Documentation Tools for Management of Cultural Heritage for Conservation of Archeology, Historical Center, Museums and Archives: T*he Case of Global Memory Net*[*]

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Abstract: Since 2000, Gobal Memory Net (GMNet) supported by the US National Science Foundation/International Digital Library Program, has developed to be an effective world culture and heritage image library and portal which provide instant access to the global invaluable cultural, heritage and historical resources of libraries, museum, and archives.[†] In addition to over 30 rich in-house digital image collections, it also provides instant access to over 2400 world digital collections from over 80 countries.

Global Memory Net has been implemented with a strong conceptual framework developed since 1993 and refined in the late 1990s and has utilized cutting-edge retrieval technologies for providing innovative user-oriented information services. This paper focuses on a range of new and exciting technical developments to implement aggressive user-centered concepts and strategies for providing the kind of multi-format and multilingual access to multimedia resources not possible before. Its Integrated Multimedia Content Retrieval System (i-M-C-S) will be introduced as a powerful tool for management, retrieval, and dissemination of cultural heritage resources.

PREFACE

I am delighted to be at this UNESCO Forum – University and Heritage with the themes on two areas which have been dominating my own research and development work in recent years – "Documentation for Conservation and Development," and "New Heritage Strategy for the Future." It is also a great treat for us to gather in this beautiful Palazzo Vecchio of this culture intensive and heritage rich city, Firenze. I must first thank Ms. Marielle Richon of the UNESCO World Heritage Centre for her persuasion to encourage me to take part at this Forum despite of very difficult scheduling problems and it is a great privilege to deliver my talk as the first of the opening presentations.

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[*] See http: //www.memorynet.org/. Global Memory Net was launched for universal access in late June 2006.

[†] Modified from a number of speeches including a keynote speech entitled "New Digital Library Perspectives from International Library and Information Point of View," delivered at the *Annual Meeting of Library Directors of Universities and Colleges in Taiwan,* Tainan, May 19, 2006; an invited speech entitled "Challenges for Developing a World Digital Library and Gateway: The Case of Global Memory Net," delivered *at Library in the Digital Age (LIDA 2006)*, Dubrovnik, Croatia, May 31, 2006; and two speeches entitled "West by East - East by West: Cultural and Technological Exchange in the Case of Global Memory Net" and "Using Tomorrow's Retrieval Technology to Explore the Heritage: Bonding Past and Future *i*n the Case of Global Memory Net" at the *World Library and Information Congress: 72nd IFLA Meeting*, Seoul, Korea, August 18-25, 2006.

The theme which I am asked to address is "Documentation Tools for Management of Cultural Heritage."   I shall use our own in-house developed systems and tools for *GMNet*, a major US National Science Foundation's International Digital Library Project, to elaborate on the theme with overlapping and linking coverage to almost all other 6 themes – documentation for building heritage; and conservation of archaeological properties, historical centers, museums, and intangible heritage, as well as the evaluation of use and impact.

As stated by Prof. Augusto Marinelli, Rector of Universita degli Studi di Firenze, "knowledge and documentation about places culture, represent in fact a fundamental element for memory preservation, indispensable for human activities stewardship, growth and development," and by Prof. Juan Julia Igual, Rector of UPV, "our complex era requires not to lose our memory… Heritage is the setting of human identity itself, its tradition and history. The understanding, value enhancement and dissemination of heritage are constant, priority and necessary tasks."   Interestingly, I cannot describe any better on how and why the idea of GMNet was conceived over 5 years ago

INTRODUCTION

I have advocated the concept of a world digital library since 1993 [Chen, 1993], but my own serious R&D work related to the development of digital libraries did not start until mid-90s.   As we entered an exciting digital era in the new millennium, we have begun to witness the exciting convergence of content, technology, and global collaboration. There are unprecedented potentials as well as challenges for developing digital libraries of all kinds. Fully realizing the importance of a triangular relationship between content, technology and user as shown in Figure 1 [Chen, 2005], a model developed by the *DELOS-NSF Working Group on Digital Imagery for Significant Cultural and Historical Materials* in December 2002.
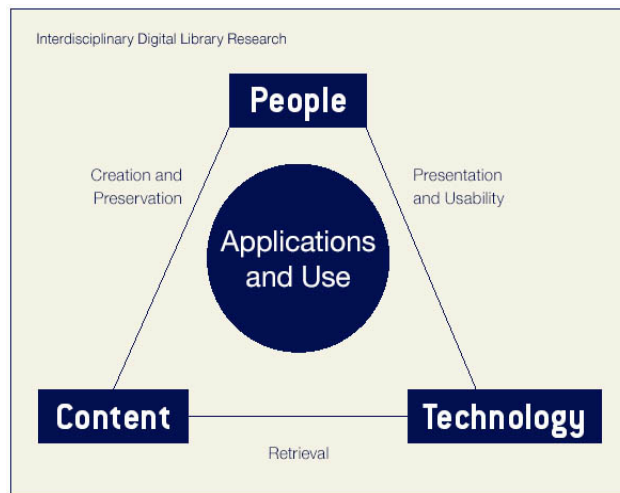

Figure 1.Conceptual Model of an Interdisciplinary Digital Library

CHALLENGES FOR DEVELOPING A WORLD DIGITAL LIBRARY

In the case of GMNet, since it is intended to be both a world digital image library and a gateway, we have conceptually set various requirements as our challenges for such digital library development. The following are some of the selected ones [Chen, 2006]:

- Instead of using web for publishing, we need to use web as a platform to enable more user participation,
- We need to provide seamlessly integrated multimedia information services in order to enrich user experience,
- Our system needs to provide innovative information services, and it is not to offer packaged software for building databases,
- User's need and behavior in information seeking should not be pre-determined, thus the search and retrieval capabilities have to be able to accommodate all kinds of needs,

- User needs to control the use of data, thus he/she can choose to search one single collection or multi-collections,
- What we offer should be a knowledge base and not database(s), therefore once simple information is found, user can and should be enriched with more related multimedia information, and mixable or re-mixable resources if desired,
- We need to provide freely accessible and searchable web resources, and not just links with them,
- To enhance user experience and ability to consume the obtained information, multilingual capabilities are essential for both presentation as well as retrieval,
- User should be able to lead from one tiny useful information to play big and link that to the world collections as well as world bibliographic and web resources,
- User should be able to address the content in any granularity,
- Geographical access to content should be provided,
- Intellectual property of the content provider should be protected,
- User should be able to use the discovered and retrieved data to develop his/her own project(s),
- User should be able to actively contribute to the library,
- Etc.

To meet these challenges, in the case of GMNet (www.memorynet.org), we have developed the latest version of the *i*nteractive **M**ultimedia **C**ontent Retrieval **S**ystem (tentatively called *i*-M-C-S) by incorporating many innovative concepts and functions. This paper will articulate how these challenges are being addressed. They include some of those listed in the following:

1) Using the Web as a platform to integrate seamlessly all types of multimedia resources.
2) Digital images can not only be retrieved in traditional ways by metadata fields, but also by cutting-edge content-based retrieval methods (CBIR).
3) Once the desired image(s) is (are) located, associated sound, digital video, textual annotation, as well as expanded bibliographical and Web resources can be obtained by the simple clicks of the mouse.
4) Available resources can be retrieved by searching a single collection, or by cross-collection (or multi-collection) search.
5) Multilingual presentation as well as retrieval should be possible.
6) Geographical retrieval should be provided.
7) While universal access is the goal, the users should be possible to contribute their resources as well.

THE DEVELOPMENT OF GLOBAL MEMORY NET'S *i*-M-C-S SYSTEM

The *i*nteractive **M**ultimedia **C**ontent retrieval **S**ystem (*i*-M-C-S) has been developed in house with its beginning as a Linux/MySQL/PHP-based system with a functionality scheme as shown in Figure 2. As time goes on, more and more functionalities are added, and currently the latest version (Verions 4.5) can address literally all the challenges listed above. We shall elaborate on these features in the following section.

In addition, realizing that more content collaborators would want to develop their own digital image collections, we have developed a generic version of *i*-M-C-S to enable our content collaborators to develop their own digital collections easily by simply plug in what is prompted after the basic image database has been created. This was tested in Croatia at a

workshop offered at University of Zadar after LIDA 2006 conference [Chen and Badurina, 2006], and it was proven to be very successful.
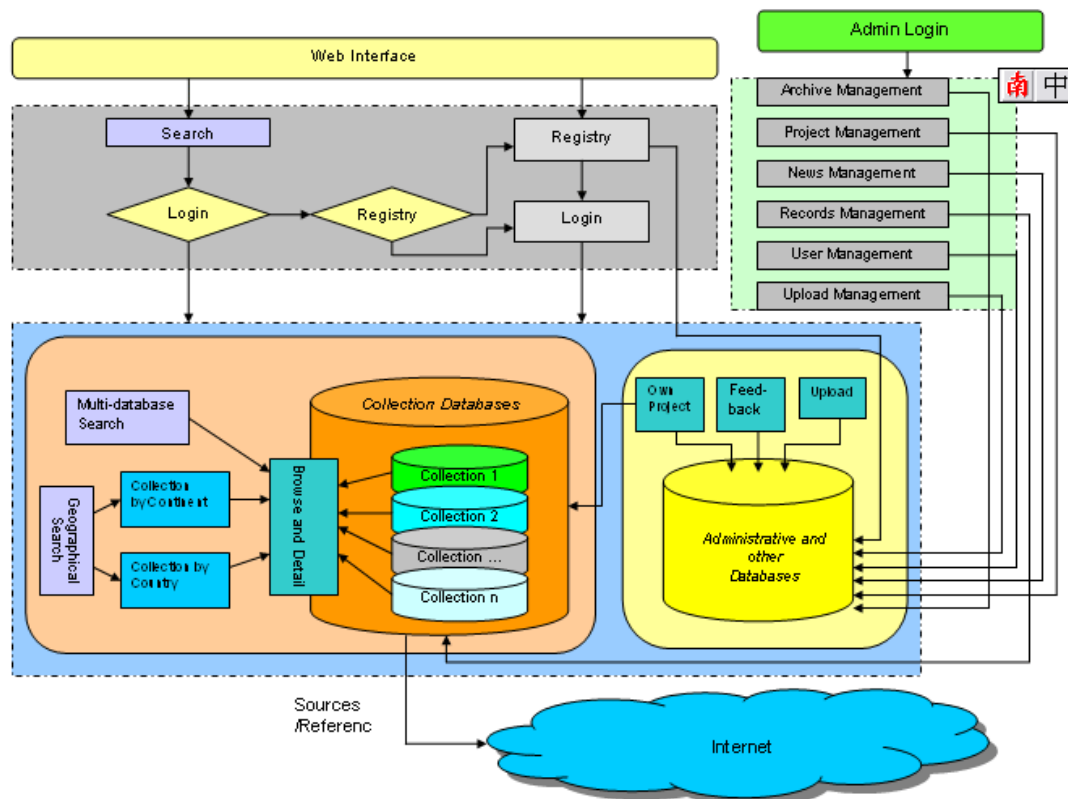

Figure 2. Functionality Scheme of Global Memory Net [Zhang and Chen, 2005].

Furthermore, this generic version of *i*-M-C-S is a 3-tier system, which is developed to meet the needs of interested organizations depending on the technical sophistication and capabilities of each of them. The 3 tiers are:

- **Tier One**: This system has almost all the systems features of the current GMNet. It required a server, with staff possessing knowledge and expertise in Linux, PHP, and MySQL etc.
- **Tier Two**: This system will use PC as a server, and the functionality is reduced from those of Tier One due to PC's functionalities.
- **Tier Three**: This is the lowest level which will start an institution with much less technical capabilities to start developing its digital collection database(s), knowing whether that all digital library applications require functional digital databases.

FEATURES OF GLOBAL MEMORY NET [Chen, 2006]

To elaborate on what was discussed above, while it is impossible to cover all features, we shall select a few in the following with appropriate illustrations:

- *Web is used as a platform*, and not as a publishing medium.

  Figure 3 is the Home Page of GMNet. It show how all the invaluable resources are available to universal access by using the Web as a platform.

Figure 3. The Home Page of the Global Memory Net.

• *Instant access to rich image collections* – One can access to over 30 image collections in GMNet with over 20,000 images as well as over 2400 digital collections from over 80 countries. Although GMNet's own current collections have focused in culture, history, and heritage, the World Digital Collection in GMNet has included over 2400 digital collections cover all subject areas. This includes over 100 collections from UNESCO's Memory of the World, over 290 collections from the US Library of Congress, as well as those from other major national libraries, archives, museums, academic institutions, etc. In other words, the world's rich resources are instantly accessible at a simple click of the mouse. Figure 4 shows how these collections can be accessed by selecting the collection from the left blue panel of "Collections". Although the panel shows only 9 major collections, but many more can be accessed by clicking "more." All collections can be listed on the front panel by selecting the choice in the "admin" functions.

Figure 4. The Navigational Panel Showing how GMNet Collections Can Be Accessed

• *Easy and flexible traditional search* – Select a collection of interest, and use traditional search by any or all of the metadata fields when one knows the precise information to search in this collection. In this case, the Google syntax is used.

- *User can explore the unknown collection and learn its coverage* – For an unknown collection of curiosity to the user, it is impossible for one to search either by author, title, subject or keyword as normally requested. In this case, we provide the capability for the user to browse the collection. But more significantly, the "random" feature permits one to explore and learn the coverage of this collection. In seconds, one will know considerably more about the collection though the variety of images displayed as well as the words showing up for the titles. These words can then be used as possible keywords for further retrieval. For example, Figure 5 shows the great diversity of images covered in the UNESCO's Memory of the World collections. A quick glance of this screen, one can have a good idea on the subjects involved. Should there be a topic of interest, then one can move to the next step. Otherwise, further random access will yield more topics of coverage.
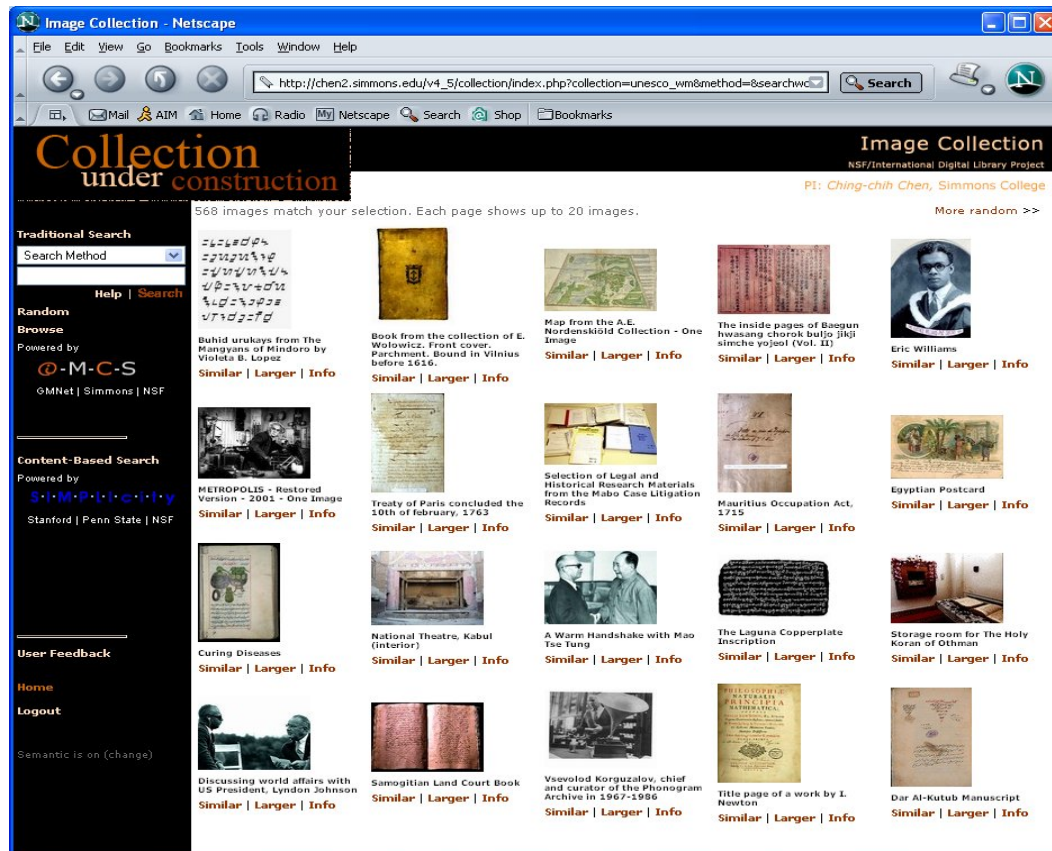

Figure 5. For UNESCO's World Memory, "Random" feature provides an instant display of
a great diversity of topics covered

- *Instant retrieval of similar images of interest by using cutting-edge retrieval techniques* – Once a picture of interest is spotted, one is given three choices – 1) to find pictures of the same color or shape using the cutting-edge content-based image retrieval (CBIR) or the same topics, or 2) to zoom the image for larger sizes and more details, or 3) to have some descriptive information, as shown in Figure 6 on the right. Our CBIR uses SIMPLIcity of Prof. James Z. Wang of Penn State University. For example, if the image shown on Figure 5 related to "Curing Diseases" is of interest, one will be able to ask for more information as shown in the enlarged illustration shown in Figure 6. The user can choose to click on any of the three choices for much more information.

  o **"Similar"** – A simple click on "Similar" will yield all the images of similar color and shape through the use of SIMPLIcity, a content-based image retrieval technique developed by James Z. Wang of Penn State University, as shown in Figure 7. Or, we

can also retrieve images of the similar title or keywords if SIMPLIcity is not used. This is an important feature which is able to provide instantly a large number of similar images to the user without having to type anything on the keyboard. For someone who knows nothing about the subject or the inclusion of the collection, undoubtedly this opens up a new horizon for learning to the user. Figure 7 shows all the similar images of an ancient Egyptian medical manuscript from a collection of the UNESCO's Memory of the World collections. The manuscript is currently housed in the National Library of Egypt.

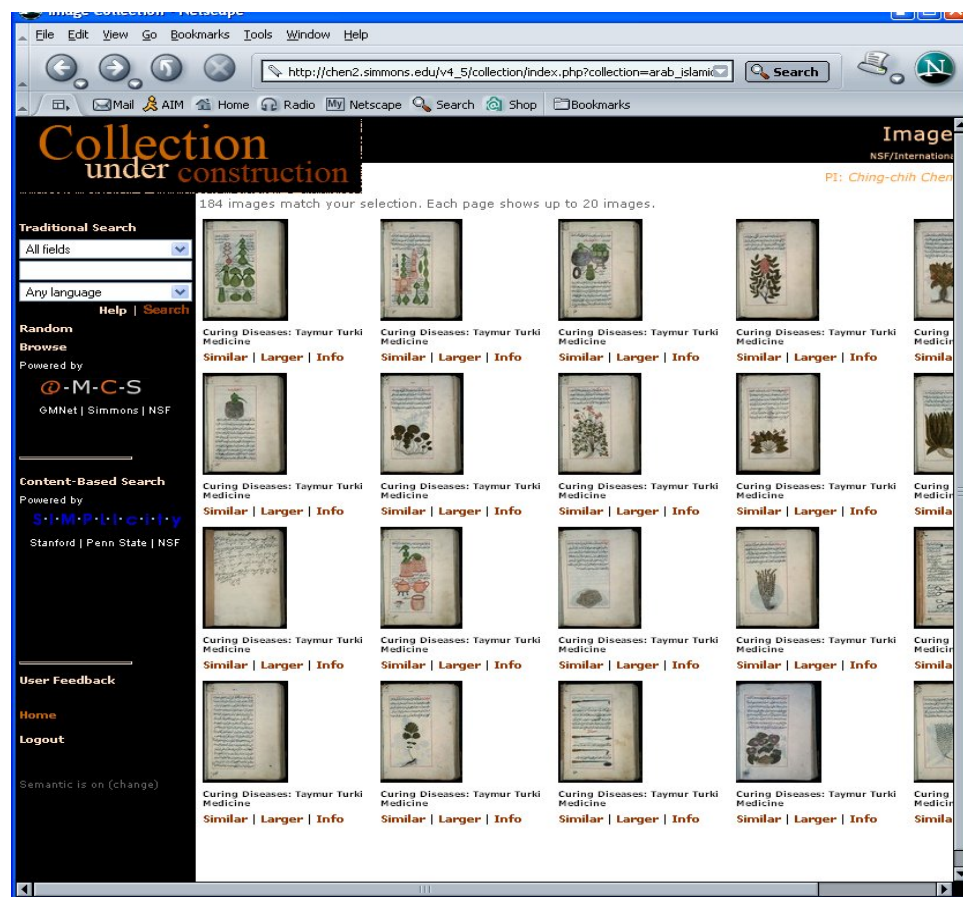Figure 6. The Chosen Image - "Curing Diseases"

Figure 7. Instant display of all similar images of the same color and shape

o "Larger" – By clicking this, instant magnification of a chosen image in defined areas is shown. Depending on the resolution of the image, some images can be zoomed over a dozen of time. Note the small icon of the rare Japanese Inoh Map of the Library of Congress' Asian Division (Figure 8). It is so small that nothing can be seen. Yet, this tiny icon-image can be magnified to 12 times with a great deal of significant information to the scholars. Note that the enlarged area is also indicated on the image icon with the blue rectangular lines. Also note that in the lower right corner shows the dynamically generated digital watermark showing "LC Asian Division." This is a very important feature – to ensure that the intellectual property right or the ownership of the image resources are properly protected and acknowledged.
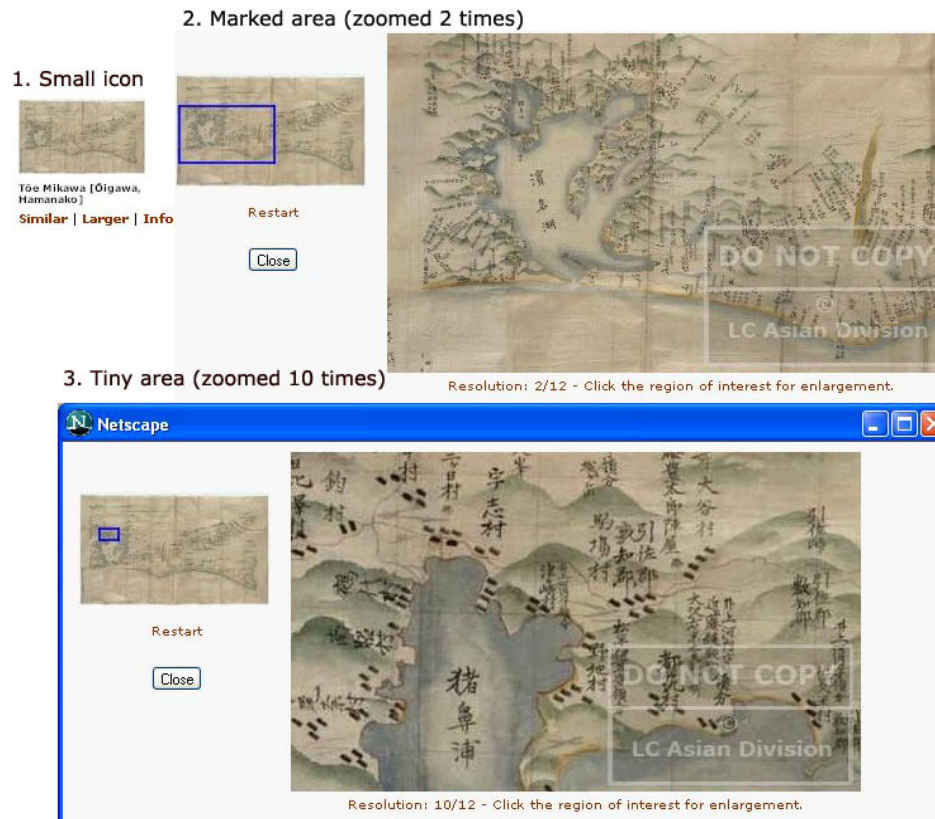
Figure 8. This figure shows the multiple levels of magnification.
Note also the dynamically generated digital watermark.

o "Info" – "Info" will yield instant descriptive information about a chosen image, as shown in Figure 9 for the image on "curing diseases," and Figure 10 on a Japanese Waka poem. This information can be in multilingual forms. In addition, a simple click on the URL of the source, the user will go immediately to the original Web page so he/she can browse and search for more information there.

Figure 9. Descriptive information (metadata) of the Islamic "curing diseases" image available in both English and French

Figure 10. Descriptive information (metadata) of an Japanese Waka poem image from the Tsurumi Collection available in both English and Japanese.

- *Dynamically generated digital watermark for copyright protection of the content provider* – As already mentioned and shown in Figure 8, this provision has encourage more content providers to feel comfortable in providing their treasures in digital form on the Web.

- *Seamless integration of multimedia information* – If relevant resource information on a chosen image is available in formats other than textual annotation, the user can then retrieve the relevant audio, video, etc. again by a single click of the mouse on a selected icon, as shown in Figure 11. For example, in Figure 11, the "Info" screen (the lower screen) shows the availability of 3 digital videos and 2 PDF document files are available for instant retrieval. Some others include sound and/or animation files. When one of the video icons is clicked, the digital video (in this case, the musical combo show with all the Chinese musical instruments will be shown instantly (the upper screen of Figure 11).

Figure 11. Info screen showing multimedia files

- *User can choose to conduct either a single collection or multi-collection search* - For example, if one wants   to find information on Naxi, one of the 56 minority ethnic groups in China, one can choose to search a single collection, the US Library of Congress' Naxi Manuscripts Collection, or one can do multi-collection search. The later will search all the 30 some collections in GMNet as well as the 2400 digital collections in the world. The search results instantly appeared are shown in Figure 12. We can see that, in addition to 1027 images found in LC'Naxi Manuscripts, one can also locate additional resources and images in other collections, such as:

- o 2 Web sites in the World Digital Collection,
- o 3 images in UNESCO's World memory,
- o 9 images in World Musical Instruments,
- o 10 images in Chinese 56 Ethnic Groups.

- *User can have much more in-depth learning of the subject by using expanded bibliographical and web resources* – Once images of interest are spotted, the metadata information given in "Info" will be useful but not likely to satisfy the information seeker. Thus, if one is interested in finding more information on an image, for example, related to "Timbuktu" such as books articles, etc., one can instantly find relevant books from the half-billion bibliographical records of OCLC/World Cat, or web resources like Google Scholar, Wikipedia, Internet Archive, Million Books etc. (Figure 13). When the desired books are found in the OCLC/WorldCat, one will be able to locate them in libraries nearby the user. They can then be obtained via interlibrary loan, etc. Google Scholar and Wikipedia will be able to provide full-text information instantly.
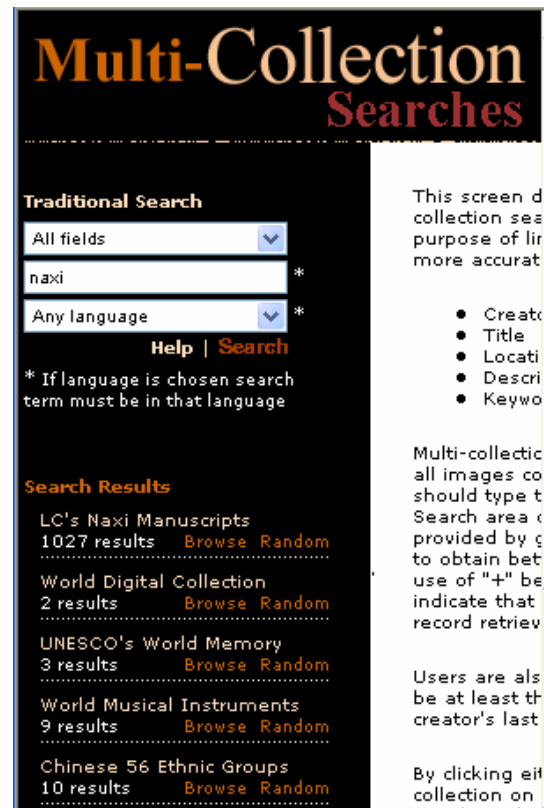

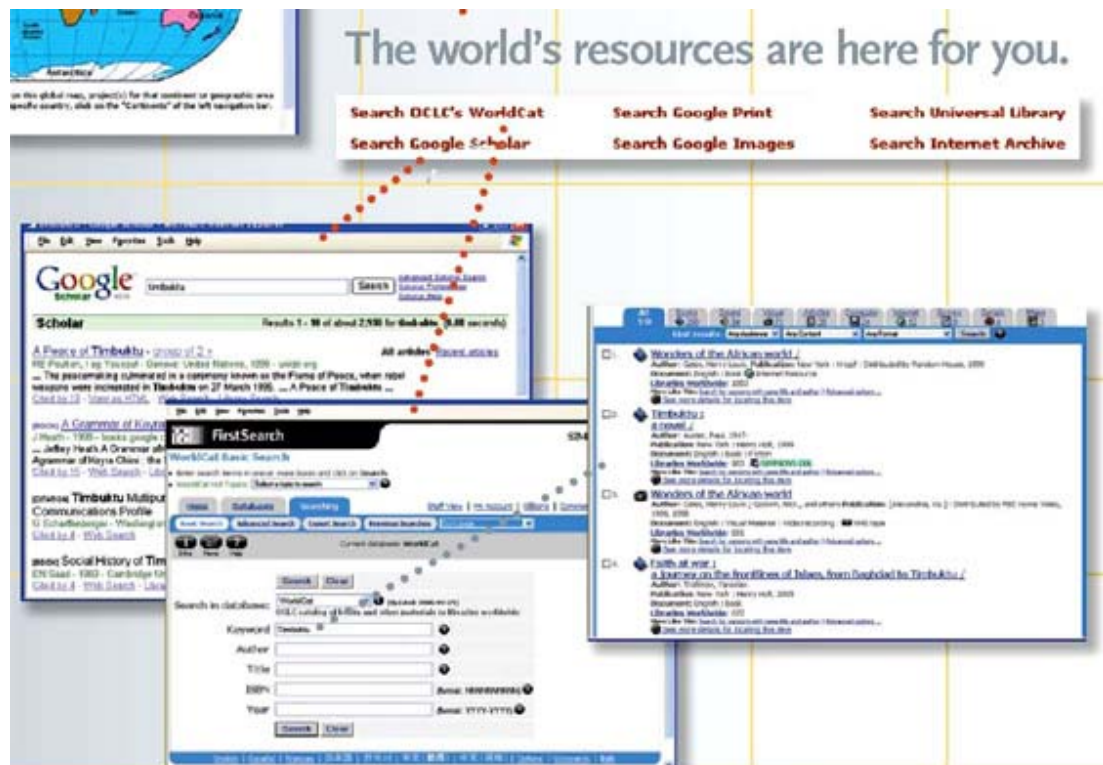Figure 12. Display of multi-collection search results

Figure 13. Searching the World's Bibliographical and Other Resources

- *Multilingual display of descriptive information as well as multilingual retrieval* – Currently GMNet already has contents in English, Chinese, Croatian, French, Italian, Japanese, Spanish, Thai, Vietnamese, etc., as shown in Figure 14. This facilitates the use greatly because the user can choose the language which is familiar to him/her.

- *User can conduct geographical searches by continent and/or country* – Information on all the digital collections can be accessed by continents as shown on the top part of Figure 15. Furthermore, over 230 countries can be searched and accessed by country as shown in the lower part of Figure 15. Unfortunately at the moment, only 80 of the 230 plus countries have digital collections, and many do not even have Web Page available on their national libraries. This is why GMNet has a seperate collection on the World National Libraries.
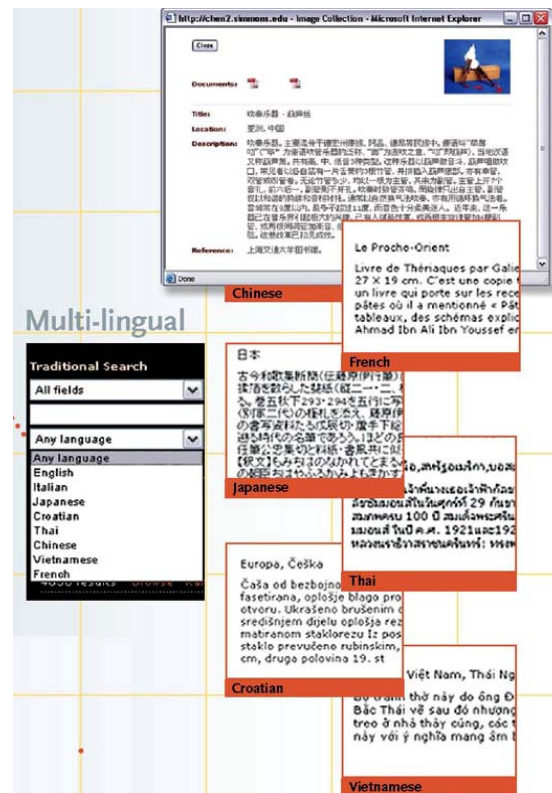

Figure 14. Multilingual capabilities

In addition to the features mentioned above, it is worthy to stress that GMNet positions its user to:

- Participate actively during his/her own information seeking process,
- Decide how he/she would like to use the discovered or retrieved information,
- Develop his/her own project(s) by choosing, mixing and remixing the retrieved images, and
- Be an active content contributor to GMNet

For example, upload capabilities are provided should one has valuable image(s) to contribute. What is also important is the provision for the user to utilize the resources of GMNet to make projects of their own. This is particularly useful for teachers, for example, they can retrieve the needed images of given subjects, go the classes for the scheduled times, and simply sign on to the GMNet and deliver their lectures.

Figure 15. Geographical Access to GMNet

ADDITIONAL EXAMPLES

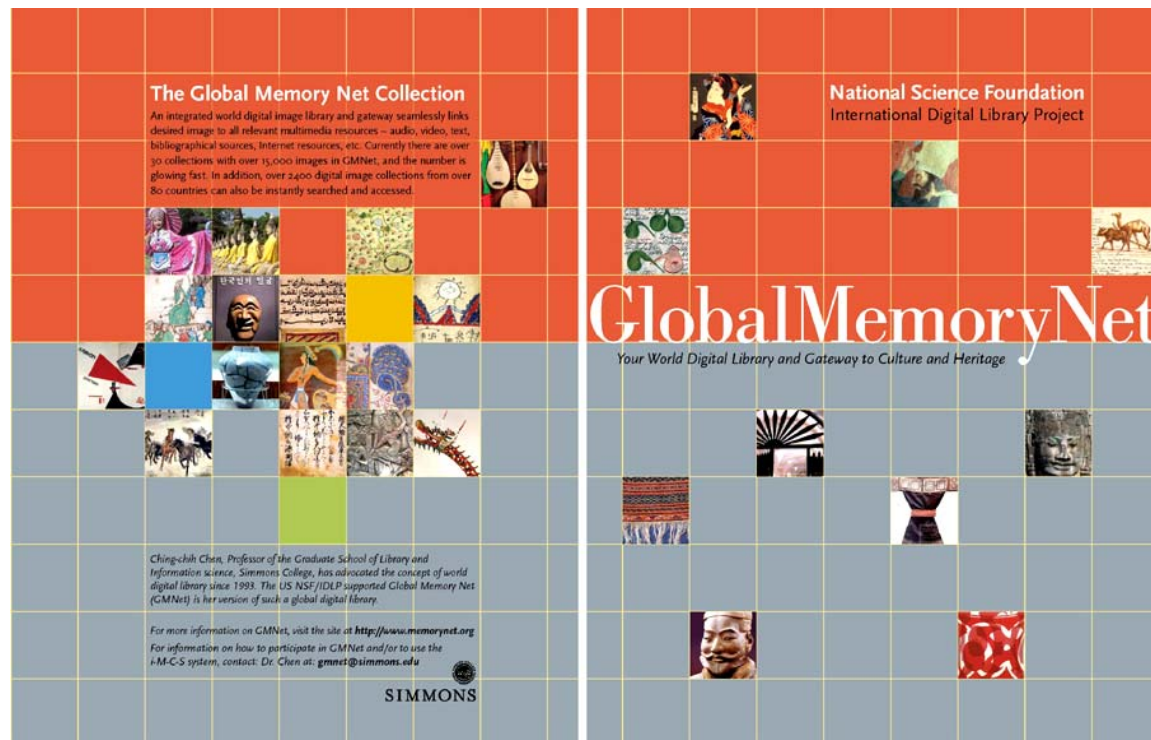The above information is summarized in a GMNet's brochure (Figure 16).

Figure 16. Brochure on Global Memory Net

It is clear from the few icons shown, the collections covers all types of cultural heritage topics. They are invaluable treasures from a great diversity of cultural organizations – international, national and local, as well as universities, museums, archives, and private sources. These include:

- The core archeological collection of the First Emperor of China's terracotta warriors and horses (200BC) and the Sanxingdui Collection (over 4800 years ago),
- The UNESCO's Memory of the World images from its over 90 collections, as well as its Arab and Islamic Manuscripts,
- Numerous rare and unique manuscript and map collections of the Asian Division of the US Library of Congress:
    - LC's Naxi manuscripts
    - LC's Chinese ancient maps
    - LC's rare Japanese Inoh maps
    - LC's Ukiyoe collection
- Restored Italian artifacts (Project Restore with University of Florence)
- Vietnam Museum of Ethnology's 54 minority ethnic groups' images,
- The collection from Museum Slavonia, Osijek, Croatia
- World musical instruments
- World ancient temples and palaces
- European cathedrals, churches, etc.
- 2400 world digital collections from over 80 country,
- World ancient maps
- Many others

Emperor Collection (An Example in Archeaology from A World Renown Museum)

The **Emperor Collection** consists of more than 4000 selected images from Chen's interactive videodisc and multimedia CD-ROM, entitled *The First Emperor of China* on the Emperor's 7000+ terracotta warriors and horses. This large number of raw resources has proven to be invaluable to form the core collection of GMNet. The interactive videodisc and multimedia CD are part of Dr. Chen's earlier PROJECT EMPEROR-I, which was supported by the US National Endowment for the Humanities (1983-1986). In addition, the collection has grown rapidly since 2000 to include additional 1000 new images collected from different sources including on-site photos taken at various museums and cultural sites in Xian and elsewhere in China, as well as those relevant to the subject. Some of them are taken from publications with permission. In addition to images, some of the digital videos from the original PROJECT EMPEROR-I products are included. More will be added whenever possible. The **Emperor Collection** serves as a model for integrating multi-format resources from museums, archives, libraries and personal resources. [http://memorynet.org]

  Figure 17 shows how 5000 images related to this collection can be retrieved easily with either traditional retrieval methods by any metadata field (Step 1), or can be explored by asking the system to display images randomly (Step 2). This expands one's knowledge on the subject
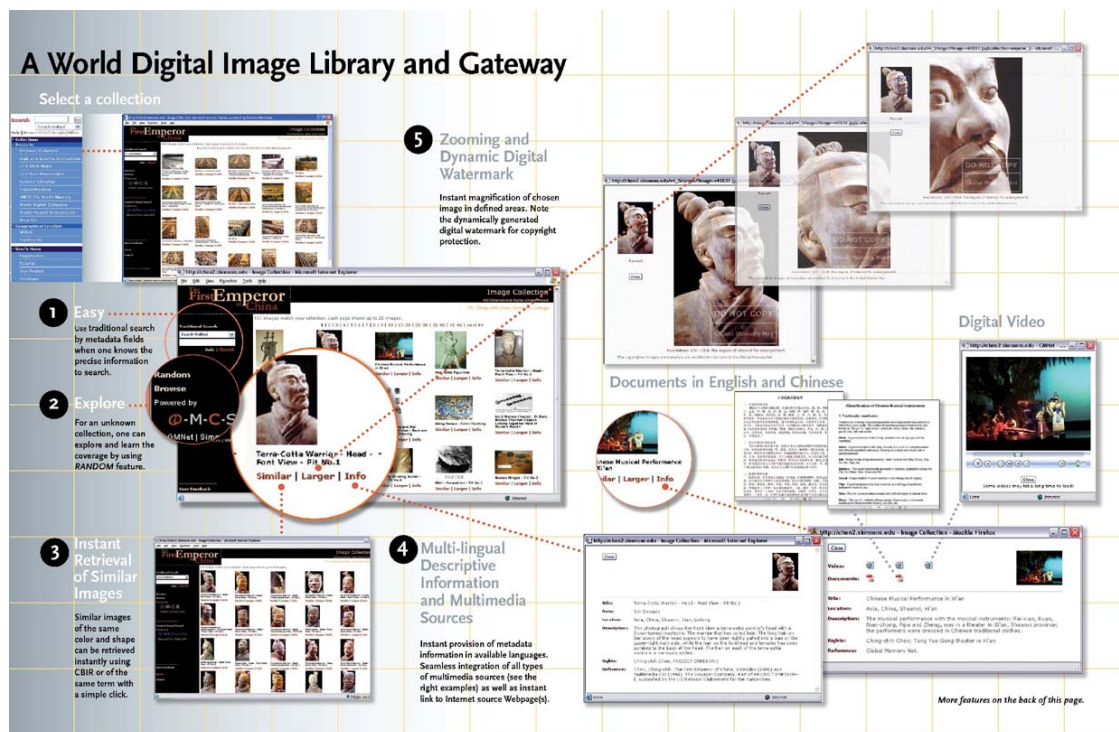

Figure 17. Some of the features of Global Memory Net

quickly. Once a desired image is spotted, one can instantly locate all the images of similar color and shape, using the cutting edge content-based image retrieval (CBIR) technique, SIMPLIcity, as shown in Step 3 of Figure 3. One can then select an image of interest, ask for either information about the image (i.e., metadata at this point will be shown) as shown in Step 4. The information can be in other languages other than English. If the source is provided in URL format, one can go to the website instantly. Furthermore, if there are multimedia sources available in either digital video or sound or PDF format, one can retrieve any of those instantly.

Or, if one would like to see the chosen image enlarged, the zooming images in different levels can be shown instantly as in Step 5. At this point, we will see that digital watermark will be dynamically generated as the image is zoomed at different levels. This protects the intellectual property of the content owner and copyright.

LC's Naxi Manuscripts (An Example in Archives and Rare Manuscripts)

Naxi Manuscripts is a collaborative project between Ching-chih Chen and Dr. Hwa-wei Lee, Chief of the Asian Division of the US Library of Congress (LC) and GMNet. The collection of 3,342 Naxi manuscripts features ceremonial writings of the Naxi people of Yunnan Province, China. This *Naxi* collection is the largest one outside of China and is unrivaled in quality, quantity, and variety among Naxi collections in Europe, the People's Republic of China, and Taiwan. It contains many unique examples of the only living pictographic language in the world today. Naxi pictographs differ from Chinese characters in that they appear more like Egyptian or Mayan hieroglyphs, with many recognizable figures of animals and objects. Because of the uniqueness of the language, studying the manuscripts can be quite difficult for scholars. The online presentation at the Library of Congress features 185 manuscripts, a 39.5-foot funerary scroll, and a collection of over 1,000 images with annotated information provided by the LC Asian Division. [http://memorynet.org]

This unique collection is essential to education and research, but most of them are not accessible due to distance, form, and technical barriers. In collaborating with Ching-chih Chen, this valuable collection of images with extensive metadata and annotations is added as a part *GMNet*, which provides new ways for academic users to access and exploit these significant research images via a global network in a way not possible before.

Although Naxi is known to many subject specialists in Asian studies as well as a good number of Chinese, it is generally not know to others. Thus, when one is totally unfamiliar

with the subject, it will not be possible for him/her to know what author, title, or keyword to use to search for needed information or image. In this case, the only way to help the user is to enable him/her to browse the image collection. Figure 18 provides random access to images of Naxi Manuscripts. If one is curious about the colorful image on the third row, one notices that it is "illustrated card with Tibetan language." In this case, one can ask the system to provide all similar images of the same color and shape (1), as well as the different enlargement derivatives (2,3) and meta-data information (4) as show in Figure 19.
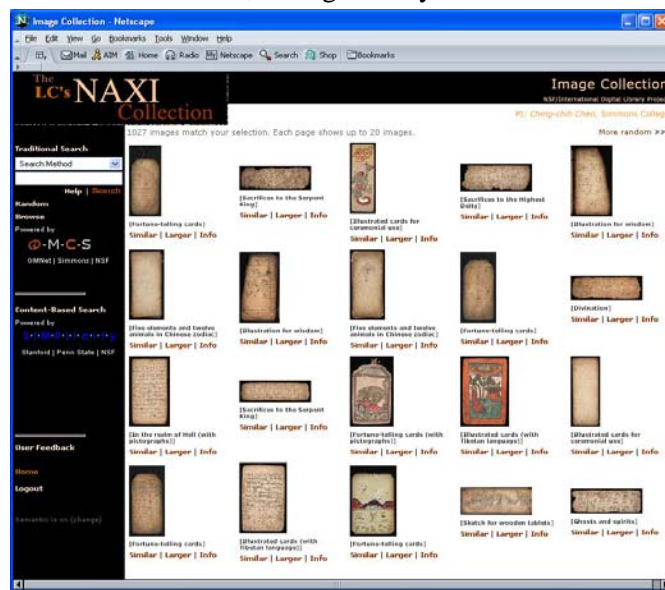
Figure 18. Random Naxi images suggest numerous keywords from titles…

Note that the URL of the Library of Congress's home page of Naxi is indicated in the "Source" of Figure 5. Thus, one can go that site instantly (5). At this time, with the knowledge gained by the random exploration, one will be able to use the traditional search by "keyword", "Title" and "Subject" and retrieve more information from the Library of Congress site (6).
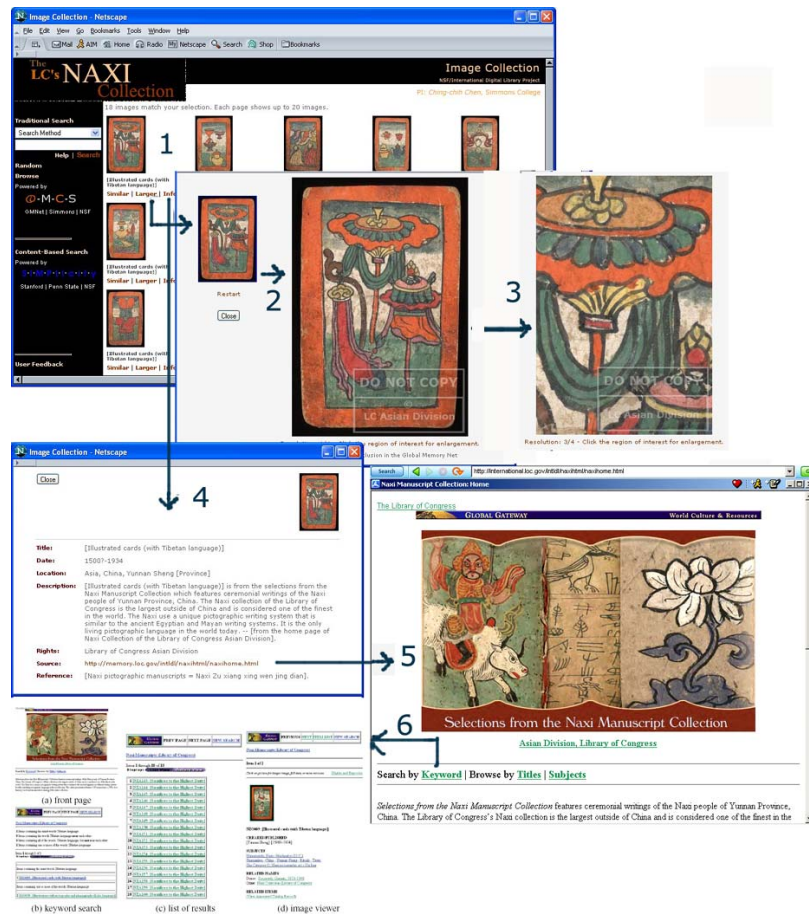
Figure 19. Random exploration of the chosen Naxi image to the use of the Library of Congress' site

Project Restore (An Example in University and Heritage)

It is fitting to end this presentation in Florence

with Project Restore, a physical preservation and restoration of Italian rare art objects and relics, as shown in Figure 20. This is an exciting collaborative project with Prof. Piero Baglioni of the Center for
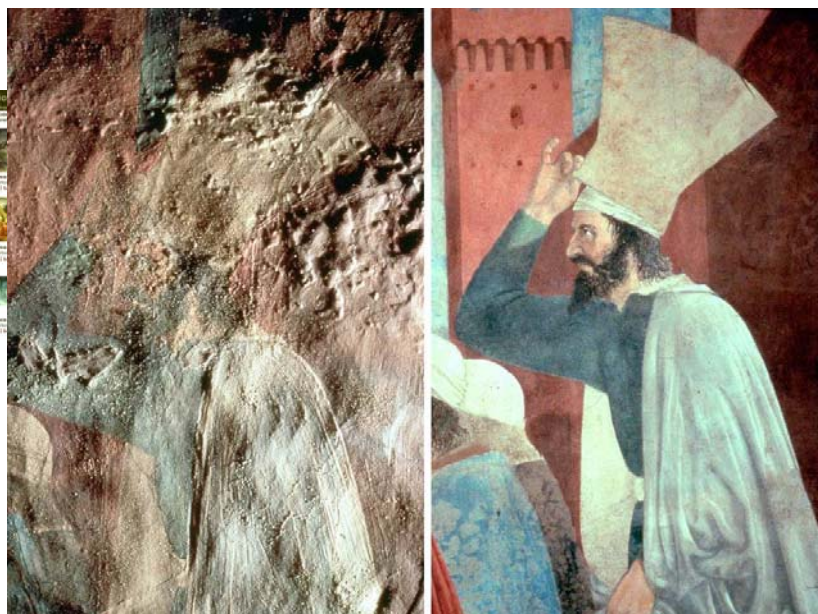

Figure 20. Project Restore shows how valuable damaged artifact is restored with nano-particle chemistry technology

Colloid and Interface Science (CSGI-Consorzio inter-universitario Sistemi Grande Interfase) of the University of Florence. Prof. Baglioni restored the invaluable but badly damaged artifacts using nano-particle chemistry technology. Figure 20 shows the dramatic physical restoration of Piero d. Francesca's damaged "Exaltation, Legend of the True Cross" a treasured frescoes in the choir of the Basilica of San Francesco in Arezzo. Currently, the content of this collection also extends beyond the country borders to include the restoration of artifacts from Mexico, Sweden, etc. This is a perfect example of the convergence of science, technology, content and global collaboration.

CONCLUSION

In this paper, we have shown how new technologies have been uses to bond the past and the present together. Since its beginning in 2000, this National Science Foundation's International Digital Library Project, Global Memory Net, has expanded to be a world image digital library as well as a global gateway to world culture, history and heritage. It has provided a model for dynamic information provision, and international collaboration. It has integrated materials from many cultures, and has enabled cross-culture and cross-discipline studies in a way not possible before!

GMNet's i-M-C-S has proven to be an effective documentation, management, retrieval, dissemination and conservation tool for managing all kinds of subjects, including cultural heritage. With this powerful system, GMNet's collaboration is expanding fast in both content and technology fronts. We welcome your use of GMNet as well as your participation and collaboration.

As we continue to provide aggressive universal access to enable the world citizen to enjoy, learn, and growth with GMNet's rich resources anywhere, anytime and on any subject, we have received invaluable feedback from users. It has also become clear to us that in developing the next-generation web-based applications, including digital libraries as GMNet, one should keep in mind the keywords such as "user," "services," "participation," "knowledge base," "open access," etc. and NOT "publishing," "packaged software," and "database(s)," etc.

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REFERENCES

[Baglioni et al, 2003]. Baglioni, Piero, Rodorico Giorgi, and Ching-chih Chen. 2003. "Nanoparticle technology saves cultural relics: potential for a multimedia digital library," In: *Online Proceedings of DELOS/NSF Workshop on Multimedia Contents in Digital Libraries,* Crete, Greece, June 2-3, 2003. http://memorynet.org/archives/gmnet/data/p2030601.pdf/

[Chen, 1993]. Chen, Ching-chih, "Technological Potentials for the Global Digital Library," In: *Proceedings of the International Conference on National Libraries - Towards the 21st Century*, *Taipei, Taiwan, April 20-24, 1993*. Taipei, Taiwan: National Central Library. pp. 859-868.

[Chen et al, 2005]. Chen, Ching-chih, Howard Wactlar, James Z. Wang and Kevin Kiernan, "Digital Imagery for Significant Cultural and Historical Materials - An Emerging Research Field Bridging People, Culture, and Technologies," *International Journal on Digital Libraries*, 5: 275-285 (2005).

[Chen, 2006b]. Chen, Ching-chih. "West by East - East by West: Cultural and Technological Exchange in the Case of Global Memory Net" presented at the Rare Book Division Meeting, No. 85, at the *72nd IFLA General Conference*, Soeul, Korea, August 21, 2006.

[Chen, 2006b]. Chen, Ching-chih. "Using Tomorrow's Retrieval Technology t Explore the Heritage: Bonding Past and Future in the Case of Global Memory Net," presented at Information Technology with Audiovisual and Multimedia and National Libraries: *Part 2:* New Access Technologies: Tomorrow's Retrieval (ITS)*,* No. 97, at the *72nd IFLA General Conference*, Soeul, Korea, August 21, 2006.

[Chen and Badurina, 2006]. Chen, Ching-chih and Boris Badurina, "Developing Your Own Digital Image Library: Practical Approach," A Post-*LIDA (Library in the Digital Age) 2006 Workshop*, Zadar, Croatia, June 6-7, 2006.

[Zhang and Chen, 2004]. Zhang, Shengqiang and Ching-chih Chen, "Global Memory Net and development of digital image information management system: Experience and practice," *Journal of Zhejiang University SCIENCE*, 6A (11): 1216-1220. November 2005.

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A Fellow of the American Association for the Advancement of Science, she was appointed by President Clinton in February 1997 to serve as a member of the U.S. President's Information Technology Advisory Committee (PITAC). PITAC was established by a new Presidential Executive Order. Under both Presidents Clinton and Bush during 1997 to December 2002, she co-chaired the PITAC Subcommittee on International Issues, and was a member of the PITAC Subcommittees on Next Generation Internet (NGI) and IT*2 Initiative Review; and Panels on Digital Divide, Digital Library, Learning of the Future, and Individual Security. She also chaired the PITAC's activity on Digital Divide for Smaller Institutions. During 1987 to 2001, Dr. Chen was Chief Organizer of a series of 12 International Conferences on New Information Technology (NIT) in many continents of the world. The outcome of NIT '99 (Taipei) and NIT'2001 (Beijing) are the two-volume books related to the development of Global Digital Libraries – *IT and Global Digital Library Development* (1999) and *Global Digital Library Development in the New Millennium: Fertile Ground for Distributed Cross-Disciplinary Collaboration* (2001). She is a recipient of many major awards, and was also elected in 1985 as Fellow of the American Association for the Advancement of Science. She served as an Honorary Professor of Tsinghua University in Beijing from August 1999 to 2002 and University of Hainan, China since 2004. Active in the digital library area she was the co-Chair of the 4th ACM/IEEE Joint Conference on Digital Libraries (JCDL) of 2004 held in Tucson, Arizona in June 2004. She was on the Advisory Board of DELOS (the European Digital Network for Excellence), serving as the US Co-Chair of the NSF/DELOS Working Group in Digital Imagery for Significant Cultural, Historical and Heritage Materials, and served as the co-editor for the *Journal of Digital Library*'s Special Issue on Multimedia Contents in Digital Libraries (February 2006). A sought-after international speaker, in the last two years alone, she delivered keynote speeches and made presentations at many international conferences including those in Delhi and Bangalore, India; Dubrovnik, Croatia; Buenos Aires, Argentina; Beijing, Shanghai and Hangzhou, China; Kawasaki, Japan; Tainan, Taiwan, etc. She is on the advisory board of the major China Digital Library Project of the National Library of China; in October 2005, she was appointed as a consultant to OCLC for its Global Digital Initiative (http://www.oclc.org/news/releases/200520.htm); and received the coveted LITA/OCLC Kilgour Award from the Library Information Technology Association in June 2006 (http://www.ala.org/ala/pressreleases2006/april2006/2006KilgourAward.htm), and the International Peace Priz from the United Cultural Convention of United State in June 2006.