

How Digital Libraries Can Bring the World's Treasures and Heritage to the End-Users Instantly!

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Abstract: To extend the traditional concept of using technology to improve library services, Professor Chen will share her multi-year experience in developing the world renowned *Global Memory Net (GMNet)*, supported by the US National Science Foundation's International Digital Library Program, and the latest activities of the first virtual US World Heritage Digital Center in partnership with the UNESCO's world Heritage Center. She will articulate as well as demonstrate how cutting-edge technology can be used to empower libraries, museums, and archives to provide innovative global and universal access to world cultural and historical treasures and heritage in a way not possible before.

With the convergence of content, technology, and global collaboration in this digital era, there are unprecedented potentials as well as challenges for developing digital libraries of all kinds. This paper discusses these challenges and introduces *Global Memory Net's* approaches to meet these challenges. *Global Memory Net's* technology has been extended to the development of World Heritage Memory Net which will bring multimedia information of 851 world heritage sites of 141 countries together for universal access.

The paper also stresses the importance of digital content development and international community building in addition to the ever changing need for research and development.

1. Introduction*

In realizing the potentials of this digital age, this author advocated the concept of a world digital library as early as in 1993 [1] when the Internet was not a common place and there were little discussions on the topic of digital libraries due to the rarity of high-speed network. In those early days, while the potential of linking the world digital collections, if available, via the possible and forthcoming high-speed and broadband network can be imaged, but little was known in how to create interoperable world digital collections. That occasion was to celebrate the 60th Anniversary of the National Central Library in Taiwan. So, 25 years later, I am delighted to be at this historical occasion at the *Digital Libraries for Learning Conference* of the National Library of Latvia, to share with you the results of our exciting global digital library development.

Three years after 1993, the U.S. National Science Foundation started its Digital Library Initiative (DLI) with its six DLI projects started in May 1996 [2]. This development has prompted extensive digital library research and development activities both in the US and internationally ever since.

In this past decade, "revolutionary breakthroughs in computing and communications with the epoch-making arrival of the Internet have begun to demolish artificial disciplinary boundaries and to open vast new fields of interdisciplinary research." One major area outlined in the report to the US president by the President's Information Technology Advisory Committee (PITAC), entitled *Digital Libraries: Universal Access to Human Knowledge* [3] was digital libraries.

*Some of the background information in this section is taken from a keynote speech given at the 8th *Russian Conference on Digital Libraries RCDL'2006*, Suzdal, Russia, October 2006. Full text is available at the *Proceedings* of this conference.

Digital libraries was defined there as “the networked collections of digital text, documents, images, sounds, scientific data, and software that are the core of today’s Internet and tomorrow’s universally accessible digital repositories of all human knowledge.”

With the exciting convergence of content, technology, and global collaboration, it has become clear that while technology is of vital significance, “content has been considered to be just as important, if not more, as technology. In other words, with all the rich information resources in the world, if they are not digitally available, they will not be able to be accessed, retrieved, shared and enriched on the Web. Research activities related to content have proliferated in the areas of digital collection creation and development, organization and standards, interoperability and scalability, and many others. One important fact in relation to content is also becoming clear – no institution can provide everything, thus global collaboration in digital collection development becomes essential.” [4]

In addition, as “digital libraries” is viewed as an emerging research field bridging *people*, *culture*, and *technologies*, a conceptual model was developed by the DELOS/NSF Working

Group on Digital Imagery for Significant Cultural and Historical Materials to illustrate the relationships among *people*, *cultural content*, and *technologies* as shown in Figure 1. This means that the “interdisciplinary research will develop technologies to enhance the way people can create, manage, and access the content of their cultural heritage. People encompass all users, from curators and library and information scientists, to scholars, teachers, and students in all areas of the humanities, to citizens of all cultures. Cultural content is the vast array of significant cultural and historical materials throughout the world. Technologies are the enabling research and development in all related technical areas such as information retrieval, image processing, artificial intelligence, and data mining.” The Working Group recommends focused, interdisciplinary research programs along the three edges and the center of the triangle, areas that traditional research programs currently neglect [5]. In other words, an interdisciplinary digital library needs to develop technologies to enhance the way all kind of users can use, share and contribute to the world digital content.

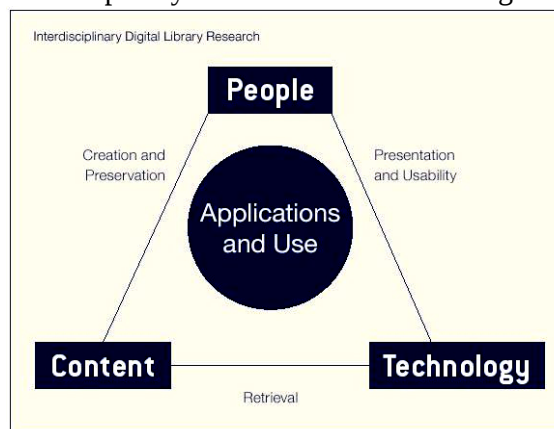


Figure 1. Conceptual Model of Digital Library Research

With the above as a background, this paper discusses how a world digital library and gateway, *Global Memory Net* has been created with its in-house developed i-M-C-S system (Integrated Multimedia Content Retrieval System) which integrates seamlessly all types of multimedia resources using the Web as a platform, and has begun to made the global digital library for universal access a possible reality through its public launching in mid-2006. *Global Memory Net* has been supported by the National Science Foundation’s International Digital Library Program since 2000. Since July 2007, this technology has been applied to the creation of *World Heritage Memory Net* in partnership with UNESCO/World Heritage Center. Both can bring the world’s culture, history, and heritage to end-users instantly!

2. How Does *Global Memory Net* Meet the Challenges for Developing A Functional World Digital Library

The conceptual map of Figure 1 can serve as a guide for planning and developing a digital library, but it is far from being a blueprint for actual creation and implementation of a digital library application. *Global Memory Net* is intended to be a functional world digital library and gateway from its very beginning in 2000, there are many challenges as listed in several previous papers of

Chen.* Readers are referred to those publications for more details. In this session, we will show how *Global Memory Net* has responded to these challenges by developing our own i-M-C-S (integrated multimedia retrieval system) when we describe the features of our systems:

2.1. Features of the i-M-C-S System

Global Memory Net was launched in July 2006 (<http://www.memorynet.org/>), and it is available for universal access by anyone interested. It is FREE with only a simple registration. In one-year time, more than 100,000 pages have been used all types of people from over 80 countries. To best appreciate the features of the system, and understand how *Global Memory Net* is meeting the challenges is to explore *Global Memory Net* on the Web. We shall highlight some in the following:

- *The Web is used as a platform, and not as a publishing medium, and more user participation can be encouraged.*

Figure 2 shows the Home Page of *Global Memory Net*, with the left blue navigation panel enlarged on the right.



Figure 2. Home Page of *Global Memory Net*

Note the enlarged panel shows that extensive collections are listed in categories, so that the users can choose what they want to explore. These include UNESCO's *Memory of the World*, as well as UNESCO/World Heritage Center (WHC)'s World Heritage Sites, which eventually will have a separate Home Page (see WHC News, <http://whc.unesco.org/en/news/326>).

- *Instant access to rich image collections.*

One can access to over 50 image collections in *Global Memory Net* with over 25,000 images as well as over 2530 digital collections from over 80 countries. This includes over 100

* http://memorynet.org/archives/gmnet/gmnet_archive.php#proceedings

collections from UNESCO's *Memory of the World*, over 290 collections from the US Library of Congress' *American Memory*, as well as those from other major national libraries, archives, museums, academic institutions, etc. in the world. In other words, the world's rich resources are instantly accessible at a simple click of the mouse. Figure 2 shows how these collections can be accessed by selecting either the collection category from the left blue panel of "Collections" or by simply clicking "More." "More" is for users who would like to have a quick glance on what are the collections under each category, or those who would like to have more careful choices. Then a detailed listing will be shown instantly on Figure 3. Users can then choose freely any of the collection for further exploration.

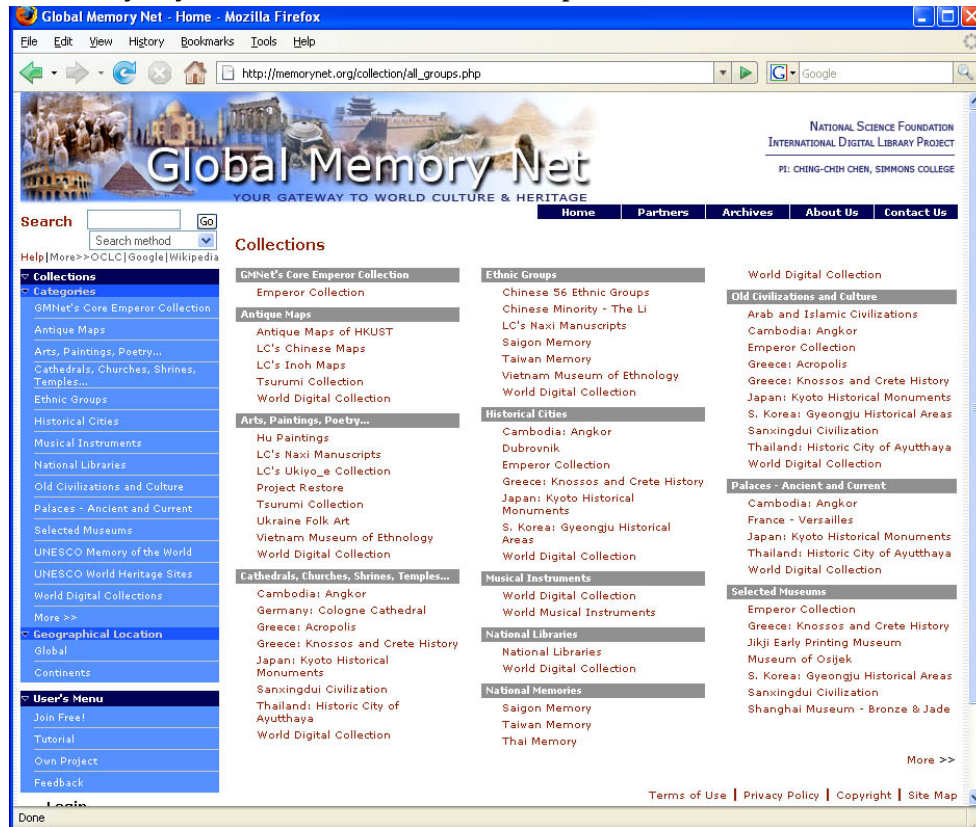


Figure 3. Details of Collection Listings in Global Memory Net

- Easy and flexible traditional image retrieval.

One can retrieve desired image(s) easily by traditional methods *when one knows what he/she is looking for*. In other words, each of the metadata field describing a given image is searchable by using the Google syntax. For example, if one is interested in UNESCO's *Memory of the World*, one can choose the collection, and images of all collections of *Memory of the World* will be instantly displayed, as shown in Figure 4.



Figure 4. The Screen Showing UNESCO's Memory of the World Collections

Then, if one is further interested in knowing what collections are related to Latvia, one can simply type “+Latvia” (in Google syntax), and Figure 5 will instantly show the three images related to Latvian *Cabinet of Folksongs* of the 19th century in *Memory of the World*.



Figure 5. Traditional Search Yielded 3 Images of the Cabinet of Folksongs of Latvia

- Random access to explore unknown collections and its innovative content-based image retrieval capabilities.

Yet, for an unknown collection of either interest or curiosity to a user, it is impossible for one to search either by author, title, subject or keyword as normally required in traditional retrieval. In this case, the user can **browse** the collection. But more significantly, the “**random**” feature permits one to explore and learn the coverage of a selected collection. In seconds, one will know considerably more about the collection though a great variety of images displayed randomly as well as the words showing up for the titles. These words can then be used as possible keywords for further retrieval. Figure 4 shows the great diversity of images covered in the collection of the UNESCO’s *Memory of the World*. A quick glance of that screen gives one a good idea on the subject diversity, but most likely one does not know what specific concept to ask for more information. For example, the first image of the 4th row (shown on the right again) is an old Islamic image on “curing disease” which the user would like to fine more information, but does not know how.



In this case, because the image of interest has been visually spotted, one has three ways to explore further – “Similar,” “Larger,” and “Info.” Each of these satisfies the user’s information needs in different ways with a simple click on the chosen button:

- (1). *Similar* – A simple click on “Similar” will yield images of similar color and shape through the use of SIMPLIcity, a semantically sensitive content-based image retrieval technique [6]. This is an important feature which is able to provide instantly a large number of images of **similar color and shape** to the user without having to type anything on the keyboard (Figure 6.) Undoubtedly this opens up a new horizon for learning to the user.



Figure 6. Images of the same color and shape

- (2) *Larger* – By clicking this, instant magnification of a chosen image in defined areas is shown. Depending on the resolution of the image, some can be zoomed over a dozen of times. Note that the center image of Figure 5 is magnified to provide significant information to scholars and interested laymen in Figure 7.

Figure 7. The enlarged image of the Latvian 19th Century Folksong →



- (3) *Info* - “Info” will yield instant descriptive information about the image of Figure 7 in Figure 8. This information can be available in multilingual forms. In addition, a simple click on the URL of the source, a user will go immediately to the original Web page – in the case, UNESCO’s *Memory of the World* – so he/she can browse and search for more additional information there. The descriptive information can be in Latvian or in any languages when UNICODES are available for them.

Figure 8. Descriptive Information of the Latvian Folksong →



- *Dynamically generated digital watermark for copyright protection.*

Figure 7 shows clearly the digital watermark, “UNESCO Memory of the World” was dynamically generated. This provision has encouraged more content providers to feel comfortable to collaborate with *Global Memory Net* in providing their treasures in digital form on the Web.

- *Seamless integration of multimedia information.*

Figures 7 and 8 show how image and text information are integrated seamlessly. More than that! If relevant resource information on a chosen image is available in other multimedia formats in addition to the metadata (textual annotation), the user can then retrieve the relevant audio, video, document, etc. again with a single click of the mouse, as shown in Figure 9 for a musical play from an image found in “World Musical Instruments” in *Global Memory Net*.



Figure 9. The icons show the availability of 3 digital videos and 2 PDF document files

Figure 9 shows that when a digital video icon is shown, once can click on that and immediately the digital video will be played on the screen. In the case of document files like PDF etc., they can be retrieved instantly as well.

- User can choose to conduct single or multiple collection searches for desired image(s).

Single collection search can be performed by choosing any of the collections listed in Figures 2 or 3. However, in most cases, one does not know precisely which collection to use to locate the desired image(s). In these cases, multi-collection search will enable the user to retrieve in all (over 50 collections) in *Global Memory Net*. For example, if one wonders what images are related to “Latvia” in *Global Memory Net*, the Multi-collection search using the term “Latvia” will yield results as shown in Figure 10. Note the instant retrieval of 4 images related to Latvia National Library and 6 Web sites from the 2530 included in the World Digital Collection. Thus, a user can immediately view any of those sites for further information.



Figure 10. Multi-collection Search on “Latvia” in Global Memory Net

- *Multilingual capabilities in both retrieval and display of information.*

Currently *Global Memory Net* has covered over 15 languages. As we are working on the 851 world heritage sites designated by the UNESCO/World Heritage Center, we are dealing with all major languages from these 141 countries. For example, Historic Center of Riga is a World Heritage Site, thus besides the 6 official UNESCO languages – Arabic, Chinese, English, French, Spanish and Russian, we will include also the Latvian native language. The following is the Latvian description of this Site:

Savulaik Rīga bija Hanzas Savienības centrs, no 13. – 15. gadsimtam tā uzplauka pateicoties saviem tirdzniecības ceļiem ar Centrālo un Austrumeiropu. Viduslaiku Rīgas ielu tīkls ir kā liecība pilsētas pārticībai, taču lielākā daļa vissenāko namu zuduši karos vai ugunsgrēkos. Rīga kļuva par nozīmīgu ekonomisku centru 19. gadsimtā, kad ap viduslaiku centru izveidojās priekšpilsētas, iesākumā ar iespaidīgiem koka namiem neoklasicisma stilā un vēlāk - jūgendstilā. Tiek atzīts, ka visizsmalcinātākais jūgendstila ēku krājums Eiropā atrodams tieši Rīgā.

In addition to the 7 languages mentioned above, for this Site, we also have descriptions in over 60 other languages from Wiki as shown in the following:

Armăneashce	עברית (Hebrew)	Polski (Polish)
(Aromanian)	Magyar (Hungarian Language)	Português (Portuguese)
Arpetan	Kiswahili (Swahili)	Română (Romanian)
Հայերէն (Armenian)	한국어 (Korean)	Runa Simi (Quechua)
Беларуская (Belarusian)	Kreyòl ayisyen (Haitian Creole Language)	Sámegiella (Northern Sami)
বাংলা (Bengali)	Ido	Shqip (Albanian)
Bosanski (Bosnian)	Íslenska (Icelandic)	Slovenčina (Slovak)
Brezhoneg (Breton)	Italiano (Italian)	Slovenščina (Slovenian)
Български (Bulgarian)	日本語 (Japanese)	Српски / Srpski (Serbian)
Català (Catalan)	Lìguru (Ligurian)	Srpskohrvatski /
Hrvatski (Croatian)	Lietuvių (Lithuanian)	Српскохрватски (Serbo-Croatian)
Česky (Czech)	मराठी (Marathi)	Suomi (Finnish)
Чăвашла (Chuvash)	Nederlands (Dutch)	Svenska (Swedish)
Cymraeg (Welsh)	Norsk (bokmål) (Norwegian-bokmål)	ไทย (Thai)
Dansk (Danish)	Norsk (nynorsk) (Norwegian-nynorsk)	Tiếng Việt (Vietnamese)
Deutsch (German)	Nowial	Тоҷикӣ (Tajik)
Esperanto	Occitan	Türkçe (Turkish)
Ελληνικά (Greek)	Иронан (Ossetic or Ossetian)	Українська (Ukrainian)
Español (Spanish)	Piemontèis (Piemontese)	Vèneto (Venetian)
Eesti (Estonian)	Plattdütsch (Low German)	Volapük
Euskara (Basque)		Žemaitėška (Semogitian)
Føroyskt (Faroese)		
Galego (Galician)		
ქართული (Georgian)		

Thus, this enhances greatly our ability of to provide universal access of the world invaluable heritage information to citizens of the world in languages familiar to them.

- *Explore in-depth learning of the subject by using expanded bibliographical and web resources.*

Global Memory Net also enables one instant access to the world largest bibliographical resource, OCLC's *World Cat*, as well as other popular web resources like Google, Wikipedia, Internet Archives, and Million Book Projects:

“OCLC | Google | Wikipedia | Million”...

OCLC - Online Computer Library Center, a worldwide library cooperative, provides access to its 57 million records in the full *WorldCat*, reflecting the holdings of some 9,000 libraries from 110 countries. Thus, books of the whole world are at one's fingertips. Similarly, when one clicks on Google, one will be able to instantly search Google Scholar, Google Images, Google Books etc. The relevant resources are boundless!

- *Geographical searches by continent and country are possible.*

Collections of *Global Memory Net* can be searched by continents, as well as any of the 230+ countries in the world (Figure 11) with a simple click. By using this capability, one will find quickly that only 90 some countries have digital collections, and many others (at least 2/3 of the 230+ countries' national libraries do not even have a Web page). This is why there is a separate “National Libraries” collection in *Global Memory Net*. Here, for example, when “Latvia” is clicked, the results will be shown instantly, similar to those shown in Multi-Collection Search (Figure 10)



Figure 11. 230+ Countries are listed →

- *Users decide their own information seeking processes.*

The users' needs are not predefined. They can decide on what and how to retrieve desired images and information. Various retrieval methods are provided to enable them to conduct flexible exploration and searches.

- *Users can develop their own project(s) by choosing, mixing and remixing the retrieved images.*

After viewing the retrieved images of various pages, one can decide whether the discovered and/or retrieved images can be useful for future use. If so, he/she can create his/her own project(s). As shown in Figure 12, three projects were created by User “Chen Ching-chih” and the third one is related to images of Latvian National Library.

Own Project

User: Chen Ching-chih

Current Subject(s) (You can set up to 3 subjects for "Own Project")

Russian study (Images relevant to discuss Russian history)



[edit](#) | [show/edit subject](#)
[add/images](#) | [delete subject](#)

Florence (Brancacci Chapel)



[edit](#) | [show/edit subject](#)
[add/images](#) | [delete subject](#)

Latvia National Library (Both old and new)



[edit](#) | [show/edit subject](#)
[add/images](#) | [delete subject](#)

Figure 12 . Three Projects with Images Chosen from Global Memory Net

When “edit subject” of Figure 12 is chosen, one will be able to add, delete, or provide notes by using the notepad, as shown in Figure 13.

Own Project

User: Chen Ching-chih

<< Back | Add more images >>

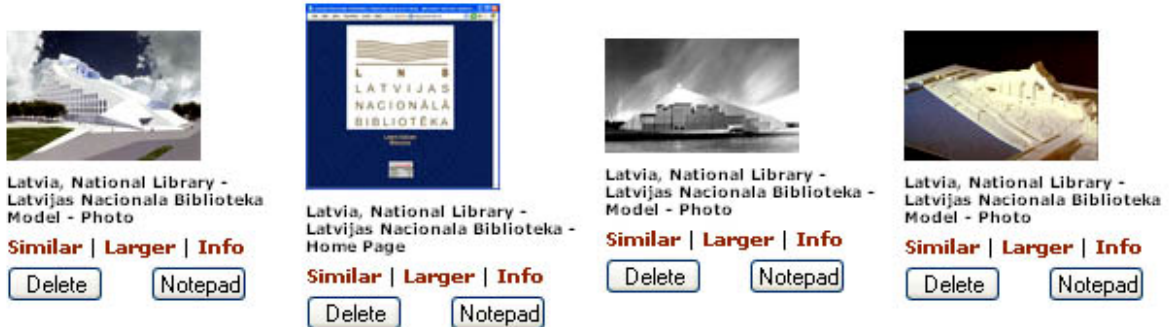


Figure 13. One Can Edit the Chosen Images. Notepad IS Also Available.

- Users can be a contributor.

Users can be an active contributor to *Global Memory Net*. For example, when image(s) of better high resolutions are available, or image(s) which is(are) not available on *Global Memory Net*, the user can contribute his/her resources by using the uploading function.

3. Latest Development

In early November 2006, the World Heritage Center of UNESCO has signed an agreement with Simmons College for me to direct the virtual World Heritage Digital Center. Starting in July 2007, we have extended the *Global Memory Net* technology to start developing a truly functional *World Heritage Memory Net* (<http://whc.unesco.org/en/news/326>).

This is an exciting development! When completed, we will be able to bring the culture, history, and heritage of 851 world heritage sites as designated by the World Heritage Center) of 141 countries together for world citizens' instant use and retrieval.

At this moment, we have found that over 10 collections in *Global Memory Net* are related to the World Heritage Sites, and therefore there is a separate category for that. But, as the number increases, there will be a separate *World Heritage Memory Net* Web Site.

4. Global Collaboration and Community Building

Global Memory Net and the forthcoming *World Heritage Memory Net* represent perfect examples of the convergence of content, technology and global collaboration. While Technology is important, content is the most important of all, because without content, there is no real “digital library”!

Having devoted the last few years in developing our functional world digital library, we have fully realized that:

- No organization possesses everything, it is necessary to develop a global infrastructure for content development together.
- Subject specialists' collaboration is significant, so are the specialists with language capabilities. This is particularly true with our work on *World Heritage Memory Net*.
- Raw content has to be processed properly to digital format.

- Standardized metadata development is labour- intensive but necessary.
- Methods have to be developed to harvest the existing non-standardized metadata or descriptive information.
- Mobilization in the use of the world digital collections is mandatory. Too much investment has been made for the development of digital collections world wide, and more utilization of these resources should be realized. Otherwise the scope of any single digital library application would be too limited! In this regard, we are truly gratified to find the wide spread world-wide use of *Global Memory Net*.
- Linking the project contents with existing multimedia information resources is crucial for the natural and integrated use of human knowledge since the users can never be satisfied with the metadata provided no matter how extensive they may be.
- The ability to enable users to find needed images without knowing the subject is essential. This enables us to develop an effective “knowledge base” and not just “database.”

From a different angle, it is important to stress that community building for global collaboration is badly needed. Collaboration does not happen without conscientious and constant cultivation. It does not happen overnight. *Global Memory Net* started this effort from Day One of its project, and experiment various ways in creating an effective infrastructure – some are more successful than the other.

Global Memory Net's community building effort goes beyond those who can provide either content or technology collaboration. It also offers education and training opportunities to help to build up the digital library development capabilities of interested organizations in other countries. One of the most successful and rewarding experiences relates to the visiting researchers program in the fall of 2005 when 7 researchers joined the project for 3 to 5 months each. They came from China, Croatia and Vietnam, and were involved either in learning how to develop appropriate content from their own institutions for *Global Memory Net* or in extensive system development . After their return to their own countries, some have continued to be closely involved in motivating institutions in their countries to collaborate with *Global Memory Net*, or to teach their students in digital library development.

5. Conclusion

Global Memory Net and the forthcoming *World Heritage Memory Net* are neither simple and traditional databases nor Web pages. They are dynamic interlocking **knowledge bases** of the world cultural, historical and heritage digital resources. I hope that I have shared with you the excitement and features of our global digital library, *Global Memory Net*. The cutting edge technologies and the available Internet and Web have been innovatively used to deliver multilingual and multimedia information services to general public in a way not possible before.

As the technologies continue to move in alarming speed, with more global collaboration, we can anticipate even more potentials! The best is yet to come!

Acknowledgment

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