Technology Enabling Universal Access to World Heritage: Implications to Libraries[*]

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Abstract

In this paper, the author will share her cutting-edge technology application in presenting the 936 World Heritage Sites of 153 countries inscribed by the UNESCO World Heritage Center (WHC) to the world (it is expected that additional sites will be added in the summer of each year). By going to the World Heritage Memory Net Site (http://whmnet.org/) with the simple click of the mouse, one is able to explore and gain instant knowledge of our amazing world heritage by visualizing the global situation related to world heritage, by exploring and experiencing this fascinating world by a quick viewing of the introductory videos, by having an immersive and interactive experience of our world through over 270 panophotographies available in 360 degrees, by finding the site(s) from associated geographical information (map) or timeline, by instantly accessing multimedia and multilingual information on any selected site from a chosen country or region, or by choosing desirable image(s) from all available photographic resources of the whole world for comparative and evaluative studies. Printed and web-based resources, such as all the published books, journals of general and scholarly nature, documents, etc., are also instantly obtainable. Traditional methods in retrieving desired information using database fields like title, location, keyword, etc. are mostly not used immediately since users generally do not know this information when beginning. Thus numerous featured retrieval methods including video, 360 degree panophotographies, geographical, country, temporal, as well as content-based image retrieval (CBIR) are introduced for easy access. Visualization development is in progress, which will bring World Heritage treasures hidden in the web-like structures to the surface for the users.
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1. Introduction

From 2002-2006, the NSF/International Digital Library Program (IDLP) supported a major global digital library of cultural, historical, and heritage image collections, called *Global Memory Net* (*GMNet*), directed by Dr. Ching-chih Chen. It was launched for universal access in late 2006 under the URL, (http://memorynet.org). This gateway to the world culture and heritage was and continues to be very well received and general public and scholars from over 4,192 cities in 142 countries have used the site (see Figure 1 for the Home Page of GMNet) during the five years.

The success of *GMNet* with its flexible and powerful Linus-PHP-MySQL i-M-C-S (integrated Multimedia Content-based System) prompted a partnership with the UNESCO's World Heritage Center (WHC). This partnership, under the leadership of Dr. Chen, with a multi-year Memorandum of Understanding (MOU), was signed between WHC and Simmons College, Boston, Massachusetts, USA in November 2006.

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[*]The World Heritage Memory Net is a mega-project in partnership with the UNESCO's World Heritage Center since 2007. It has been a topic of numerous keynote and invited speeches given by the Author in various parts of the world. This article covers much of the basic background information from these talks given by the author in the last two years. Several most recent ones are listed in References [1]-[5].

Figure l. Current Home Page of *GMNet*

This MoU is a fitting display of WHC's interest and enthusiasm in the research and development activities of Dr. Chen. It has led to the development of *World Heritage Memory Net (WHMNet)* since 2007, which provides universal access to the World Heritage Sites in a way not possible before. "The World Heritage Center considers this an important project with great potential to enhance the humanities for universal access and enrichment through the use of emerging technologies," commented Francesco Bandarin, Director of the WHC then.

The *WHMNet* leverages the results of previous highly successful multi-year R&D projects supported by the US National Endowment of Humanities on the development of interactive videodisc in presenting an incredible period of Chinese history (the period of The First Emperor of China) in the mid-1980s to early 1990s and by the US National Science Foundation from 2002 in using innovative multimedia technology developed for *Global Memory Net* (*GMNet*). Without much marketing effort and banking on the power of Internet technology, *GMNet* has already reached general public and scholars from 4,192 cities in 142 countries in the last five years. We expect that *WHMNet* will reach a much greater global audience with its much enhanced multimedia and multilingual capabilities, as well as its new approaches in engaging users. *WHMNet* hopes to enhance the humanities for universal access and enrichment through World

Heritage Sites by using cutting-edge information technologies, and thus contribute to the promotion and awareness-raising of the UNESCO's 1972 Convention.

With intensive R&D effort extending capabilities far beyond those of the *GMNet, WHMNet* was officially launched April 29, 2011 [1] for universal access, which has greatly promoted a better knowledge of World Heritage properties and increased awareness of everyone's duty to protect them.

This paper will provide an overview of what is now an invaluable web-based knowledge base on World Heritage with immeasurable potential, which hopes to motivate more dynamic and digital activities of a similar nature among libraries, archives and museums. The conceptual ways of presenting multilingual and multimedia information will have considerable implications to libraries, which we hope to further elaborate.

2. How Does *WHMNet* Work?

With limited amounts of time and space, it is difficult to provide an adequate overview of such a huge project. Thus, only the bird's eye view can be provided in the following with the help of abundant graphics. "A picture's worth a thousand words," thus the graphics will help us to decrease substantially the detailed narratives, and to enhance readers' conceptual appreciation of the kind of information access this flexible system is able to provide and which is not possible elsewhere.

At the present, initial multimedia and multilingual data of all 936 sites as of July 2011 have been processed and uploaded to our Server. The current MySQL database already consists of about over 15,000 records in about 103 languages on 41,550 images of these 936 sites. In addition, there are many videos, some sound tapes, and many unique document files.

Figure 2 shows the current Home Page of *WHMNet*. This graphic together with that of Figure 1 can serve as a good PowerPoint slides showing most of the multimedia and multilingual cultural and heritage resources which are available for instant access at a simple click of the mouse.

Our web-based knowledge base aims at providing users with an incredible general experience first. As already stated, while we have enormously rich multimedia resources, we don't want our users to access them only through a stiff and inflexible traditional database approach. Thus, for exploring our amazing world on this *World Heritage Memory Net* site, we want to engage our users from the very start, making them look first at what we have and what we can provide them. We want their first experience to be immersive and exciting, leading them to explore further, and gain more knowledge of this amazing world on their own. This made interface design a very challenging task.

To achieve this, the current Home Page invites users to explore their world heritage by offering them an overview of the many features of the Site. They are able to see, explore, and discover

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[1] For UNESCO World Heritage Center's news on WHMNet, see htttp://whc.unesco.org/en/news/740.
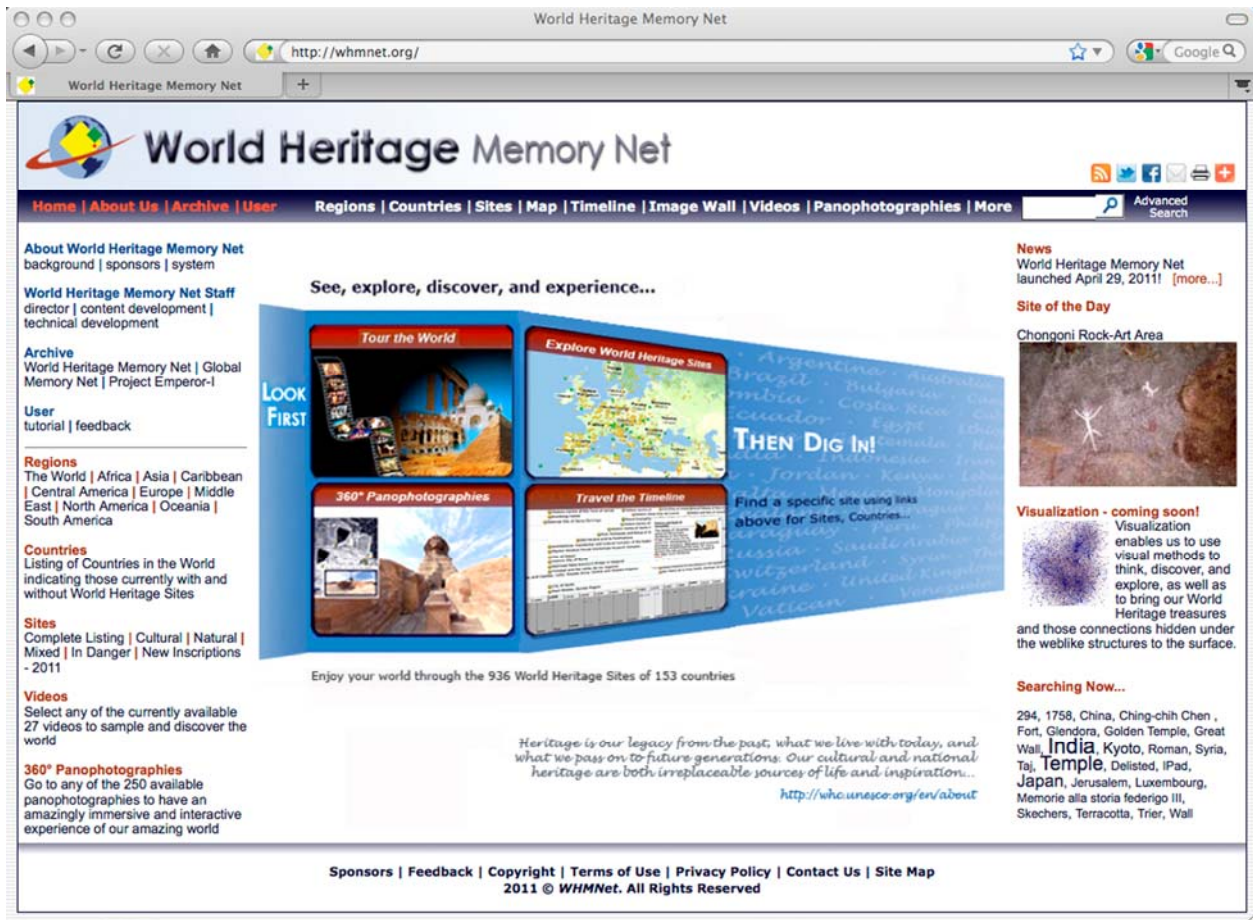
Figure 2. Current Home Page of *WHMNet*

world through at least 4 different very visually oriented approaches, specifically highlighted in the center column of the home page:

1. Videos – We have created 27 introductory videos of various lengths, which offer sample images by region or country from our sites so that the users can instantly be visually attracted to whatever they choose to see and enjoy first. By viewing the videos, users also gain knowledge on names and keyword of various sites. For each site, we provide 2 to 3 images.
2. 360 degree Panophotographies – we are able to provide users truly amazingly immersive and interactive experience of about 270 world heritage sites in collaboration with Tito Dupret of http://patrimonium-mundi.org. Users feel that they are physically there!
3. Maps – Our users can pan over the entire world and visualize the density of world heritage sites in different parts of the world with indication of categories (cultural, natural, mixed and sites in danger), as well as select any particular one for quick viewing.
4. Timeline – The 936 world heritage sites of the 153 countries are locatable by a timeline of their existence extending from the late centuries B.C. to the very present, except for those natural sites which have existed for millions of years. Again, one can select any particular one for quick information.

After these explorations and discoveries, one can then zero in for more specific information on any chosen world heritate site of interest. This is very much in line with what was expressed at a keynote speech of Ben Shneiderman delivered at a *humanities+digital: visual interpretations conference, May 20-22, 2010* and organized by *hyperstudio* at MIT. Shneiderman said that "the Visual Information Seeking mantra – overview first, zoom and filter, then details-on-demand – was a compact way of conveying the lessons from designing interactive exploration tools for statistical data. But this principle turns out to be broadly applicable to a range of information searching situations [6].

Navigable Information Accessible on Home Page

One can see from the current home page (Figure 2) that all 936 sites can be accessed collectively or by Site/Region/Continent/Country from both the top navigational bar as well as from a listing on the left navigational panel. The right panel provides news, a Site of the Day, forthcoming research activities such as visualization, and current searching activity by means of a Tag Cloud which is linked in real-time to the terms most frequently linked to the searches performed by the users at that time.

In addition to providing background information about *WHMNet*, its development, history, staff and archival information, the left panel's main focus is on providing quick access to the World Heritage Sites by Regions, Country and Sites by designated type. For example, when one chooses "The World" under the Regions category on the Left Panel, the next screen shows the 153 countries with available world heritage sites alphabetically listed on the left column of screen, as shown in Figure 3, and all 936 sites which the World Heritage Committee considers as having outstanding universal value are arranged alphabetically on the center column of Figure 3.

This page also includes a geographical map of the 936 sites, based on UNESCO/WHC's classification, which are classified as:

- Cultural – 725 sites (marked with "yellow" dots),
- Natural – 183 sites (marked with "green" dots),
- Mixed (both cultural and natural) – 28 sites (marked with half "yellow and half "green"), and
- Heritage In Danger – A few of the above combinations (marked in "red" dots are sites in danger.)

Thus, the world heritage sites are appropriately indicated with symbols of the types of sites on the Map as shown on the right column of Figure 3. On the map, one can move the pane horizontally left and/or right to view all the sites in the world, or select any specific site for further exploration. One can also go to Map for the full-screen geographic view.

It is worth mentioning that the World Heritage Committee meets each year in late June to decide on new sites to be inscribed by WHC. Thus, it is expected that in early July each year, there will be additional sites to be added, and we shall make every effort to include them as soon as possible.

Figure 3. 936 world heritage sites of 153 countries are shown by country,
name of site and geographical map.

A Quick Glimpse of the World Heritage Sites

If one has no idea what information he/she can expect to find on the 936 sites in the world, then the two buttons – "Image Gallery" and "Random Images" under the Map of Figure 3 can be of great help to the user. "Image Gallery" will bring out all the 41,550 images of these 936 sites currently available on the server in the order of image acquisition or organization, as shown in Figure 4. Browsing these many images from one page to the other with each page (or screen) displaying 20 images at a time can be a very tedious, time-consuming and inefficient process. In this case, the "Random Images" feature will serve the users well! It will randomly provide images of these 41,550 images, so that one's knowledge on the World Heritage Sites will increase dramatically from a few simple clicks of the button because each image will also be shown with the title of the Site.

Each site page additionally offers links to relevant textual resources where the user can further obtain additional needed books, articles, images, videos, web-based materials relevant to a chosen site. This "one-stop" approach will enable a user to find literally anything, in print or online, which they are looking for. For example, the instant link to the OCLC World Cat will provide users access to library resources from over 170 countries. One can also instantly search Internet resources such as Google Image, Google Scholar, Google Video, Internet Archives, etc.
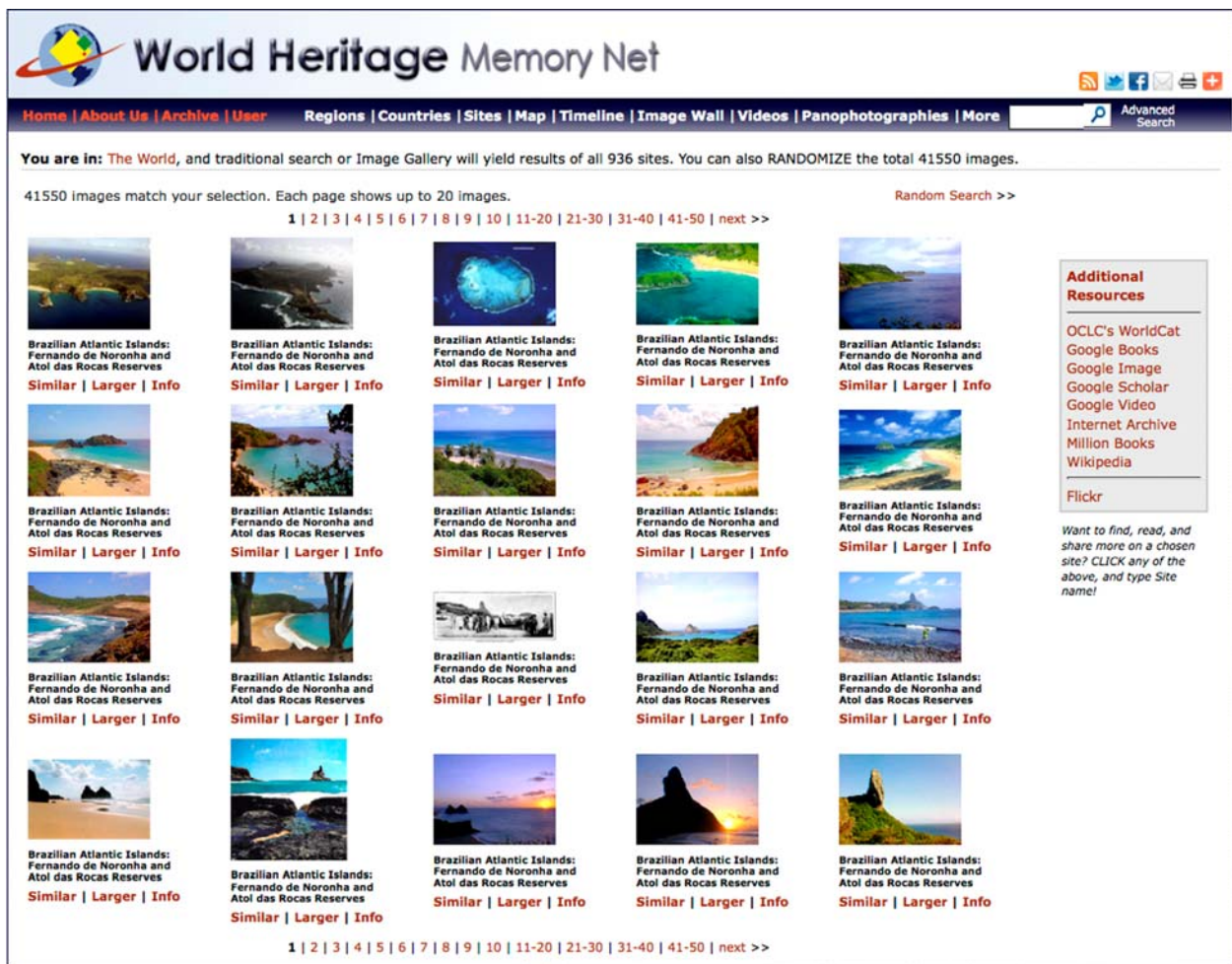
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Figure 4. Random images of the current 41,550-image collection are shown with titles of the sites.
One is given the choice of finding similar images, enlarging the image icons,
or getting the site information for any chosen image

Once an image of interest is spotted, one can find images of similar color and shape in all world heritage sites by choosing "Similar," as shown in Figure 4. For example, if a Roman Column in Italy was chosen, then similar columns in various parts of Europe, Africa can be shown quickly. One's knowledge on this Roman Column can then be expanded quickly. A click on "Larger" will enlarge the chosen image and the zooming can be performed easily but the ratio of enlargement depends largely on the resolution of that image.

One other quick view of the world heritage sites randomly is the image wall (Figure 5), which can be accessed on the top navigational bar. When the cursor hovers over individual thumbnail images, the user is provided with country and site information, which will enhance their ability to search. When the thumbnail is selected, a larger image appears and the descriptive information provides the name of the site, a brief description, and the image rights information related to that image. A user can also search on the image wall by site name, country, keyword, and instantly only relevant information are highlighted and all others are dimmed.
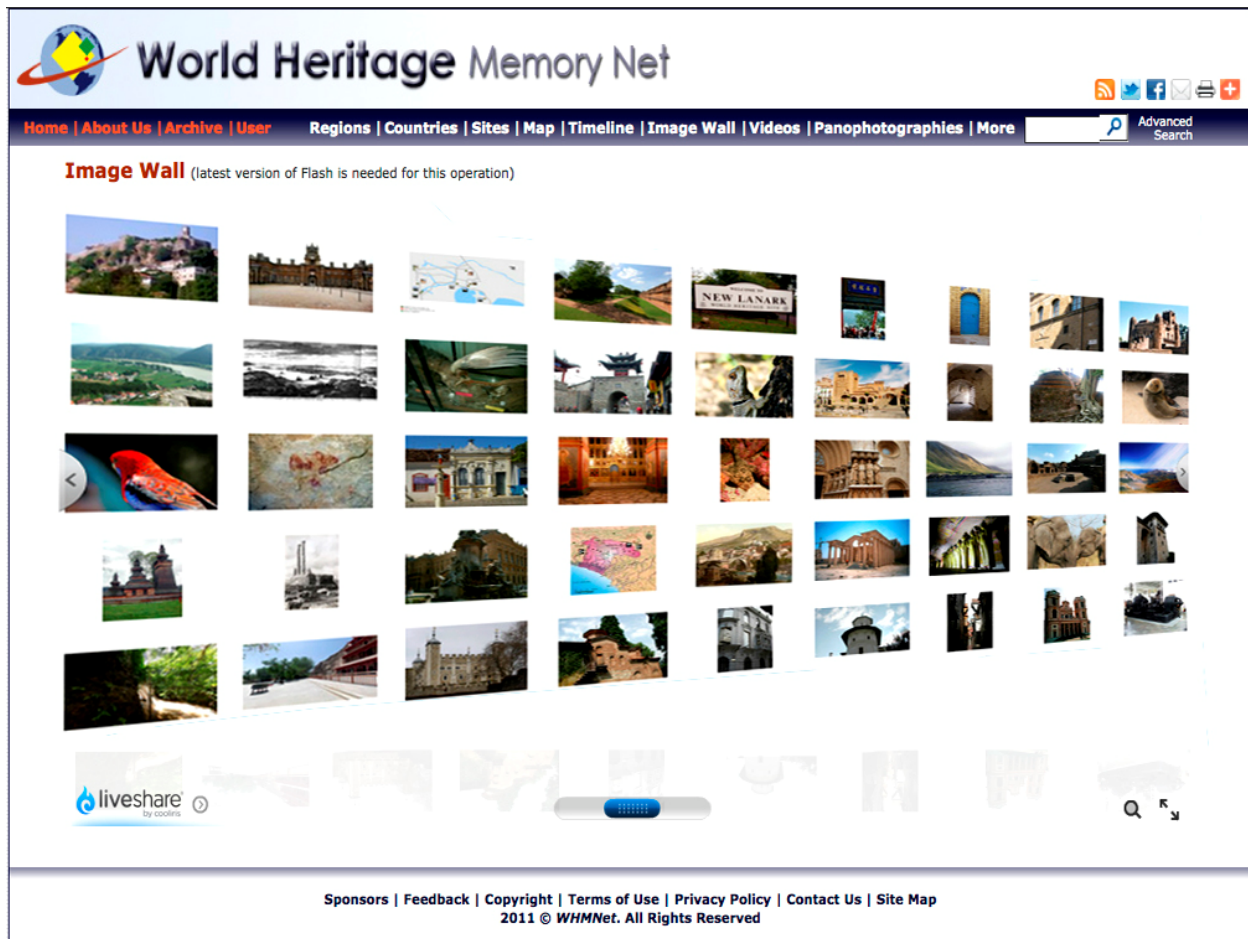
Figure 5. The image wall, accessible from the top navigational bar

Selecting A Specific Site and What Can One Find?

To enhance the readers' appreciation of the diversity and richness of the resources, instead of selecting one specific site and going through the entire process, we shall show three selected sites and describe the featured multimedia information which the user is able to obtain. These sites are:

1. China's Great Wall,
2. India's Taj Mahal, and
3. Jordan's Petra.

For these sites, the user selects **Asia -> China** or **Asia -> India** or **Middle East -> Jordan.** As shown in Figure 6, the user can instantly see the 41 world heritage sites in China displayed with the map locations and types of sites indicated when China is selected. Similarly when India is chosen, the 28 world heritage sites in India are displayed instantly, so Jordan's 4 sites are shown when **Middle East -> Jordan** is clicked.

You are in: Asia -> China, and traditional search or Image Gallery will yield results in China

China

Countries:	Sites (WHC No.):
Afghanistan	◇ Ancient Building Complex in the Wudang Mountains (705)
Azerbaijan	◇ Ancient City of Ping Yao (812)
Bangladesh	◇ Ancient Villages in Southern Anhui — Xidi and Hongcun (1002)
Cambodia	◇ Capital Cities and Tombs of the Ancient Koguryo Kingdom (1135)
China	● China Danxia (1335)
India	◇ Classical Gardens of Suzhou (813)
Indonesia	◇ Dazu Rock Carvings (912)
Japan	◇ Fujian Tulou (1113)
Kazakhstan	◇ Historic Centre of Macao (1110)
Korea, Democratic People's Republic of	◇ Historic Ensemble of the Potala Palace, Lhasa (707)
Korea, Republic of	◇ Historic Monuments of Dengfeng in "The Centre of Heaven and Earth" (1305)
Kyrgyzstan	● Huanglong Scenic and Historic Interest Area (638)
Laos	◇ Imperial Palaces of the Ming and Qing Dynasties in Beijing and Shenyang (439)
Malaysia	◇ Imperial Tombs of the Ming and Qing Dynasties (1004)
Mongolia	● Jiuzhaigou Valley Scenic and Historic Interest Area (637)
Nepal	◇ Kaiping Diaolou and Villages (1112)
Pakistan	◇ Longmen Grottoes (1003)
Philippines	◇ Lushan National Park (778)
Sri Lanka	◇ Mausoleum of the First Qin Emperor (441)
Tajikistan	◇ Mogao Caves (440)
Thailand	◉ Mount Emei Scenic Area, including Leshan Giant Buddha Scenic Area (779)
Turkey	● Mount Huangshan (547)
Turkmenistan	

Category of site
◇ Cultural site ● Natural site ◉ Mixed site

Site inscribed on the List of World Heritage in Danger
◆ Cultural site ● Natural site ◉ Mixed site

[Random Images] [Image Gallery]

You are in: Asia -> India, and traditional search or Image Gallery will yield results in India

India

Countries:	Sites (WHC No.):
Afghanistan	◇ Agra Fort (251)
Azerbaijan	◇ Ajanta Caves (242)
Bangladesh	◇ Buddhist Monuments at Sanchi (524)
Cambodia	◇ Champaner-Pavagadh Archaeological Park (1101)
China	◇ Chhatrapati Shivaji Terminus (formerly Victoria Terminus) (945)
India	◇ Churches and Convents of Goa (234)
Indonesia	◇ Elephanta Caves (244)
Japan	◇ Ellora Caves (243)
Kazakhstan	◇ Fatehpur Sikri (255)
Korea, Democratic People's Republic of	◇ Great Living Chola Temples (250)
Korea, Republic of	◇ Group of Monuments at Hampi (241)
Kyrgyzstan	◇ Group of Monuments at Mahabalipuram (249)
Laos	◇ Group of Monuments at Pattadakal (239)
Malaysia	◇ Humayun's Tomb, Delhi (232)
Mongolia	● Kaziranga National Park (337)
Nepal	● Keoladeo National Park (340)
Pakistan	◇ Khajuraho Group of Monuments (240)
Philippines	◇ Mahabodhi Temple Complex at Bodh Gaya (1056)
Sri Lanka	◆ Manas Wildlife Sanctuary (338)
Tajikistan	◇ Mountain Railways of India (944)
Thailand	● Nanda Devi and Valley of Flowers National Parks (335)
Turkey	◇ Qutb Minar and its Monuments, Delhi (233)
Turkmenistan	◇ Red Fort Complex (231)
Uzbekistan	◇ Rock Shelters of Bhimbetka (925)
Vietnam	◇ Sun Temple, Konârak (246)
	● Sundarbans National Park (452)
	◇ Taj Mahal (252)
	◇ The Jantar Mantar, Jaipur (1338)

Category of site
◇ Cultural site ● Natural site ◉ Mixed site

Site inscribed on the List of World Heritage in Danger
◆ Cultural site ● Natural site ◉ Mixed site

[Random Images] [Image Gallery]

You are in: Middle East -> Jordan, and traditional search or Image Gallery will yield results in Jordan

Jordan

Countries:	Sites (WHC No.):
Bahrain	◇ Petra (326)
Iran	◇ Quseir Amra (327)
Iraq	◇ Um er-Rasas (Kastrom Mefa'a) (1093)
Israel	
Jordan	
Lebanon	
Oman	
Saudi Arabia	
Syria	
Yemen	

Category of site
◇ Cultural site ● Natural site ◉ Mixed site

Site inscribed on the List of World Heritage in Danger
◆ Cultural site ● Natural site ◉ Mixed site

[Random Images] [Image Gallery]

Figure 6. Sites of China, India and Jordan

When China's Great Wall or India's Taj Mahal or Jordan's Petro Is Chosen

As shown in Figure 7, when one clicks on the site name of "The Great Wall," or "Taj Mahal," or "Petra," one is instantly offered the basic metadata, descriptive information in multiple languages. In addition, for each site, links are made also to available video, sound, documents (in PDF files), 360 degree panographical tour, and WHC's official site for other additional information. "Image Gallery" can be linked to all the relevant images of the site.

Figure 7. Instant showing of descriptive information on the chosen site in multiple languages as well as site links to videos and 360 degree panographical tour, as well as Image Gallery

- *Instant Multilingual Access*

For all sites, the six UN official languages – Arabic, Chinese, English, French, Russian, and Spanish – are available, as to other languages, the number differs from a few to the maximum of over 50 languages as in the case of "The Great Wall" as shown in the upper portion of Figures 7 and 8. One can instantly obtain the multilingual information by clicking on the language. Figure 8 shows the Chinese description for "The Great Wall," Figure 9 the Tamil for "The Taj Mahal," and Figure 10 the Arabic for "Petra."

Figure 8. Switching metadata from English to Chinese for "The Great Wall"

Figure 9. Switching metadata from English to Tamil for "Taj Mahal"

Figure 10. Switching metadata from English to Arabic for "Petra"

- *Instant Multimedia Access*

Figures 7 and 8 also show that in addition to the multilingual descriptive information on "The Great Wall" site, for example, various associated multimedia information can also be instantly retrieved and displayed:

o The site content screen includes a sliding image browser showing all images of the site, which can be quickly browsed and explored by flowing freely either left or right, and then a specific image can be selected for enlargement, as shown in Figure 11.

o By clicking on "Image Gallery," an image collection on the chosen site can be viewed either in the order of images pre-organized or randomly. A user can also select an interesting image and ask for similar images of the same color or shape by clicking "similar," or enlarging the image by clicking "larger," as shown in Figure 12 on the images of Petra.

o Relevant video, sound clips, etc. can also be instantly retrieved when available and clearly indicated, as shown in Figure 8 for the video from *The First Emperor of China* produced by Ching-chih Chen on The Great Wall.

- In collaboration with Tito Dupret of patrimonium-mundi.org, when the URL link is indicated, the user can take a 360 degree panographical tour of the site by clicking the URL as shown in Source 2 for all three sites on Figure 7. This provides the user an incredible experience as if he/she is standing on the top of The Great Wall, the only fascinating man-made military structure visible from the moon, or standing in front of the magnificent Taj Mahal, the universally admired immense mausoleum of white marble, or touring the unforgettable Petra with its elaborate built and monumental rock-cut tombs and temples.
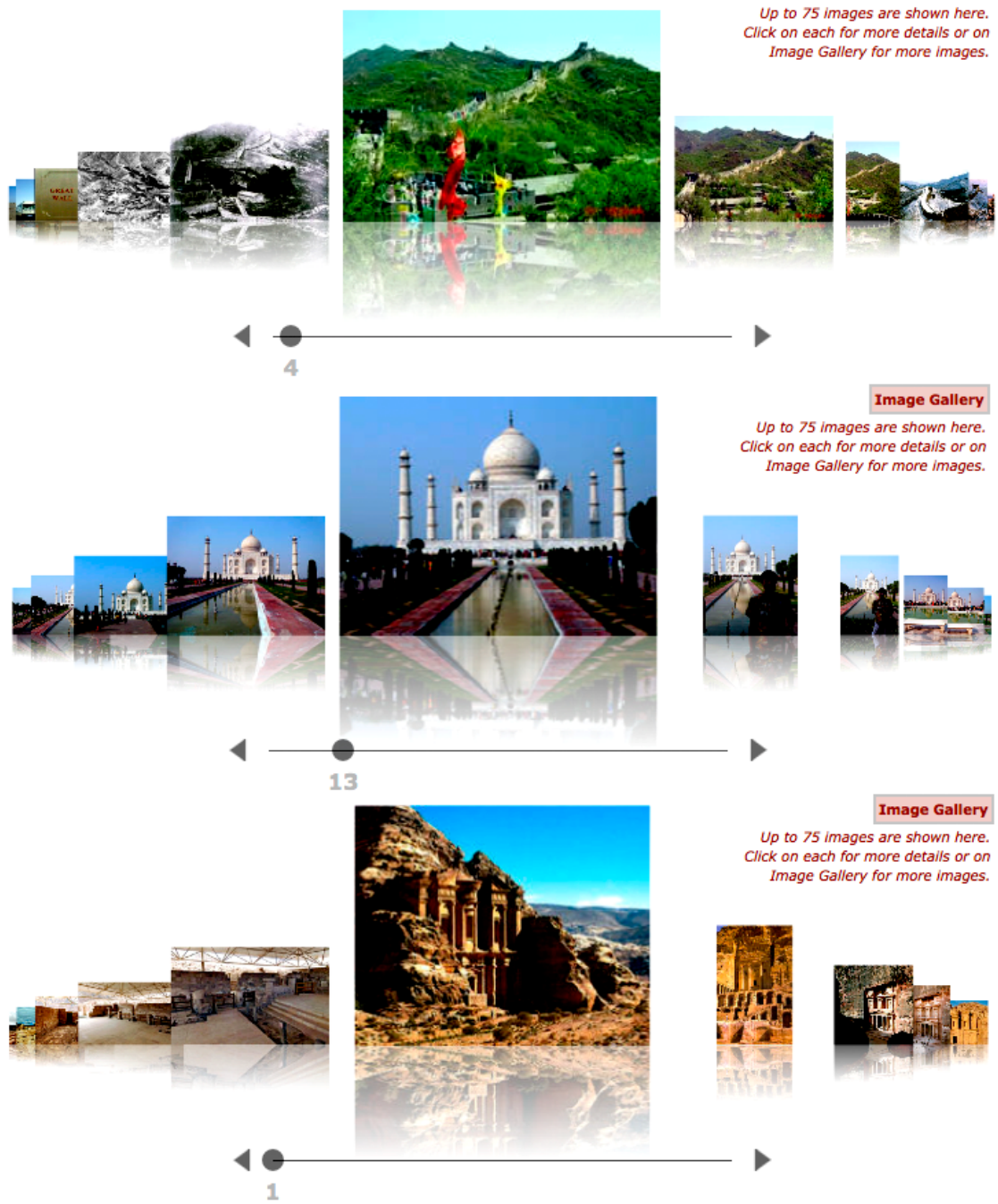

Figure 11. Image Flows of The Great Wall, Taj Mahal and Petra
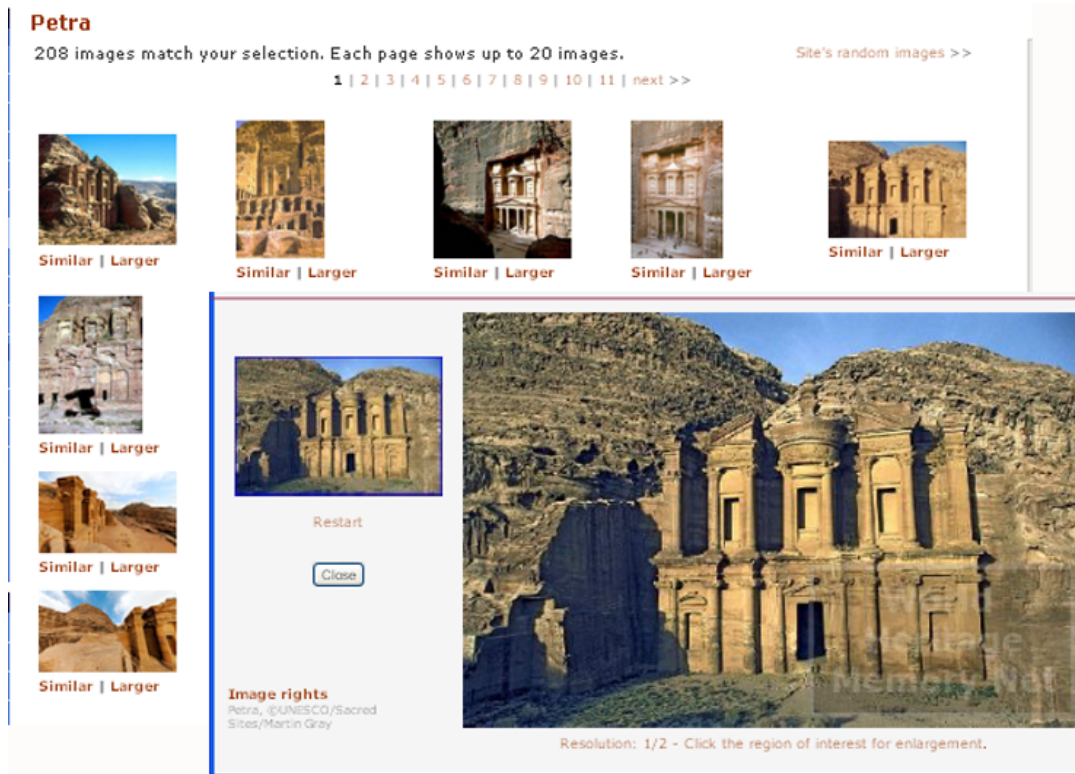
Figure 12. Image Gallery provides 208 images on Petra, each of which can be enlarged with dynamic watermark

- *Geo- and Temporal-Retrieval Capabilities*

In addition to the whole array of features described above, more geo- and temporal-retrieval capabilities are available as already mentioned earlier in this paper. In fact, users are directed to look and explore first these features immediately at the overview level at the Home Page of *WHMNet* as shown in Figure 2. We shall elaborate only slightly more on these features in this section. Figure 13 shows how one can go to browse the world map and click on any site of interest for further information on the upper Map Search, or select the country of interest from the countries listed in the lower screen of the Country Search. The 936 Sites from 153 countries are all there! When using the Country Search, it should be noted that countries in "black" are those countries with no world heritage site inscribed by WHC. Only those in "brown" have.

In addition to geographical access to the World Heritage Sites, temporal access is also available. This is an important feature because the 936 sites range from those prehistoric ones with age of millions of years, to sites of the 20th or even 21st century, such as the Sydney Opera House in Australia. On *WHMNet*, one is able to horizontally browse through time, and select the sites of interest, and then obtain quick descriptive information instantly. Figure 14 shows that the "Historic Centre of Lima" site starts around Year 1700. Note that the basic UNESCO WHC's descriptive information is paraphrased here. In general, we have placed emphasis on those sites no older than 300 B.C. Thus, "natural" sites are not included for the obvious reason that they are much older than 300 B.C. and went back to millions of years ago.

Map search

Category of site: ◇ Cultural site ● Natural site ● Mixed site ◆ Cultural site in danger ● Natural site in danger ● Mixed site in danger
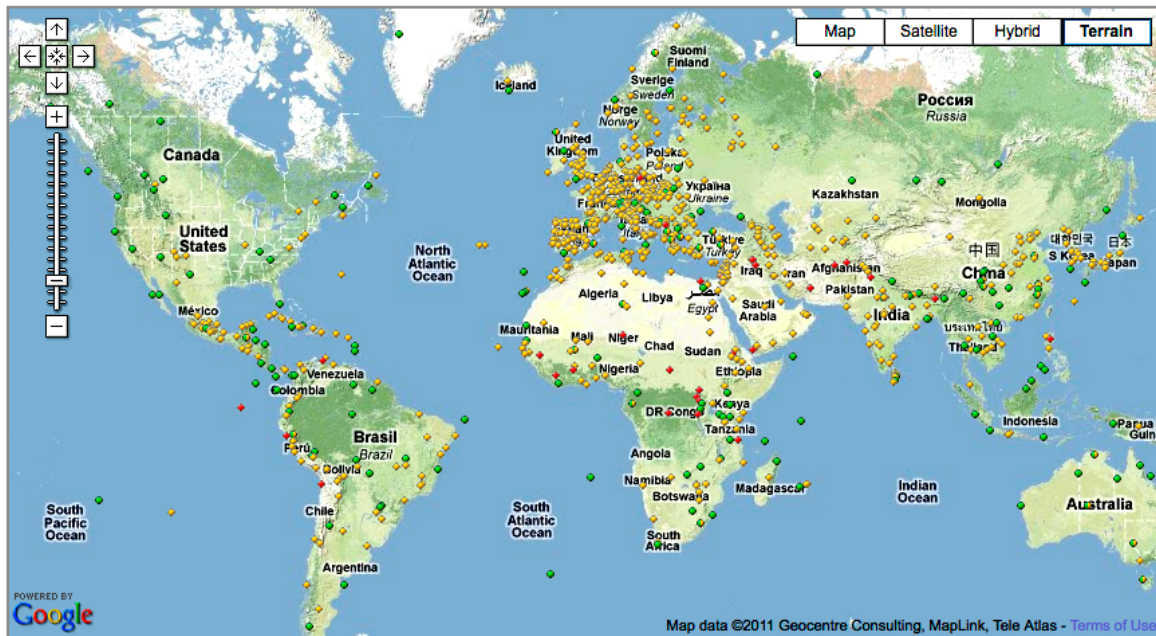
Search Sites by Country

A - C

Afghanistan • Albania • Algeria • Andorra • Angola • Antigua and Barbuda • Argentina • Armenia • Aruba • Australia • Austria • Azerbaijan • Bahamas • Bahrain • Bangladesh • Barbados • Belarus • Belgium • Belize • Benin • Bermuda • Bhutan • Bolivia • Bosnia and Herzegovina • Botswana • Brazil • Brunei Darussalam • Bulgaria • Burkina Faso • Burundi • Cambodia • Cameroon • Canada • Cape Verde • Central Africa Republic • Chad • Chile • China • Colombia • Comoro Island • Congo, Democratic Republic of the • Congo-Brazzaville • Cook Islands • Costa Rica • Côte d'Ivoire • Croatia • Cuba • Cyprus • Czech Republic

D - K

Denmark • Djibouti • Dominica • Dominican Republic • East Timor • Ecuador • Egypt • El Salvador • Equatorial Guinea • Eritrea • Estonia • Ethiopia • Faroe Islands • Fiji • Finland • Gabon • Gambia • Georgia • Germany • Ghana • Greece • Greenland • Grenada • Guatemala • Guernsey • Guinea • Guinea-Bissau • Guyana • Haiti • Honduras • Hungary • Iceland • India • Indonesia • Iran • Iraq • Ireland • Israel • Italy • Jamaica • Japan • Jordan • Kazakhstan • Kenya • Kiribati, Republic of • Korea, Democratic People's Republic of • Korea, Republic of • Kuwait • Kyrgyzstan

L - Q

Laos • Latvia • Lebanon • Lesotho • Liberia • Libya • Liechtenstein • Lithuania • Luxembourg • Macedonia • Madagascar • Malawi • Malaysia • Maldives • Mali • Malta • Marshall Islands • Martinique • Mauritania • Mauritius • Mexico • Micronesia, Federal States of • Moldova • Monaco • Mongolia • Montenegro • Morocco • Mozambique • Myanmar (Burma) • Namibia • Nauru • Nepal • Netherlands • New Caledonia • New Zealand • Nicaragua • Niger • Nigeria • Niue • Norway • Oman • Pakistan • Palau • Panama • Papua New Guinea • Paraguay • Peru • Philippines • Poland • Portugal • Qatar

R - Z

Romania • Russia • Rwanda • Saint Kitts and Nevis • Saint Lucia • Saint Vincent and the Grenadines • Samoa • San Marino • Sao Tome and Principle • Saudi Arabia • Senegal • Serbia • Seychelles • Sierra Leone • Singapore • Slovakia • Slovenia • Soloman Islands • Somalia • South Africa • Spain • Sri Lanka • Sudan • Suriname • Swaziland • Sweden • Switzerland • Syria • Taiwan • Tajikistan • Tatarstan • Thailand • Togo • Tonga • Trinidad and Tobago • Tunisia • Turkey • Turkmenistan • Tuvalu • Uganda • Ukraine • United Arab Emirates • United Kingdom. England • United Kingdom. Northern Ireland • United Kingdom. Scotland • United Kingdom. Wales • United Republic of Tanzania • United States of America • Uruguay • Uzbekistan • Vanuatu • Vatican • Venezuela • Vietnam • Westerm Sahara • Yemen • Zambia • Zimbabwe

Figure 13. Accessing world heritage sites geographically.
 Upper: World heritage sites are geographically marked with appropriate "type" symbols
Lower: Countries are alphabetically arranged. Those in "brown" have world heritage sites
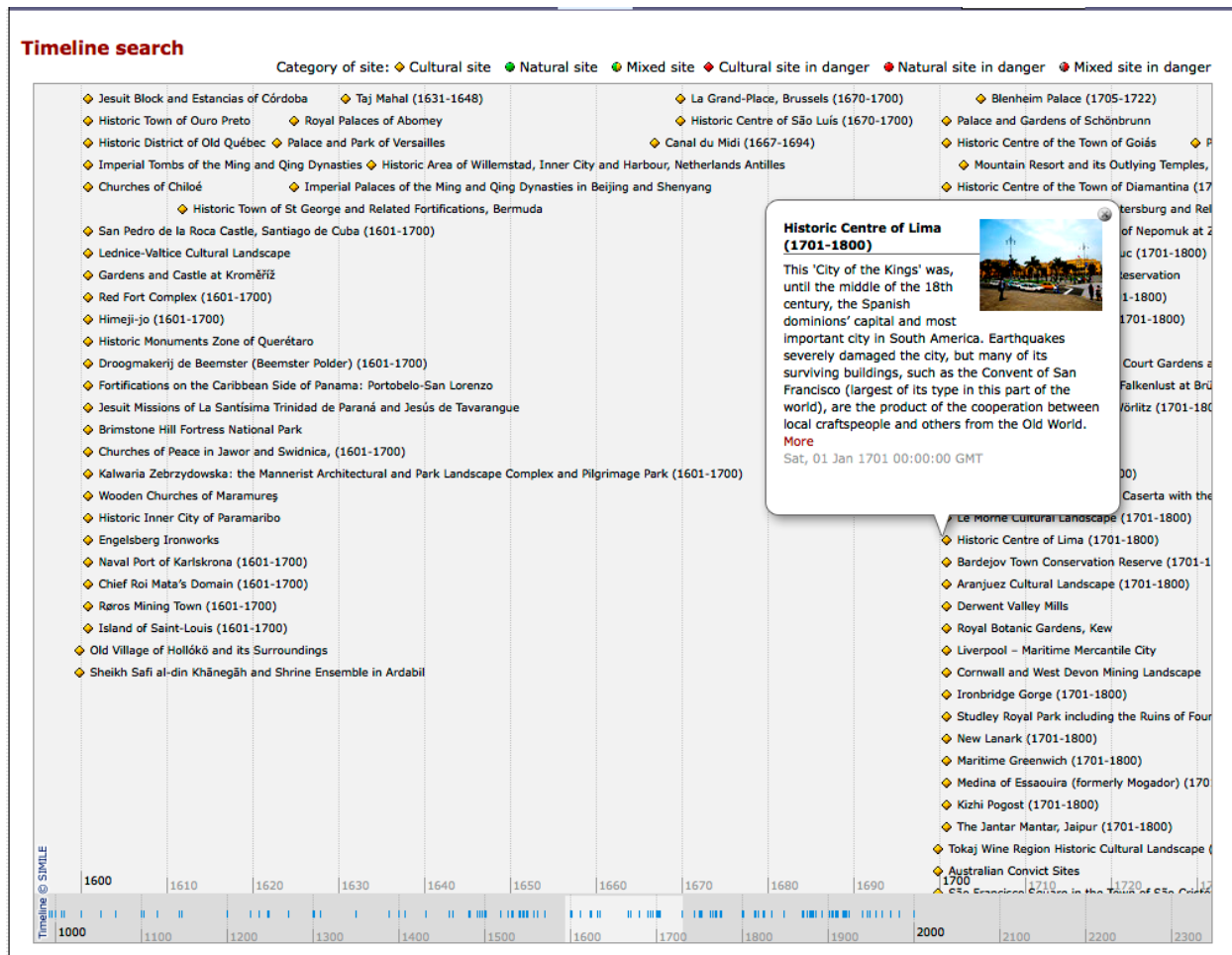
Figure 14. Timeline retrieval of the "Historic Centre of Lima" site

In addition to additional information provided in References [1] to [5]. Readers are also refered to articles on both GMNet and WHMNet on Wikipedia for more information:

- World Heritage Memory Net, http://en.wikipedia.org/wiki/World_Heritage_Memory_Net
- Global Memory Net, http://en.wikipedia.org/wiki/Global_Memory_Net

3. Usage and further development

- *Use of WHMNet*

In the short 7 months from the public launching of *WHMNet* in April 29, 2011 to the end of November 2011, Google Analytics shows that *WHMNet* has been used by citizens from 1692 cities in 130 countries (See Figure 15).

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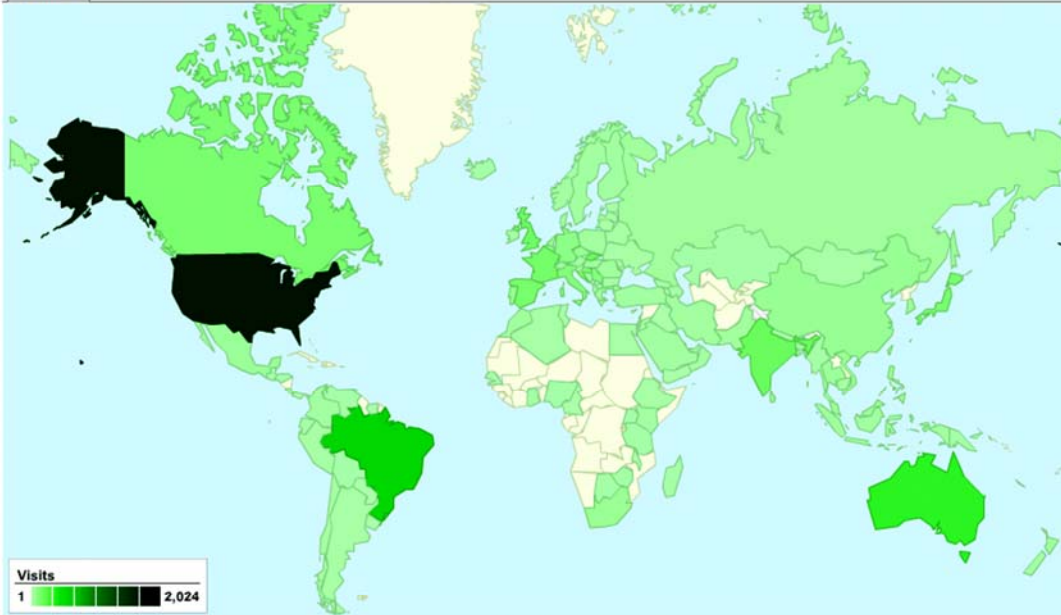
Figure 15. How use of *WHMNet* has spread all over the world during April 29-Dec. 1, 2011

Google Analytics' in-page data show that all elements of our home page design are well-used for the intended purpose as shown in Figure 16. Specifically the four center squares highlight features of our sites, and all of them enjoy relatively high use:

- Tour the World: 12%
- 360 degree panophoto-graphies: 17%
- Exploring World Heritage Sites: 20%
- Travel the time-lines: 2.7%
- Digging in: 7.4%

It has also revealed all kinds of other interesting data such as:

- Time on Page: 1:38 minutes
- Bounce Rate [2]:   23.19%
- Language Used: English (51.2%)
- Operating Systems used: Windows (64.0%)
- Browser Used: Firefox (43.4%)

It has been estimated that the number of websites in the internet world is at least 8.45 billion pages (Friday, 02 December, 2011), as shown in http://www.worldwidewebsize.com. Some other estimates went as high as 21 billions. While no one is sure of the exact number, yet it is reasonable to expect that over 10 billions are currently available and the number is increasing daily.

Thus, we are encouraged to find that according to Alexa.com [3], as of December 1, 2011, *WHMNet*'s Alexa traffic rank globally is 170,602, and U.S. rank is 130,757. Alexa also has the ability to compare usage between and among specific websites. According to Alexa's site comparisons, *WHMNet*'s usage already exceeds that of many major world digital libraries.

Alexa's statistics also show statistics compatible to those of Google Analytics described above, such as: the daily page views per user on the *WHMNet* was 6 pages, estimated daily time on site for *WHMNet* was between 5-20 minutes, and the bounce rate was less than 25%, which is attractively low. Thus, our relatively high page views, long daily time, and low bounce rate show that once visitors arrive at *WHMNet*, they stay for significant periods of time, view multiple pages and do not leave the site after only short stay. These are all good indicators of the usability and value of *WHMNet*.

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[2] According to Wikipedia, bounce rate is an Internet marketing term used in web traffic analysis. It represents the percentage of visitors who enter the site and "bounce" (leave the site) rather than continue viewing other pages within the same site.

[3] Alexa claims on its website that "Alexa is the leading provider of free, global web metrics. Search Alexa to discover the most successful sites on the web by keyword, category, or country. Use our analytics for competitive analysis, benchmarking, market research, or business development. Use Alexa's Pro tools to optimize your company's presence on the web."
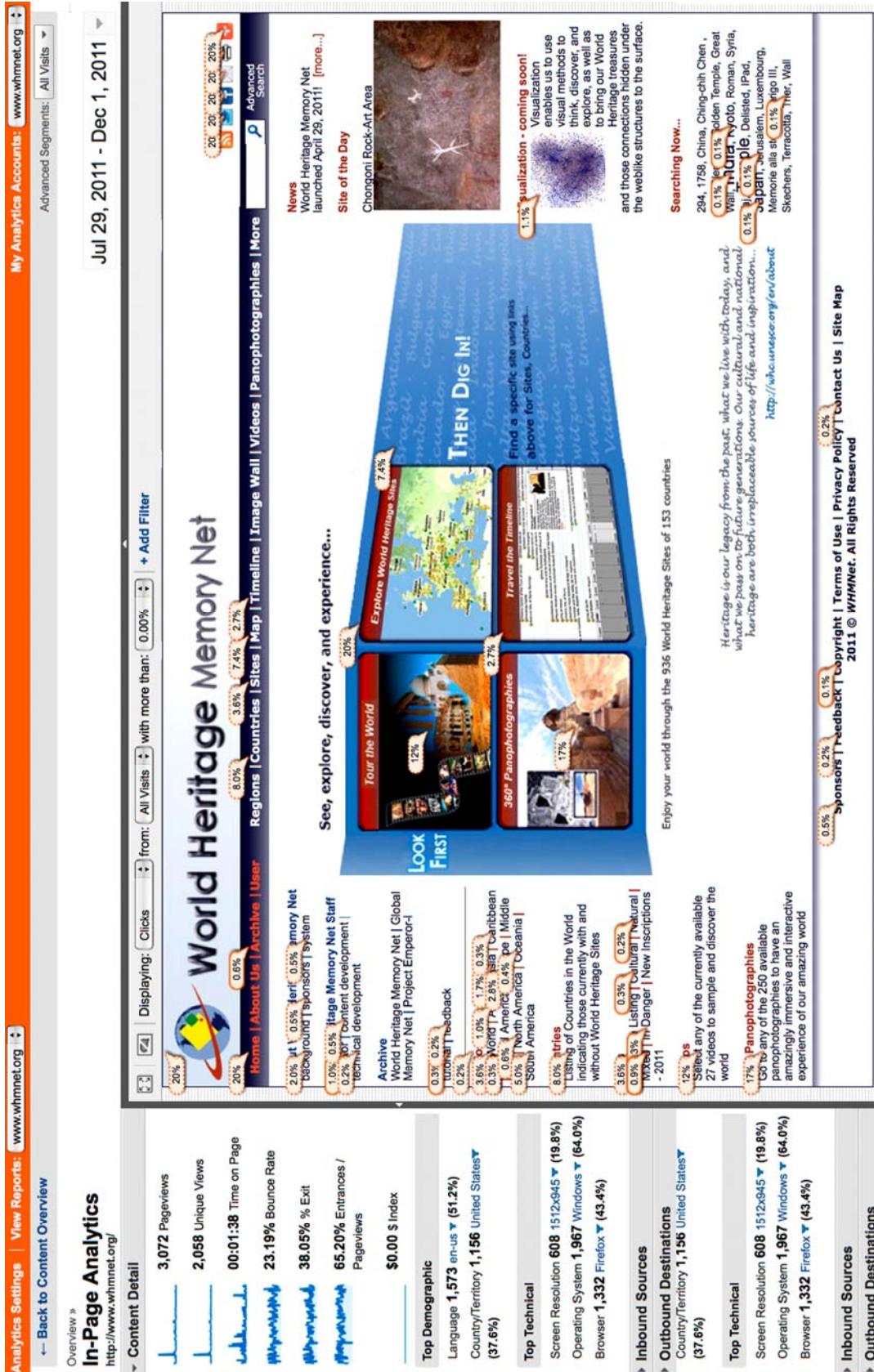
Figure 16. Google Analytics's In-Page statistics of *WHMNet*

- *Further Development: Visualization*

Digital humanity has come of age. Visualization technology can be most effective in platforming humanistic inquiry. At the *humanities+digital: visual interpretations conference*, held at MIT on May 20-22, 2010, all keynote speakers like Johanna Drucker of UCLA, Ben Shneiderman of University of Maryland [6], Martin Wattenberg of Flowing Media, and Lev Manovich of UCSC, articulated in their own ways that despite the challenges, visual knowledge representation can immerse users in a seamless beautiful environment while exploring and experiencing the subject from many different angles [7]. For *WHMNet,* although we have been thinking about visualization for some time. While we already have all 936 world heritage sites well presented in a global map with type of sites properly identified and with very useful historical timelines, there are a lot more things we can do since we have not fully leveraged our enormously rich multimedia data and resources.

It is time to explore some real uses of what Shneiderman calls a "visual information seeking mantra." There are many definitions for the word "mantra," but simply it is a "powerful tool" or "a tool for power." For the former definition, how can we use visual methods to think, discover, and explore, as well as to bring our world heritage treasures and those connections hidden under the weblike structures to the surface? For the latter definition, how can we use visualization to empower our users?

In Gudrais' 2010 article [8], she narrows down any complex networks to two basic elements of nodes and links (also called ties). She said:

> *"But as the numbers of nodes and links increase, the number of possible configurations grows exponentially. Likewise, there are innumerable possibilities for what a node and a link can represent… Structurally simple, yet analytically incredibly complex, networks hold the answers to so many questions…[are studying]."*

More succinct introduction to complex networks can be found in Newman's 2010 book [9]. Newman also defines a network, "in its simplest form, a collection of points joined together in pairs by lines." The points are nodes and the lines are links or edges. He further said that "many objects of interest in the physical, biological, and social sciences can be thought of as networks" and his book shows that "thinking of them in this way can often lead to new and useful insights." Thus, *WHMNet* is in the process of collaborating with expert(s) in this important area to look for these new and useful insights. While the results are very preliminary, we can already share with the readers our computer-generated global image of the 890 World Heritage sites based on our 2009 data as shown in Figure 17 where our amazing 890 World Heritage sites are displayed with their links or connections or relations in a very complex network system with ability for us to zoom in any aspect of it.

On this image, the "brown" nodes are the World Heritage sites, and the "blue" nodes are "keywords," taken from the *WHMNet*'s image list. Links denote that a site has an image that is tagged with the connected keyword. The node size is dependent on degree: the more links, the larger the node. Link color depth depends on link frequency: The darker, the more images per site bear the keyword. Thus, from Figure 16, we can see that the network is very dense, which

means that the keywords used to describe the images are very broad ones (which we are aware of), or our world heritage sites are quite aggregated with a lot of data gathered together.
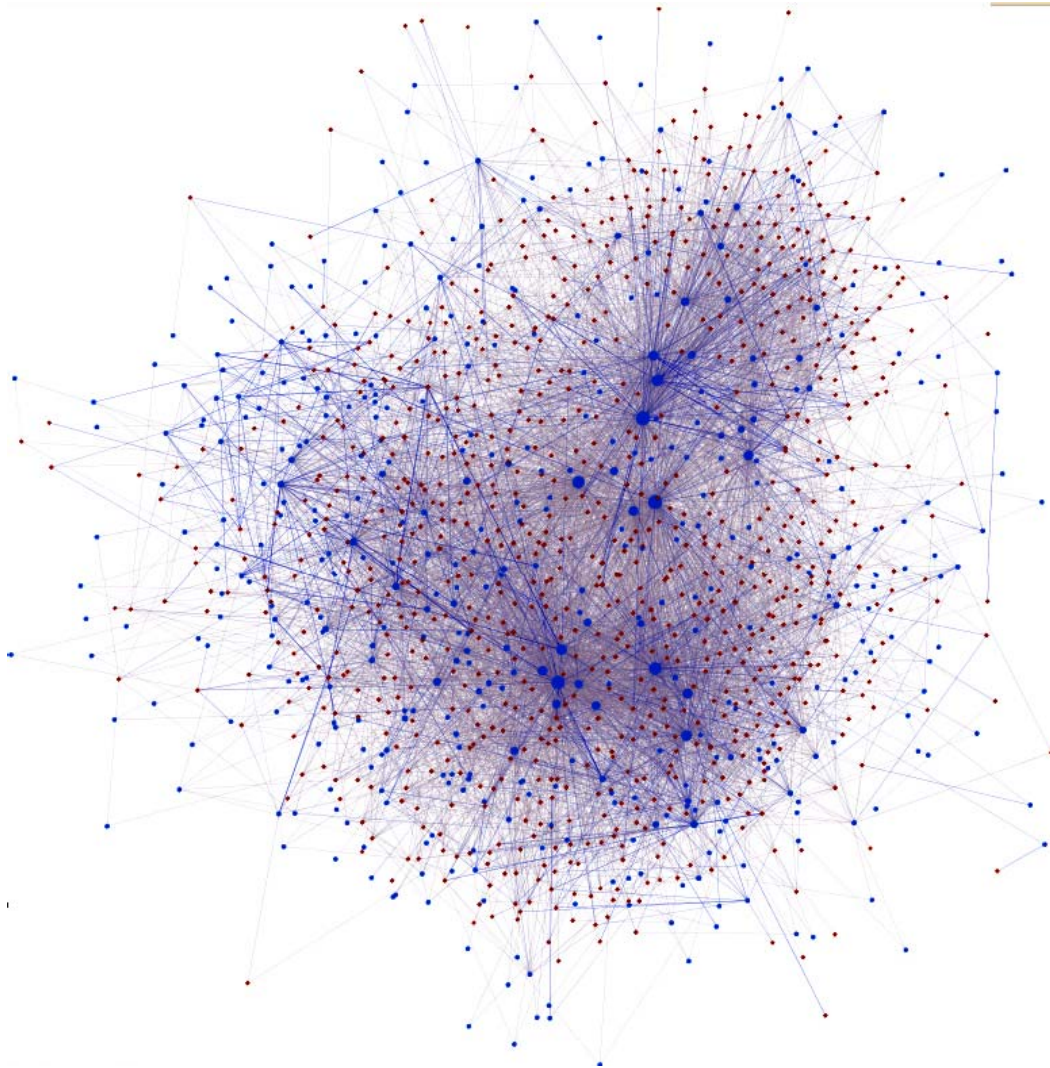

Figure 17. The global image of the 890 world heritage
sites based on *WHMNet*'s sets of description data of 2009
Image: Maximilian Schich, www.schich.info

4. Conclusions

The bird's eye view of *WHMNet* presented in this paper covers only the tip of the iceberg of the functionalities of this important mega-scale global digital project. It is clear that with the help of cutting-edge technologies, for the first time, multimedia and multilingual information on the world's invaluable heritage sites is able to be accessed, explored, experienced and learned instantly with a simple click of the mouse. This is truly bridging the cultures of the world, and thus in this post-9/11 era, it has tremendous effect on "enhancing understanding among people in

this troubled time," as an award was given by the Cultural Convention in 2006 recognizing Chen and her *GMNet*'s contribution in this aspect.

As this chapter is in a book mainly prepared for librarians and archivists, this dynamic approach should have great potential for them and for museum professionals as well. They can contemplate using similar approaches for bringing their own institutional treasures to the surface for universal access and exploration beyond the traditional database approach, which is important, but it is just the beginning. They can also consider seriously in sharing their resources in a network environment.

Users are increasingly relying on "born-digital" content, and traditional methods of collection, organization, and information searching are no longer able to effectively compete with the massive amounts of web-based information currently available to us. In order to remain relevant in this global digital environment, libraries must explore alternate and complementary modes of providing information in addition to the traditionally organized methods.   In most cases, users are interested in certain subject topics, but do not have precise information about author, title, keywords, etc.   Thus, the utility of a traditional database is generally limited to more sophisticated information seekers. It is essential to devise applications in which all users can search and explore, discover and dig deeper, and instantly bring their knowledge to the next level with the simple click of a mouse.

A nontraditional model like that of the *World Heritage Memory Net* is just one example of how multimedia and multilingual content can be integrated seamlessly and made widely available through a flexible, nonlinear, user-friendly, digital knowledge base.   This concept can be applied to any media on any subject for any purpose. For example, the systems developed for *GMNet* and *WHMNet* have been successfully modified and expanded for a popular multimedia and multilingual application called *NTHU Memory Net* (http://memorynet.nthu.edu.tw), which celebrates Taiwan's National Tsing-Hua University's Centennial Anniversary, and which was developed jointly by NTHU and Ching-chih Chen's non-profit organization, Global Connection and Collaboration (http://globalcc.org).   With the system in place, this rich knowledge portal including selected images of important historical artifacts, objects, people, events, and buildings, all with multilingual descriptive information, was able to be created in a very short 5-month time period.

In the current economic climate, libraries are seeking new ways to attract users and have reached out to other organizations in an effort to share resources. The *World Heritage Memory Net* model provides a vivid example of how international collaboration in content building and technological application can enhance and provide new opportunities for global content development, collection management, preservation, outreach, and education. This is a time of tremendous opportunity and change for libraries as they redefine and expand their role within an increasingly digital and global network. *WHMNet* should be viewed as a model on how digital technology and global network has been fully utilized to seize the opportunity for providing universal multimedia and multilingual information access in a way unattainable in traditional library environment.

5. Acknowledgment

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