

Global Memory Net Offers the World Instantly: Potentials for Universal Access to Invaluable Japanese Contents^{*}

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In technological terms, it has been a long time since my *PROJECT EMPEROR-I* -- a multimedia interactive videodisc project on the First Emperor of China's famous terracotta warriors and horses in 1984. At that time, *PROJECT EMPEROR-I* demonstrated that multimedia technology could change the way we seek, demand, and use information. Two decade later, fueled by enormous progress in science and technology, we have come a very long way from the use of interactive multimedia technology in the workstation environment to the global networked environment. We have moved from the use of hardcopy and analog resources to digital content, which users can search, retrieve and use instantly to meet their needs over the global network with no national boundaries. We have also moved from the offering of multimedia content of one specific subject topic to the digital content of all media formats on all related subject topics to the world instantly. We are truly living in a new period of unprecedented opportunities and challenges [1]! So, in this digital era, we have witnessed the exciting convergence of content, technology, and global collaboration in the development of digital libraries [2] with great potential for providing universal information access.

Thus, today's information seekers, regardless whether they are general public, school children, or those from research and higher education communities seek information for education, research, entertainment, or enrichment in very different ways from before. From the information resources point of views, the old model of "owning" a collection has given way to "sharing," and the new emphases have shifted from possessing large "physical libraries" to "virtual libraries" digitally distributed all over the world.

In the last two decades, I have experienced much of these transformations up-close and personal through my own R&D activities – from the creation of interactive videodisc and multimedia CD in the 80s and 90s to leading a current international digital library project, *Global Memory Net*, supported by the International Digital Library Program of the US National Science Foundation [2, 3, 4].

^{*} This paper is modified from several keynote and invited speeches given by Prof. Ching-chih Chen on *Global Memory Net* in 2004 in Hanoi, Vietnam; New Delhi, Bangalore, and Mysore, India; Dubrovnik, Croatia; Orlando and Miami, Florida, USA; Beijing and Shanghai, China. While the illustrations differ from one talk to the other, basic concepts and introductions are similar. Modifications made tend to update the new developments, but duplication of information is unavoidable.

GLOBAL MEMORY NET AND RECENT DEVELOPMENT

From PROJECT EMPEROR-I to *Chinese Memory Net* to *Global Memory Net*

In the early 80s, the by-product of *PROJECT EMPEROR-I's* is a set of interactive videodisc, called *The First Emperor of China*, content of which later was converted to a popular multimedia CD product of the same title in 1991 and published by the Voyager Company. The core image collection of this product together with the extensive descriptive annotations (later known as metadata) of these resources has become the core collection of *Chinese Memory Net (CMNet)* which I proposed to NSF's International Digital Library Program (NSF/IDL) in 1999, and funded from 2000.

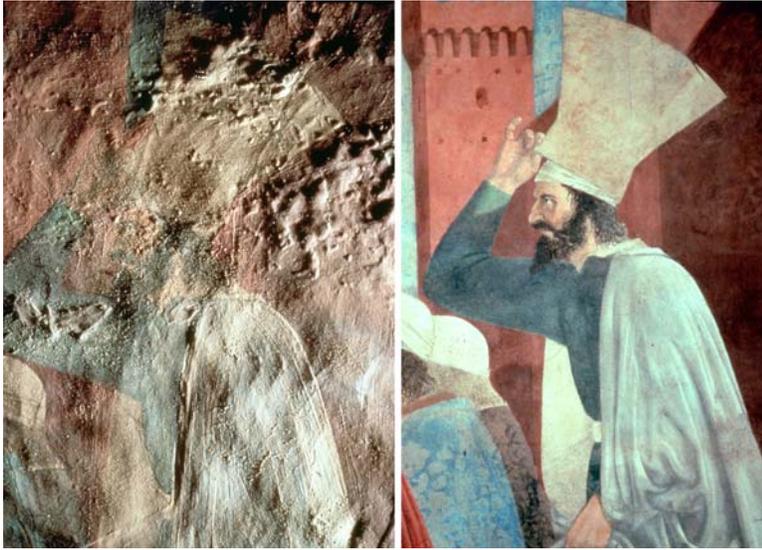
The NSF's supported *CMNet* since 2000 is intended to develop a model for international collaboration with various R&D activities in digital libraries. It hopes to accomplish "more" with "less," avoid duplication efforts, and capitalize R&D results from other major funded digital library R&D projects. *CMNet's* Chinese partners are Peking University, Shanghai Jiaotong University and Tsinghua University. Although we did not achieve one of the original goals in bringing the digital contents available in our partner institutions together, in the short four years, it has made progress in developing collaborative infrastructure for digital library development. Both *CMNet* and my *NIT 2001 conference* in Beijing played important role in fueling the development of digital libraries in China [5].

While building the digital library community and infrastructure, *CMNet* also started the labor-intensive R&D activity in content and metadata building. This activity has paid off because these invaluable image resources and metadata have formed attractive basis for a number of exciting and productive technology-oriented collaborative works with computer scientists, such as a few listed in the following with more complete reference provided in [7, 7]:

- Open Archive Initiative (OAI) research,
- Intelligent agent and text-based image retrieval [8, 9],
- Semantic sensitive content-based image retrieval [10],
- Digital video using the Informedia technologies [11], and
- Machine learning for annotation [12].

Once it is possible to develop a multimedia digital library in one subject disciplinary or for one geographical area, it is upward scalable to include more subject topics and bigger geographical areas. This was the case with our activities of *CMNet* with the core contents related to the images and video related to the First Emperor of China. In the first two years of *CMNet* (2000-2002), we made considerable progress in the use of cutting-edge technologies in the organization and retrieval of multimedia contents, specifically the digital images. The success in the technical application area has attracted considerable interest and thus resulted in collaborative activities with several major institutions in different countries other than China. This made the expansion of the scope of *CMNet* to *GMNet* since 2002 a natural necessity. For example, *Project Restore* is an exciting collaboration between University of Florence and *GMNet*. It involved several thousands of images of significant artifacts in Italy which were badly damaged over time or by water, heat, etc. and restored with the incredible nano-particle chemical technology of the University of Florence [13].

Figure 1 is an excellent example. For images like this, they don't belong to *CMNet*. They have to be properly included under "Italian Memory."



This collaboration offers us incredible opportunities not only to include many invaluable artifacts of Italy – paintings, ceramic objects, marble structures, manuscripts, etc. to *GMNet*, but also provide us the chance to offer the badly needed technical knowledge and information related to physical preservation and restoration. Take Japan for example, I am sure that there are countless treasures which have been damaged over time by various reasons, and would love to have them restored and preservation for generations to come.

Figure 1. Damaged Italian artifact showing pre- & post-restoration images

With the expansion of *CMNet* to *GMNet* in 2002, we can now cover the 'memory' of any part of the globe [2, 3, 4] in addition to those Chinese memories. Also, *GMNet* is now having a more accurate vision by truly providing capabilities to bringing all distributed digital library systems together rather than the earlier objectives "to bring collections of various distributed digital library systems on Chinese related topics together. In other words, even we do not have the actual collections; we can point to the collections once a relevant image is retrieved. This is why I am so very excited to be here in Yokohoma to day to present to you the great potentials of *GMNet* for new collaboration with Japan.

Figure 2 is a tentative *GMNet* homepage. It shows clearly that there is a space holder for all countries in the world although this tentative homepage has listed only a few continents and countries under each in the Geographical category.

By expanding *CMNet* to *GMNet*, this expedites the digital library collaborative development and frees the R&D activity from unnecessary logistical delays and inflexibilities. Since there are over 200 countries in the world, there are endless opportunities for digital collection development, digital partnership, and collaborative research activities. There is currently a long list of topics in addition to the core image collection on the First Emperor of China's terracotta warriors and horses, such as those listed in the following, and the list is growing longer quickly:

- China - Chinese painting, many historical unique collections, architecture, historical site, historical figures, etc.
- Cambodian - Ancient temples, etc.
- Japan – Temples etc.
- India - Architecture, palaces, temples, goddess, etc...

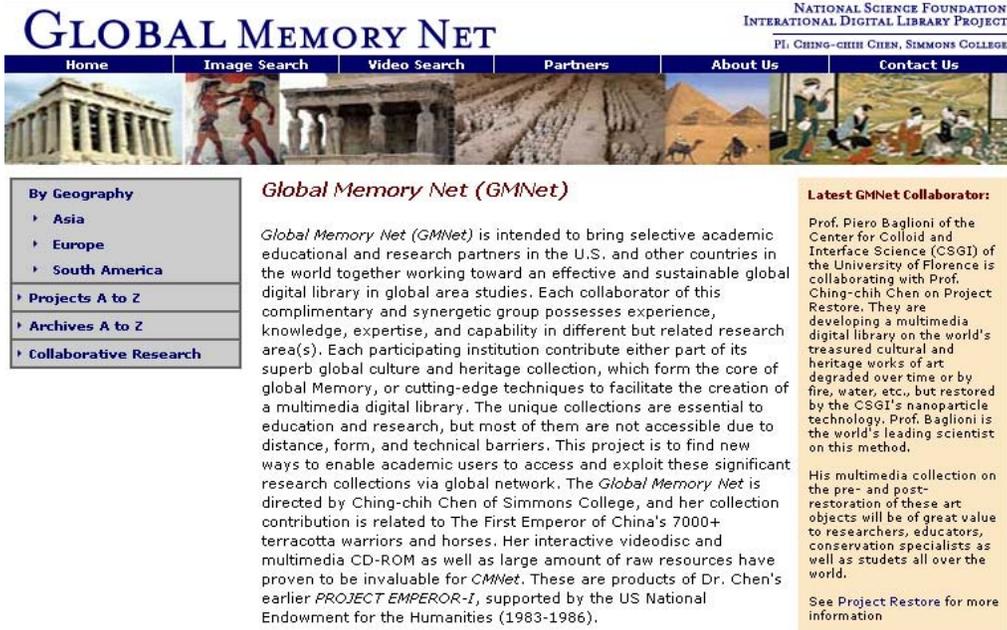


Figure 2. Tentative Home Page of Global Memory Net

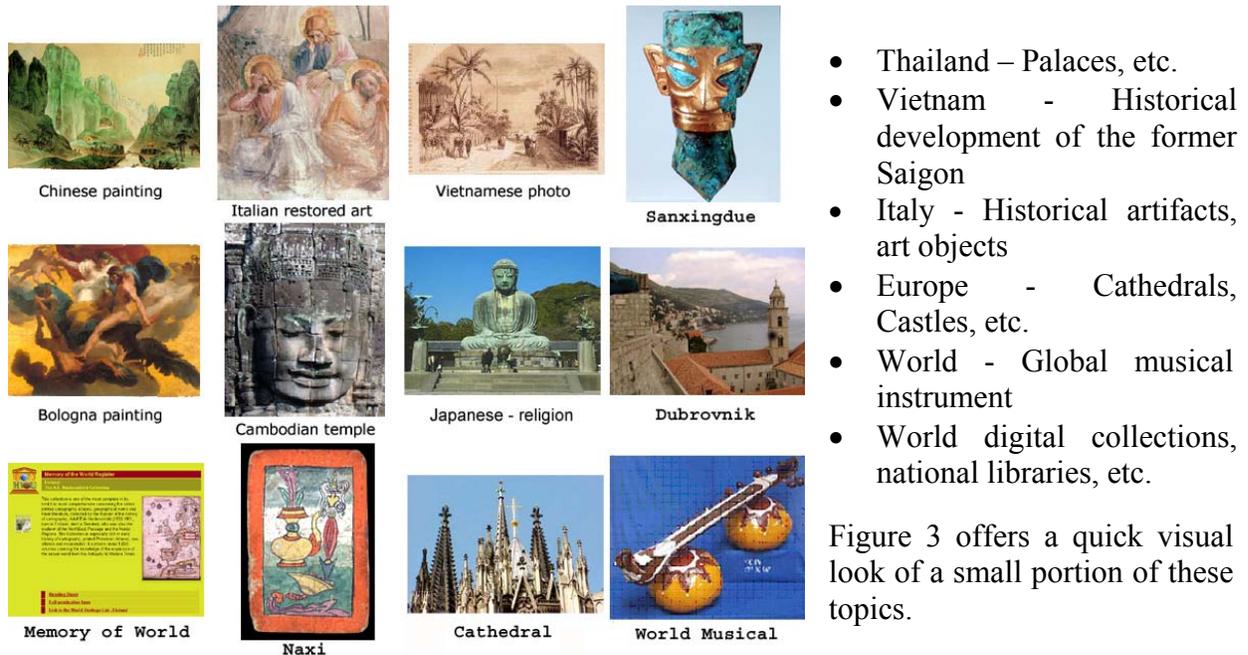


Figure 3 offers a quick visual look of a small portion of these topics.

Figure 3. A small selective topics of *Global Memory Net*

Global Memory Net Offers the World Instantly

For the First Emperor of China's content, *GMNet* is a comprehensive image digital library on that subject. For other world's cultural and heritage contents, *GMNet* is an effective digital portal which offers the world instantly to the information seekers.

It is impossible to describe all the features of in such a short introduction. In the simplest way, consider *GMNet* an easy to use digital portal utilizing the cutting edge image retrieval technology to enable one to take a visual tour of any country's culture, heritage, history, and world contributions, all while sitting at one's computer. This soon to be available *GMNet* will provide, in addition to the traditional search by image retrieval capabilities with considerable textual supports in a way not possible before. For example, from the page like that shown in Figure 1, one can go to China and then *Emperor Image Base* quickly. Then one will be able to retrieve invaluable images related to the First Emperor of China, for example, by conducting the traditional search using the Google protocol if predefined specifics of the images are known. In this case, one can search literally every field of the metadata, such as creator, title, location, time period, description, keyword, reference source, etc. In this approach, keyword search is likely to be the most popular one.

However, in most cases, one does not have any idea on what kind of images are available in *GMNet*. Just like in a library, we need to provide the user an opportunity to browse the stack, and find what they need and want. In this case, in *GMNet*, we powered our images' random retrieval with the cutting edge content-based image retrieval technique, SIMPLicity, developed at the Stanford University under NSF's DL-I phase, and then at the Penn State University under NSF/ITR [Ref. 10 provides more references]. This allows users to browse, retrieve, enjoy, and learn in just seconds through multiple thousands of digital images accurately and effectively.

For example, when one goes to the *GMNet Image Base*, or go to the *Emperor Image Base* under China, under the "Random" access, one spots an image of terracotta warriors' heads of specific interest, as shown in Figure 4 (middle image of the second row).

In this case, one can ask the system to provide "SIMILAR" images by clicking "Similar" without typing any word, *GMNet* will display in seconds all the images in the collection similar to the one selected. This opens up all possibilities

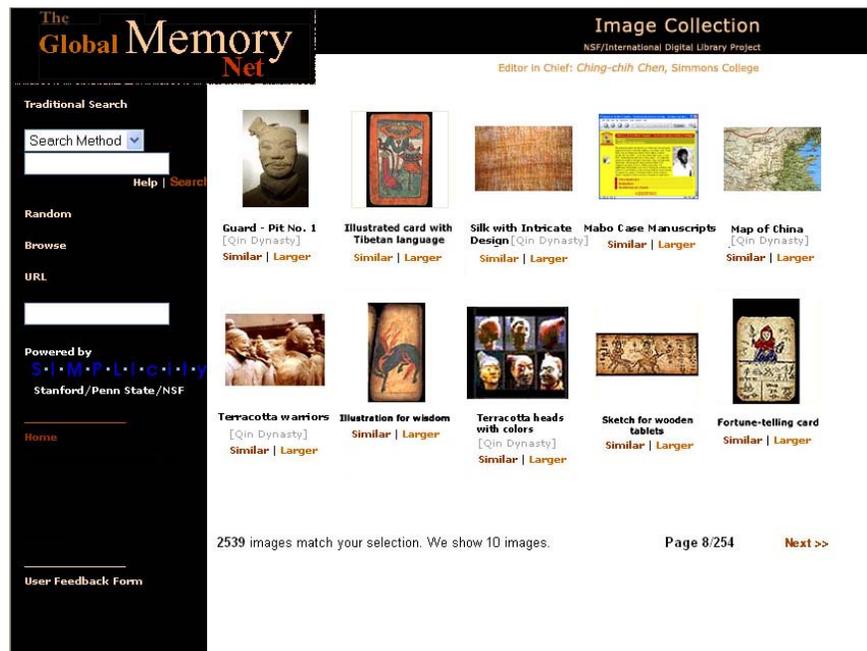


Figure 4. Random images for user's browsing and selection

for all related images which are totally unknown to the user (see Figure 5).



Figure 5. Similar images on related “Warriors’ heads” are displayed

Once these massive numbers of images are displayed, one would be able to enlarge a chosen image by clicking on “larger”, and multiple levels of zooming will be possible and dynamic digital water mark will be instantly generated to offer the “ownership” information of the image as shown in Figure 6. One will be able to find more textual descriptive information as well as reference sources and in some cases, full-text original source on a chosen image instantly by clicking “Info” (Figure 7).



Figure 6 (above). The chosen image can be enlarged many times



Figure 7 (left). When “Info” is clicked for the image, the descriptive annotation of the images will appear as shown in the left panel of the figure.

Global Memory Net – New Collaboration



Figure 8. Project Restore’s pre- and post-restoration images from University of Florence

The move to *Global Memory Net* has enabled us to expand our collaborative community and subjects greatly, far more than we could imagine during the first three years of *CMNet*. Starting from our exciting collaboration with University of Florence on Project Restore [13] with the exciting pre- and post- restoration images of the invaluable Italian art objects with nano-particle chemistry technology (Figure 8), other collaborative collections have mushroomed to include many countries and subjects as already mentioned (Figure 3).

In addition to these, the collaboration with the Asian Division of the Library of Congress is an exciting development. Currently we have included the unique Naxi manuscripts’ images of the Library of Congress in *GMNet* (see Figure 9).



Figure 9. Images of the unique NAXI manuscripts’ can be retrieved instantly in 3 steps [14]

Currently we are also exploring the collaboration with Unesco’s *Memory of the World* Programme. We have identified over 1000 digital collections in the world, and it is possible for us to retrieve all web sites of digital collections of similar color and design of an organization instantly, such as those of the Unesco’s *Memory of the World* Programme as shown in Figure 10. Once the website is selected, information on the site can be located instantly, and the user can be linked to the site instantly. Currently, Unesco has 91 digital collections from 45 countries of this nature, thus, our digital portal has certainly boosted the accessibility and value of these collections instantly.



Figure 10. Images of Unesco's *Memory of the World* sites can be retrieved and linked instantly (in yellow)

Global Memory Net – New R&D Activities

As mentioned earlier, although *GMNet* has concentrated thus far on digital image cultural and heritage collections thus far, we have already collaborated with Carnegie Mellon University in exploring the sophisticated digital video retrieval capabilities using the world renown Informedia Technologies [2, 3, 4, 11], see Figure 11. In addition to digital videos, our research will also incorporate sound and music. One of the perfect starting points will be with the world's musical instruments. Another possible area would be with the language learning and writing. Figure 12 shows a screen of Asian drum instruments, some of which are Japanese. If they can be further linked with music, it would be fantastic!

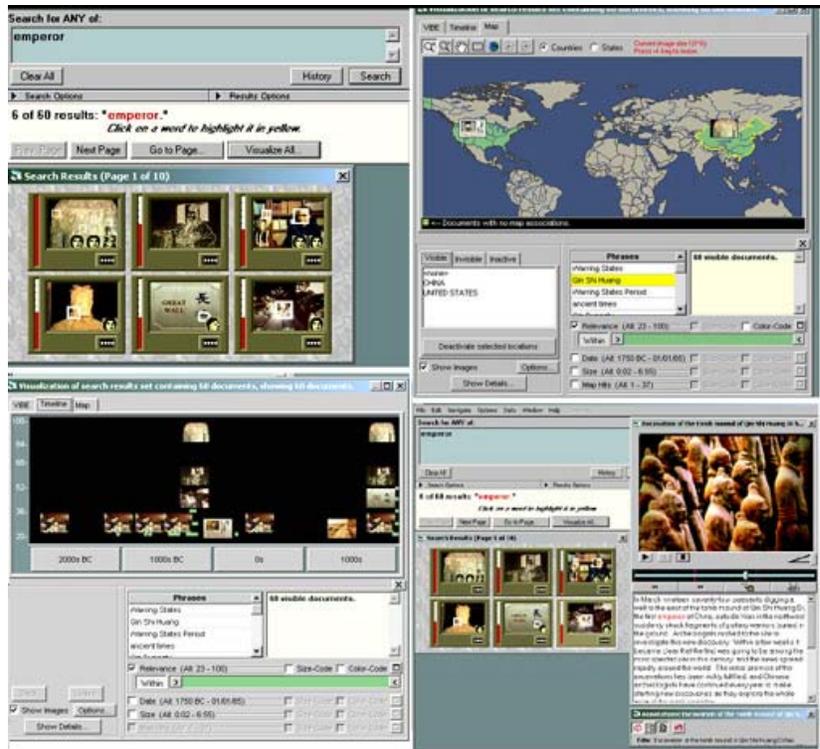


Figure 11. Screen from Informedia's Emperor Application

One final mention of an exciting new activity would have to be our newly funded NSF/IDLP [NSF/IIS-Special Projects (IIS)] 2-year project from 2004-2006, entitled "*International Collaboration to Advance User-oriented Technologies for Managing and Distributing Images in Digital Libraries*" with James Z. Wang of Penn State University and Jianbo Shi of University of Pennsylvania as my co-PIs. This project will develop user-oriented image management of distribution technologies for digital libraries. An interdisciplinary team of computer and information scientists from US, China, and Taiwan will investigate efficient ways to search digital collections of images using an integrated approach. The team will use real-world digital library datasets to develop user-oriented technologies suitable for practical deployment. Notably, the

research will utilize an existing collection consisting of a large quantity of images associated with The First Emperor of China's terracotta warriors and horses of all types of resolutions and with enormous cultural significance as well as the existing rich descriptive information. In addition to Ontology-based image retrieval, machine learning based content-based image retrieval including, we will explore the difficult object-based partial image searches. We also hope to extend the intellectual property (IP) protection techniques.

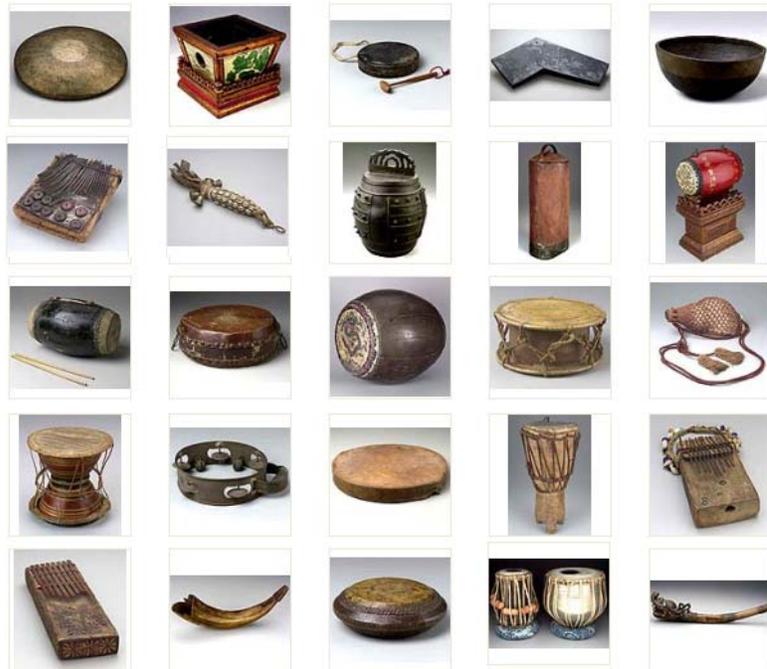


Figure 12. Some of the world instruments (most are drums)

CONCLUSION

During 1998-2002, I was privileged to serve on the US President's Information Technology Advisory Committee's (PITAC). Our PITAC's Digital Library Panel's Report, *Digital Libraries: Universal Access to Human Knowledge*, has a vision for digital libraries:

"All citizens anywhere anytime can use any Internet-connected digital device to search all of human knowledge. ... In this vision, no class-room, group, or person is ever isolated from the world's greatest knowledge resources." [15]

This is a vision easily said than done! There are many obstacles on the road, thus we are a long way from approaching this "elusive" vision.

From "sharing" and "accessing" points of view, we must first have much more "quality" digital contents, we must collaborate internationally in content building because no one can have everything, then we must have the technology to cope with these contents, and the infrastructure to deliver, access and retrieve them [2, 3, 4]. This is what *Global Memory Net* is inspired to do specifically in content building and method development areas. The new collaboration and new R&D activities have expanded our research horizon, and have offered us great opportunities for digital library community building, for making digital collections alive and accessible, and for contemplating much more practical R&D agenda in areas of metadata standards, interoperability, scalability, retrievability of difficult multimedia contents, and usability of these resources for knowledge creation.

I would like to end my talk with another screen to show that the world is full of "living museums. Figure 13 are familiar images to all of you. They are the well known temples and religious sites of Japan in the Kyoto area. There are a lot of culture, history and heritage information related to

these. Although our work will continue with many topics similar to Figure 13 on the “living museums around the world, the potential for collaboration is truly great, because we will need subject specialists in different countries to provide us more in-depth knowledge on the significant cultural and historical “memories” of their countries. Japan has so many invaluable resources and contents, and they are not yet readily accessible by people. *Global Memory Net* provides incredible opportunities for us to make it possible for global sharing and distribution of these resources of Japan. Let’s work together to leverage on the infrastructure of *Global Memory Net* in content building, technology development, and application development!

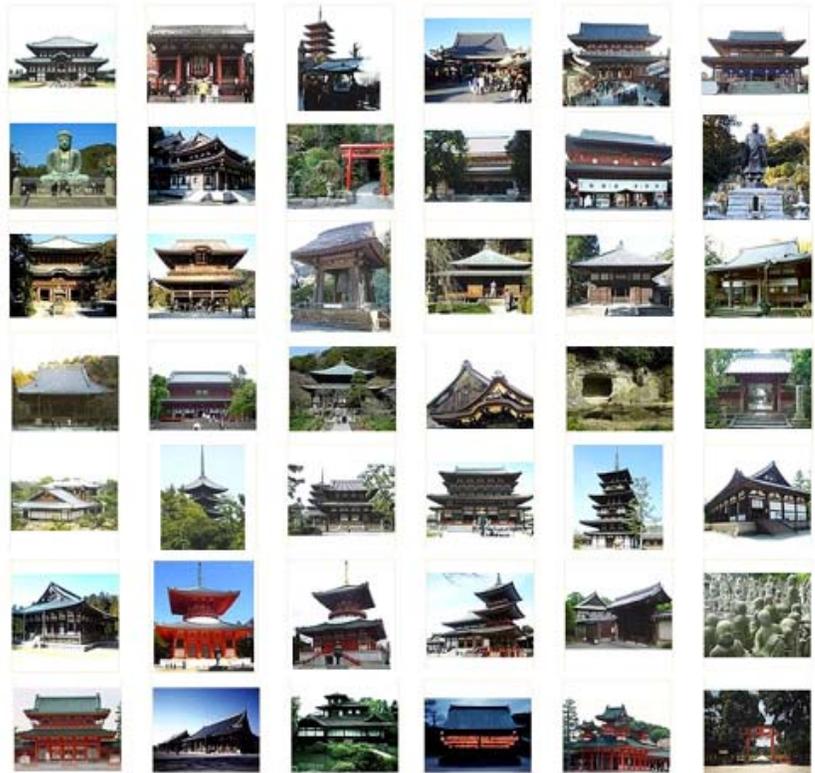


Figure 13. Images of Japanese temples and religious sites

ACKNOWLEDGMENTS

Chinese Memory Net and *Global Memory Net* are supported by the US NSF/IDL under grant no. IIS-9905833. PROJECT EMPEROR-I was supported by the Humanities in Libraries Program of the US National Endowment for the Humanities. Examples given on the use of SIMPLIcity is in collaboration with James Z. Wang of the Penn State University whose work is supported by the NSF/ITR program under grant no. IIS-0219271.

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Biographical Information of the Author



Dr. Ching-chih Chen is Professor of the Graduate School of Library and Information Science, Simmons College, Boston, USA. A sought-after international consultant and speaker in over 40 countries, she is an author and editor of over 35 books and more than 180 scholarly journal articles. She produced the award winning interactive videodisc and multimedia CD entitled, *The First Emperor of China*. She was the Chief Conference Organizer of a series of 12 *International conferences on New Information Technology (NIT)* from 1986-2001 in different parts of the world. The Proceedings of *NIT 2001*, held at Tsinghua University, Beijing, was published as *Global Digital Library Development in the New Millennium: Fertile Ground for Distributed Cross-Disciplinary Collaboration* by Tsinghua University Press in 2001.

Since 1993, she has been advocating the global digital library concept by linking libraries, museums and archives all over the world together, and this *Global Digital Library Initiative* has helped the development of digital libraries in numerous countries. Since 2000, she has led a NSF/International Digital Library Project, *Chinese Memory Net (CMNet)*. She is also co-PI with Prof. Raj Reddy of the *China-US Million Book Digital Library Project*. She is a member of the Advisory Committee of DELOS (European Digital Library Network) and co-Chaired the *DELOS/NSF Working Group on Digital Imagery for Significant Historical, Cultural and Heritage Materials*. She has been advocating the need for international consortium in making cultural and heritage digital contents accessible to users. To this end, *Chinese Memory Net*, serving as a model for archiving, content building in specifically image and video areas, as well as international collaboration, has grown now to be *Global Memory Net*, with collaborators from different part of the world.

A Fellow of the American Association for the Advancement of Science, she has received many awards and honors, including the *Best Information Science Teacher Award* of the American Society for Information Science, the Library and Information Technology Association's *LITA/Library Hi Tech Award*, the *LITA/Gaylord Award for the Advancement in Library and Information Technology*, and many others. During 1997-2002, she served as a member of the *US President's Information Technology Advisory Committee*.

A sought after international speaker, in 2004 alone, she was a keynote speaker at the *International Conference on Digital Libraries* in Delhi, India; the *Libraries in the Digital Age (LIDA 2004): International Conference*, Dubrovnik and Mljet, Croatia; the *International Conference on Digital Libraries*, Beijing, China; the *International Asian Digital Library Conference*, Shanghai, China; and the *Invited Annual Lecturer of the Annual Lecture in Informatics in Bangalore*, India. She also delivered invited speeches in Mysore, India; Orlando, Florida; Xian, Guanzhou, and Haikou, China; and Yokohoma, Japan.