.

3 Evaluation of the applications in the German Salt Museum

3.1 Proceeding

Both applications have been developed by evolutionary prototyping in interdisciplinary co-operation between the Museum's staff, computer scientists, and external specialists. Prototypes have been presented to experts from different museums and tested in public use in the German Salt Museum. By informal observation and by discussions with experts and visitors some problems in interaction and presentation could be solved.

In a second phase in 1994 both systems ran without supervision in the exhibitions. Every action of the users was recorded in a logfile. Each logfile entry consisted of five items: the time of the event (in seconds since midnight), the nature of the event (e.g., click, double click, holding button down for a while), the target of the event (e.g., button, hotword, photograph), the page displayed when the event ocurred, and the page displayed after the event. Logfiles are plain ASCII text and can easily be loaded into a database for evaluation. A preliminary evaluation of these logfiles lead to some minor changes of the user interfaces of both applications.

Since 1995, both applications have run continously. We now have logfile data stretching over a period of five years. Only a part of it has been evaluated yet. Nevertheless, there are already some interesting results.

3.2 Results of the second phase

As a detailed discussion of the evaluation of the second phase has been published by Heinecke, Bumann and Kerstan, 1995, we'll present a short overview of the main results only.

In this preliminary evaluation we had about 480 persons using the system "Salt.". As users don't have to login or logout, it is a little difficult to get the number of users, but data led us to the assumption that after a pause of more than 2 minutes there was another user at the terminal. Total duration of use was 34.5 h which was only about 11% of operation time. Visitors spent between 0 sec (isolated user action) and 37 minutes at the terminal with an average of 4 min 20 sec and a median of 2 min 36 sec. The number of interactions per user ranged between 1 and 904 with an average of 57 and a median of 27 actions. 65% of user interactions had a result (effective actions), 35% had none (errors). 45 % of effective actions were navigations with buttons like forward or backward, another 17 % selections of chapters by menu buttons. Navigation with hotwords took only 1 % of effective user actions in total. Nevertheless, on pages which carried hotwords, navigation with hotwords was up to 10 %. In each of the nine chapters the number of calls of the second page was about half of the number of calls of the first one. This means only about half of the users which had stepped through the menus to the first page of a chapter continued to stay in this chapter by using the forward button leading to the second page.

For application "Lüneburg", the duration of use per visitor was longer. Also, the duration of stay on a page was considerably longer with an average of 17 seconds compared to 7 seconds for application "Salt.". The differences in total number of calls of a page were higher in application "Lüneburg" than in application "Salt.".

Although use of both systems seemed rather poor to us, questionnaires showed very good user ratings both for usability and content.

3.3 Logfile data of application "Lüneburg"

So far, we have evaluated logfile data of application "Lüneburg" of the year 1996. In 1996 total operation time was 2,109 hours. The system was in use for 296 hours which is 14% of operation time. We had about 3,850 users. Thus the average time a visitor spent at the system was about 4 ½ minutes. There was a total of 121,700 recorded user actions which results in an average of about 32 actions per user.

As 49,704 persons visited the German Salt Museum in 1996 only 7.7% of the visitors used the system. At a first glance this seems rather low. Nevertheless there are two main reasons for this ratio. On the one hand, the German Salt Museum didn't want computer terminals to dominate the exhibition. Computer applications were regarded as an additional source of information only. Thus the screen of application "Lüneburg" is situated in an inconspicious desk beneath the original map. On the other hand, 60% of the visitors of the German Salt Museum come in groups. Most of these groups participate in a guided tour through the exhibition and don't have enough time to use computer applications. Comparison between user counts and visitor counts shows that the percentage of users rises with the percentage of single visitors (up to 16.1%).

Navigation was done mainly by use of the six buttons "Home", "Contents", "Previous Page", "Next Page", "Back", and "Help" (from left to right in Fig. 2). About 28,000 times one of these buttons was pushed. 9,100 times visitors clicked at an object of the map. 7,600 times a page was adressed by selection from the table of contents. Only 1,400 times users followed a link between pages by clicking at a hotword within the text although there are 280 hotwords on 108 pages.

The total number of calls of different pages ranged between 1,379 for Saline (Salt Works) and 53 for Bürgerhäuser (Houses of Citizens). Pages of the overview were called more often (between 1,283 and 209 times with an average of 459) than pages of the zoom view (between 1,379 and 53 with an average of 295). As the system comes up in overview after each restart by the "Home" button, this shows that many users don't change from overview to zoom view.

The highest number of calls by selection from the table of contents was 301 for Stadtentwicklung (Evolution of the City) which is the first entry in the table of contents. The lowest number was 3 for Altenbrücker Tor (one of the gates of the city). Again, pages of the overview were selected more often (between 301 and 11 times with an average of 72) than those of the zoom view (between 188 and 3 with an average of 29). In both views there was a significant difference between pages which could be selected without scrolling the table of contents and those which required scrolling. The first 15 pages of the overview were selected 122 times on average, the 20 other pages 35 times on average. The first 15 pages of the zoom view were selected 74 times on average, the 56 other pages 16 times on average.

About 12,700 times users changed between pages in overview by use of a navigation button. This means an average of 362 hits per page by the buttons "Previous Page", "Next Page", and "Back". The first page in sequential order had 982 hits. Numbers of hits decrease continously to a level between 226 and 194 for pages 24 to 34. The last page 35 was hit 320 times obviously due to the fact that it can be reached from the table of contents by clicking the "Previous Page" button.

In zoom view users changed between pages by use of a navigation button about 7,950 times. This means an average of 112 hits per page. Again, the first page in sequential order after the table of contents of the zoom view had the most hits (345). Numbers of hits decrease more or less continously to a level between 100 and 47 for pages 20 to 68. Like in overview, the last 3 pages were hit more often (up to 520 times for the last page).

8,900 times users clicked an object of the plan in zoom view. Thus each of the pages belonging to objects like houses, places and so one was selected 151 times on average. Selections range between 512 and 5. Roughly, the larger an object appears in the plan the more often it was selected.

The toggle buttons which colour diffferent groups of objects in the plan (lower right side in Fig. 2) were used about 12,700 times. Numbers of use are in order of arrangement on the screen from top to bottom and range between 3,650 for Salzgewinnung (Production of Salt) and 1,424 for Gewässer (Rivers).

About 1,060 times the "Help" button was clicked. 580 users left the static help system immediatedly from its first page, 240 from the second page. The other pages of the help system were called about 100 times each. Except of the first page all pages of the help system had an average duration of stay remarkably shorter than the time needed to read the information on the page.

4 Analysis of Results

4.1 Basic conclusions

The more intensive use of pages of the overview suggests that quite often users don't get into zoom view. The graphical buttons which indicate the current view and allow to change to another one (top right side in Fig. 2) are not obvious enough.

In 1996, the use of hotwords as links between pages was rather low. Perhaps then the concept of links was not as widespread as it is today with the rapidly increasing use of the World Wide Web. Logfile data of 1999 will soon show wether the use of hotwords has increased.

Most interactions which change pages are clicks on the "Next Page" button. Combined with the fact that average duration of stay on a page is in most cases shorter than the time to read all of the information this proceeding reflects our handling of unknown books. We turn pages rather quickly to check if there is anything interesting.

Selection of pages from the table of contents is remarkably lesser if the table has to be scrolled. Users who are not accustomed to standard scroll bars may have problems to see the whole table of contents.

A detailed help system which explains all means of interaction is wasted effort. Only about ¼ of users press the help button. ¾ of those who do only read the basic instructions.

Colouring groups of objects in the plan and clicking at coloured objects is used rather frequently. In zoom view changes between pages are more often done by clicking objects than by clicking navigation buttons.

4.2 Re-design of application "Lüneburg"

The German Salt Museum currently rearranges some of ist exhibitions. The application "Lüneburg" shall be presented in a more central place and shall be available on CD at he museum's shop. This is the reason for a re-design which shall address the findings from our evaluation, too.

Besides a clearer arrangement of the display we plan some changes in the elements of interaction. Figure 3 shows the prototype of the new version with the same page as in Fig. 2. All buttons are arranged in an interaction bar at the bottom. The graphical buttons for the change between views shall be replaced by a "View" button (lower left side). The toggle buttons for colouring the objects are replaced by a "Marking" button. The buttons for pictures (two buttons in Fig. 2 above the text) are replaced by a single "Picture" button. The buttons for sounds which become available in the old version only if a picture is displayed are also replaced by a single "Sound" button. Pressing one of these four buttons offers a menu each.

We hope that the new "View" button will lead to a more frequent selection of the zoom view. The navigation buttons are a bit more unobtrusive than in the old version in order to put more emphasis on other means of interaction. The help system has been omitted as the information which was given on the pages that were actually read in fact was necessary to know in order to get the help, too. In the table of contents we shall use scroll buttons similar to the navigation buttons instead of scroll bars.

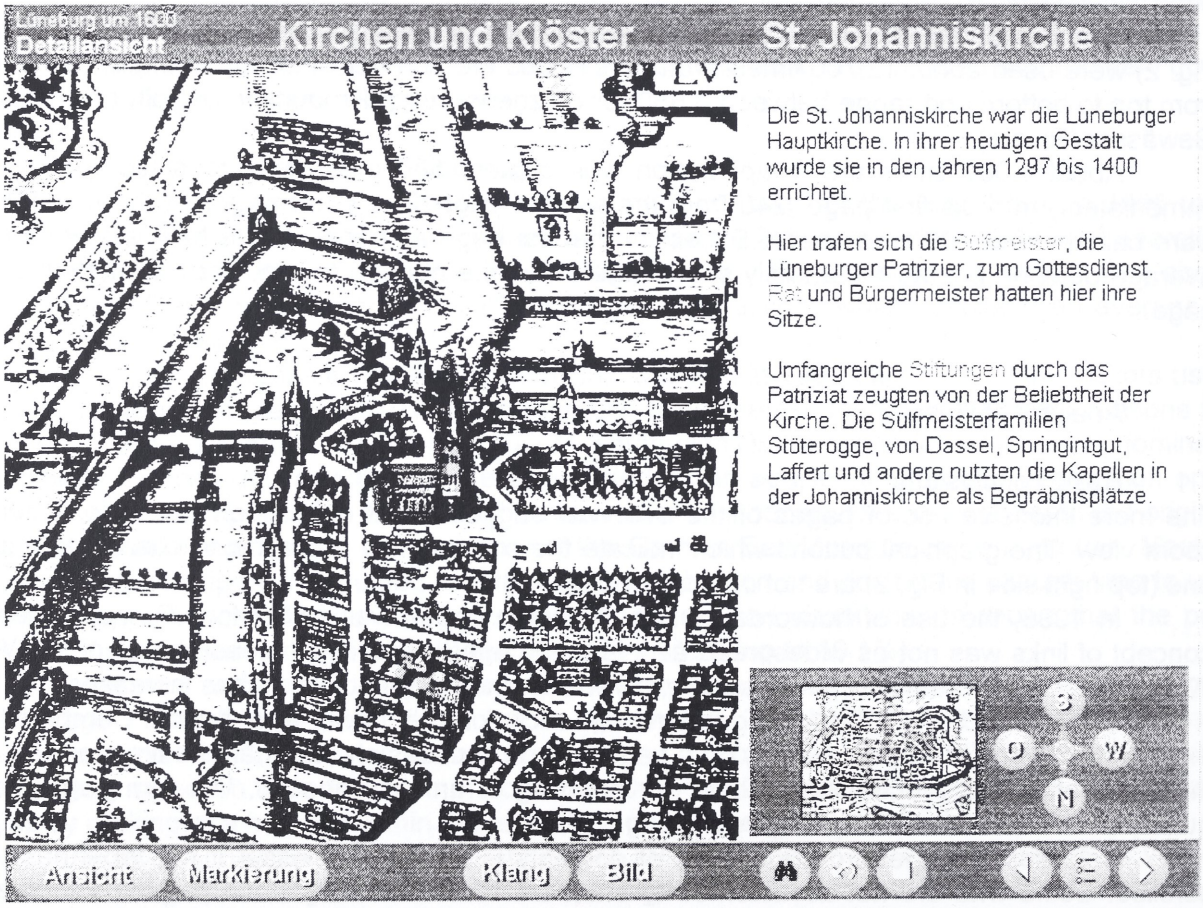

Fig. 3: Application "Lüneburg" in zoom view, prototype of new version

5 Conclusions

Logfile recording is a valuable means for evaluation of POI systems in museums, provided that logfiles can be analysed easily. This can be achieved by using a standard database which supports detailed queries. Analysis of logfiles can give hints for ergonomical improvements of the user interface. Logfiles are also capable of showing user preferences with respect to media and / or contents.

Questionnaires and observations can be used additionally in order to study different groups of users. For future studies we shall make use of existing control cameras in order to correlate logfile recordings to different types of users with respect to age, sex, and single visitor vs. group of visitors.

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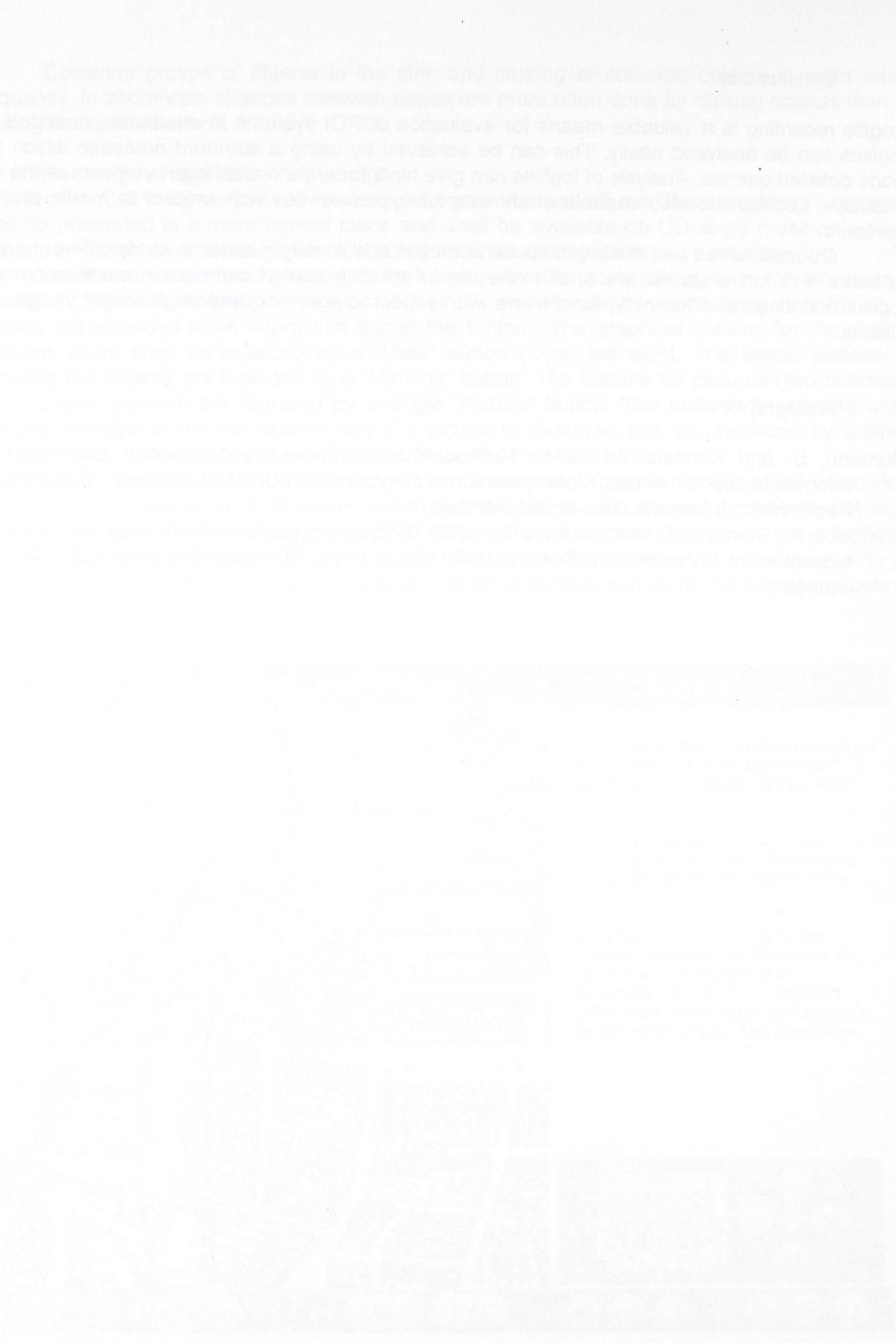

COMZ – THE ALTERNATIVE KIND OF PRESENTATION

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Today`s market of interactive presentation and information systems

The world is full of infoterminals, POI`s, POS`s, kiosks and interactive presentation systems – providing proof for the increasing acceptance and for the future importance of electronic information and sales promotion aids.

Unquestionable advantages over traditional media make interaktive presentation attractive.

- lively presentation of information,
- easy updating
- and space saving installation.

In Europe most installations are found in the retail business with 35%, followed by finance institutes with 33% and public institutions with 13%. The balance is devided into 8% transport and traffic, 4% tourism and 7% miscellaneous.

Preferred localities for infoterminals are junctions and intersections of traffic like railway stations, airports and public transport stops, branches of banking houses and retail business chains as for example supermarkets for building materials, foto retailing and entertainment electronics.

In spite of all the enthusiasm only a few installations fufill the expectations of acceptance and utilization of interactive information and presentation systems.

Numerous analysis of the users structure illustrate again and again that the majority of users is less than 30 years old.

User`s behavior

Evaluating studies of usage on various systems one will see, that the acceptance to a great extend depends on the human interface of the terminal. As more technical it looks as more aversion it generates with many people. Aversion is generated by too much of action as well. Because many systems show exactly this properties an appropriate reputation of interactive infosystems has been adopted by many people.

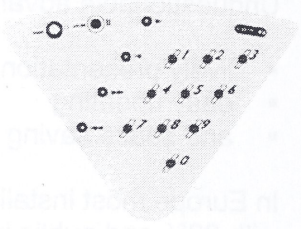
The user of a multimedia CD ROM plans the work with it and enjoys the task of exploring thoroughly a manylayered information pool step by step. In the normal case the CD ROM will be used many times utilizing experiences of earlier sessions in regard to navigation and approach to specific information. Contrary the user of a multimedia terminal expects quick and easy approach to information or presentations pressing a button. Normally usage of an infoterminal is not preplanned. People are not prepared to spend time nor are they willing to reflect on the question of how to obtain information or how to get contents presented. They simply wont it by a click.

Interactive infosystems in museums and galeries

Visitors of museums and galeries are more of the middle-aged group showing less playful tendencies. They may have less problems navigating an interactive system due to average higher educational level, but they develop a real aversion against too technical outlook and too much action. Seriously and lively presented interesting information is asked for. The visitor anticipates to spend his time dealing with the content instead of surging for the content.

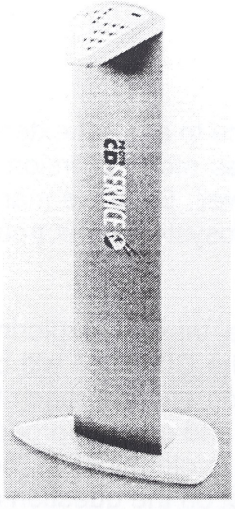
An excellent combination of multimedia information systems is presented by the Hällisch-Fränkische Museum in Schwäbisch Hall, Germany. Exceptional interesting and attractive ideas offering electronic image- and sound experiences are realized in various installations. Nevertheless there is no traditional multimedia computer or touchscreen infosystem in the museum. The exhibition follows one basic principle: The visitor likes to experience events by means of audio, video and image presentations, selecting the topic simply by pressing a button. A plain subject is to be allocated to the button easily seizable by the user. By pressing a button a video, an audio or image sequence gets started which automatically returns to the start position after the end of the presentation. More navigation is not needed and leads to less usage.

Recalling the essential



Telephone and consumer electronics are standard equipment of today`s households. The phone connection is selected by pressing buttons, choosing the TV channel is done by pressing buttons and navigating a video player is done by pressing buttons as well. Every button has a concrete function executed by pressing it. The easiness of the process and the dactylic feeling of the click is the attraction and stimulates the relation between the human being and the accurate machine.

Based on this knowledge and extensive own investigations and observations the firms CD Service Günther Gromke, Leipzig, Schröder Design, Leipzig, Ingenieurbüro für Systemlösungen, Erfurt, and DAS Computer, Leipzig, have developed a new interactive system for presentation and information. It is called comZ. The system consists of various modules and presents multimedia programs controlled by a special keyboard of 16 buttons.



How comZ differentiates from other systems?

All the time you were inspired by the aesthetics of life and you expect comforts like handyness, elegance and variability in modern technologies as well. These comforts your customers are used to. Your requirements simply exceed the edge of the screen. That is why we concentrated on a well balanced, attractive and slim design. ComZ creates ambience around your interactive presentation.

The navigation is reduced to input options known by everybody from telephone and television. 16 clearly arranged input keys invite the visitor to try it. Everything else is done by the program.

Today`s variety of plasma screens, electronic projektors, TFT displays and traditional monitores offer plenty of choice to be combined with comZ. The presentation can be adapted to various room situations.

What can a comZ be used for?

Mainly a comZ serves as an appliance to control sequences of electronic images, videos, animations and sound events or combinations of it. The function of comZ is not exhausted by operating the program. Before the wish arises to get information on the terminal, comZ provokes the the attention of the visitor, makes him curious and interested to become involved with the contents of the presentation. It is simply fun to touch the aesthetic form of the terminal and to establish communication to lively presentations. The visit to a museum should not be boring. It should be fun and serious and objective at the same time.

Components, control and software of the comZ

Basically a comZ consists of a terminal, the comZ cupboard housing the controlling technics and the screen or projector. If for example a plasma screen fixed on the wall is used for the presentation the cupboard is not necessary.

The contents will be worked up according to various requirements. Generally a number of main menus is divided into a number of under menus. One subject is presented by a chart or a sequence of charts containing images, videos, animations, text and sound. For every presentation an individual screen is designed with a button line at the bottom and at the left side for the main and under menu buttons. The remaining space is allocated to images.

The controlling concept is very simple. The 16 buttons of the terminal are dedicated to the following functions. There is a start button for a new start and a pause button to interrupt the presentation. One double next and one double previous button change between main menus the topic of which is shown in the bottom line of the screen. By means of 10 number buttons the under menu is selected. Zero is widely used for special functions as help or sound on/off. A forward and a back button enables the user jumping between charts of an under menu.

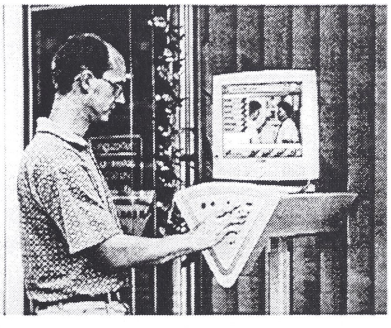
If necessary comZ may also control extern devices like players. This kind of application normally needs a main menu layer only for controlling the various extern devices directly.

Three standard software modules are offered. Creating a new presentation only an individual screendesign is to be worked out, the number of main and under menus must be fixed and the program is to be filled with images, sound, text, animation and video. The three modules are developed for different applications and differentiate as follows:

- Online presentations parallel to Internet programs with centralized updating on a server,
- presentations with a maximum of multimedia functionality and
- programs enabling the customer to update contents on his own.

Operating through shop windows and other options

Initiated by a lot of inquiries we developed a variation of comZ which can be controlled through shop windows of various compositions. Because all the technical equipment of the comZ is completely located behind the window it is extremely interesting in public areas where vandalism is a problem. The only thing outside is a sturdy foil guiding the finger the reactive areas on the window representing the input buttons. The technology works behind double glasses, metal coated and bulletproof glasses as long as the total thickness does not exceed 30 mm.



Motion sensors are an interesting option to start the presentation when people get closer to the comZ. With this option the attention of the visitor can be directed automatically at certain exhibits. After the attention is caught the visitor will use the comZ to get more information.

Small room or spacious presentation

One should allocate approximately two sqare metres for a presentation with the comZ terminal und the comZ cupboard holding computer and controller and the monitor on top. A presentation with plasma screen mounted to the wall needs less space but somewhere behind the wall some space has to be provided for the computer equipment. If there is enough space and the light conditions allow an electronic projection comZ may be used to control a very attractive spacious presentation.

The new kind of controlling a multimedia infosystem

The interactive presentation system comZ was developed under consequent evaluation of user studies of various infoterminals. A new kind of controlling of interactive presentations has been created specially taking in account the operating conditions of museums and galeries.

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THE LOGISTICS OF IMAGES: ON THE PARTICIPATION OF ART HISTORY IN THE DESIGN OF NEW FORMS OF INFORMATION

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When art history became an academic discipline in the middle of the 19th century it belonged to the *avant-garde* in the field of image reproduction and application. 125 years ago, slides and photographic prints were introduced as a medium of art historical teaching in Europe, and researchers began to co-operate with publishers and photographers and participated in the creation of large picture collections. At the same time publishing houses specializing in art history improved the quality of illustrations in their books and magazines, reaching millions of readers and increasing the social importance of the arts. Soon after, the so-called *Bildatlas* that was designed to visually compile the knowledge of that time became a successful instrument and was also adopted by the well-known founder of the *Kulturwissenschaftliche Bibliothek* in Hamburg, Aby Warburg (to whose name and ideas the current project *Warburg Electronic Library* is obliged). As a result, art historical efforts in improving the pictorial reproduction in public university lectures and publications had a strong influence on the appearance of today's conferences, of poster presentations or even, indirectly, of multi-media applications.

The discipline has lost this innovative role since the use of high-quality illustrations in full colour became a matter-of-course, and journalism or the natural and economic sciences developed their own forms of visualization. Art history is still an important player because it delivers valuable contents: in spite of the "digital age", the number of copies of illustrated book titles is higher than ever. But scholars and students in art history have to be aware in how far far modern technologies for the digital storage and automatic analysis of images, their transfer and exploitation have become an economic factor they have to calculate with. Otherwise they will ignore in which way they could keep on contributing to the global market of images.

Technological innovations (and barriers!) concerning the image are now coming from software producers, picture agencies or internet providers. But as well as "art history" is no longer a coherent entity but signifies a wide range of particular activities in museums, academies, archives, libraries etc, also those branches have different ideas about the solution of technological and logistical problems and the exploitation of the pictorial world. This is where art history should step in by co-operating with IT faculties or private entreprises.

Art historical institutes provide high quantities of images that need to be digitized, classified, and interpreted; they stand for rich experiences in investigating visual resources and offering a broad cultural, geographical, and linguistic knowledge. Compared to former times, many representatives of art history now consider themselves incompetent for a co-operation with high-technology providers to change the situation, or they are content with old techniques. Indeed, some of those techniques (e. g. the card box which is to be discussed below) are not yet replaced by better ones; this is one of the reasons why art history is a challenging application domain for the IT, helping technology providers to evaluate their methods and tools and insisting in the simplicity, adequacy and economy of old *and* new media.

[Presentation of the Warburg Electronic Library *prototype]*

The *Warburg Electronic Library* project was set up in 1997 by the Art Historical Institute in Hamburg and the Department of Software Systems at the Technical University of Hamburg-Harburg; it is based on the *Image Index of Political Iconography* (Bildindex zur politischen Ikonographie), containing 300.000 reproductions (photographs, postcards, extracts, photocopies) of works of art, stored as paper cards that give only a short source information. The cards were brought together in order to draw illustrations out off different publications and to provide a general view of the various phenomena of the arts in their political contexts; they shall not display the aesthetic quality of works of art and architecture, medals, decorations etc. but their political and social functions. Therefore, the index does not focus on the quantity of images but on the complexity of their relations. All entries are classified by a thesaurus of some hundred keywords that are subdivided again into small groups; thus, the index is a hybrid of an alphabetic keyword list and a systematic catalogue. Also, some of its terms are borrowed from other academic disciplines such as political or social sciences.

The WEL project had to consider the logistics and the limits of the basic material, e. g. the quality of the illustrations which is reduced - like thumbnails - to the mere preview information; the lack of copyrights which means that a distribution of the contents in the web would cause legal problems; or the intention of the index not to follow a systematic catalogue but to keep several entries under a certain keyword until the contents allow or demand the creation of a more adequate one. The collecting of images means a constant evaluation of the underlying thesaurus that is changed from time to time due to the re-interpretation of the contents.

The central issues of the WEL project are:

- expressing the co-operative character of a long-term collection by applying the internet technology to it, thereby allowing all participants to make use of their actual ressources where-ever they work (be it in the library, the computer department etc.); in this respect, the WEL should rather be compared to the editorial system of a newspaper than to a mere database
- preserving the simplicity and flexibility of the card box and its concept of evaluation by a complex architecture
- revising and extending the image index by integrating other contents (like the institute's book collection) and classification systems (of publishing houses or historical institutes); the WEL allows individual approaches to the material through personalized indexes, by chosing keywords from the actual list or adding a different list
- supporting a comparative way of seeing (which was popularized by art historians in the beginning of the 20th century as a means of argumentation)
- becoming a technological basis for educational purposes and research by supplying university courses and seminars with information that can be supplemented (or replaced) by the students; this will have a deep impact on their forms of discussion
- testing recent products, improving the communication between different faculties and increasing the competence in the field of visual and multi-media administration.

The image index is a special solution for a special problem, and the properties of the source material are a decisive factor for the project's orientation. Therefore the WEL project does not pretend to provide any kind of standard software (even though its concepts are to be transferred to other domains) or to produce a new type of art historical scholar. The WEL group proposes, quite on the contrary, to establish further co-operations with the IT on the basis of the profiled art historical experiences which both sides can profit from in the long run.

For further information on the "Image Index of Political Iconography" and the collections of the Forschungsstelle Politische Ikonographie, see: www.warburg-haus.hamburg.de (in German); for information on the current project, see: www.sts.tu-harburg.de/projects/WEL (also in English)

DIGITAL IMAGING DATABASE SYSTEMS NEED "DIGITAL ORIGINALS"

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1. Why do we need to digitize our contents?

Public institutions like archives and museums have an increasing need to digitize parts of their objects, images, documents, contents. As the major reasons we can be identy the following issues:

- In many cases the documentation of our heritage is doomed to perish; film and paper are difficult and expensive to preserve; the depreciation accelerates dramatically when originals are used for scientific purposes.

- Innovative institutions are changing their communication strategy and open up themselves to become a true public service, a trend which has started in major US institutions, and which is being recognized now in Europe as well.

- A third reason is simply the protection of originals from being used up or even lost; they should be replaced by a "digital working copy", which can easily be used in all scientific work, and which is suited best for all communication efforts. The portability of these files over the web and per e-mail will save time and travel expense for scientific staff; the readiness of publishing this content will carry our heritage into the broad public.

- Concerns about rights and unauthorized access arise since all professional database solutions must offer differentiated methods to control access especially to highresolution data.

Database projects have been started in many archives, both industrial and public, and not all of this work is implemented without problems. Many times issues have not been identified, products are being oversold by systems vendors, and the special needs of longterm archiving were not considered.

2. The planning of a database system merges different disciplines.

The planning of such a digital content management system is an exercise which brings together several disciplines into one project. It is the combination of

- **Strategic intent of the institution** like becoming a service institution
- **Definition of those disciplines and target audiences** who should use the material
- **IT organizational technologies** to be installed and maintained
- Redefinition of finding and searching mechanisms, and **rights for the content**
- **Specifying the contents** in a way that it can be used for many purposes
- Care for the **Color Management** of the imaging content which must show the "digital origianls" as they are in the books, paintings, or graphs on display
- Definion of **organizational rules** which have to apply to the new digital workflows
- Changing the **communication behaviour** of the institution

to mention just a few.

Some institutions are being mislead in picking the appropriate technology for storing and distributing their content, since the typical vendor wants to implement his best solution which does not necessarily fit to the needs of the user. In some cases it may be even a combination of analog and digital technology, and that is rarely programmed in the predefined software.

It may take the help of outside consultants to collect and tailor all necessary knowhow, and specify the needs for the application. Compromises are still the rule, standard recipes do not exist.

3. Project management of a dedicated person with a systematic approach is mandatory.

In the case of the Kantonsarchäologie in Brugg / Switzerland, this process was directed by a project leader who had the energy to learn what standards exist in software, hardware, imaging, and colormanagement. The management of the institution set the necessary time aside for a dedicated approach, a wise decision from the start.

The necessary steps of planning and implementing a digital archive were taken in a very systematic way, and it is rare to watch such a process to be successful without too many loops.

The systematic process in phases like

- Imaging audit
- Analysis of needs
- Definition of objectives
- Conceptual phase, definition of systems specs and
- Partnering and implementation

is a must, since we are dealing with issues which cannot be bought from the shelf. Every database project is unique and must be tailormade to the user`s special needs.

4. The critical issues deal with the transition from analog to ditial technologies.

The project management at the Kantonsarchäologie which exhibits their objects in the Vindonissa Museum went through those steps and had to make several critical decisions such as:

- Decision of the appropriate **storage technology** (microfilm, duplication, digital).
- Definition of **search criteria**, reorganize and prepare the analog archive.
- Decision for the **fileformats, image size and colorspaces** which are closest to the "digital original".
- Specification of **software and hardware needs** for the total system, based on the existing systems infrastructure and within budget limits.
- Selection of **partners for imaging and systems software.**
- Decision for **to make or buy** the scanning process.

Of course at the start of the project in 1996 not all of these steps and investments could be foreseen since the experience was missing.

5. Database systems need to be filled with the "digital original".

The notion of the "digital original" was one of the most difficult ones to clarify. The imaging vendors and the software industry so far do not define standards for longtime archiving, they concentrate on the mass markets of publishing, printing, and recently for the internet. So, the existing standards had to be screened according to specifications which were defined internally and through the interchange with vendors and other institutions. These standards cannot be looked up in relevant dictionnaries.

So it was mandatory to define the images in a way that they would

- contain **all necessary detail** which is being stored already on film
- be defined in **a colorspace which is device independent**, an issue which is relatively new for the publishing industry, which once was percieved as leading in the "science" of color management
- be captured in **a filefomat which will be accepted as a standard for a long time** by all software vendors (incidentally, this comes close to the definition of longevitiy of a digitial imagefile)
- be easliy be integrated into all possible workflows with different computer systems, in other words have the characteristics of being **platform independend**.

What was essential for the success of the project, that is the supportive role of the administration of the Kantonsarchäologie, and the conviction that this technology would be key in further activities to use the documentation for scientific purposes, and for enhanced communication to the outside.

6. Project management and consulting are essential ingredients for success.

In cases where there is no systematic projectmanagement from the start, things will fail due to the inability to handle a complex situation, where many people are involved with many differing opinions, sometimes biased by certain vendors.

The conceptual work was accompanied by Image Management Solutions, a consulting initiative of Kodak with experience in the auditing and redefinition of workflows. Fundamentals of colormanagement were transferred as well.

It was like pathfinding at times, since one thing is true in installing database systems: there is no standard solution, and at the start of any database project stands the meticulous auditing of existing workflows and the profound definition of the strategic objectives.

Most of the work has been done, and the results obviously stand up to the most strategic requirement such as: Database systems should have an extremely long livecycle, and only be built under the implementation of standards.

August 1999

A brochure of the project in German with the title "**Spurensicherung**"can be ordered from **info@Image Management.de**

EVA 1999

THE PROJECT "THESES ONLINE" PUBLICATIONS BETWEEN SCIENCE AND LIBRARY

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The project "Theses Online" (Dissertationen Online), sponsered by the German Research Foundation (DFG) and initiated by a subgroup within the Initiative of the German Learned Societies for the Advancement of Digital Information and Collaboration ("IuK-Initiative"), started in spring 1998 and was terminated in March with a conference held in Jena, Germany. Funds for a second project year were granted by the DFG with a heavy emphasis on the collaboration with libraries and university computing centres, with research and development running from March 1999 to March 2000.

Among the learned societies involved in the project are chemistry, computer science, education, mathematics, and physics, involving five German universities. Participants in the second proposal are also computing centers, libraries and the German National Library (DDB).

Traditionally, in Germany every graduate student is obliged to publish his doctoral thesis, putting a heavy financial burden on young professionals. Unless the thesis is published by a well known publishing house, theses often are not easily accessible. Furthermore, retrieval by means of bibliographic sources will be combersome, if not impossible. With the advent of digital production, a convincing alternative model is being developed, using the Internet as means of dissipation as well as retrieval, thus making scientific research more productive.

The project evoked intensive communications between learned societies and libraries concerning a special type of scientific publication: theses. The discussions of the last year, which have gone far beyond valuable, but isolated single projects in the past, made meaning and consequences of electronic documents lastingly clear: Archiving and supply of research results laid down in theses do not any longer represent a mere act of administration of the libraries. Rather, under the conditions of modern electronic publication possibilities, archiving and protection of scientific work in electronic form as well as retrieving scientific information via "meta data" from digital sources necessitates the active participation and collaboration between learned societies, libraries and graduate students is indispensable.

The learned societies can bring in their demands regarding the graduation procedures and the search aspects necessary for the individual scientific subject and offer a fast and economic publication form to graduate students, enabling a quick world-wide dissimination of research findings. For libraries, a precise arrangement is necessary, defining the format of documents and meta data for different objectives: retrieval, reading, printing and archiving. The inclusion of the German National Library (DDB) in the project is also necessary, since this library is obligated legally to collect theses of the Federal Republic (also in electronic form) and have them accessible in years hence. Also, cooperation with publishing houses seems necessary. This was discussed at the Jena conference in March 1999.

At a time of rapid development within the area of electronic publication, coordination between the parties involved - faculties, computing centers, libraries, publishers – is indispensable. Coordinating the efforts of different learned societies by agreeing on common interdisciplinary, basic assumptions and by developing mutually acceptable concepts and solutions, will produce synergies and guarantee widespread acceptance.

For the scientific use of theses not only in the humanities and social sciencies, it is necessary to offer not only bibliographical metadata and full text but also structural information for retrieval purposes, such as

1. tables of content
2. headings of tables and graphs
3. reference to important contentwide terms (special index, name index etc.)
4. references (links) to external sources (printed as well as Web sources)
5. bibliography
6. references within the work
7. definitions
8. mathematical / chemical formulas
9. theses / hypotheses

These structural meta data are an integral part of the document and have to be defined by the author himself. At present, this predominantly takes place over formatting the text (e.g. headings, footnotes etc.). In order to be able to use these structural data also for a retrieval, they must be tagged as such by the author, either by the use of a structured language like LaTeX, or by "style sheets" as with WinWord.

The project is structured in several parts that together form an integral approach:

1. Metadata (Prof. Törner, Duisburg University)
   implementation of RDF
   adaptation of existing tools for the use of RDF
   implementation of DTD's
2. Retrieval (Prof. Hilf, Oldenburg University)
   installation of Harvest (broker&gatherer)
   distributed search engines
   searching in mathematical formulas
3. Formats (Dr. Schirmbacher, Humboldt University)
   converters from LaTeX to SGML/XML
   converting of an existing SGML-DTD to XML
4. Multimedia (Prof. Gasteiger, Erlangen University)
   creating of an easy-to-use toolset for libraries
   multimedia theses in medicine, mathematics, physics
5. Support (Prof. Diepold, Humboldt University)
   tutorial system for graduate students
   supporting information for several groups (faculties, libraries, universities etc.)
   web pages and CD-ROM as basic information
6. Libraries (Dr. Niggemann, DDB; Prof. Mittler, Göttingen University)
   test of products from the research groups in libraries
   discussion with libraries
   connect to libraries
   problems of long term archiving
   metadata and RDF

On the basis of the experiences, which were already made within the two projects

"digital theses" (http://dochost.rz.hu-berlin.de/epdiss) and
"theses online" (http://www.educat.hu-berlin.de/diss_online/index.html)

at the Humboldt university Berlin, the following areas are to be discussed:

1. file formats for electronic publishing,
2. authors and science,
3. retrieval possibilities in electronic documents,
4. problems of authenticity and integrity of documents,

File formats for electronic publishing

The question about file formats, which are usable for university libraries for electronic publications and from it the following recommendations became within the last two to three years in most diverse places extensively discussed. Therefore it is referred here to well-known publications in Germany ([Ohst 1999a] [Ohst 1998b], [Schirmbacher 1998b], [DiML-Dokumentation1.0]), and the recommendations of the DDB regarding this topic.[1]

At the Humboldt university[2] chiefly two arguments led to the use of SGML (see [Rieger 1995], [Goldfarb 1990]) and/or XML (see [Behme/Mintert 1998]), to select SGML/XML as the best suitable file format for electronic publications. That is on the one hand the argument of long-term archiving and to the second that of retrieval.

Long-term archiving

By its availability on different hardware platforms, the independence from operating systems as well as its convertibility into other data formats (presentations, print and retrieval formats) without lost of data and the associated freely selectable presentation according to contents as well as the standardisation by an independent, international committee SGML/XML is regarded as the format, which guarantees the best legibility in future decades and is best suited for archiving.

Retrieval

By its defined structure SGML/XML is particularly well suitable for the search in a large set of documents of same type. Thus goal-more exact information searches become possible,[3] since the knowledge structures can be standardized here over the quantity of the documents which can be administered. A condition here is the structuring of the text into semantic and semisemantic units.

Another argument for the use of a SGML based publication concept is the possibility of the use and/or the integration of multimedia elements.

Authors and science

Theses are originally not intended for an electronic publication by graduate students; even today the production of a paper copy is the center of attention; therefore the authors use the same text processing systems for the production of the digital publication as for the production of the printout. The most usual systems are different versions of Microsoft Office, Corel WordPerfect, Star Office or, in special fields, LaTeX. These programs store texts usually in proprietary file formats, which are not in WWW readable formats. In order to provide from these proprietary file formats electronic publications for the use in the WWW, it requires a process, if the electronic

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[1] http://deposit.ddb.de/formate.htm, Stand: 03.05.1999

[2] And other universities like the Virginia Polytechnic Institute and State University (http://etd.vt.edu), University of Montreal (http://www.pum.umontreal.ca/theses/), University of Iowa (http://vedavid.org/diss/), Helsinki University of Technology (http://www.hut.fi/Yksikot/Kirjasto/HUTpubl/), University of Lyon 2 (http://iep.univ-lyon2.fr/IEP/Recherche/theses.html)

[3] Similar attempts are made in the Global-Info-Program "Carmen - ein integriertes Hypertext- und Informations-Retrieval-System für digitale Bibliotheken" by Norbert Fuhr, University Dortmund.

publication isn't limited to the production of a PDF or a Postscript file. This process must take place on one hand by the author himself distinguishing certain parts of the text as heading, register term etc. and also assigning some meta data, and on the other hand by the library or the computing centre, if the text is converted into a archive/presentation format. The libraries also catalogue the text according to the appropriate sets of rules, report to the DDB etc.. Parts of these steps can be automated if in the processing of texts the necessary precautions was met: e.g. production of the so called "Katalogisat" from the meta data and the production of a presentation format for the Internet.

If the high claims of quality for retrieval and archiving are keped it is necessary however to train the authors as early as possible and make them familiar with basic questions and problems of electronic publishing.

The work, once invested into the development of certain tools and into the processing of texts itself, is however not end in itself of libraries, computing centres or even the authors. The profound development, which stands among other things at the end of this work, serves also the science by a quicker access to thesis, and better searchability. By the creation of meta informations (registers, tables, formulas) in the research various possibilities of the search, which are in a printed text today only heavily or not at all possible. In addition there is the possibility to integrate not only multimedia elements (sound, picture, video etc..) into a scientific work, but also to search such elements, as soon as these elements are tagged as multimedia.

Retrieval in structured documents

At present a usual search practice in libraries plans that a search can happen purposefully only in the information taken up in the (online) catalogues of the library. These informations are provided according to an appropriate set of rules and is stored in a data base system. The search can access only the text, which is in the title, and/or appropriate contents-opening components such as classifications.

With resources electronically available frequently a full text indexation is offered. However in the decade of the Internet it has the consequence that the hit rate of such systems is extremely high and the relevance of the found information for the user becomes ever smaller. Newer standardisations within the range of the meta data retrieval of electronic resources, as the development of the Dublin core set[4], give the possibilities to look for further meta information in electronic documents and to bring these information itself into the documents, which are then usable over the WWW for search machines. A WWW based search in a DC meta data of the HTML documents, because the meta data are currently used only there, limit the search area and the hit rate already purposefully.

Full texts however contain further components, which, as the meta data of the first page, describe the contents. These elements must be marked by the author himself intellectually by semantic and structure-describing tags: as headings, tables, indices, and bibliographies.

Protection of the authenticity and integrity of the data

The protection of electronic documents can be regarded under the following criteria, as they were among other things already represented in [Ohst 1998b].

Physical preservation

A substantial task of a document server is the protection of the physical integrity of the documents. For this a detailed backup and archiving concept belongs. For the preservation of the documents different media (e.g. CD-ROM, MO) are to be used. As the documents on the server must be protected against illegal manipulation, also the backups must become secured.

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[4] http://www.oclc.org/oclc/research/projects/core/index.htm

Access protection

The access protection of digital documents represents the basis for further safeguard concepts. So there can be a limited access to the document server to a certain user circle. This can be achieved by relatively simple procedures, e.g. via the use of IP filters or by the assignment of access accounts and passwords. Technical solutions of this safety problems in the Internet are digital certificates, see [Geschonneck 1998], [HU-CA], and special security protocols such as SSL, see [SSL Specification].

Authenticity and integrity

In order to be able to ensure a durable archiving, an protection of the integrity of the document server and the deposited documents is indispensable. While a conventional publication ensures a relatively good protection by the adjustment on the medium paper digital documents can be copied more easily or changed substantially. With electronic theses author, contents and publication time of the documents must be protected conclusive against falsification and doubts about the authenticity. In addition cryptographic concepts as digital signatures (see in addition [Fox 1997], [to Welsh 1991]) and water-marks, see [ACM Security Workshop 1998] are to be applied. By these characteristics integrated into the documents the origin of the documents at each time can be reconstructed.

License management

For some documents it can be meaningful to limit the number of simultaneous accesses e.g. for copyright reasons. For this the use of a license management is necessary. Also the collection of fees for reading from full texts is perspectively surely conceivable. Here procedures are to be used, which permit a detailed account. Paragraph or access protection by page could support certain sales concepts, then a user e.g. free reading of the first chapter of a document could be permitted, while further chapters require the payment of a fee.

Result

Within the range of the digital university publications, particularly electronic theses, new tasks come both to libraries and to computing centres. It is an area, which makes changes in the scope of duties very clear and clarifies the necessity for a change in the past work of these two facilities. Further one can read in [Schirmbacher 1998a] that there are in Germany several initiatives of these service facilities taking the altered tasks into account.

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MULTIMEDIA MANAGEMENT AT 'DIE DEUTSCHE BIBLIOTHEK'

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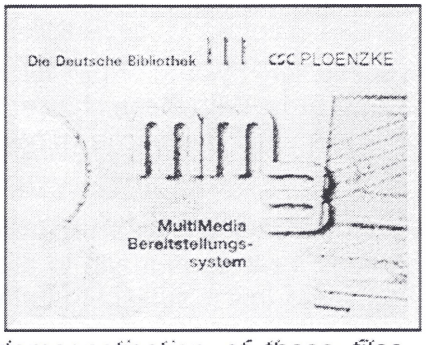
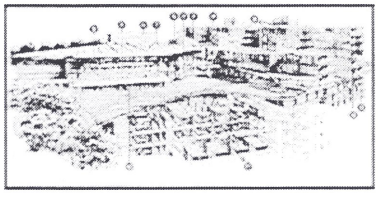
"Science and commerce are using up to date information material. Today this comprises especially electronic publications and multimedia. The acceptance of these in large scale digital archives depends strongly on the fast and reliable access, the direct and combined possibility of presentation and document usage and the inter system compatibility in the global network. The MMB system comprises excellent preconditions for all these."
Professor Klaus-Dieter Lehmann
General Director
Die Deutsche Bibliothek



The Library

'Die Deutsche Bibliothek', with sites in Leipzig, Frankfurt/Main and Berlin is committed by federal law to collect all German publications or publications translated in the German language, to provide public access and to perform the long-term deposit of these publications. This commitment also covers video and audio material, music sources and colour slides, and very recently the rapidly increasing number of more and more important electronic publications. Due to the risk of demagnetisation of these files, and especially the publications and accompanying media on diskettes, it is necessary to transform the information/data onto longer lasting media for archiving.

The Project



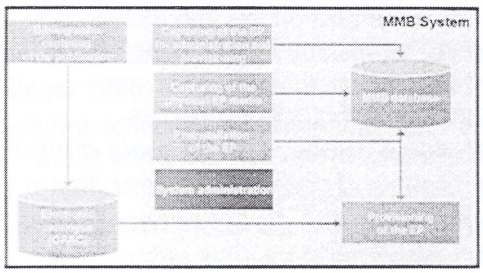
The Frankfurt site is responsible for the access to the electronic publications of the library. Together with the opening of the new building in may 1997, a newly Multimedia Management System, developed by CSC PLOENZKE, was put into service. This MMB System, which is fully integrated into the IT infrastructure of the library, utilises the internet protocol for the transport of the large data volumes on the basis of an ATM net work. The System contains roughly 50 multimedia workstations, 40 of these are publicly available in a multimedia reading room.

The System supports entry, administration and access to the electronic publications and also for conventional publications, which are provided in digitised form. It doesn't matter anymore what kind of data carrier (CD ROM, Diskette, online or in future DVD) or which format (proprietary, standard or de facto standard) is used for the publications. The long term archiving of endangered publications is performed on CD-R. In this way it is possible to administrate electronic publications, films, colour slide series, archived journals and other documentations as digital objects in a unified way and provide access to these publications with a standardised user interface.

The user interface is a typical Internet based web browser lay-out. Via an extended version of Microsoft's Internet Explorer, users can access the information via an online catalogue, which

introduces an overview of all archived material in the library, and - as far as these publications are installed/available in the MMB system - access the selected publications immediately. Original published documents on diskettes, actual publications on CD-ROM, colour slide series and digitised material are accessible with a mouse click. All necessary installation procedures for the presentation of the publication are running in the background and so invisible for the user.

From the users perspective



'Die Deutsche Bibliothek' provides two different kinds of system usage to their visitors:

1. Anonymous users: In the normal framework of the overall library usage, these users also have the right to access the system of preinstalled publications and are allowed to use the print and export facilities for pictures and texts at the self service print and export workstations.

2. Registered users: These users have additionally access to a private long term workspace. They are allowed to use the Internet and to use the functions to request access to electronic publications which are not preinstalled (ad hoc installation). This user class is also entitled to store excerpts of publications in their personal workspace and - in a later version of the system - to create and maintain their own documents.

The workstations of the MMB system are fully integrated into the accounting system of the library. Library users can book amounts of money onto their library usage chipcards. With these chipcards, users are able to pay the different service offerings, from carbon copies and microfiche prints to printouts and data export of the MMB system.

Users at the offices Leipzig and Berlin can access the MMB system in Frankfurt via an Extranet based on a high speed network between these locations. Preparations have been made to allow internet access to the preinstalled publications of the system; nevertheless this is subject to further clarification of copyrights and payment regulations.

The MMB system also provides improved facilities for the employees of ' Die Deutsche Bibliothek', Eelectronic publications, which are necessary for the daily work of the librarians, will be accessible from the workstations. Furthermore, the facility of a temporary installation of the material will improve the precision of the bibliographic information to be entered into the catalogue system.

From the Developers perspective

A special feature of the MMB system is to provide access to a broad variety of publications as there is still lack of standardisation and/or conventions for the structure and construction of electronic publications. The archived material, which is digitised by the library itself can be prepared in a uniform way. Publications on CD ROM are mostly accompanied by their own presentation software. Depending on the date of issue, these publications have quite different requirements regarding the operating system, software drivers and supporting hardware of the workstations.

With the past special experience of CSC PLOENZKE Logistic Information Systems Munich in the development of technical documentation systems, it was possible to develop a universal approach for the automatic installation and deinstallation of the electronic publication over the network. *"Our intention is to comfortably protect users from the nasty technical requirements by using the right technology"* explains Rainer Kuhn, manager of the unit Logistic Information Systems, the focal point of the project team.

The key Concept for everything: Preinstallation

Together with the initial entry of the bibliographic information of the publication a preinstallation of the publication is performed. All details of this installation are recorded in an installation script. When later on a publication is requested by a user the installation script is replayed on this workstation to equip the users workstation with all modules, files and registry amendments that were necessary during the preinstallation of the document or the application. After this step is finished, the data and the corresponding presentation program are loaded. This procedure runs fully automatically for standard PCs with Intel hardware and operating system of the windows family.

A well defined mechanism is implemented, to put the workstation back into it's basic configuration under specific circumstances if this deemed to be necessary. For this purpose the initial configuration of the workstation is copied as an image into an additional partition of the workstations hard disk. If necessary this image is automatically copied back to the boot partition and the workstation is rebooted under it's initial configuration. The saved image can also be used to update other workstations with a modified version of the initial configuration. The initial configuration of the workstation can always be amended.

Demand driven access categories

The expectations of the users, regarding the availability of publications and the technical possibilities, is perfectly balanced with the limitations of the systems storage capacities in a four step concept of media storage.

1. The most often requested publications (currently several hundred) are imported as images on a RAID system with at the moment 250 GB capacity and are accessible from this RAID system. The MMB media server controls all activities to convert all necessary data from the original carriers (primarily CD ROM) onto the RAID system.

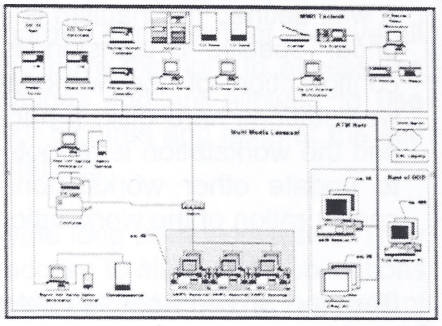
2. Other frequently requested publications are held in jukeboxes with approximately 150 slots and are permanently available on demand of the users. Due to the positive development of the price/performance ratio of today's RAID systems, it is subject to further analysis, whether the initially planned capacity of 1000 jukebox slots will be installed. Meanwhile, the much more favoured RAID systems do not only work with a much higher transfer rate - but also allow a performance access to the publications of parallel access of different users - provided that this is not restricted due to licence regulations.
Scalability and flexibility play a major role in the architectural design of the system. Therefor it wouldn't be a major operation to meet future capacity needs of the system. Both categories of electronic publications are automatically installed on the users workstation using the pre-recorded installation scripts.

3. Individual electronic publications, more rarely requested by the users, are taken out of the archive manually and - depending on the type of data carrier - imported into the corresponding media server subsystem. The user is given access to the electronic publication across the ATM network. Currently the system deals with three major media server components: CD ROM server (currently 28 drives) CD ROM Jukeboxes and the RAID system mentioned previous. In this case the temporary installation of the individually and exclusively provided electronic publication is done by the user himself on his workstation.
EPs of all three categories are available on all multimedia workstations of the network. Each usage case and the respective user behaviour is anonymously recorded, depending on the type of access category, for the purpose of statistical analysis. The result of this statistical analysis safeguards that each electronic publication is held in the right access category and the system can be optimised and extended to satisfy the requests of the users.

4. Such electronic publications which cannot be installed within the MMB system- e.g. due to copy protection mechanisms - are provided to the users under especially configured single user workstations.

The Infrastructure

The basic communication infrastructure at 'Die Deutsche Bibliothek' is an ATM Network to which all components of the MMB system are connected. Devices with a broader demand of bandwidth like for instance the RAID server, all Jukebox servers, CD writer, CD servers and the database server, are connected to the backbone via



155MBit adapters. All servers operate under Windows NT 4.0 and Microsoft BackOffice. The database system SQL Server is the central element for all administrative data management. Corner stone of the access to the database is an object oriented class library developed by CSC PLOENZKE in the scope of other projects. This class library reflects the experience of CSC PLOENZKE out of several industrial projects. The object oriented approach supports the distribution of the various server functions onto several powerful pieces of server hardware and therefore leads to a high degree of scalability of the system.

In the first version of the system the various server functions are mapped onto two powerful servers. One server runs the database service, the WWW-service and the full text index service. The other server is purely used as data and communication server.

During the architectural design of the software requirements fault tolerance and robustness were playing a major role. Important for the daily work for instance is, that all user and employee workstations can continue to work even under short term breakdown conditions of single system components.

The workstations in the reading room of 'Die Deutsche Bibliothek' are operating under Windows 95 to ensure compatibility as high as possible with all currently available multimedia applications. Especially video and audio applications which are reaching the upper class limits of multimedia hardware, are currently best supported by Windows 95.

The workstations of the employees at 'Die Deutsche Bibliothek' are operated under Windows NT. With the introduction of version 2 of the MMB system in autumn 1998, employees - in the course of their daily work - are able to access all electronic publications managed by the MMB system, provided these are tested to run free of problems under Windows NT.

The way ahead

The overall IT project at 'Die Deutsche Bibliothek' was split into three connected projects: the network infrastructure, the workstations and the multi media management system. Management of the overall project and the handling of the interfaces between the different partners was performed by the ADP department of 'Die Deutsche Bibliothek'. In a strong competition, the contract for the production of the multimedia management system was awarded to CSC PLOENZKE. Winning points during the evaluation of the different vendor proposals that lead to the selection of CSC PLOENZKE were the following underlying concepts

- Windows NT as server operating system and Windows 95 as operating system for the multimedia workstations in the reading room,

- a relational database system as the reliable basis for the client server data management and

- the planning and implementation of the system using object oriented models and methodologies

and the large scale of experiences and references of CSC PLOENZKE as a professional IT service provider. These properties fulfilled the requirements of 'Die Deutsche Bibliothek' to a very high degree.

The system is in production since the 15th May 1997 - the day of the ceremonial opening of the new library building - and fullfils the expectations of the library in terms of scalability, integration into the existing installation and future developments as far as this is possible in an area of such an innovative movement.

Peter Schmich - the project manager of the system at CSC PLOENZKE- summarises his project experiences as follows:

"In a joint endeavour 'Die Deutsche Bibliothek' and CSC PLOENZKE succeeded to deliver a remarkable and innovative solution for the challenges of the multimedia era in the library area"

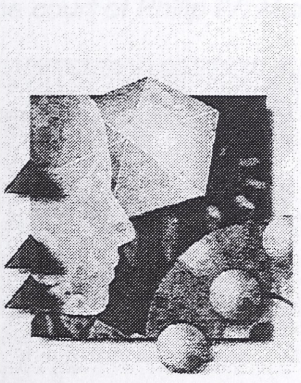
With the additional experiences gained in the design and implementation of distributed systems, incorporating modern internet technology, CSC PLOENZKE will launch new projects in the areas of libraries, museums and - last but not least also in the industrial business domain.

'Die Deutsche Bibliothek' and CSC PLOENZKE have signed an agreement for the joint marketing of the MMB system to use the MMB system as a sound basis for future challenges in the business area of libraries.

In the European project "Networked European Deposit Libraries (NEDLIB)" 'Die Deutsche Bibliothek' and CSC PLOENZKE together with other important European national libraries and state archives, have started to develop joint solutions for long term archiving and access of electronic publications. The MMB system is considered as a remarkable corner stone for the intended development by all partners involved.

Point of contact:

CSC PLOENZKE



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Artchannel. Video content on the web.
Live Webcasts at the Kunst- und Ausstellungshalle der Bundesrepublik Deutschland - Bonn, Germany

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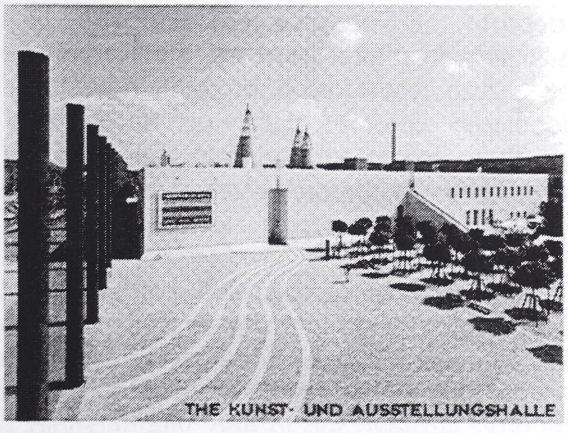
Within this written report I will present the work of the Kunst- und Ausstellungshalle in the field of live web broadcasting. It represents the status of early 1999. More recent experiences and projects will be presented during the EVA conference session - including an outlook about video on demand projects for the year 2000 - Artchannel.

Introduction

"The programme of the Kunst- und Ausstellungshalle is based on a broad concept of culture which alongside art and cultural history also includes the fields of science and technology. The institution has the task of presenting intellectual and cultural developments of national and international significance in visual form and promoting dialogue between leading figures from the fields of art, culture and intellectual life, as well as from the field of politics.".

When the Kunst- und Ausstellungshalle was founded in 1989, as can already be seen in the quotation from the Memorandum of Association, the possibilities and fields of activity were broadly defined. Since the opening of the exhibition hall in 1992, exhibitions 74, 75 and 76 are presently on display in Bonn: *"Orinoko-Parima - Indian societies in Venezuela. The Cisneros Collection"*, *"Alexander von Humboldt. Networks of Knowledge"* and *"Velasquez, Rubens, Lorrain. Painting at the court of Philip IV. Museo Nacional del Prado in Bonn."* (http://www.kah-bonn.de/a/ae.htm).



The breadth of the spectrum of exhibitions produced is matched by the variety of the side events arranged to tie in with the exhibitions and events, which are staged in the premises in and around the Kunsthalle. One example was the idea of showing a film retrospective on the major Louis Buñuel exhibition in 1994 in the Forum, a multi-purpose event venue in the exhibition hall, while the exhibition was running, whilst at the same time a whole host of the most varied events is organised, quite separate from the exhibition programme.

Simply in order to underline the variety of these events, I shall mention just some representative examples: a several-part series of international conferences on the "five senses" was organised from 1993 to 1997, the European Film Music Biennial will be staged in the Kunsthalle this year for the second time (http://www.kah-bonn.de/i/forume.htm), cooperation projects with the opera and theatre in Bonn has led to numerous productions and premières in the Forum of the exhibition hall - thus, all in all, the Kunsthalle has developed into a "cultural centre" over the past few years. The Kunsthalle's main activity is and remains exhibition work, however over and above this, it has

become a place for every kind of fine and performing art and culture - not to mention the more than 300 events put on by outside organisers every year in premises rented from the Kunsthalle.

Basic requirements: Internet, TV studio



All these activities have also been mirrored on the Kunsthalle Website since 1996 (http://www.kah-bonn.de). This is where, over the course of the years, a comprehensive archive of well over 1600 pages and 3500 images has been built up, now covering almost 40 exhibitions and countless events. When the Kunsthalle first went online, a mere 20 German and English pages were produced with some images from the exhibition. Since then the use of the medium of the Internet has gradually spread to all areas of multimedia. Nowadays, besides detailed information on every exhibition in the form of texts and images, you will also find videos from the exhibition galleries (e.g. http://www.kah-bonn.de/1/24/1e.htm), 360 degree panoramic views (QuickTime VR, e.g. http://www.kah-bonn.de/1/25/1e.htm) and digitised versions of the audio guided tours (e.g. http://www.kah-bonn.de/1/20/move.htm).

In this way the Kunsthalle is trying to transport its activities and the results of its projects into the outside world via the medium of the Internet. The possibilities used thus extend far beyond those of traditional media such as the exhibition catalogue, folders or teaching materials, and also naturally complement the institution's promotional activities as part of its press and media relations work.



Another "reasonable" requirement for carrying out the projects described below was fulfilled from within the structure of the Kunst- und Ausstellungshalle. The Kunsthalle is one of the few museums/exhibition halls which have a department for television and video productions with its own studio. High-quality films on important exhibitions are regularly produced in-house, and the many events in the Kunsthalle are documented by this department. These productions are in turn made available in digital form via the Kunsthalle Website (http://www.kah-bonn.de/ei/move.htm). The videos can either be called up 'on demand' online or they are integrated into the KAH TV channel programme line-up, which is updated on a daily basis (http://www.kah-bonn.de/cgi-bin/tv/tve.cgi).

The existing digital videos were compressed into Quicktime Movies format by 1997 - with different resolutions and levels of quality. Since 1998 a RealNetworks RealServer (http://www.real.com) has been installed on the Kunsthalle Webserver, so that most of the Kunsthalle's video and audio data are now produced in formats for the popular RealPlayer - the technical details will be discussed at greater length below.

The existence of the department for television and video productions, with a broadcast standard television studio, three cameras, sound technician, camera man and production manager, is a basic requirement for the online projects described below. Without the in-house studio, the recordings could either not have been produced at all or could not have been produced to such high quality. The financial means to hire external camera teams would not have been available.

First project idea, the "open-air season"



Every summer since 1997 a four-day "MuseumsMeilenFest" ("Museum Mile Festival") is celebrated on the square in front of the Kunst- und Ausstellungshalle, a square which architecturally both separates and connects the Kunsthalle with the Kunstmuseum der Stadt Bonn, the Art Museum of the City of Bonn, situated opposite. Open days at five museums in Bonn give free entrance to all collections, exhibitions and events. Children's events, concerts, cabaret - on these days a wide variety of entertainment is offered by all the museums involved. The "MuseumsMeilen-Fest" also always marks the start of a long series of concerts which are given throughout the summer on this square under the "floating" marquee structure erected for this purpose. In 1996 Laurie Anderson opened this new series of concerts. Since then the stage on the Museumsplatz square has become an established venue in the programme of many concert organisers. Classical concerts are also given there, as well as rock and pop acts. Well over 100 concerts have been organised over the last two summers and up to 9000 visitors have come to Bonn for individual concerts (the list of artists ranges from Nick Cave via Van Morrison, Tori Amos, Kool and the Gang, CCR and Shirley Bassey through to the Bee Gees).

Having such an attractive event "on our doorstep" led to the idea of trying to make use of the technical possibilities described above and to plan a live broadcast of one of these events on the Internet. This is consistent with the concept of maintaining and extending the Internet services of the Kunsthalle, not simply extending the structure of existing categories, but rather installing an ever increasing number of new areas onto the server, and using new technologies as means of communication - depending on how appropriate and suitable this is for the content in question, and how feasible this is using the financial and staff resources of the Kunsthalle team, and possibly also outside employees.

EVENT 1

In February 1998 I met with the Manager for Central Europe at RealNetworks, which was then market leader for video broadcasting software and video servers for the Internet, at the MILIA in Cannes. RealNetworks was very interested in a cooperation project with the Kunsthalle, in particular once the concert programme for summer 1998 was published - RealNetworks had just then opened a new branch in Hamburg. They were therefore very interested in contacts within Germany and offered support for our projects.

Coincidentally, one of our external Web employees was responsible for the Website of the record group EMI-Electrola (Cologne). Through him contact was established in March 1998 with the manager for new media at EMI, who also showed great interest in cooperation with the Kunsthalle in the area of the Internet. A look at the coming events and concerts scheduled for summer '98 in the Kunsthalle revealed that a female artist, under contract with EMI, was to be playing on 22 June 1998 on the Museumsplatz square in front of the Kunsthalle: Vanessa Mae, a violinist trained in classical music who specialises in performing pop classics.

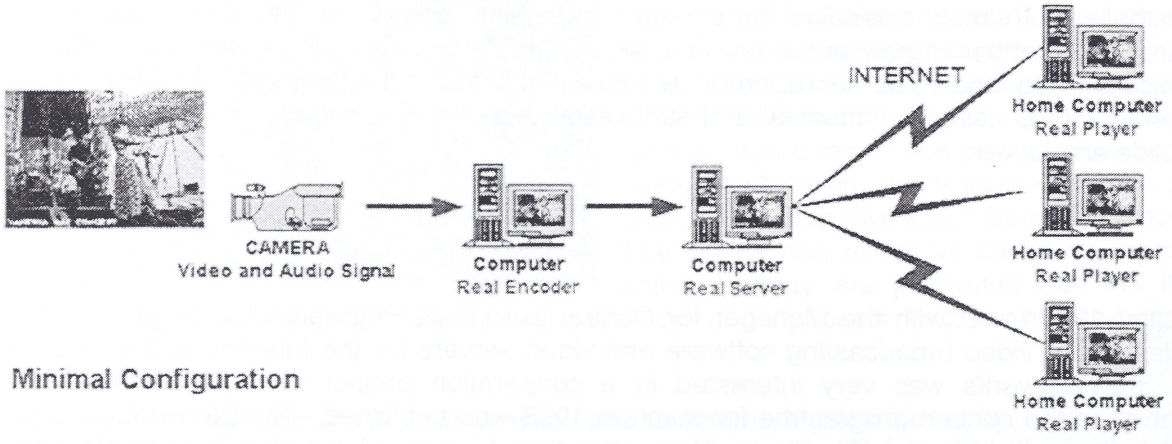
Our common aim in making this choice was first and foremost to test the technology under what for us was a new set of conditions, to subject the equipment of the Kunsthalle and of EMI in Cologne to this "test" and to study how a live broadcast of this nature on the Internet would be received. This was to be a first attempt which, if successful, would be followed by further live events.

Negotiations

The tasks over the coming weeks were to be divided as follows: within his own company the person responsible for the Internet at EMI first had to convince Vanessa Mae's product manager about our project. The product manager in turn had to negotiate with Vanessa Mae's manager, her mother, in order to be given the rights for carrying out the broadcast. Within the Kunsthalle, a deadline and project schedule had to be drawn up together with the department for television and video productions, advertising measures and press announcements had to be discussed with the Press and Media Relations department and finally the technical implementation had to be discussed in detail with EMI.

Minimum requirements for a live broadcast using RealNetworks technology

Before I describe the configuration actually implemented and the progress of the project, I would like briefly to mention RealVideo technology and illustrate the minimum configuration by means of a diagram - since, as is so often the case with computer-based applications, the principle can be very simple, but in putting the project into practice, however, much more complex requirements arise. At this point I shall confine myself to a description of RealNetworks technology not only because this is what we used at all three events, but also because, with a market share of over 85%, it is the most widespread streaming technology (see appendix for information about "streaming" and other streaming products).

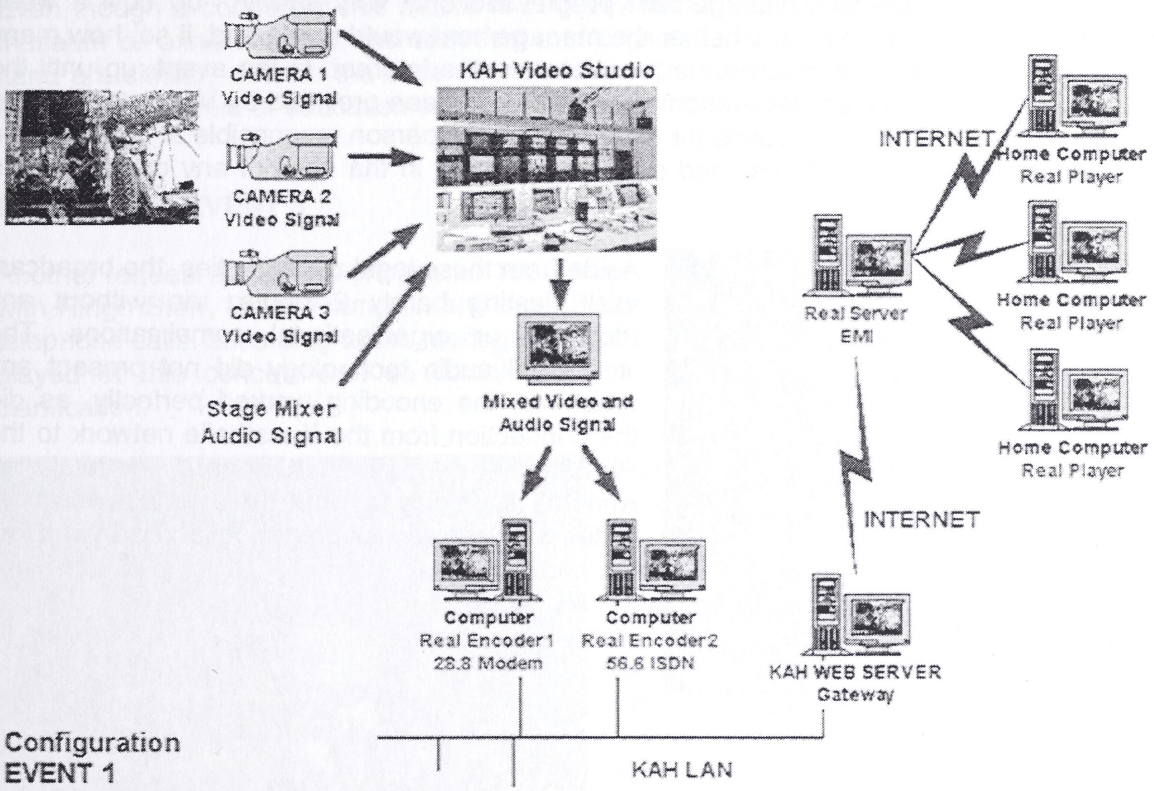


Minimal Configuration

In order to broadcast sound and images live on the Internet, the following equipment represents a minimum requirement: video camera (with internal or external microphone, mono or stereo) - the output of the video camera is connected to the video input of a computer graphic card - the audio signal of the camera is connected to the audio input of the computer sound card - the "RealEncoder" software (basic version available as freeware) is active on the computer - the computer is connected to a second computer via a modem or network - the RealServer software is installed on this second computer (available in various scaleable versions). The RealServer must be accessible via the Internet, so the RealServer software is typically installed on a Webserver, or is also connected to the Internet like a Webserver via a permanent connection.

The live signal is thus produced by the camera and the microphones, digitised and compressed in the RealEncoder and transmitted by the RealEncoder to the RealServer. Every RealPlayer - the small programme which Internet users need in order to view the images - can connect to the RealServer and establish a signal path. The RealPlayer then receives the transmitted images live and non-stop from this connection (in actual fact over the entire path, the signal is delayed by a total of between 5 and 20 seconds).

When realising the Kunsthalle's first live event, the minimum requirements described above were exceeded in some areas. It became clear to us that in order to achieve image and sound material recorded and edited to professional quality standards, it was necessary to work with three cameras. In contrast to the efforts required for video images, in this instance it is relatively easy to achieve an audio signal of professional quality: the signal can be fed out of the audiomixer of the amplifying equipment and into the video studio. This is where all three video images are edited live and transmitted to the computers for digitisation together with the stereo sound. Together with EMI, we decided to perform two separate digitisations simultaneously, in order to be able to provide the optimal bandwidth and quality of signal for users of relatively slow modems, as well as for users of ISDN lines.



Configuration
EVENT 1

Nowadays encoding technology is already a step further: using the so-called G2 technology from RealNetworks, only a single broadband signal needs to be produced. The RealPlayer of the "end user" and the relevant RealServer automatically agree on the optimal rate of transmission in each individual case. Using these new software versions, it is then no longer necessary to work with more than one encoding computer, as was still the case when our event was produced.

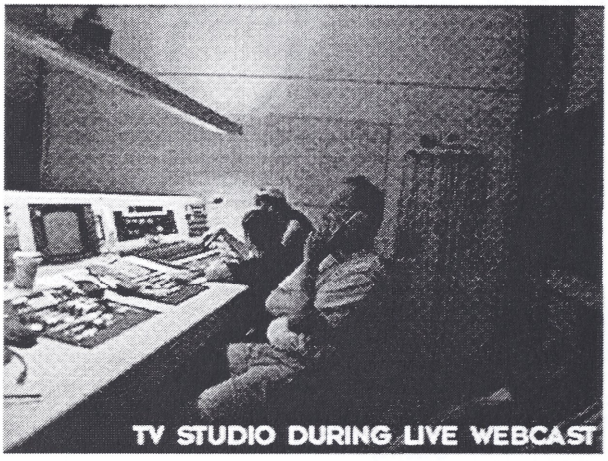
Since, although the Kunsthalle has its own permanent Internet connection, this has a bandwidth of only 128 KB, the RealServer for our project had to be installed at EMI, which had a 2 MB connection. Bandwidth is one of the most important requirements for transmitting "streaming video": every user who establishes a connection to the RealServer from their PC, requires the bandwidth with which the signal was encoded - for the entire duration of the connection. If, for example, the video and audio signals when encoded together require a bandwidth of 20 KB (for

slow 28.8 KB modems), our 128 KB permanent connection would be at full capacity with between 5 and 6 users connected at any given time (6 x 20 = 120 KB).

Since it was clear from the very start that the Kunsthalle, for financial reasons, could only cover the costs of the part of the project carried out by its own in-house staff and could only hire additional staff for the video work (cable carriers, image controller, cameramen), the responsibilities were divided as follows:

Public Relations	Kunsthalle and EMI
Negotiations with the artist	EMI
Extra fee for artist	EMI
Copyright clarification	EMI
Television and video technology	Kunsthalle, 3 camera teams, video editing, image control
Video encoding	EMI in the Kunsthalle studio
Video streaming	Kunsthalle (from Kunsthalle to EMI)
RealServer	EMI

Negotiations with Vanessa Mae's management progressed only very slowly - up until a week before the concert it was still not clear whether the management would agree and, if so, how many songs in the concert would be allowed to be broadcast on the Internet. In the event, up until the evening of the concert, no written declaration of consent had been provided by Vanessa Mae, so that it became necessary for legal reasons for us to request the person responsible at EMI to make a written declaration in which EMI assumed sole responsibility in the case of any compensation claims.


TV STUDIO DURING LIVE WEBCAST

Aside from these legal uncertainties, the broadcast itself, lasting barely 2 hours, ran without any technical or organisational complications. The video and audio technology did not present any problems, the encoding worked perfectly, as did the connection from the Kunsthalle network to the RealServer at EMI in Cologne. In total ten Kunsthalle employees and three employees from EMI were involved in preparing and carrying out the live broadcast.

Conclusions from event 1

Later statistical evaluation showed that about 900 people had wanted to follow the event live on the Internet (the number of "hits" on the event login page; http://www.kah-bonn.de/ei/vanessae.htm) - the evaluation of the statistics on the RealServer at EMI on the following day indicates, however, that during the two-hour broadcast only about 250 people were able to actually establish a connection to the EMI RealServer. The server was at the limit of its capacity with 2 MB of Internet traffic. As has been mentioned previously, streaming technology is extremely bandwidth-intensive - i.e. with 2 MB bandwidth, a maximum of approx. 80 people can access the server at any one time.

This statistic was clearly unsatisfactory in relation to the work generated by this production. People from over 15 different countries were able to follow the concert, and there were many positive e-mails before and after the concert. Nevertheless, on this occasion there was definitely a disproportionate relationship between effort made and the "viewing figures" achieved. For EMI and

the Kunsthalle it was a pilot project and therefore an important experience from which there are appropriate lessons to be learned.

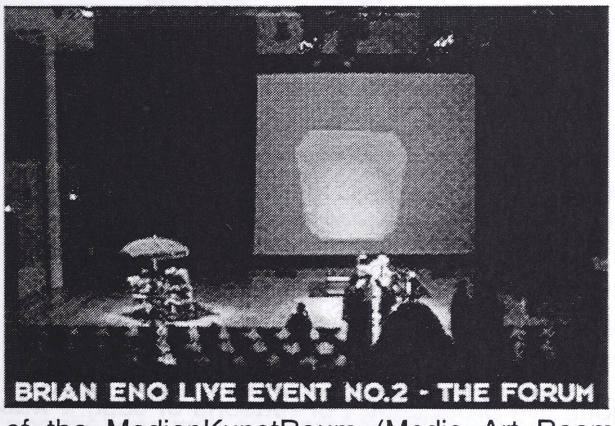
If there were to be further live broadcasts from the Kunsthalle, it would be necessary to provide greater bandwidth, the broadcasting rights would have to be secured at an early stage and the recording should, if possible, also be accessible on the server of the Kunsthalle once the live broadcast was over, so that the public would also benefit from the work which was invested after the event. Increased demand addressed to the artist's management led to the strict ruling out of any repetition of the broadcast.

Last but not least, the television team also learned lessons from this experience: for Internet broadcasting, picture production and picture editing must be carried out in a fundamentally different way than for television recording. Since bandwidth constraints mean that the RealPlayer video image is not much bigger than a postage stamp, it is completely redundant to blend shots, and fast pans and zooms cannot be recognised. The editing has to be clear-cut and the camera work must fundamentally be calm and slow. Close-ups are better than wide-angle panoramic views, long-distance shots are better than wide-angle shots.

Even though a concert of this nature is certainly not an everyday event in the "working life" of a museum or exhibition hall, the technical and organisational problems encountered and tasks at hand are similar, even in the case of a performance, a classical concert, a press conference, an event from the field of education or science or an event from the field of media art.

EVENT 2 and EVENT 3

Another request at the end of summer 1998, involving broadcasting a concert on the same location with Ringo Starr, Peter Frampton and Jack Bruce, produced a negative result within the first few telephone calls: according to the management, the copyright situation in relation to the songs to be played at this concert was so complicated that it would be better to avoid any attempt at clarification.



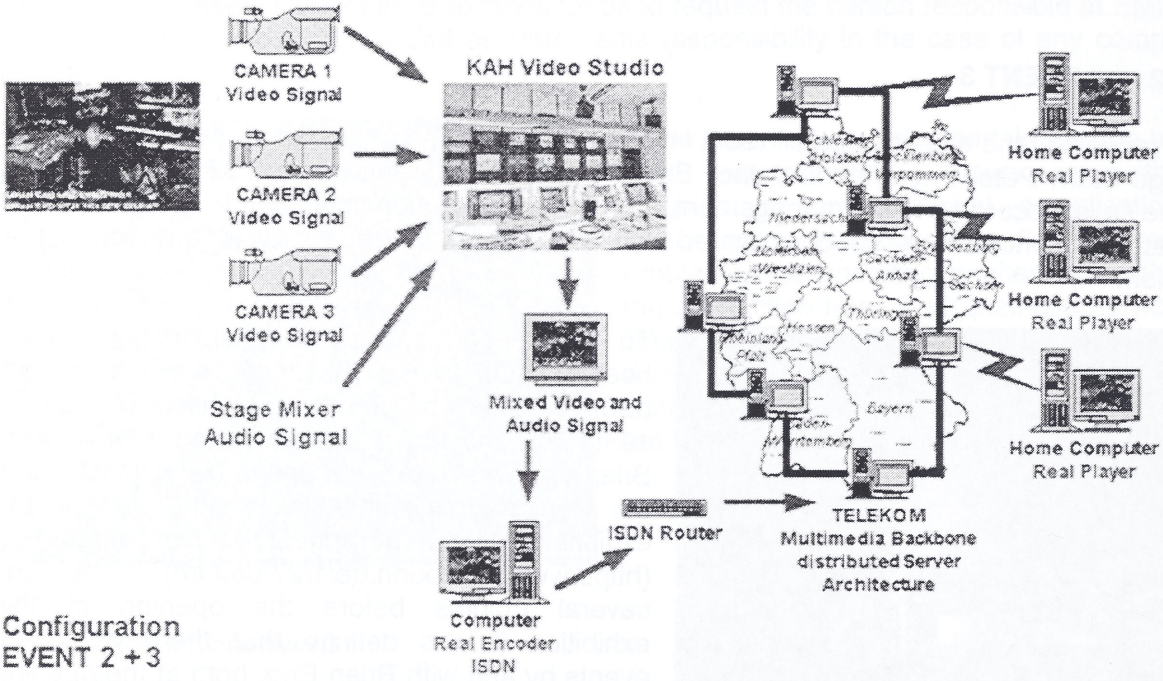
The programme of media art exhibitions which has been running in the Kunsthalle since 1992 did, however, offer one promising highlight for autumn 1998: the musician, producer and media artist Brian Eno was to present one of his installations in the MedienKunstRaum (Media Art Room) in the exhibition hall from 28 August to 8 November 1998 (http://www.kah-bonn.de/1/27/0e.htm). Already several months before the opening of this exhibition it was definite that there would be events by and with Brian Eno, both at the opening evening and at a later stage. Through the curator of the MedienKunstRaum (Media Art Room), Axel Wirths, contact was made with Eno and enquiries made as to whether he would be interested in a live broadcast of both these events. There were no problems and the artist quickly agreed, even though it was not then entirely clear what would happen on the two evenings, 27 and 29 August 1998.

Since the EMI server connection had proved to have limited capacity, contact was then made through RealNetworks Europe with the multimedia centre at Deutsche Telekom. By definition, Deutsche Telekom, which enjoyed a monopoly in the area of cable networks in Germany for decades, owns the most extensive data network in Germany. After several meetings and consultations, the Kunsthalle and Deutsche Telekom agreed to work together to produce these events and "broadcast" them on the Internet. Deutsche Telekom would pay most of the

telecommunications costs, whilst the Kunsthalle would cover the production costs on the ground and part of the power costs, which amounted to DM 5 000 (approx. US$ 3 000) per event.

This arrangement had the enormous advantage that for both these events we had the most powerful "backbone" in Germany at our disposal, and thus, de facto, unlimited bandwidth. In this way servers would not be working at full capacity or be overloaded. The multimedia backbone of Deutsche Telekom works with distributed servers, so that each user is connected to the RealServer which he or she can access the fastest. This distribution of traffic and the broadband backbone structure of Deutsche Telekom ensured unlimited capacity - theoretically thousands of people could follow these events.

In order to make the best use of these very good conditions, a well-timed and intensive advertising campaign was necessary. We had the agreement of Deutsche Telekom to provide links on both days to the live events from the homepage of T-Online, the biggest online service in Europe, with almost 3 million users (http://www.t-online.de). RealNetworks Germany, RealNetworks Europe and RealNetworks Great Britain were also prepared to offer links to the events from their homepages (http://www.real.com). For our part, we informed a large number of magazines, mailing lists, fan pages, daily newspapers, etc. of the planned events by e-mail. We also provided the relevant information to Timecast (http://www.timecast.com), the most comprehensive listing on the Internet for audio, video and live events. Finally, there were successful negotiations with the television company VH-1 (a subsidiary of MTV), who were interested in reprocessing the video material. So the Brian Eno events were also publicised on the VH-1 homepage (http://www.vh1.de).



Configuration
EVENT 2 + 3

The technical set-up differed in detail from the previous live broadcast. For reasons of cost, it was only encoded with one data rate - this signal was then sent via a dedicated permanent ISDN line to the Deutsche Telekom distribution server, from where it was then automatically distributed via the entire Deutsche Telekom multimedia backbone.

Several weeks before the opening of the exhibition, the events to be offered on both days had been clarified: "Sushi! Roti! Reibekuchen! A High-Altitude Food Performance with Incidental Music by Slop Shop and Brian Eno" - this was the title of the first event, which took place in the open air under the marquee on the Museumsplatz square. Five cooks from five countries prepared specialities and later there was an improvised concert on a small stage with the band Slop Shop,

Brian Eno and Holger Czukay. That day over two and a half hours were recorded live and broadcast.

"Public Talk. Brian Eno: Conversation with Umbrella, Tape Recorder, Record Player, Overhead Projector and Michael Engelbrecht" was the title of the event that took place two days later. In the Forum of the Kunsthalle, Brian Eno and the music journalist Michael Engelbrecht met for two hours in front of an audience of some 500 to talk about music and art and to listen to music.

More than 1000 people in over 30 countries followed these two broadcasts, the German and English login pages were accessed about 3500 times on both days and 1.5 GB of data was transferred. Both events led to increased traffic on the Kunsthalle Webserver for several days before and several weeks afterwards. From a statistical point of view, both days of broadcasts also recorded the most "hits" on the Kunsthalle Internet pages to date. Two weeks after the events we were also given the OK from Brian Eno to permanently install the four and a half hours of material on our server, where both videos remain accessible at any time:
http://www.kah-bonn.de/tv/media/BrianEnoTeil1.ram
http://www.kah-bonn.de/tv/media/BrianEnoTeil2.ram

Conclusions from the live broadcasts

Even after the much more successful last two broadcasts, the question arises as to whether the efforts required for carrying out a live broadcast are justified. From the point of view of the Kunsthalle, I can say that both the costs and the amount of work involved are justified, if one is bold enough to make comparisons with other "conventional" means of reaching the public. The cost of a full-page advertisement in a well-known art journal can be greater than the cost of a live broadcast on the Internet - and the measurable benefit is much smaller than that achieved by a Web event, the results of which can be evaluated statistically. "Target groups" can be reached much more directly on the Internet and there is no imprecision or uncertainty in answering the question of whether that was what the "viewer" really wanted to see.

On the other hand, in my experience, projects of this kind can only be carried out in close cooperation with reliable partners: without good connections with service providers (Deutsche Telekom), management/copyright owners (EMI) and with the artists (Brian Eno), events of this kind are not feasible.

When planning the three events, it was pleasing to discover that, at least in Germany, it is possible for a non-profit organisation in the field of culture, simply through communication with cooperation partners and without major financial commitment, to secure the involvement of these companies, an involvement which would be very costly to other commercial enterprises. It remains the case that in Europe many service providers, telecommunications companies and "portal sites" are looking for "valuable", high-quality content - something museums have traditionally been able to provide in abundance. In this way museums should be able to expand their position on the Internet. The Kunsthalle at least will attempt to perform some live broadcasts in 1999 again - initial negotiations with cooperation partners are already underway.

Appendix

"Streaming"

"Streaming", as opposed to "downloading", is the name of a technology which allows the Internet user to view data (video, audio, etc.) as the file is being received, whereas normally a data file has to be completely transmitted before the result can be seen on the user's screen. Only in this way is it practically possible to transfer high volumes of data to the Internet user, such as for example digitalised videos (the size of the file of the first two-and-a-half-hour-long Brian Eno recording, for example, is 45 MB).

Live streaming video technologies (as of Feb. 1999)

In my description of the three live events, which the Kunsthalle organised in 1998, I confined myself to RealNetworks technology. However I should also mention that there are also indeed other systems on the market which can achieve a similar result. Here is a short list of the most important products with some keywords and explanations:

RealNetworks:
RealServer - Realplayer
(http://www.real.com)
On 28 January RealNetworks published statistics, according to which they now have 50 million registered users and thus an 85% market share of users and servers. Back in the autumn of last year, cooperation with Netscape was announced: RealPlayer Plug-In is an integral part of the Netscape browser from version 4.5 upwards, i.e. Netscape users do not need to download the software package separately.

RealNetworks is offering server solutions in the form of the Basic Server, which allows up to 40 user sessions at any one time for prices starting from US$ 695. A server licence for 400 users at any one time, however, does cost as much as US$ 20 000 - but in this case, as with all software manufacturers, it is advisable to ask for prices for non-profit organisations or for education licences. The RealPlayer, necessary for receiving the 'RealContent', is available free of charge.

Microsoft:
NetShow Server - MediaPlayer
(http://www.microsoft.com/ntserver/nts/downloads/recommended/mediaserv)
RealNetworks' greatest competitor is definitely Microsoft. Microsoft also offers streaming technology, consisting of a server (NetShow server) and a client (MediaPlayer); the MediaPlayer is already contained in the Windows operating system and therefore enjoys the widest possible circulation. In addition, MediaPlayer also processes foreign formats such as RealVideo, RealAudio, MPEG and Quicktime.

VDO:
VDOLive Server - VDOLive Player
(http://www.vdo.net)
Similar to RealNetworks and Microsoft, VDO offers the entire package of server and client tools for transmitting video on-demand and live video on the Internet. Once again, the consumer needs a plug-in for the browser or a separate VDOLive Player.

VIVO:
VIVO Active
(http://www.vivo.com)
VIVO developed video streaming technology which was based purely on the programming language Java both at the server end and at the end user end, and which can therefore still be viewed on any Internet browser, regardless of the platform, without additional software. VIVO was acquired by RealNetworks in 1998.

Geo Interactive:
Emblaze
(www.emblaze.com)
Just like VIVO, Emblaze is based on Java and the associated tools for creating and compressing video files. The prices for these tools are between US$ 300 and US$ 1000, depending on the package.

GTS:
GTS Video
(www.graham.com)
GTS Video also works without a separate player, but it does require server software. From the client end, the solution is again based on Java. Server licences range from licences for servers for 10 users at any one time (US$ 2 000) to those for an unlimited number of users (US$ 15 000).

Apple:
Quicktime 3.0
(http://www.apple.com/quicktime)
With the new release 3.0, Quicktime offers a kind of "pseudo-streaming". As previously, Quicktime Movies are downloaded by means of simple HTML links, however data can already be viewed before the downloading is complete. Apple does not yet however offer genuine streaming with a flexible data rate and live broadcasting possibilities.

AUSTRIAS CULTURAL INFORMATION SYSTEM AEIOU
3 YEARS OF ONLINE EXPERIENCE

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The earliest recorded mentioning of the name of Austria in its early German form of "Ostarrichi" dates back to a deed of gift of the year 996 covering the rights of possession of a piece of land in the present area of Lower Austria. This 1000th anniversary of Austria's "name day" was celebrated in 1996 in many ways. It was also the inspiring idea for the present Cultural Information System AEIOU.

Under the title of "Cultural Information System AEIOU" (http://www.aeiou.at) all projects proposed in the context of the Austrian Millenium 1996 dealing with the electronic representation of data related to culture were brought together in one unified project. The following criteria were used for selection:

- contribution to national identity
- international interest
- presentation of aspects of Austria's present, past and future
- creation of lasting values.

The technical platform for AEIOU is the distributed information system Hyperwave, which was created at the Institute for Information Processing and Computer Supported New Media (IICM) at Graz University of Technology, Styria. HyperWave offers unique possibilities for search and navigation through huge databases like AEIOU. IICM has also helped with the integration of the contents and the creation of the links.

The basis of all the materials is the "Österreich-Lexikon", a concise Austrian encyclopedia newly edited in 1995 and published by an Editors Association (13,000 text contributions and 2000 pictures). One of the main tasks of this encyclopedia is to present the positive as well as the negative aspects of 20th century Austria, and to give credit to Austrians who brought about political, cultural, social and economic progress. It is equally important, however, to maintain the discourse about past and present ills of Austrian society and other critical developments. For this purpose a team of editors is in charge of updating the entries in the online *version several times a year* in order to provide the latest information on all aspects of Austria.

For the music section, an Austrian history of music with examples of music from the beginnings to the present was prepared by the Institute of Musicology at the University of Graz. In addition, the Austrian music teacher Manfred Schilder has prepared works of Austrian composers for multimedia presentation according to the principle "seeing - understanding - hearing - experiencing".

The Institute of Research into the Material Culture and Everyday Life of the Middle Ages and the Early Modern Period of the Austrian Academy of Sciences has prepared a vast amount of pictorial material with detailed descriptions covering 1000 years of Austrian history.

Many key words of the encyclopedia are illustrated by video clips selected by the Austrian Federal Institute for Scientific Film from historic film material at the Austrian Film Archive in Laxenburg. Likewise, suitable modern material from the Archive of the Austrian Broadcasting Corporation (ORF) was included.

Other contributions to the Cultural Information System were made by the Austrian Tourist Board, which presents its collection of photos of Austria. The Austrian Postal and Telegraph Administration contributed a synopsis of its special-issue stamps from 1986 to 1996. The Sigmund Freud Society prepared a biography of Sigmund Freud and the Museum of Applied Art created a data base of living Austrian designers.

The system as it stands today is not a closed system but is the nucleus of a comprehensive information system on Austria which can be enlarged in depth as well as in size to encompass new subjects at a later time. The material presented is intended to demonstrate the multitude of possibilities and usage of multimedia systems. In view of future enlargements, discussions with various contributors are being held on an ongoing basis.

Since the project started as an Austrian contribution to the celebration of the Austrian Millennium, most of the material was only available in German at the beginning. However, since the worldwide feedback was very positive, ongoing efforts are being developed to provide an English translation.

Two thirds of the translation of the encyclopedia are already finished. It was not an easy task because many of the lexical entries needed additional information to make them understandable for foreign users. The experiences made by the team of translators headed by Michèle Kaiser-Cooke produced a new scientific approach in translating this special kind of cultural information.

One of the newest additions is an interactive timeline of approx. 5000 biographical entries of the encyclopedia. The biodata of famous Austrians were categorized and visualized synchron-optically, a new possibility of access to the original data. Very soon, a virtual guided tour will also be added that would enable the user to enjoy an informational parade through interesting epochs of Viennese literature.

Worldwide, the user statistics clearly shows great acceptance. Last year the number of user sessions increased to almost 100 000 per month with an average session duration of about 15 minutes and the number of page impressions was about 300 000 per month. Examining the keywords entered by users in search engines gives also an interesting insight. Of course, many are searching for famous Austrian composers or the Venus of Willendorf. However, during the last Alpine Skiing World Championship the name „Flachau", the birthplace of Hermann Maier, was a keyword used very frequently. AEIOU has visitors from about 100 countries all over the world with United States and Germany as the most active countries. It is interesting to mention that in the United States, genealogical research is very popular and as a matter of fact we are receiving many e-mail inquiries about family names which often can only be found in the Austrian encyclopedia.

Besides the video album, the "Musik-Kolleg" – a collection of musical works is likewise popular. It was utilized as a medium of instruction and learning in a German school in Guatemala. Here in Germany, it can be found on teachers´ networks as well as cited by students of music in their research papers.

The information system is not a one-way line. It enables the user to participate actively by directly contributing entries which are relevant to the theme or topic. These entries are then checked and validated before they are finally integrated. Undoubtedly, through this method, the information system increases dynamically.

THE GENERATION OF DYNAMIC VIRTUAL (3D) PRESENTATION LOCALITIES IN THE INTERNET; ELECTRONIC COMMERCE AND SECURE TRANSACTIONS SHOWN BY MEDIA AND NET ART FROM BERLIN

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Electronic Commerce and Secure Transactions

There is an expanding tendency for using the internet as a virtual marketplace and also for the presentation of arts. Parallel the need for secure transactions is growing, too.
Therefore we offer you an attractive, individually adaptable concept.

The Dynamic Generation of Virtual (3D) Presentation Locations in the Internet, for instance Galleries

New is the customized dynamic generation of 3D (VRML-Virtual Reality Modeling Language) internet presentation locations. We offer to the customer the possibility to propose his needs as a retrieval. From this information we instantly generate a room inclusive design. The number of rooms and passages is variable. The access is shaped to certain persons or groups. One could invite experts to a virtual opening and organise an exchange of idea (chat). The entry into a special room or the access of an information could cost a fee. Electronic cash systems control the release of the information.

Electronic Cash-Systems and Security-Mechanism:

Entry-tickets could be realised time or content dependant.

The commercial usage of virtual galleries requires security mechanisms :

- Authentication of service suppliers,
- Authenticity and integrity of information,
- Anonymity of customers, release of data after payment.

Media and Net Art

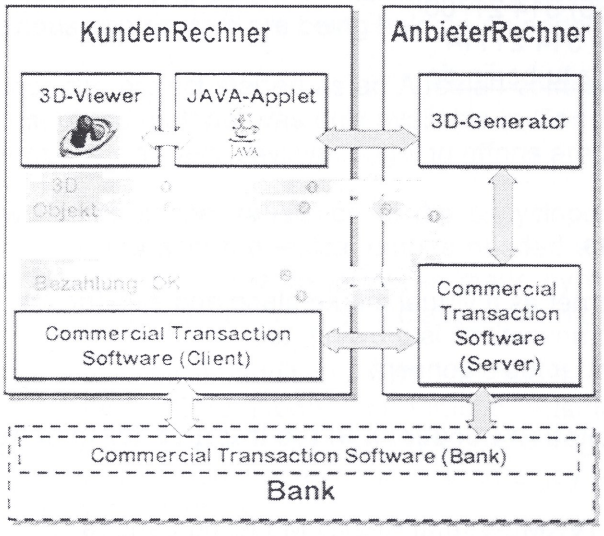
Media and Net Art take more and more room in the actual development of the arts. The electronic techniques are increasing the possibilities of expression. We want to encourage these art directions in co operation with teachers and students of the HDK-Berlin (Highschool of Fine Arts Berlin) and:

Launching an experiment for commercialisation.

As an experimental contribution we generate a virtual 3D-Internet gallery, embedded in an Online Art Magazine, where the access costs a fee. Besides the expositions, theoretical material will be offered. The content will be released on CD and as a catalogue.

3D Visualisation linked with Online-Shop

The basic structure of commercial locations (connection of security mechanism, payment systems and serveral forms of presentation) is shown with the virtual gallery but they are the same as for an internet shop. The graphic shows how a customer may access on an offer of a 3D-Shop and use his internet bank connection.



project homepage:
http://wwwpc.prz.tu-berlin.de/prz/messen/schaufenster/index.htm

homepage of the center FSP-PV / PRZ:
http://www.prz.tu-berlin.de/

We are partners of „cultur+", a community of interests within the initiative of the Berlin administration: "Projekt Zukunft / Berlin die offene Stadt".
The main aim of the initiative is to show and spread the possibilities of internet and multi media in connection with art and culture in Berlin. For realisation of several project ideas we aim a co operation of partners from commerce, research and culture. Mainly we search for commercial partners.

WAVELET COMPRESSION TECHNIQUES AS A TOOL FOR THE PRESENTATION OF PRINTED DOCUMENTES ON THE WWW

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The Internet has become so popular and is expanding in a such an explosive way, because it is the greatest source of all kind of information. It is often said that almost everything can be found somwhere on the WEB. However, there are great problems in providing information which has been released before the Information Age. We mean here magazines and newspapers, old books, documents of historical and artistic value, technical drawings and so on.

Of course, using a sophisticated OCR software it could be possible to obtain the text together with pictures from an old document. However, in most cases the user is interested in a copy of the original and not in a processed version of it.

The only reasonable way to provide copies of older printed documents to the intersted audience is their scanning or making digital photos of good enough quality. At this point however great problems arise, because of the huge data amount and the need for using an appropriate compression technique.

JPEG, which is the most popular compression tool, can not be used for processing of files representing document text, as it causes blocking artefacts at the edges of the letters and in this way the decompressed image would be of very poor quality.

In the last few years, there has been a rapid development of compression techniques based on the wavelet transformation. On of the most efficient and flexible format is the DjVu, developed byAT&T Laboratories. This technology is just intended for the compression of scanned documents containing both text and pictures. Our tests performed on different types of printed documents, show that the the information regarding the efficiency of this technique provided by its developer is not exaggerated. Indeed, a scanned document of let say 10 MB can be compressed do 300 KB or less without much quality loss.

In our opinion the common usage of such kind of compression will be a breaking point in the history of the Internet, as all the information which is stored now on paper could be made avaulable in an electronic way through the WWW.

Wavelets are a highly efficient tool for image compression because they organize image data in a way that closely resembles the human visual system. By using a multiscale decomposition rather than the blocking approach of JPEG, wavelets provide a superior representation for localized image features, such as edges. The wavelet advantage achieves 2 to 3 times better compression efficiency than JPEG for high compression ratios. Wavelet transform-based image compression involves the use of a relatively new field of applied mathematics often called "wavelet theory" or simply "wavelets".

The method is well suited to "lossy" image and video compression. Lossy compression involves the slight loss of data during the compression process, so that the decompressed image is not bit for bit identical to the original.

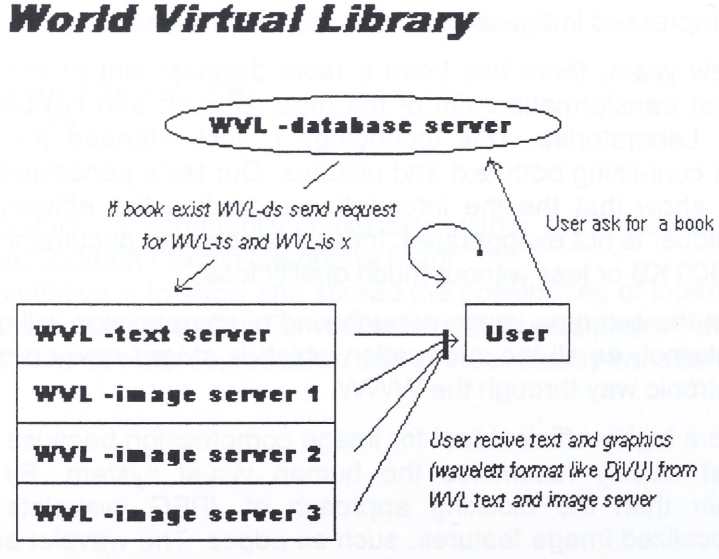
Wavelet compression is a method of mathematical modeling of images, which breaks the image down into small waves that represent the frequency analysis of a function. The shapes and patterns in an image are identified, and then described using mathematical functions. The function that models or describes the image is contained within the compression and decompression software. The image file contains only the coefficients or numbers used by the function and compression is achieved by averaging the values of these coefficients, so that an image is represented by fewer numbers.

Wavelet compression is very efficient, with ratios up to 200:1 and more. The efficiency of the compression and the quality of the image are very dependent on the structure of the images being compressed; typical wavelet compression ratios range between 15:1 and 100:1. As a comparison, typical compression ratios for JPEG are usually between 10:1 and 20:1 and for LZW around 2:1. Wavelet compression can take a longer time to compress images due to the complex mathematics involved. However, the time required to decompress a wavelet or fractally-encoded image is usually comparable to decompressing of a JPEG image.

An advantage of wavelet compression is that image processing can be incorporated into the wavelet transformation, including sharpening, contrast enhancement, and noise reduction.Images can be also enlarged or reduced via embedded interpolation, using common interpolation algorithms, such as bicubic, bilinear, or nearest neighbor, as found in Adobe Photoshop and in other pixel-based image editing software. Generally the quality of this type of interpolation will not be as good as fractal interpolation.

Wavelet compression is used in many varied digital applications: photographic imagery, audio and video recordings, 2D and 3D rendering, multimedia, fingerprints imaging (used by the FBI), medical imaging (radiography, MRI, etc.), satellite and remote sensing imaging, geographic information systems (GIS), and document imaging.

Our new project called WVL (World Virtual Library) is using a wavelet compression format for fast transfering (via Internet) of pictures and text as usually found in books and magazines.



The pictorial data can be viewed by a user who has a typical internet browser (like Netscape or Explorer) or using a simple program taken free of charge from the main WVL serwer.

It is worth mentioning, that the WVL viewing program is much easier in using than the internet browsers, especially for the beginners or people not using computers in their work.

OVERVIEW OF IMAGE FORMATS SUITABLE FOR PRESENTATION OF ART ON THE WWW

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An important aspect of image processing is the enormous amount of data which has to be handled when transmitting digital images. The efficient transmission of images is extremally important as the image data transfer takes up over 90 percent of the volume on the Internet. In this aspect computer data compression is a powerfull technology which is playing a vital role in the Information Age.

The compression of information can be devided into lossles and lossy techniques. In some cases such as text or financial data transfer only the losless algoritms can be applied. However when transmitting or storing digital images or music data, the application of losssy techniques is almost invisible to the user, but enables a drastic reduction of the data volume.

In this article we present some of the compression techniques which can be used when transmitting or storing digital images. All the formats we were able to gather are accompanied by a short description and an Internet link, which can be used when detailed information is needed. Our intention is to find the optimal compression format for presenting artistic images over the Internet. The first step of our project is the cataloging of the existing formats and evaluating their efficiency when transmitting data containing artistic features. In this short article we provide the reader with the substantial information on the existing formats and make some comments regarding their usage when presenting mages. In the next step we want to measure the efficiency of the algorithms and make some suggestions regarding their usage based on scientifical research.

This work is extremaly important and difficult as the most efficient formats are distributed on commercial basis and making any suggestions without sound scientific data is in our view not appropriate. That is why we present most of the existing formats but our intension is not their qualitative evaluation. We just show some of their advantages and drawbacks and the interested user has to find out the technique which best satisfies his needs.

Standard formats:

Name	Full name	WWW_page	Plu gin req.	Type	Max. Colors
GIF	Graphics Interchange Format	http://www.ora.com/centers/gff/specs.htm	No	Picture	256
PNG	Portable Network Graphics	Http://www.cdrom.com/pub/png	no	Picture	24 bit
JBIG	Joint Bilevel Group	http://www.pdsimage.com/html/news/jbig/faq.htm	yes	Picture	256 (gray)
JPEG	Joint Photographers Expert Group	http://www.ora.com/centers/gff/specs.htm	no	Picture	24 bit

New image formats (selected from over 40):

GIFX	Graphics Interchange Format –anim	http://www.webutilities.com/Tips/gifx-1.htm	yes	Picture/ ANIM	256
PTI	System for Progressive Transfer of Images	Http://server.hvzgymn.wn.schule-bw.de/pti/Intro/Index.htm	yes	Picture	24 bit
DJVU	Deja Vu	http://www.djvu.com	Yes	Picture/ Text	24 bit
FIF	Fractal Image Format	http://www.iterated.com	Yes	Picture	24 bit
SWF	Shockwave Fla0sh	http://www.macromedia.com	Yes	Picture/ Vector/A NIM	24 bit
FPX	FlashPix	http://www.livepicture.com	Yes	Picture	24 bit
WSQ	Wavelet Scalar Quantization	http://www.aware.com/products/compression/wsq.html	Yes	Picture	24 bit
MrSID	Multi-resolution Seamless Image Database	http://www.lizardtech.com	Yes	Picture/ Databas e	24 bit
FIF	Fractal Image Format	http://www.altamira-group.com	yes	Picture	24 bit
WIF	Wavelet Image Files	http://www.cengines.com/wavelet.htm	yes	Picture	24 bit
COD	Lightning Strike Image Compression	http://www.infinop.com/infinop/html/image_compress.html	yes	Picture	24 bit
SVG	Scalable Vector Graphics	http://www.ora.com/centers/gff/specs.htm	no in ms win	Vector	24 bit
LWF	LuraWave® image format	http://www.luratech.com/products/productoverview/fse.html	yes	Picture/ Databas e	24 bit

Graphics Interchange Format (GIF)

Surrounded by both popularity and controversy. Although limited to 256 colors and 95DPI resolution, GIF images are found in vast quantities and supported by most image-using software applications.

Portable Network Graphics (PNG)

The format was designed to replace the older and simpler GIF format and, to some extent, the much more complex TIFF format. For the Web, PNG has three main advantages over GIF: alpha channels (variable transparency), gamma correction (cross-platform control of image brightness), and two-dimensional interlacing (a method of progressive display). PNG also compresses better than GIF in almost every case, but the difference is generally only around 5% to 25%.

Joint Bilevel Group (JBIG)

JBIG is a data-encoding standard used to compress 1-bit, bilevel image data. JBIG is a prime example of a standard that does not define an interchange file format. The recent extensions to JPEG have defined a file format (SPIFF) that will also store facsimile and JBIG-compressed data.

Joint Photographic Experts Group (JPEG)

JPEG is a standardized lossy encoding method used for compressing truecolor and grayscale image data. JPEG if one of the most popular methods of data compression. JPEG data is stored in its raw form, or using the JFIF file format. Recent extensions to the JPEG standard have defined an official file format for JPEG (and others) named SPIFF.

Scalable Vector Graphics (SVG)

Work in progress at W3C (World Wide Web Consortium) on SVG, a vector graphics format written in XML and stylable with CSS, is expected to be a popular choice for including graphics in XML documents. It may be included either by linkage, or by textual inclusionin an XML document that uses a different namespace. Because SVG can itself include raster images such as JPEG and PNG, SVG can be used to add raster and mixed vector/raster graphics to XML documents

MrSID

MrSID (Multi-resolution Seamless Image Database) is a powerful wavelet based image compressor, viewer and file format for massive raster images that enables instantaneous viewing and manipulation of images locally and over networks while maintaining maximum image quality. Features include unprecedented compression ratios while maintaining highest image quality, true multiple resolutions, selective decompression, seamless mosaicking and browsing.

DJVU

AT&T Labs - Research has released an image compression program called DjVu. This format is particularly appropriate for web designers who wish to scan high-resolution colour images and deliver them over the Internet or Intranets.

WSQ

WSQ is a wavelet transform based compression standard designed by the FBI for compression of digital fingerprint images. Aware™ is the leading provider of WSQ solutions and has a customer base that includes major system integrators as well as livescan vendors and application developers. WSQ by Aware is 3 - 4 times faster than the next fastest commercial implementation of the WSQ algorithm

LWF

LuraImage is a scaleable Internet/Intranet frontend technology that enables access to image databases, utilizing the highly efficient LuraWave image format. LuraImage is a web-based database optimized for image communication in low-bandwidth environments - such as the internet.The usage of LuraWave-image compression rapidly speeds up the transmission of digital images in the internet. LuraWave images contain all user-relevant resolutions (thumbnail representation up to the original image size) as one image file. The very first bytes of an image transmission are used to generate a good image preview.

Lightning Strike Image Compression

Lightning Strike software delivers the most advanced image compression currently available. Consider the possibilities: Lightning Strike outperforms JPEG by 200 to 500 percent. In fact, on a 28.8 modem, a 1MB image file would take 90 seconds to download as a GIF image, 15 seconds as a JPEG image, and just 3 seconds as a Lightning Strike image. Speed plus quality is the clear advantage. At identical file sizes, Lighting Strike images have been judged significantly better than JPEG images.

Wavelet Image Files (WIF)

Are created using the groundbreaking advances in the mathematical compression method called "Wavelet Transform" made at the Houston Advanced Research Center (HARC™). By applying the complex wavelet algorithms to a digital image, the "compression engine" software is able to represent the image as a mathematical expression. The result is a compressed WIF file that can be 300 times smaller than the original image file size while still maintaining high image quality.

Fractal Image Format (FIF)

Fractal compression works by using a variety of methods to identify features within an image and then breaking down the image into a mathematically modeled series of repeating shapes and patterns. Fractal compression is very efficient, achieving compression ratios of up to 250:1; typical fractal compression ratios will range between 20:1 and 100:1. Images can be magnified or reduced, because the compression process allows the modeled images to be resolution-independent. When a fractally-encoded image is converted to a pixel image, it can be enlarged or reduced to any desired size with minimal loss of image quality. However, published reviews of fractal compression software indicate that there is probably a practical limit to how much a fractally-encoded image can be enlarged before there is a significant loss of image quality; perhaps up to 300% of the original size.

DEPENDENCE OF IMAGE QUALITY MEASURES ON THE LOSSY JPEG COMPRESSION RATE. CAN THE OPTIMAL COMPRESSION RATE OF IMAGES INTENDED FOR PRESENTATION OF ART ON THE WWW BE FOUND?

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The JPEG standard derived its name from the Joint Photographic Experts Group, a committee of the International Standards Organisation (ISO), the International Telephone and Telegraph Consultative Committee (CCITT) and the International Electromechanical Commission (IEC).

Work on JPEG began in 1986 and it was approved as a international standard in 1992 (IS 10918-1). The compression algorithm of JPEG is based on a Discrete Cosine Transform (DCT) applied to 8 by 8 blocks of image data and is combined with a lossless entropy coding method.

Because of the growing significance of image communication methods, the assessment of image quality is becoming an increasingly important issue

However, very different procedures have been used for such tasks, so that frequently neither comparison, nor evaluation could be made. As a consequence, for instance, the rendering of the image colours, derived from graphic data processing methods on different monitoring devices is not exact. In order to obtain comparable results, test images and procedures (e.g. from television technology) have to be modified and new methods will have to be developed. Due to the predominant significance of image information in multimedia systems, quality analyses for this type of information are of particular importance.

Most JPEG compressors let the user to pick a file size vs. image quality loss by selecting a quality setting. There seems to be a widespread confusion about the meaning of these settings. "Quality 95" does NOT mean "keep 95% of the information", as some assume. The quality scale is purely arbitrary; it's not a percentage of anything measurable. In fact, quality scales aren't even standardised across JPEG programs.

The quality settings discussed in this article apply to the free IJG JPEG software and to many programs based on it. Some other JPEG implementations use completely different quality scales; for instance, Apple™ uses a scale running from 0 - 4, not 0 -100. A few programs even use a scale running in the opposite direction, with higher numbers indicating lower image quality (more compression). Other programs don't use a numeric scale at all, just "high/medium/low" style choices. Fortunately, this confusion doesn't prevent different implementations from exchanging JPEG files. However, the user has to keep in mind, that quality scales can vary from one JPEG-

creating program to another. In most cases the user's goal is to pick the lowest quality setting, or smallest file size, that decompresses into an image indistinguishable from the original. These settings are unfortunately dependent on the image structure and the user visual system features. However some rules for good-quality, full-colour source images can be established.

The default IJG quality setting (Q 75) is very often the best choice. This setting is about the lowest, which can be used without expecting to see defects in a typical image. So the rule is: Try Q 75 first; if you see defects, then go up. If the image was of perfect quality to begin with, you might be able to drop down to Q 50 without objectionable degradation.

Another rule is that except for experimental purposes, never go above about Q 95; using Q 100 will produce a file two or three times as large as Q 95, but of hardly any better quality. Q 100 is a mathematical limit rather than a useful setting. If you want a very small file (say for preview or indexing purposes) and you are prepared to tolerate large defects, a Q setting in the range of 5 to 10 is about right.

If your image contains sharp coloured edges, you may notice slight fuzziness or jaggedness around such them no matter how high you make the quality setting. This can be suppressed, at a price of file size, by turning off chroma downsampling in the compressor.

The IJG encoder regards downsampling as a separate option which can be turned on or off independently of the Q setting. With the "cjpeg" program, the command line switch "-sample 1x1" turns off downsampling; other programs based on the JPEG library may have checkboxes or other controls for downsampling. Another JPEG implementations may not provide user control of downsampling. Adobe Photoshop™, for example, automatically switches off downsampling at its higher quality settings. On most photographic images, we recommend leaving downsampling on, because it saves a significant amount of space at little or no visual penalty.

Quality settings around 50 are often perfectly acceptable on the Web. In fact, a user viewing such an image on a browser with a 256-color display is unlikely to be able to see any difference from a higher quality setting, because the browser's colour quantization artefacts will swamp any imperfections in the JPEG image itself.

It's also worth knowing that current progressive-JPEG-making programs use default progression sequences that are tuned for quality settings around 50-75: much below 50, the early scans will look really bad, while much above 75, the later scans won't contribute anything noticeable to the picture.

As could be expected we encountered great problems in finding an efficient compression level for the JPEG method. It seems that at the current state of research, an automatic setting of an optimal compression rate is impossible. Further research is needed, as the problem is too important to be left unsolved.

In our opinion the image texture is playing a crucial role, with regard to the result of JPEG compression. Our future work will concentrate on the analysis of the dependence of the compression efficiency on the textural features of the image. This seems to be a promising approach, as the most defects occur just in image region, which are characterised by a texture.

THE ELECTRONIC SLIDE LIBRARY
THE APPLICATION OF AN ELECTRONIC DATABASE IN THE ART HISTORY SLIDE LIBRARY AT HUMBOLDT-UNIVERSITY BERLIN

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Apart from the library in every Art Historical Institute the slide-library supplies the most documents for the lectures and seminars. As usual the library supplies information about artist's biographies or the development of styles, as they are described in art history writing. Additionally the slide library provides an extensive collection of art-reproductions for the use in lectures and seminars.
It is an old and consistent paradigm that images do not present key scientific documents of historical studies. Inquiries about images are very often only the second step in the process of scientific research and the organisation of images in the archive resembles the structures of traditional art history writing. The reproductions are graded alphabetically by the names of artists or by names of locations.

Since the rise of Iconography as a method of history writing art historians work mainly with pictorial documents. To fulfil this idea art historians needed the possibility of a more direct access to visual documents.
The Institute for Art History at the Humboldt-University Berlin started in 1993 the project of a picture-database specialised for the needs and competence of art historians. The database operates like an electronic picture-catalogue. According to the inquiry it shows the images present in the actual slide-collection. The user can choose among ten different groups of classifications - Artist, Date, Stile, Technique, Material, Art Genre, Cultural Landscape, Location, Formal Structures and Iconography, the last group basically takes hold of the figural motifs of an image. This ten classifications can be combined if the user undertakes for more specific enquiry. As the result of the inquiry images appear on the screen comparable to a picture-board. If requested further background information about the images can be delivered.
Compared to traditional archives this presents already a beneficial tool but it does not present a great innovation in the possibilities of research.
But there are much more sophisticated and promising qualities of an electronic database which provide enormous benefits specially for art historians.

On the level of iconographic study the database enfolds the full range of its qualities. Without any further information the user can capture pictorial material of a very wide range and of all techniques and historical periods. If the user specifies his inquiry by further classifications, he or she will receive a more focused information. This flexibility allows the inquiry in conventional means like names, stiles or locations besides more visual defined aspects like Iconography or formal design. The flexible structure of the database allows searches for different pictorial motifs. This is an achievement which could not be obtained by any other catalogue-form. The advantage especially for the purposes of cultural history writing seems obvious and can not be discussed in the briefness of this text.
The administration of the database requires a high level knowledge from the slide library staff. The pictorial documents have to be analysed in art historical means and systematised in various

abstract groups. Thus the database not only contains objective information but also historical and analytical interpretations.
The electronic slide-library offers a choice of pictorial material and the user can choose from a wide spectrum of thematically related material. This effect can be compared to the benefits of a systematic library system. If books are shelved in terms of topics or themes, than the user might find interesting books related to his or her topic by chance. This associative capacities are the second crucial characteristic of the database.
Last but not least: our electronic slide library is made for internal use. It displays the profile and interests of our institute. In other words: we are not documenting every possible image, but we display the profile of the Art History Institute at the Humboldt-University. Of course this had consequences for the structure of the Thesaurus. We did not had to use the very complex numerous-alphabetical classifications of Iconclass. With some references to Iconclass and also to other classification-systems we developed a simpler vocabulary. The Thesaurus is a work in progress and developed corresponding to the images in the database. The vocabulary is, if possible, generally intelligible.

Angela Fischel

STEREO/3D SCANNER FOR USE IN ART AND MUSEUMS

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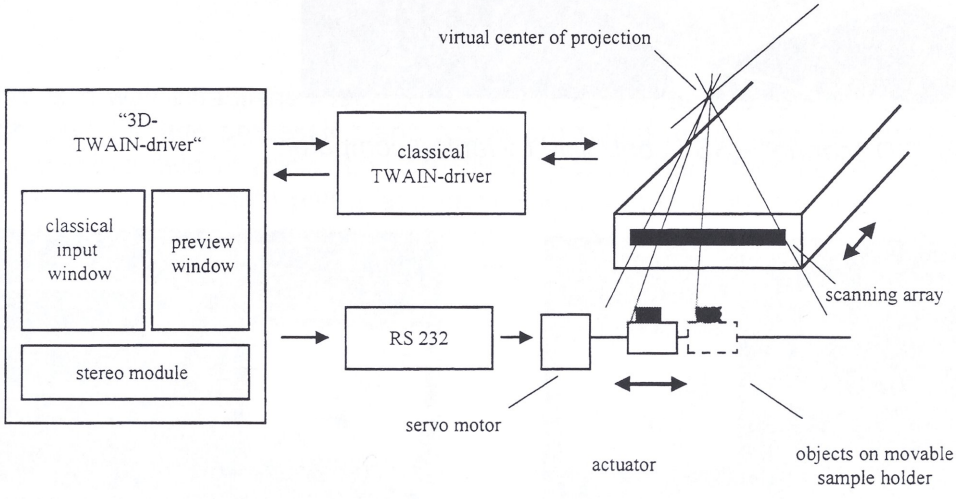

Fig. 1 Principle of stereo/3D scanner

The prototype of a stereo/3D scanner based on the flatbed principle [1] is presented (fig. 1, fig. 2). Due to the non parallel optics of modern flatbed scanners, objects can be scanned with slightly different viewing angles, when placed at different lateral positions (fig. 3). In the prototype RSS I, shown at the exhibition, the scanning unit of a conventional flatbed scanner is placed in top down orientation above an actuator allowing for an automatic scanning at different lateral positions. This patented 3D scanner gives very good stereo / multiview pictures of small, especially flat objects. There is a large variety of possible applications in industry [2] and multimedia [3]. Directors of Museums and Galleries, goldsmiths, jewelers and all other curious visitors are invited to bring small, precious objects to the exhibition to be scanned stereoscopically. Using 3D glasses the visitors can convince themselves of the high quality of the pictures. Those missing the exhibition are invited to come for a presentation to the office at the science and industry park WISTA in the south-east of Berlin. The Company STEREOSCOPIC SCANNING offers a professional stereo/3D scanning service – please call for more details!

[1] R. Schubert, Höhen und Tiefen, Stereoskopische Aufnahmen mit Flachbettscannern, c't 18/98, August/31/1998
[2] R. Schubert, Stereoscopic Scanner in Quality Control, QCAV'99, Trois-Rivières, Québec, Canada, May 1999
[3] R. Schubert, Neues stereoskopisches Aufnahmeverfahren für Bilder und Relief mittels Flachbettscanner, EVA98, Berlin

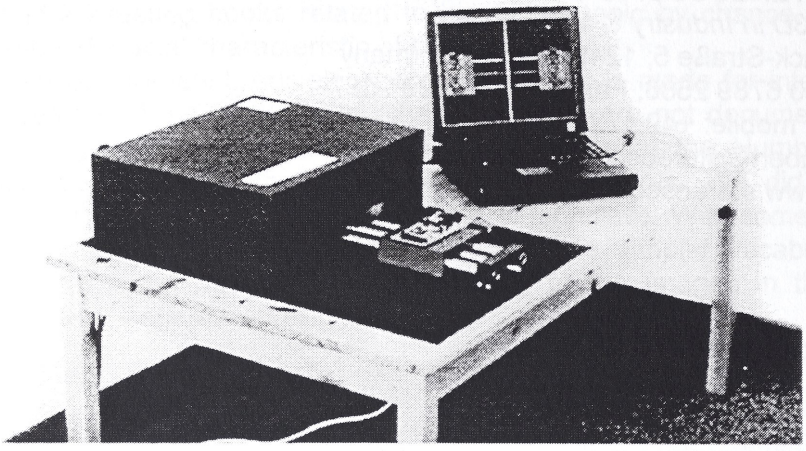

Fig. 2 Stereo / 3D scanner RSS I controlled by laptop computer.

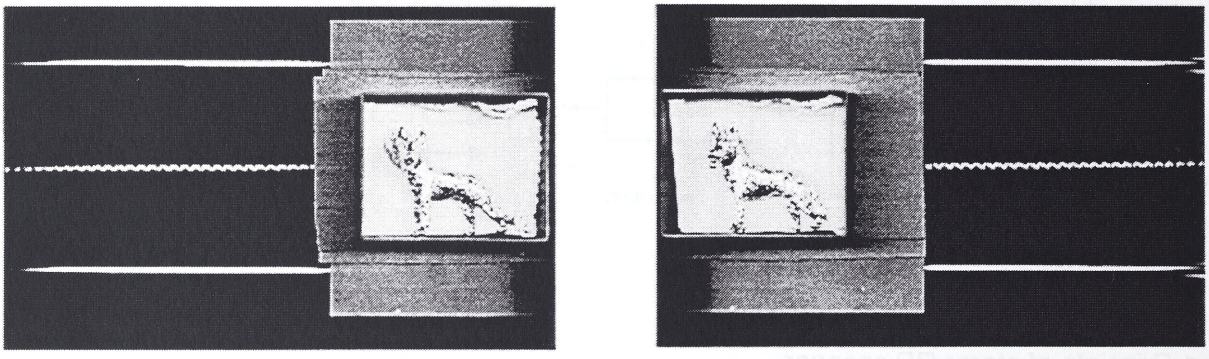

Fig. 3 For stereoscopic scanning the objects are placed automatically at different lateral positions.

RSS I – Prototype Stereo/3D scanner

principle:	flatbed scanning with automatic lateral displacement
depth of field:	5 cm
object size:	18.5 cm x 29.7 cm (= DIN A4 minus minimum displacement distance of ca. 2.5 cm)
resolution:	600 dpi x 1200 dpi in focus plane; for practical operation 300 dpi x 300 dpi recommended
control unit:	PC / laptop computer; Win 98/NT 40
interface	SCSI (scanning unit); RS 232 (actuator)
actuator:	servo motor 70 W, step = 5 accuracy = 30 ; span = 45 cm
output	all commonly used picture formats (tif, jpg, gif, png, ...)

keywords:

3D scanner, lenticular prints, 3D glasses, quality control, 3D picture reconstruction, stereoscopy, multimedia

OPTICAL ACQUISITION AND EVALUATION OF RANGE DATA FOR ANALYSIS AND DOCUMENTATION OF ARCHAEOLOGICAL SAMPLES

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Introduction

Photogrammetry is a well established technique for the optical acquisition of 3D coordinates. In conjunction with digital image processing and active projecting techniques like phase measuring profilometry, its possible field of application greatly increases, since topometric sensors are now able to digitize far more coordinate points automatically and thus allow a digital reconstruction of the object surface. This method therefore has an interesting potential for the digital documentation and analysis of archaeological samples. Various types of diagnostic tools may then be employed for numerical evaluation and comparison of samples.

Methods

The basis of the system for 3D coordinate measurements is a topometric sensor head consisting of two CCD cameras and a fringe projector fixed on an adjustable-height rail via a tilting device (Fig.1). During the measuring process a sequence of four phase shifted quasi-sinusoidal fringe patterns is projected onto the object and registered as stereo images by the CCD cameras. After calculating the phase distribution, the stereoscopic images are evaluated by photogrammetric techniques and a 3D coordinate is caculated for each valid pixel. The achievable measurement accuracy depends on the triangulation angle (angle between the cameras), the image field size, as well as on the number of camera pixels. With a triangulation angle of 40 degrees and an image diagonal of approximately 20 cm, for example, the height resolution is situated at < 50 µm, the lateral at approx. 200 µm. With this computer controlled setup, data from different viewpoints can be acquired, integrated and processed automatically.

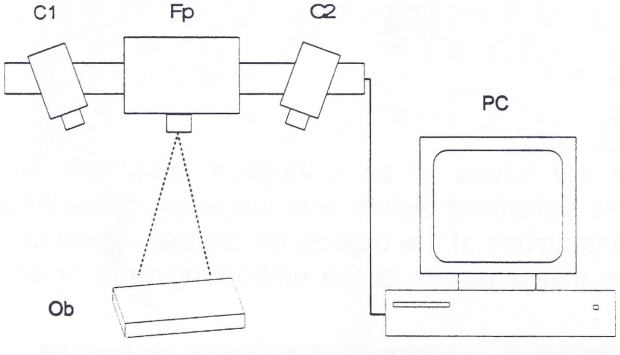

Fig.1. Experimental setup for 360 degree 3D data acquisition
Fp: fringe projector, C1, C2: CCD-cameras, Ob: Object, PC: personal computer

Using the obtained coordinate points (*point cloud*) the object surface is reconstructed by triangulation, i.e. by covering it with a grid of triangles. As the investigated objects are quite

complex, an approach is used which does not make special assumptions about the surface structure and iteratively connects neighbouring points, only controlled by preset angular and distance constraints. It allows automatic processing - including the computation of range images - of large numbers of samples.

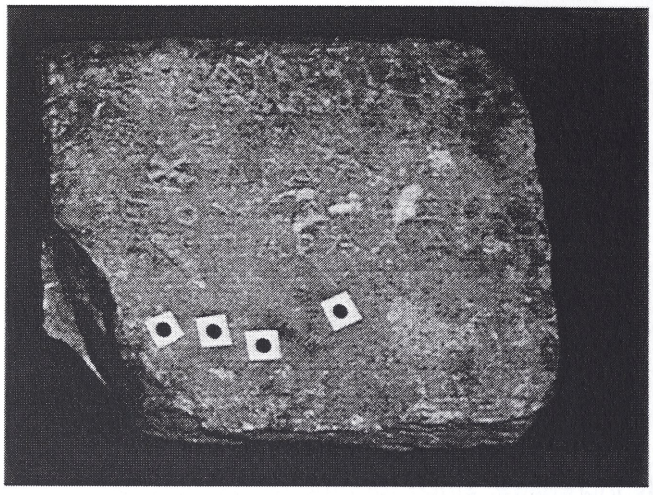

Fig.2a. Photo of the inscription tablet

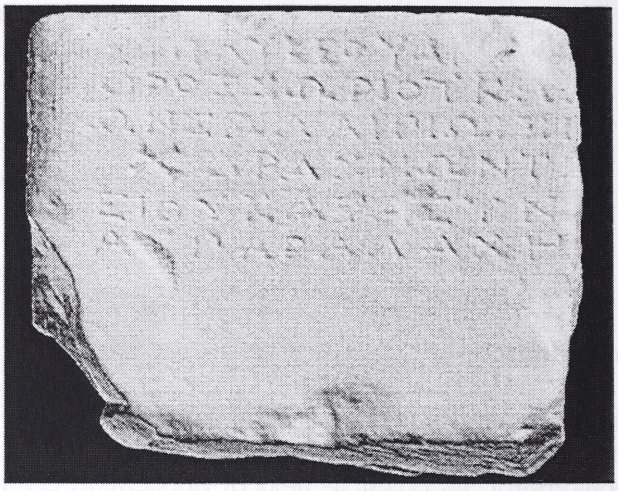

Fig.2b. Reconstructed object surface of the inscription tablet

Archaeological applications

The presented system has been applied successfully for the investigation of inscription tablets (Fig.2a,b) for example. Besides being a digital documentation, the achieved data allow a further quantitative evaluation.
After computing a height or range image, usually visualized in false colors, image processing routines may be applied to enhance e.g. shallow inscriptions and thereby support their deciphering (Fig.3).

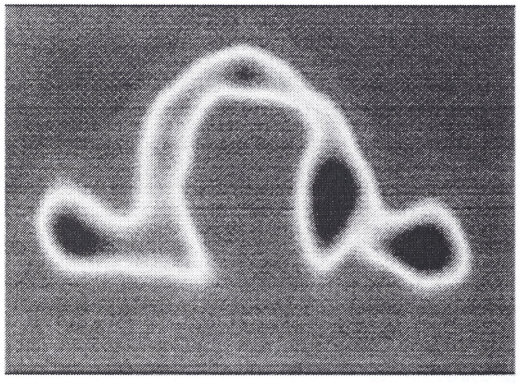

Fig.3. False color range image (reproduced in gray-level form) of one letter of the inscription tablet

Another advantage is the possibility to distribute the letters of an inscription tablet not in standardized form as it is used in books today but as a digitized picture with the exact shape for example via Internet. Due to the distortion-free reconstruction of the objects for archaeological or historical samples, this technique allows quantitative investigations of the embossing work or of numismatics .

Financial support of the Ministry of Education, Research, Science and Technology of the Federal Republic of Germany is gratefully acknowledged.

3D-PHOTOMODELS AND DIGITAL METRIC IMAGES - THE USE OF NEW TECHNOLOGIES IN ARCHITECTURE AND MONUMENT CONSERVATION

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Photogrammetric single image techniques, like the generation of rectified images and image unwrapping methods are well suited for use in architecture and monument preservation. They combine true scale geometric measurements with full image information under quite inexpensive production costs. Digital image processing methods play a more and more important role for the production of rectified images. Because of the increasing performance of personal computers as well as the availability of necessary peripheral hardware, like CD-writers and photorealistic printer and laser imaging units, rectification with analogue equipment is no longer necessary today. Especially the PhotoCD delivers good requirements for digitising and storing digital image data for photogrammetric purposes.

Besides the rectification of digital metric images, in many cases a 3D-visualisation of the whole building is desirable. In contrast to a simple visualisation, the use of 3D-models in restoration and monument conservation requires a high degree of detailed information and exact measures in the model. For this purpose, a 3D-photomodel has to be constructed on the basis of geodetic and photogrammetric measurements. A 3D-photomodel consists of a three-dimensional CAD-model, which describes the shape of the building and the image information that is wrapped over the CAD-model with the correct position information. Because of the high accuracy, which is required for conservational and restorational purposes, the CAD-model and the images have an exact coordinate reference in a unique coordinate system. Depending on the required accuracy and the degree of detail information, we choose different approaches. But in every case we use exact geodetic information and rectified images for the construction of the 3D-photomodel.

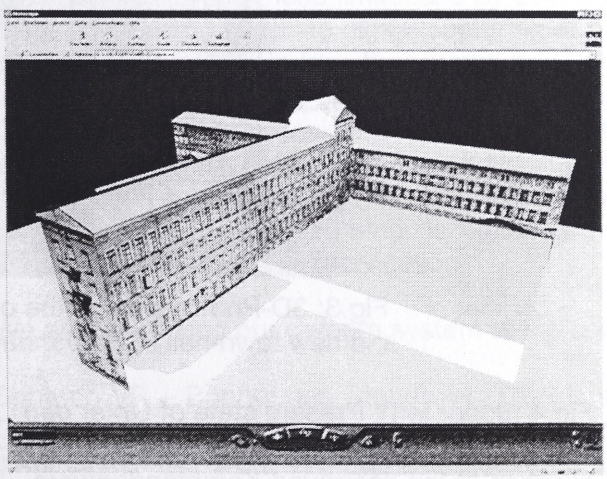


Fig.1: 3D-Photomodel of furniture factory in *Lunzenau* in a VRML-Browser

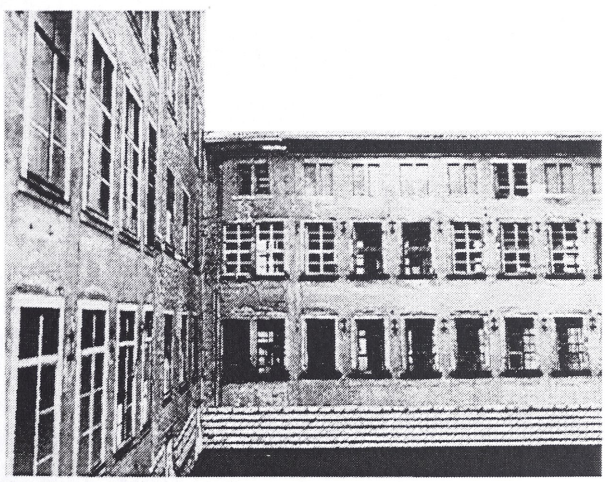
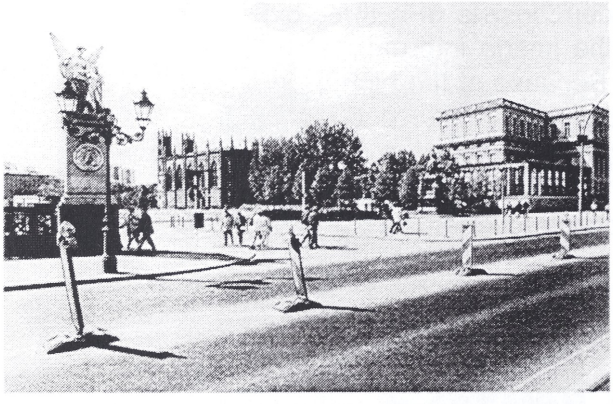


Fig.2: 3D-Photomodel of furniture factory in *Lunzenau*, detail view

The easiest way to build and view a 3D-photomodel is the construction of a VRML-scene directly from the rectified images with the help of a 3D-CAD-model. For this purpose, Fokus GmbH developed a new software (Fig.1 and 2). The input data for this software consist of a 3D-model and rectified images. The 3D-model has to be created from geodetic measurements for instance with Autocad in DXF-format. The rectified images and the belonging reference information can be directly imported from the rectification software *EDDI-2D* which is available from the Fokus GmbH, too. A special feature of the created photomodel is the interactive functionality. By double clicking on a part of the photomodel, the user gets more information about the chosen part of the building and he can directly go to the rectified image in order to make detailed measurements. Thus, the photomodel becomes the visual user interface of a metric image data base system.

For higher quality demands with more detailed information, the resolution of VRML-scenes is not sufficient. In that case the 3D-model has to be constructed with more details. The data for that 3D-model can be determined for instance by photogrammetric methods. If the building was destroyed, a lavish construction on the basis of historical plans is necessary. After that, the rectified images can be wrapped over the 3D-model with the help of a 3D-rendering software. Fig.4 shows the result of such a work. The 3D-photomodel of the town hall in *Halberstadt* was derived from present and historical images and shows the building after a possible reconstruction. The texture of the historical part of the building was completely taken from historical photographs taken by Meydenbauer in the year 1896. The figure is an image from a digital animation, which lets you walk around the historical building.

As you see, also historical photographs can be used to visualise the authentic state of historical monuments in a three-dimensional way. In some cases, it isn't possible to build a CAD-model, because there exists no measure information about a destroyed building. But under special conditions it is possible to calculate the camera viewpoint of a historical photograph. With this information an image of the present state of the surrounding area can be taken and laid over the historical image (Fig.4 and 5).





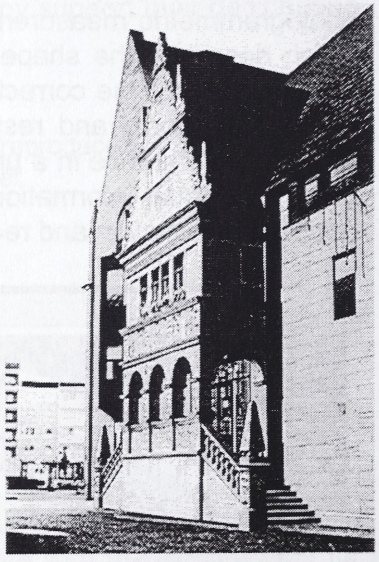


Fig.3: 3D-Photomodel of the old and new town hall in *Halberstadt*

Fig.4 (upper left): Present state of *Unter den Linden 1*, Fig.5 (lower left): Photorealistic visualisation of the destroyed *Kommandantur* in today's surroundings

A SYSTEM SOLUTION FOR DIGITAL PANORAMIC PHOTOGRAPHY

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QuickTime VR, an award-winning software technology of Apple Computers Inc., enables interactive presentations of buildings, outdoor and indoor scenery, museum exhibitions, art galleries, hotel complexes, real estate and more. The concept of QuickTime VR (QTVR) revolves around panoramic images, i.e. photographs covering the complete 360 degrees around the horizon. The human viewer utilizes the computer's monitor like a window and perceives a selected segment of the surrounding panorama. By moving the mouse, this window can be adjusted and the direction of view changed, simulating a movement of the head. This way, the viewer can look left, right, up, down and behind. Much more impressive and convincing than with a conventional photography, the illusion of „actually being there" is created.
The individual panoramics (nodes) may be linked in order to form an interactively navigable virtual world consisting of adjacent points of view. As an example, a virtual tour of an art gallery can be realized this way. Arbitrary multimedia elements may be embedded into a QTVR application as parts of a panorama. Similar feats are possible using software products of other manufacturers.

Conventional methods for taking panoramic photographs are cumbersome, expensive and unsuitable for large projects involving dozens or hundreds of panoramic images.
One method is to employ special film-based panoramic cameras, which require developing and scanning a complete roll of film per panorama. Checking for quality is not possible while on the scene.
On the other hand, one may use so-called „stitching" software, which combines a number of individual images taken with a conventional camera from a fixed point of view into a complete panorama covering 360 degrees. The images have to be perspective-corrected and image overlap has to be accounted for. Usually, editing the final image is inevitable. The quality of „stitched" panoramas is not always optimal.

We have addressed these limitations by developing a sophisticated *digital panoramic camera.* The system enables immediate digital capturing of panoramic images with a resolution of up to 12000 x 2500 pixels, typically in less than a minute. The speed of the camera makes large documentation projects of hundreds and thousands of panoramas feasible.
Our system solution consists of panoramic camera and accompanying notebook computer, which is used for camera control and image storage. The photographer can judge the quality of his work right on the spot, while still on the scene. The process of stitching individual images, hitherto necessary and time-consuming, is completely obviated. There are no additional costs for film, development or scanning services.

We are presenting our camera system at the conference exhibition.

Spheron VR – Bonnet und Steuerwald GbR is a privately held company located in Kaiserslautern, Germany. Our aim is to provide superior solutions and tools to the virtual reality and digital imaging community. Spheron VR has won several awards for its concept, including the prestigious „Gründerwettbewerb Multimedia 1997" award.

Touchless On-Site Data Acquisition System For Freeformed Details Of Architecture Like Statues, Reliefs, Capitals

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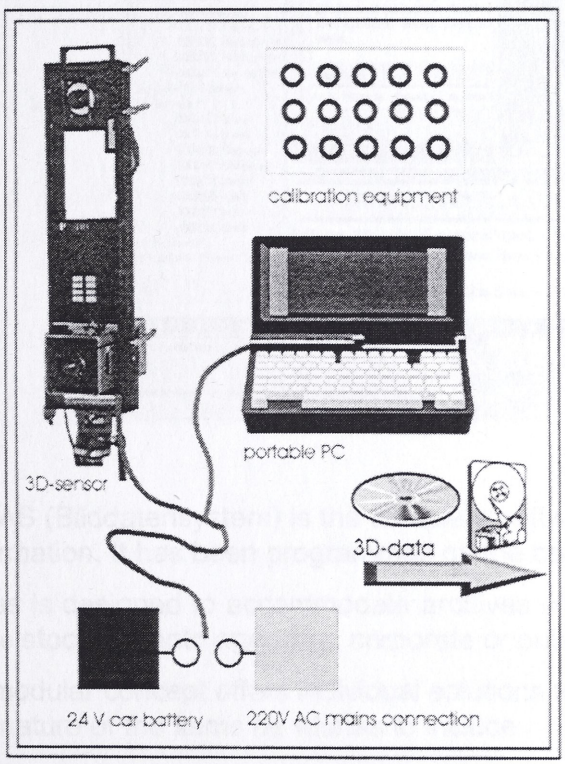
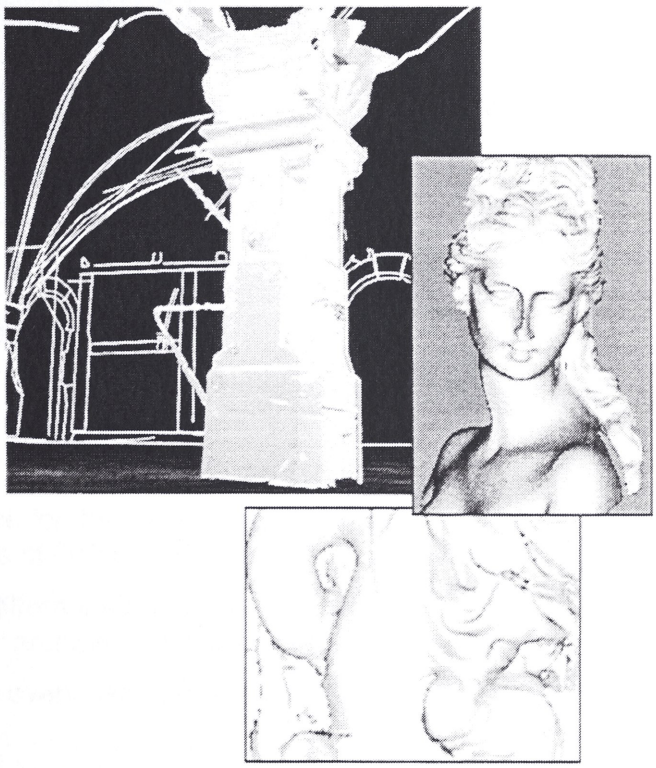
Three-dimensional documentation of cultural objects like architecture, facades, monuments, statues or during archaeological excavations becomes a standard more and more. Practical works in the field of on-site measurement and documentation of cultural heritage often demand different, object specific accuracy and resolution. If for large, regular object parts a single-point measurement with point-distances up to 1m may be sufficient, other object parts or details should be measured with millimeter space resolution or even more. Available non-destructive, contactless measurement methods and digitalization approaches are mainly limited to special tasks, object sizes and environment conditions.

At EVA´99 Berlin we present an On-Site 3D-geometry acquisition system for complex freeformed objects that could be widely used in documentation and restoration of cultural heritage. Measurement and modelling capacity as well as the implemented possibilities for result visualization, presentation and analysis are demonstrated. We are ready to show some result examples of indoor and outdoor measurements of objects sized up to several meters.





The presented system can be used in stand-alone mode and -in the case of need- as complementary equipment for the widely used theodolits and laser range finders. It allows toaquire high-dense 3D-coordinate sets of freeformed object parts, to fit this data into given global co-ordinate systems and to calculate and visualize virtual surface representations of the freeformed objects. The system is transportable and can be used on-site, powered by car-batteries. The point resolution is mainly defined by the size of the object part covered by one measurement (about 1/1000 of the lateral size and 1/2000 in depth). The acquisition of one 3D-data set (up to 1.000.000 co-ordinates) is performed in 2-3 seconds.



BIDAS
Bilddatensystem

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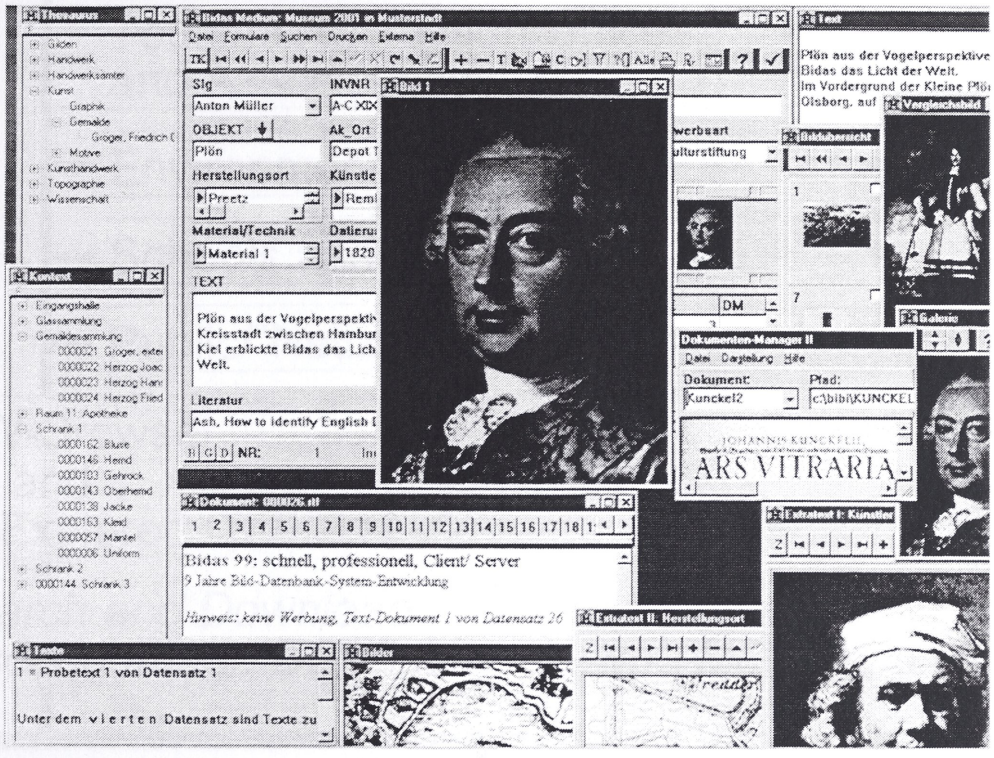

BIDAS (Bilddatensystem) is the complete software for the management of image archives and related information. It has been programmed on the basis of Delphi and uses the databaseformat DBase.

Bidas is designed to accommodate archives of different sizes, from the small private collection to the large stock of photo agencies, corporate or public archives, museums or universities.

Its modular concept offers individual solutions for every user, since he can adapt all menues exactly to the nature of the items he wishes to include.

Multiple tools allow for a quick and easy presentation of all images and texts in the archive. Several search methods are available.

Information already existing in other programs or databases can be imported into Bidas by means of a special editor.

Bidas is available in the versions BiMaxi, BiMedi und BiMini for single unit installation or as client server solution for several workplaces.

Public and Regional Landscape Image Database/Photo Library

P. Paar & J. Peters

Fachbereich Landschaftsnutzung und Naturschutz
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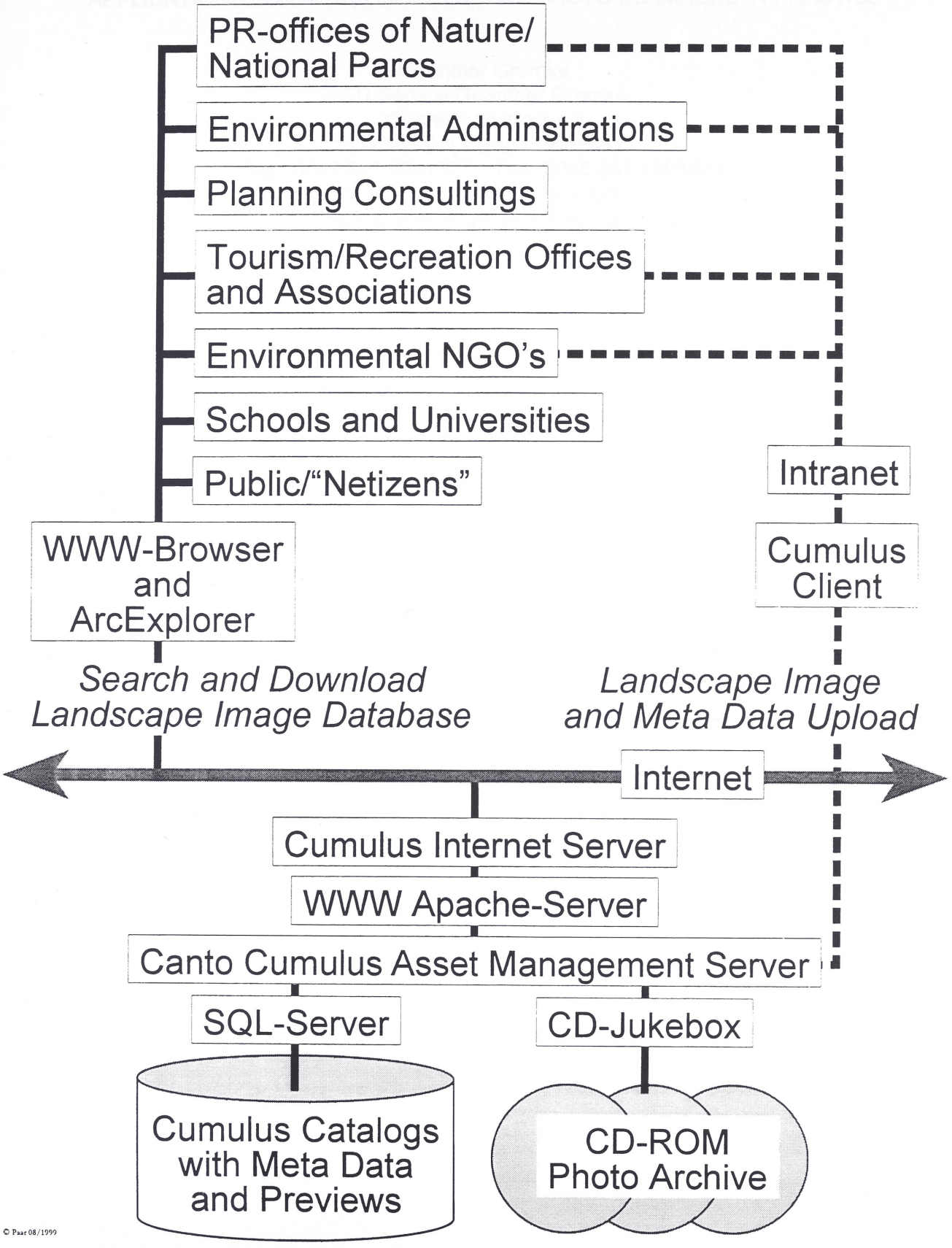
ppaar@zalf.de
http://www.zalf.de



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APPLICATIONS FOR MEDIA INDEPENDENT PHOTO CD IMAGES IN PRACTICE

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The digital Original

The stock of digital images grows rapidly and is going to develop exponentially in future. Only with the help of image data bases we shall be able, to search for images effectively, to find them immediately and to distribute them well in time. There is not justification any more for repeated scans from originals to satisfy various applications. The only solution is the digital original. A standardized image file format open for all applications and output options has to be used.

The Photo CD Image Pac is an input standard fulfilling this conditions in an ideal way. With Photo CD the original scene is colorimetrically documented in accordance with a defined standard of exposure. The images stored in YCC color space are free of color reductions due to color space limitations and transformations. The hierarchical file structure of the pro Photo CD Image Pac contains six different image sizes enabling any kind of application independent from the required image size and resolution. All applications like large format printing, Internet, slide exposing, foto print or offset printing can be done from the same file.

Examples of application

On the exhibition floor of EVA Berlin `99 CD Service Guenther Gromke shows a selection of practical applications demonstrating the variability of the Photo CD Image Pac format.

Examples from the fields of building renovation and restoration, surveying, combined catalogue, internet and CD ROM production, multimedia for CD ROM and infoterminals from industry, trade and public institutions are presented and explained on the floor.

At the same time the booth shall provide a platform for active discussion on the topic of media independent image archiving. The topic is as fresh as never before and has still not reached its end. Discussions about interesting future developments are most welcome and will be provoked by the exhibitor.

Informationssystem OBJEKT
Dynamic object- and mediaadministration

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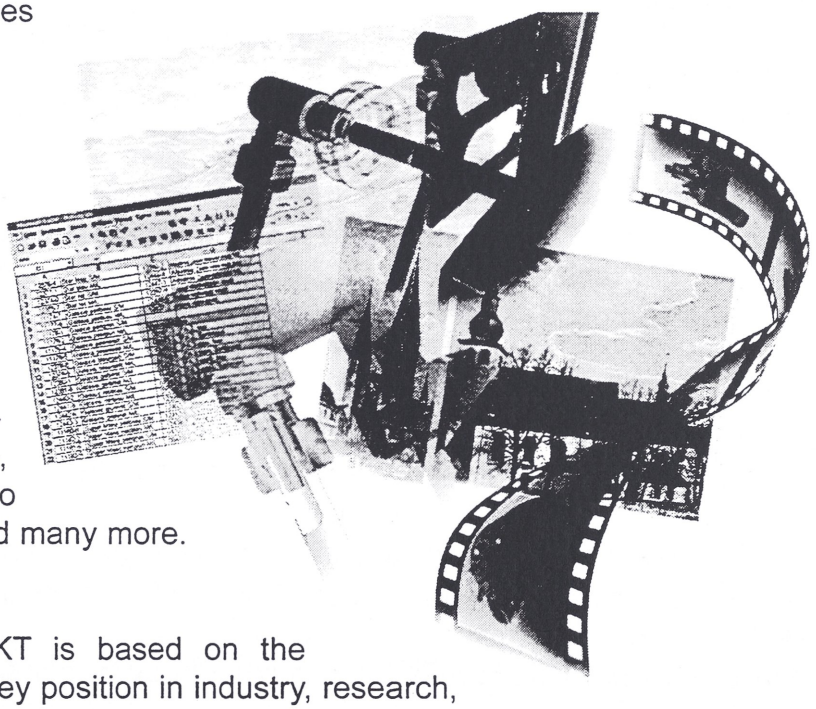
The slogan „the individual standard" means new dimensions in flexibility, dynamics and speed of archiving software. Statements like individual standard and structured data storage of unstructured data do not contradict each other. They apply to practical requirements, which are met by the Dem GmbH products.

Common client requirements

Together with software-, system- and database-specialists, storage managers, archivists, and scientists we created a list of features which apply to the practical demands. We collected those features regardless of system, server, data base, costs, and realisability:

- High speed (up to the terabyte range)
- Heterogenous server landscapes
- Investment security
- Dynamic field structures
- Maximum input
- Multimediality
- Extensibility
- Standardisation



These are the most important demands for modern database systems, in addition to the standard demands like field choice, creation of reports, connection to a modern Office environment and many more.

Basics

The Informationssystem OBJEKT is based on the Oracle database. Oracle has a key position in industry, research, and science. This means that our clients get a reliable partner in connection with a high level of investment security. Oracle is the simple answer to the question of server and system.
Oracle is compatible with most of the modern server- and operating systems.
We use C/C++ and JAVA instead of the classic Oracle tools in order to achieve maximum flexibility. Sub-suppliers keeping the latest state of engineering are important partners which guarantee the further usage, development, and updating of programs in the future.

Retrieval

The speed of retrieval is dependent on the structure of a query and the amount of fields and field types held by a query. In addition, there is the problem that retrievals often are restricted. There is a need for new developments and one of them is RSM.

Reduced Storage Management is a kernel enabling quick data access. Especially complicated queries (joins) will run much faster. RSM has especially been developed by DEM GmbH. It hasn´t been developed to replace, by-pass, or modify SQL but as a background feature. Standard data access is not influenced.

Advantages

The Informationssystem OBJEKT features several advantages:

- Individual solutions can be created within a short time by using standard software. For this reason Informationssystem OBJEKT means: individual standard!
- Modular construction gives the the user the possibility to use only those parts of Informationssystem OBJEKT, which he actually needs.
- Informationssystem OBJEKT contains security-features on both system and user level. Single users can be given access by passwords.
- Logical user-guidance with clear and easy to survey screen layouts according to the Microsoft-standards helps the user to deal with very complex data amounts.
- Retrieval results including results from the search for roots, fussy, and phonetics within data sets are displayed by a high-lighting-feature.
- Retrieval of the contents of structered and unstructured fields of an application is possible at the same time.
- Open interfaces enable the utmost flexibility in connecting to other programs (e.g. Microsoft Office, DMS GIS).
- Very complex queries are performed without any delay with assistance of the kernel Reduced Storage Management
- Informationssystem OBJEKT is multilingual.
- The consideration of internationally acknowledged standards guarantees the long term benefit of our technology: ORACLE data base, C/C++ and JAVA development environment, and Microsoft / ORACLE standard libraries.

Informationssystem OBJEKT contains the following features:

- personal administration with dynamic distribution
- multimedia archive for the inventory for various data (e.g. sound, pictures, 3D, Office data)
- object-stocking for the administration of archive goods and monuments
- literature administration (starts december ´99) for books, journals etc. with dynamic registration structures

All applications are able to refer to each other in every considerable way.

In operation for: fields of

- archeological preservation of historical monuments
- inventory for art and monuments
- preservation of architectural monuments
- collections
- folkloral archives
- industrial archives

VIRTUAL RECONSTRUCTION OF THE BERLIN CASTLE AND NOBUNAGA'S PALACE

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The initiation of this VR-project goes back to the first EVA-Conference in Japan, held in April 1998 in the City of Gifu.

Virtual Reality (VR) and especially virtual reconstruction are highly efficient means to support the preservation and dissemination of our cultural heritage.

With this in mind, Prof. Iwainsky, Chairman of the Board of the Society for Applied Computer Sciences (GFaI), suggested an intercultural project of virtual reconstruction. His idea was, that a Japanese team should model a famous, but destroyed German building, and a German team a corresponding Japanese one.

Only in September 1998 a next step for the preparation of such a project followed. Mr. Morimoto, Vice Governor of Gifu Prefecture, visited the Science and Technology Park in Berlin-Adlershof (WISTA) and pushed forward the *intercultural* project.
At the end of the year 1998 the budgeting of the project could be specified: Gifu Prefecture would finance the Japanese team, the City of Berlin the German one. Furthermore both sides decided which buildings should be virtually reconstructed, namely the Berlin Castle and Nobunaga's Residence in Gifu.

A difficult project phase followed. This phase included search work, the collection of various documents, data acquisition and the elaboration of complex instructions for the reconstruction. The German team at the IIEF and the GFaI developed an HTML-presentation of the Berlin Castle for the Japanese reconstruction team at the Virtual Technology Center. This HTML-representation includes a large amount of photos, plans, references, schematic drawings, historical and architectural data and various explanations (texts). Vice versa the Japanese team prepared new CAD-drawings of Nobunaga's Residence, that was completely destroyed in the year 1600, and collected reference photos.

On the bases of these (purely two-dimensional) documents 3D-modelling of the buildings was carried out in the next project phase. Because of the higher complexity of the Berlin Castle in comparison with Nabunaga's Palace, the Berlin team helped to reconstruct the Castle.

In only one and a half months the virtual reconstruction could be nearly finished. Finally the 3D-model of the Berlin Castle was integrated in the Virtual Berlin presentation of artemedia, the largest 3D-model in the world. On 29 September 1999, during the Asian-Pacific Weeks, both virtual reconstruction objects were presented for the first time to the public. In real time a flight from the Brandenburg Gate over the street Unter den Linden, around the castle dome, a "landing" on the street, and a walk through the South-East portal to the famous Schlüter's courtyard was demonstrated.

BERLIN CONNECTION
An interactive Documentary Thriller!

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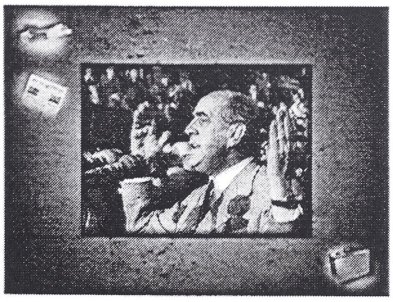
The multimedia CD-ROM BERLIN CONNECTION has been on the market under the label eku interactive since last year. Set in the chaotic days following the fall of the Berlin Wall in November 1989 – a historic date which has its tenth anniversary this year – this interactive Documentary Thriller leads one through a synthesis of information and amusement in postwar Berlin.



While on assignment in 1989 in Berlin, the English photographer Roger Penrose falls into the hands of unscrupulous agents and profiteers who have been profiting from the Cold War. The player slips into the role of our leading man and determines the plot's progress. The game calls for cunning, sharp observation, powers of deduction, and a feel for criminology.

From the days after the war to the fall of the Berlin Wall: contemporary Berlin history is worked into this exciting crime thriller's plot in an entertaining and informative way. The audio-visual photo-documentary presentation merges interactive game scenarios and historical original recordings and footage in a fascinating atmosphere. The user interface is simple and can be quickly grasped even without specific computer experience. The famous German crime thriller writer Horst Bosetzky reacted enthused, "Exciting and informative – a must for every fan of crime thrillers!"





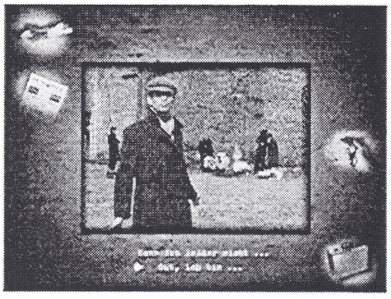
The plot in BERLIN CONNECTION continues yet, starting in October 1998, an investigative panel will meet in the Internet to expose the evil doings of Autumn 1989. More information to help solve the case can be found at www.berlin-connection.de. The plot will be extended in the Internet with

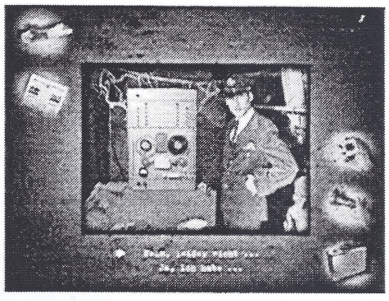
interesting additional information such as transcripts of tapped telephone conversations and background information on the origin of BERLIN CONNECTION.

Eku Wand – Author, Director and Designer

Eku Wand's personal graphic style, already well known in the multimedia scene, is reflected in the exterior design of the multimedia CD-ROM BERLIN CONNECTION. The graduate designer has lived in his city of choice, Berlin, since 1983 and the local flavor and intensive atmosphere of the once divided city are characterized here in attentive detail.

With BERLIN CONNECTION, Eku Wand, one of the founders of Pixelpark in 1991 and one of the multimedia pioneers in Germany, has managed to bring contemporary history to life with the consequent utilization of multimedia applications. "This modern historical presentation goes beyond the usual conservation and exhibition of historical exponents and is directed toward young and old alike", says the 35 year old creator and producer of the CD-ROM.





First all the scenes were filmed like a movie-production, and then individual freeze frames (ca. 3000) from the video takes were digitized, retouched and integrated into the story. A contrast of moving scenarios (stop motion) and static scenery (freeze frames), evolved, which, for example, shown in sequence, make up a panoramic view, helping the player with orientation. The authentic audiovisual atmosphere conveys the player a feeling of being in the middle of the action.

Eku Wand worked together with a production team of 40 people from the film and media industry over a period of over three years on the completion of this precisely detailed Documentary Thriller. The high degree of professionalism and quality holds up to international standards. BERLIN CONNECTION was honored with the Landeshauptstadt Stuttgart Multimedia Prize in 1998.

Facts, Figures and Data

PC
Windows 95/98 or Windows NT 4.x
Pentium 90 MHz, 16 MB RAM

Macintosh
Mac OS System 7.1 or higher
68030 or PPC, 12 MB RAM

An eku interactive production
With thanks to Der Tagesspiegel

German version:
Recommended retail price DM 69,90 / öS 530,— / sFr 69,90
Available in bookstores, computer stores and in the Internet.
ISBN 3-00-002766-1 / 2 CD-ROM in Eurobox / German Version

English version:
The English version is expected to be available in 2000.

MULTIMEDIA AND ARCHAEOLOGY

A CD-ROM ON THE ANTIQUE CITY OF PERGAMON

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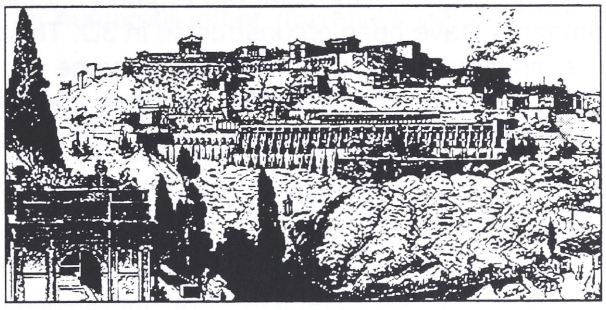

Hill of Pergamon (Illustration made by R. Bohn / M. Koch 1886)

Subject:

The CD-ROM "Pergamon – a multimedia journey through the antique metropolis" aims to get the user acquainted with the antique city – nowadays located in Turkey – by the use of digital media.

Due to its location, its ruins and its complex history, Pergamon belongs to the most fascinating cities of the antiquity. Originating from a small mountainous settlement, it evolved to become the capital of a powerful Hellenistic empire and the splendid residence of the Attalid dynasty.

The CD-ROM focuses on buildings, history and inhabitants and covers a time span that reaches from the antiquity to the Byzantine period, with each period being introduced in both a diverting and informative manner. The user becomes familiar with, for instance, the famous Altar of Pergamon, which can be seen in the Berlin "Pergamon-Museum" , or the Traianaeum, a temple erected to honour the Roman emperor Traian. But also antique everyday life, including sports, theatre, thermal spas and medicine is covered in detail.

Target group:

The application will be published in English and German. It is intended to meet the interests of both youth and adults who have an inclination to archaeological issues.

Platform:

The CD-ROM will be hybrid, i.e. it will run on both Macintosh and IBM compatible computers.

Concept:

The user accesses the program via an interactive map, where he can choose among several possibilities: Either he decides to inspect a building, or to learn about a period, or to become acquainted with a historical personality.

Each building offers the chapters "location", "architecture", "function" and "history". If, for instance, the user clicks on a certain "urban period", he will cause all the buildings on the map erected during this period to highlight. He then can choose among the highlighted buildings. Historical personalities like the powerful King Eumenes II. appear and introduce themselves, their period and their city. In doing so, they communicate an authentic impression of Pergamon to the user.

Realisation:

- The *vocals* are based on secured scientific knowledge, but are formulated in generally comprehensive words.

- *3D technology:* Important buildings like the Altar of Pergamon or the Traianaeum, which in our days only persist in remnants, have been reconstructed in 3D. This allows the user to get an impression of the former architectural space, all the more as he can walk around the buildings and turn around about 360°. The buildings contain hot spots that lead to further information, like photographs and explanations on architectural details of the respective spot.

- A *2D animation* helps to explain the Hellenistic water pipeline, working according to the principle of communicating tubes.

- Interactive maps and plans: The program contains both interactive maps and plans of buildings. The user not only can access specific information individually, but with their help he is able to understand spoken explanations more easily.

- Music: Background music in different styles characterises the different periods and underlines the diverting aspect of the application.

Publication:

The CD-ROM is published by Konrad Theiss Verlag GmbH (P.O.B. 104827, D-70042 Stuttgart) and expected to appear in August 2000.

Following persons are involved into the realisation:

Dr. Jürgen Süß (project management, concept, image editing), Wido Weber (3D modeling, translation into English), Sandra Eberl (screen design), Jürgen Hinderer (programming), Gottfried Säftel (music composition, sound engineering, image editing) und Christiane Wörner (3D modeling).

Further projects:

Several further projects are being developed, destined either to serve as POIs in museums and exhibitions or as end consumer applications. If interested, please contact the persons indicated above.

MuseumPlus – THE COMPREHENSIVE COLLECTION MANAGEMENT SYSTEM

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MuseumPlus is a modular computer program specially designed for the multiple tasks and functions of your museum. MuseumPlus is a complete, flexible and modern **Collection Management System**, capable of optimum integration of multimedia data.

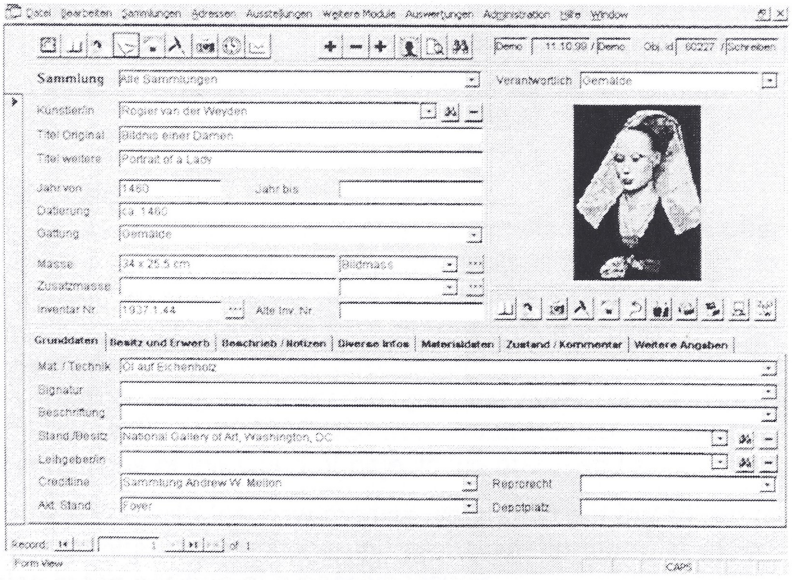
In order to meet the requirements of different kinds of museums, MuseumPlus was developed in close co-operation with the Kunstmuseum Berne (Art Museum), the Kunstsammlung Nordrhein-Westfalen Düsseldorf (Art Collection) as well as the Historical Museum Lucerne (Historical Museum). These as well as numerous other museums successfully apply MuseumPlus in their daily administration.

Modular Structure: Thanks to its made-to-measure modules, MuseumPlus provides efficient support for the administration of your collection, the organisation of exhibitions, educational tasks of the museum as well as office administration.

Network Technique: MuseumPlus allows you to offer all kinds of information to everyone linked to the network. MuseumPlus can be connected to Intranet and Internet and is compliant with different database systems like SQL-Server, Oracle or Access.

Flexibility: MuseumPlus can be adapted to the specific requirements of your museum without any further programming steps.

The modular structure of MuseumPlus allows you to adjust the program to your special tasks and even to extend it with additional modules at a later stage. Its networking technique forms the basis for common access to data.



To collect information on the objects of your museum is the prime objective of MuseumPlus. Besides core information on each object, any complementary information, links to literature and exhibitions, information on origin and actual location, reports on restoration work done as well as keywords and multimedia data can be gathered.

We ensure that your collection management system can be adapted to varying requirements in the future as well. MuseumPlus also optimally integrates new media like multimedia and Internet.

Please to not hesitate to contact us for consultation, further information or a workshop in your museum. We will be happy to present MuseumPlus without any obligation on your part.

TO PERCEPT MEANS TO GIVE TRUTH

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The present time is not alone defined by closed systems or perfekt cycles, it is marked by simultaneity, abstraction and transparency. The telematic space is making itself at home, in the world and in our mind.

Our perception varies according to a changing environment, depending on new information and knowledge. By approaching an object, links between objects and informations are created. What for example has a railroad track got to do with impressionism? Which connection is there between nature, man and machine at the end of the 20th century, the theme of the world exhibition EXPO 2000 in Hannover?

Being confronted with such complex questions it is necessary to find and develop a context in which single questions, which might seem rather incomplete, lead to a process of further questioning. It is not sufficient to collect questions and answers each one for itself. No! To get answers one has to acknowledge, and here I quote *Ken Wilber*, a main thinker of our time, the existence of a higher or deeper dimension that offers a principle... a pattern that combines separated, seemingly contradictory and isolated parts to a coherent unit, to a ROOM in which seperated parts recognize themselves as a wholeness, escaping the fate of being solely fragments.

Multimedia in the museum

I presume you agree with me in the fact that museums are important institutions for the history and the self-awareness of modern day society and that with increasing importance. In museums, we collect the objects of our world, they are documented and exhibited.

Exhibited means lifeless, not to be perceived with other senses than the eyes. Responsible managers of museums have expressed a demand for new methods of staging an exhibition. Exhibitions which enable the visitor to perceive with all senses.

Multimedia and Interaction

The known features of an interactive multimedia-show offer only one-dimensional solutions in the realization of high-profile multimedia applications. Referring to contents they are static and short-lived. To present knowledge we have to combine collected facts and their transportation to the public under consideration of the individual interests of the user, the client, the student. That means individual navigation and interaction through and with multimedia, or to put it in a simle way, a worthwhile presentation of contents according to the needs of the user within or without the monitor. We have to establish intelligent ROOMS that react to our questions, a THINKROOM that completes the presentations of the world of objects we are used to.

In interaction with the new medias we should not install rooms of reaction for the audience, we should rather emphasize situations and processes to them, in which they take part as creators of reality, not being in the position of a passive viewer.

Our aims should be:

1. To transfer the presentation and steering of contents from the monitor into the existing room.
2. To replace a constructed mixture of multimedia with a new structure of communication between methods of working, contents and chosen medias.
3. To understand interaction not as a logic of machines, but as an interaction with the digital medias on a higher level, the level of attention and intensity.

The Museum of the Future

The museum of the future will become an experimental field, in which one has access to past and present developments, which are made transparent.

The demand: the addition of fragments should count less than the reconstruction of equivalences and the offer of possibilities to experience new models of time and space. It is important to create rooms of possibilities, in which developments are made visible: contemplation is a sense of stepping back.

Watching is, in order to enter the process of visibility, a form of growth, to quote John Berger. The emptiness is not to be condemned as being scary, but as a chance for overheated multimedial society?

Such a public building will be a future place in which culture can be experienced as a historically transmitted complex of meanings and imagination. Meanings and imaginations, which appear as symbols and signs and which enable us as human beings to inform each other about knowledge of life and our view of the world, which also should be maintained and developed. This is not meant as a substitution for the traditional museum, but as a supplement.

"In my opinion..., man is a being, who is caught in a selfsspun net of meaning. Their examination is therefore no experimental science, which is looking for laws, but an interpreting one, searching for meanings.

Societies like human lives include their own interpretation, one just has to learn to get access to them."

Clifford Geertz "Dichte Beschreibung"



twosunsgmbh media development

European Museums' Information Institute

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Launched at the **mda**/cidoc 99 conference (London 6 – 10 September) the European Museums' Information Institute, or EMII, is a pan-European network encompassing 16 member states.

Project aims

- To facilitate on-line access to the cultural heritage of Europe's museums
- To create long term partnerships between museums throughout Europe
- To promote a European focus for international initiatives

Active Partners

Denmark	Statens Museumsnævn
France	Direction des musées de France, Ministère de la culture et de la communication
Germany	Institut für Museumskunde der Staatlichen Museen zu Berlin
Iceland	Þjóðminjasafn Íslands
Italy	Ministero per i Beni e le Attività Culturali
Netherlands	Bureau IMC
Norway	Norsk museumsutvikling
Portugal	Instituto Português de Museus
Sweden	Statens Kulturråd
UK	mda

Supporting Partners

Austria	Bundesministerium für Unterricht und Kulturelle Angelegenheiten
Belgium	Musée de Louvain-la-Neuve
Finland	National Board of Antiquities
Greece	Ministry of Culture, Department of Museums
Ireland	Department of Arts, Heritage, Gaeltacht and the Islands
Luxembourg	Musée National d'Histoire et d'Art

NEUTRON AUTORADIOGRAPHY OF PAINTINGS

C. Laurenze-Landsberg [1)], C. Schmidt [1)], C.-O. Fischer [2)], K. Slusallek [3)]

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1. Introduction

Neutron activation autoradiography (NAAR) is a method used in the examination and analysis of the materials and techniques of paintings. The information provided by methods of examination using photon radiation at both extreme positions of the electromagnetic spectrum is limited. X- radiography principally indicates the distribution of the pigment lead white, whilst infrared reflectography is used to reveal black, carbon- based media which have been employed on a light ground (i.e. underdrawing). In contrast, NAAR is capable of revealing different coloured paint layers piled- up during the actual creation of a painting. In many cases, the individual brushstrokes applied by the artist are made distinctly visible as well as changes and corrections that were made during the painting process. By using paintings that have been reliably authenticated it is thus possible to identify the particular style or ´handwriting´ of a specific artist.

2. Image processing of autoradiographs

The first step in the examination is to expose the painting to a flux of cold neutrons. For the activation of the painting, one of the six neutron guide tubes at the Cold Neutron Source of the 10 MW research reactor BER II is used. The activation chamber in front of the 3 cm x 12.5 cm window (neutron flux 1.1 x 10^9 n/cm^2 s), was specially constructed for the activation of paintings. The entire surface area of pictures with dimensions up to 120 cm x 120 cm can be activated in one session. Larger paintings have to be activated in sections.

The neutron-induced radioactivity decays with time. Around a dozen different isotopes are created which emit beta and gamma radiation. The most important isotopes and their half-lifes for the investigation of paintings are: ^{24}Na, 15 h; ^{32}P, 14.2 d; ^{42}K, 12.5 h; ^{56}Mn, 2.6 h; ^{59}Fe, 50.7 d; ^{60}Co, 5.3d; ^{64}Cu, 12.8 h; ^{76}As, 1.1 d; ^{122}Sb, 2.8 d; ^{124}Sb, 60 d; ^{198}Au, 2.7 d; ^{203}Hg, 46.6 d.

In the second stage the area distribution of the inducted radioactivity of the isotopes is recorded as an image. Previously, this was only possible by means of highly sensitive X- ray film (Kodak X- AR5, 35cm x 43 cm). However, in the last few years imaging plates (Fuji BAS 2000, 20 cm x 40 cm) have been employed. Today, it is part of the normal procedure to use both methods alternately.

The exposure time required for the films is dependant on the specific half-life of the isotope involved and ranges from 1 hour to 6 weeks. Following exposure, the X-ray films are developed in the normal way and then assembled on a large light box. The imaging plates are ten times more sensitive than the X-ray films and therefore require proportionally less exposure time. This means that they can be placed on the painting and successfully exposed between two exposures of the X-ray films. The information recorded on the imaging plates is read by a laser scanner and stored as an 8- bit greyscale image, 2 MB per plate. Digital processing and assembling of the images is performed on an Apple PowerMac using Adobe Photoshop 5.0.

In between exposing the X-ray film and imaging plates a germanium detector with multi channel analyzer is used to analyse the entire radiation as well as that from specific locations on the painting. In this way it is possible to draw conclusions about the complete range of pigments that have been employed in the painting.

The poster displayed at EVA ´99 shows an example of digital image processing. The painting "Girl with a platter of fruit" by Titian was examined in the ´Hahn- Meitner- Institut` in 1997. It is a good example to show the differences between X- radiography and neutron autoradiography.

Through the X-ray film, which shows the distribution of the pigment white lead, we know that Titian used a canvas that was already painted with another portrait. This underlying portrait was interpreted as an official portrait of a doge in a standing position. There also are incisions indicating the lace of a dress and incisions for a skirt. Lines that are to be seen under the girls head were interpretated as a pentiment of an ornament in her hair. Before repainting the canvas with the girls portrait, Titian turned it upside down.

In contrast to the X-ray film neutron autoradiography revealed a woman sitting on a chair, her arm on an armrest. The dress is tied in front of her breast. The deep folds in the drapery around the armrest were formerly interpretated as the pentiment in the girls hair. The gamma-spectroscopy of the dress indicates a high rate of arsenic. In between some crackles a red paintlayer can be observed with the microscope. Thus we can say that the overpainted dress was done with the red pigment orpiment.

Trying to overlap the contours of the portrait shown on the X-ray film with that on the neutron autoradiography, it was found that they do not match in size. The portrait from the x-ray film is larger and seems to be in a standing position. Thus the result is that there are at least two different paintings lying below the visible painting. If they ever were completed cannot be said.

By neutron autoradiography the precise design of a pattern in the girls dress becomes visible. It is executed in an astonishing carefulness and it seems incomprehensible that Titian coated the pattern with a thin brown layer. But it was not Titian's purpose to turn one's eyes on a precious dress but to heighten the value of the represented girl by means of a precious gown.

Gamma spectroscopy indicates the presence of antimony in the pattern. The analysis of a taken sample proofed that Titian already used the antimony containing pigment Naples Yellow. This is the earliest evidence of Naples Yellow in a painting so far which as to literature only got into use two hundred years later.

INFORMATION SYSTEM IN THE NATIONAL MUSEUM OF ART OF ROMANIA - ACHIEVEMENTS AND PROJECTS

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Since April 1997 the National Museum of Art of Romania became the first museum in Romania presenting a home page on the Internet on his own computer server with a whole class of Internet users.

The difficult economical period wich Romania as an eastern country is going through makes it almost impossible for the cultural institutions to maintain an adequate level of high technology. Under the circumstances our solution was to create a general program in order to ensure a possibility to up-grade the configuration, from the level of the LAN up to the external communications and Internet connection. Together with our colleagues from IT institutes in Bucharest, we started different programs designed to be followed step by step.

The general aspect for our information system has 3 main categories:

A – internal administration for the museum's collections, including archives, research, conservation and restoration, environments parameters' control, multimedia kiosk

B – internal administration for human and financial resources, protection and security in redundant structure

C – administration of communications and the exchange of information with others, including protocols, techniques, copyrights and benefits

Steps and results

- LAN divided in four subnetworks following the topology of the building and also for the other branches of the museum (at this moment 35 workstations and a dedicated data line for one branch at Zambaccian Museum);
- installation of Linux operation system on the web, ftp and mail server - cooperation with the Institute for Research in Informatics
- dial-up clients for e-mail accounts on the museum's server
- a team from museum's employees trained to develop technical support for usual technical assistance hard and soft
- implementing first necessary knowledge in data base configuration at the level of curators and restorers
- Configuration for a model of RDBS for museums under Oracle 2000 – cooperation with Institute for Research in Informatics. The general structure of the data base system consists in:
    1. a class of entities concerning process-states, operations, actors, files and associated multimedia objects
    2. classified lists concerning on one hand term lists in a kind of dictionary and on the other hand categories lists for art object's category, materials, school, period, storage methods, department specificity, techniques a.s.o.
- developing the museum home page initially started in cooperation with the Institute for Computers – our web site is http://art.museum.ro
- high quality printing line consisting in: digital professional camera with SCSI interface, graphic workstation, slides scanner, print server and network color printer

Problems

- because of the little money involved in the cultural activities is very hard to maintain a high standard concerning hard (our dedicated lines' speed at 512 baudes) and soft configuration (that's why our option for free Lynux system)
- very weak financial possibilities to advertise about what the museum can do, show and teach for the public (the main achievement is our web page)
- difficult connection with similar institution in Western Europe concerning the possibilities to cooperate in European programs, which is a general problem for East European countries.

Projects

- in cooperation with the specialists from IT institutes we will develop next steps concerning:
    - multimedia kiosk for the European collection of the museum which is going to reopen after 10 years (the museum was seriously damaged in the events of 1989)
    - CD ROMs by themes and/or artists
    - improving the image presentation on the museum home page, in order to obtain a good rate quality, communication speed, price
- Local video and multimedia interactive presentation for children, students and general public.
- Drawing classes and art thematic games on computers for children.
- Starting a project of cultural tourism in cooperation with 3 other museums in Romania concerning a virtual tour on our home pages

We must underline that in the course of time Romanian IT specialists have presented at EVA meetings the idea of cooperation in the field of multimedia access to the European heritage between West and East European countries.

Our museum was a signatory member of MoU and after this of MEDICI program and unfortunately for us it was a transfer from Working Groups in MoU to Action Lines and Special Interest Group in Medici. We hope that now, due to the general policy of the Medici's board that Internet can be a solution for everybody to cooperate and to be informed about state of the art in this field.

We intend to focus on the idea that East European countries have a very rich cultural message, their heritage being part of the European heritage and also a bridge for the European integration.

In a few words we see a possible European cooperation for multimedia access to the heritage as follows:

- Defining at the level of the EU (through EVA, Medici, public institutions and/or private companies) a portfolio of projects on different themes without restrictions for participants.
- For each project there will be nominated museums and IT companies teams from each country
- Using the previous experience from MoU – the former group Priorities in Culture Economy in order to develop the idea to "foster the International Virtual Bridges Initiative based on public – private partnerships between national/regional governments and industry"

Proposals

- An important support for cooperation must be the free access to information in the field of multimedia access to heritage especially for museums, which will give the real quality of each project in this field by involving curators and artists.
- At the level of European organizations it will be useful to have links to all the sites of the museums participating to the European projects with specialists and/or ideas
- Defining an European touristic tour presenting the cultural sites of each country or following a certain theme in two versions:

    1 a virtual tour presented on the web site of each country from the defined touristic path

    2 the second step by creating a CD-ROM with detailed presentation on the same theme

The main advantage will be that people surfing the net will know more about museums.

Concerning the eventuality of CD ROM production our proposal for the revenue is that it be shared between museums and the IT companies involved, with a 70% quota for the museums.

THE ASSESSMENT OF COMPRESSION INDUCED IMAGE DEGRADATION.

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The introduction of image distortion during compression is of widespread concern, to the extent that it may influence the choice of codec and associated compression rate. The ability to quantify this image distortion (or reduction in exploitation potential) for particular applications is therefore highly desirable. The work presented at this conference represents part of a programme aimed at selecting a codec and compression rate automatically based on the exploitation potential of the input imagery and that required of the output imagery.

In the military domain, the quality or interpretability of reconnaissance imagery is normally measured using the National Imagery Interpretability Rating Scale (NIIRS). It consists of integral levels ranging from 0-9; higher values indicating a capability to support more detailed analysis. The assignment of NIIRS level is subjective and is driven by the requirements to detect, distinguish between, and identify specific imaged objects. If the particular object does not appear in the image, then an analyst must imagine it to do so and assess the image accordingly. A Civil NIIRS also exists. It is quantised down to tenths of a rating and includes a more general set of agricultural, cultural and natural features.

The performances of a number of metrics capable of quantifying image degradation have been evaluated on various imagery types [1]. Here we report on the application of JPEG, wavelet and VQ (vector quantisation) codecs, over a range of compression rates, to visible-band imagery, and, in particular, we examine the correlation between these metrics and the reduction in subjective NIIRS value. The assignment of NIIRS ratings is based on the March 1996 release of the IRARS (Imagery Resolution Assessments and Reporting Standards) committee's Civil NIIRS Reference Guide, and represents the consensus of opinion of a group of seven image analysts drawn from military intelligence centres across England.

In addition, we present a novel and straightforward method of graphical and scalar image quality measurement utilising integer wavelet transformations. The image is decomposed down to 3 levels using an S&P transform, as ultilised in the SPIHT [2] codec. It has been observed that the diagonal and edge transform-subbands are complementary in capturing blur and noise degradation caused by application of a codec to an original image. The measure can perform a similar function to the Hosaka [3] plot whilst not requiring segmentation and threshold parameters. By weighted summation, the graphical measure can be degenerated into a scalar quality measure. The scalar measure is found to present consistently high correlation with subjective image quality assessment using NIIRS.

The study used digital versions of the calibration images associated with the Civil NIIRS Scale. All of the scalar quality measures assessed in this study are bivariate, that is, they measure the differences between corresponding samples in the original image, f, and the (reconstructed) compressed image, f'. The study also evaluated graphical image quality measures, such as histograms and Hosaka plots, against the results. However, the dimensional inconsistency between the graphical measures and the NIIRS rating did not facilitate correlation.

Results have indicated that the following numerical image quality measures provide very good correlation with NIIRS ratings when applied to JPEG and particularly to both VQ and wavelet compressed imagery: Mean Square Error (MSE), Image Fidelity, Peak MSE and Normalised MSE. The unexpectedly high correlation between MSE and NIIRS degradation appears to negate much of the criticism of its low correlation with subjective assessment. These results support recent studies from academia [4] which found that the latter three of the above measures were amongst the best metrics in their subjective/numerical image quality correlation project.

It is apparent that the entire library of numerical measures used in this study were better able to reflect the NIIRS degradation in wavelet and VQ compressed imagery than they were for JPEG. This is due in part to the ability of wavelet and VQ compression to encode the imagery to produce an optimally minimised MSE image on reconstruction. The wavelet encoder produces embedded codefiles which ensure that recovered bits minimise optimally the MSE of the reconstructed image when decoded. Since MSE has been shown to provide a good correlation with NIIRS evaluation in this study, the use as a controlling parameter in the wavelet codec has been shown to provide a higher degree of correlation with the NIIRS assessment. In common with wavelet compression, VQ compression uses MSE to optimise the codebook generation during compression. At each level of compression, the algorithm optimises a codebook collection of model blocks using the Generalised Lloyd Algorithm (GLA) to minimise the MSE of the reconstructed image.

Image compression algorithms tend to introduce their own characteristic artefacts. For instance, at high compression rates JPEG and VQ introduce blocking artefacts whereas wavelet techniques tend to introduce blurring. Our analysts' order of preference was for JPEG, wavelet and then VQ. This is supported by the average NIIRS ratings, which indicate less perceived distortion using JPEG than wavelets except at low bit rates. The analysts expressed concern about the appearance of localised artefacts when viewing highly compressed wavelet compressed imagery and indicated that the artefacts could easily be misidentified as genuine image features in reconnaissance imagery. The analysts reported that, to a limited extent, they could look through the JPEG blocking artefacts.

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V14 RealTimeImage - der erste digitale Bildkatalog im Internet
Wilhelm Halling (dimedis GmbH, Köln)

V15 Rechnergestützte Präklassifizierung von Portraitminiaturen
Robert Sablatnig, Ernestine Zolda (TU Wien, Institut für Automation, Abt. für Mustererkennung und Bildverarbeitung)

V16 Zur zerstörungsfreien Analyse von Kunstwerken mit bildgebenden Verfahren
Dr. B. Illerhaus, D. Meinel (Bundesanstalt für Materialforschung und -prüfung, Berlin)

Präsentationen

P1 Virtuelle Tempel - Der Löwentempel von Musawwarat es Sufra
Steffen Kirchner (Humboldt-Universität Berlin, Institut für Sudanarchäologie und Ägyptologie)

P2 Multimedia-Informationssystem Pergamonmuseum
Lothar Becker (CompART GmbH, Berlin)

P3 PC-Bildmanager
Dr. Hans-Werner Maye, Margit Schmidt (Systemhaus Dr. Maye GmbH, Frankfurt/Oder)

P4 Multimedia & Design
Jaroslav Piálek (COMPAL Datenverarbeitung GmbH, Berlin)

P5 Präsentation der Schätze der Ostgoten auf Schloß Bevern
Anne Griepentrog, Dr. Matthias Pleßow (Gesellschaft zur Förderung angewandter Informatik e.V.)

P6 Multimedia-Präsentation zum Aktionskünstler Joseph Beuys
Michael Thierschmann (LuRaTech GmbH, Berlin)

P7 CD-ROM „Martin Luther 1483-1546"
Dr. Arthur Engelbert (Gesellschaft für Multimediaproduktionen in Berlin mbH, Medienlabor für kommunikative Strategien e.V.)

P8 CD-ROM „Bauen im Licht. Das Glashaus von Bruno Taut"
Dr. Arthur Engelbert (Gesellschaft für Multimediaproduktionen in Berlin mbH, Medienlabor für kommunikative Strategien e.V.)

P9 DISKUS - Digitales Informations-System für Kunst- u. Sozialgeschichte.
CD-ROM-Edition 1995-1996
Dr. Andreas Bienert (Staatliche Museen zu Berlin - Preußischer Kulturbesitz)

P10 Das Museums-Inventarisierungs-System „MUSYS"
Sven Kreutzhagen (DYNIX/MDIS GmbH, Hamburg)

P11 EDV-Anwendungen in der Restaurierung
Roger Kossann, Restaurator, Bremen

P12 Chemical Mapping - Die Methode flächenhafter Darstellung von Elementverteilungen an Beispielen frischer und verwitterter Gesteine
Prof. Gerd F. Tietz, Wiebke Hachmann, Janio Victor (Universität Hamburg, Geologisch-Paläontologisches Institut und Museum)

P13 Anwendung von 3D-Studio MAX
Kurt Jankowski-Tepe, CAD-Systeme, Berlin

P14 Präsentation der 3D-Computertomographie-Daten
D. Meinel, Dr. B. Illerhaus (Bundesanstalt für Materialforschung und -prüfung, Berlin)

P15 3D-Aufnahmesystem für den Freilufteinsatz, 3D-Vermessung von Artefakten
Lothar Paul (Gesellschaft zur Förderung angewandter Informatik e.V., Berlin)

P16 Optische 3D-Vermessung im Mikrobereich
Dr. Gottfried Frankowski, (OMECA Meßtechnik GmbH, Berlin)

P17 grafiLAP - Feldrechner für Archäologen
Mario Wunder (Institut für Informatik in Entwurf und Fertigung zu Berlin GmbH)

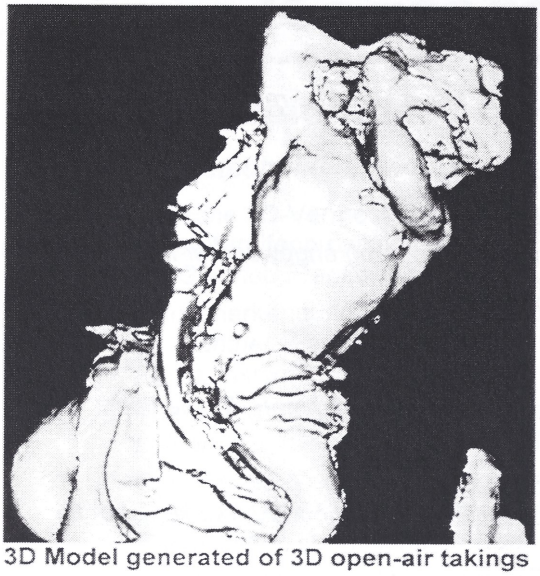
P18 Computergestützte 3D-Modellierung und 3D-Präsentation am Beispiel des großen Altars von Pergamon
Joachim Schulze (Institut für Informatik in Entwurf und Fertigung zu Berlin GmbH)

P19 Präsentation einer CD-ROM-Sammlung
Dr. James Hemsley (VASARI Enterprises, Aldershot)

P20 Image Finder Cultura - Die komplette Software für effizientes Bild-Management in Wissenschaft und Kultur
Barbara Kopf (Universität Wien, Institut für Klassische Archäologie)

Gesellschaft zur Förderung angewandter Informatik e.V.

Society for the Promotion of Applied Computer Science



3D Model generated of 3D open-air takings

The GFaI (Society for the Promotion of Applied Computer Science) was founded on 1st June 1990 in Berlin and promotes non-profit research projects. It is located in one of the largest European IT & MM-Parks in Berlin-Adlershof.

With about 65 employees the GFaI works especially in the fields of Image Processing, Multimedia and Information Systems. Furthermore modern Technologies of Knowledge Based Information Systems, Fuzzy, Neuron Networks and Evolution Strategies as well as "Acoustic Photography" are used.

Beginning with the successful co-operation of the GFaI in the VASARI Project (1992) and the continuation of the contents in the MUSA Project coordinated by the GFaI (1994) the GFaI is responsibly involved as co-organiser in the annual organisation of the EVA Series since 1994 in Berlin. The co-operation with the SMPK (State Museums of Berlin – Prussian Cultural Heritage), the FHTW Berlin (University of Applied Sciences) and other institutions extend the opportunities and scope of this event. The GFaI itself has developed various activities in the field of Art, Culture, History.

Completed Cultural Oriented Projects (selection):

VASARI

Starting study of the Application of Image Processing in the Visual Arts

MUSA

Study of the Content-Based Retrieval in Image Databases

MUSA

3D-Modelling and Visualization of the Altar of the Pergamon Museum (IIEF as a subcontractor of the GFaI)

VAMP

Production of Personalized Catalogues for Museums and Galleries

Puzzle

Image Processing Aided Automated Puzzling of 2D & 3D Archaeological Fragments

Ostrogoths Treasures

Multimedia Presentation of the Ostrogoths Treasures at Bevern Castle

The Berlin Style Guide

Rules for the Development of Unified Interfaces for Berlin Information Supplier also in the Cultural Field

Processing Cultural Oriented Projects (selection):

3D Acquisition

Computer-assisted 3D Acquisition, Modelling and Documentation for Culture, Art, History and Medicine

SpuBiTo

Reconstruction of Sound Information from Negatives of Edison Cylinders with Help of Image Analysis

Stadtplan

Multimedia Planning System for Urban Development and Architecture with the Aim of an Automatic Generation of Views of Future Towns

Stadtschloß

German-Japanese Project for the Virtual Reconstruction of the Berlin City Palace and the Nobunaga-Residence (together with IIEF)

Results in other fields like Image Processing, Visualization, Intelligent Character Recognition, Document Processing, Information Systems etc. are aimed at future applications also in Culture, Art and History.

Further Information: GFaI Homepage http://www.gfai.de

VASARI ENTERPRISES

A Research Consultancy & Conference Organiser specialising in the Cultural Systems Area

VASARI provides three types of services to clients in the museum, government and corporate sectors:

1. Consultancy on multimedia systems strategy procurement and independent project reviews.
   Past clients include:
   - British Museum
   - National Museums of Scotland
   - National Galleries of Scotland

2. Training in Electronic Imaging ranging from User Requirements capture and market analysis to technology awareness and understanding for management and users as well as technology specialists. Clients include a wide range of organisations internationally.

3. Special research studies in the European Cultural Systems field including surveys of the state of art of technology application in museums and galleries, the future application of multimedia and the competitive situation of Cultural Electronic Commerce. Clients include:
   - The European Commission
   - A major international company

In addition, VASARI participates in EC supported research and technology development projects in consortia with members from various EU countries. Currently, it is involved in two:

- **TOSCA**: developing advanced portable digital audio and multimedia guide for visitors to archaeological and other open-air sites of cultural interest e.g. city tours.
- **ACOHIR**: carrying out research into new 3D imaging and display systems.

In each of these projects, VASARI's role is primarily to carry out user requirements and market analyses and help develop exploitation plans.

VASARI has the co-ordinating role in the EVA Conferences (Electronic Imaging and the Visual Arts) which began in London in 1990 as part of the original EC supported VASARI project into ultra high quality imaging of art works. In 1998 / 99, events were held in California, Texas, New York, Japan and Russians well as across Europe with altogether over 3,000 participants. These act as a cross-sectoral, multidisciplinary, 'local and global' set of fora for people interested in new technologies in the cultural sector. The proceedings are published by VASARI which also has its own Web site. This work is supported by the 'EVA Cluster' EC project.

In 1997, VASARI (Italy) was founded in Florence, which offers a similar range of services.

Further information from the VASARI Website: http://www.vasari.co.uk

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