DIGITAL ARCHIVE OF THE SILK ROAD HERITAGE
-Digital Silk Road-

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ABSTRACT

This paper presents the progress of the Digital Silk Road project currently being conducted at NII in cooperation with many institutions and researchers over the past seven years. The Digital Silk Road (DSR) project aims to create a digital archive of the cultural heritage related to the Silk Road, and to establish a new style of Silk Road study for the 21st century. The major achievements of the DSR project are: 1) Digital archiving of the Toyo Bunko Rare Books related to the Silk Road. 2) 3D-VR restoration of the Citadel of Bam destroyed by the earthquake. 3) Digitizing some old maps of the Silk Road drawn by M.A.Stein about 100 years ago and browsing old maps on Google Earth. 4) A DSR Imaginary Museum portal that provides a digital Library, Museum, Cinema and Panorama of the Silk Road. Silk Road route map and chronological map were developed to submit and share the multimedia contents of the Silk Road images and videos in public and group domains.

1.   INTRODUCTION

In the recent years, substantial progress has been achieved in the digitization of historical and cultural resources. Historical, cultural, and natural heritage is on the verge of disappearing due to the passage of time, wars, disasters, and other factors. However, information technology has provided us with opportunities for recording, archiving, and disseminating digitized information on cultural resources, creating space for intercultural dialogues, and new cultural expressions.

We started the Digital Silk Roads (Shortly DSR) project in 2001 in cooperation with UNESCO. The project aims to create a digital archive of the cultural heritage in the Silk Road region, and establish a network collaboration system by linking advanced information technology with cultural sciences. (Ono et al. 2002) (Ono et al. 2004) This paper presents the progress of the Digital Silk Road project by referring to our ongoing subjects and past achievements.

2.   DIGITAL SILK ROAD

2.1   Background

The "Silk Road" is the name for the trade route where a vast amount of commodities and cultural activities were exchanged in the Eastern and Western areas of Eurasia Continent. The German geographer Ferdinand von Richthofen was the first person to use the term "Seidenstrasse" (the German word for Silk Road) .

The Silk Road is presently interpreted in a very broad sense, and it was a network that not only traded silk but many other exchanges occurred through cultural activities. The Silk Road refers to the numerous trade routes that served to carry silk and other commodities across the

Eurasia continent over past centuries. Vast amounts of information concerning science, technology, art and religion have been transferred along the Road, influencing many different peoples and their civilizations in the region.

Figure 1 shows the map of the Silk Road, which shows the typical view of three main routes of the Silk Road. The Oasis routes run across a series of large deserts and large mountains connecting the Oasis cities. The Steppe route runs north of the Oasis Road in the northern Asia Steppe. The Maritime Roads gradually expanded from the Mediterranean Sea to the Aegean Sea, Red Sea, Arabian Sea, Persian Sea and the Indian Ocean. Finally it extended all the way to the southern and eastern coastal areas of China and Nara in Japan.
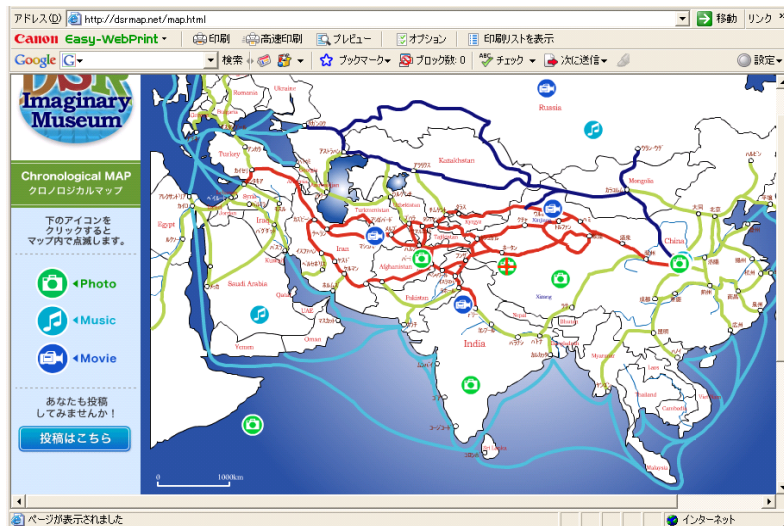

Figure 1. MAP of Silk Road

2.2   Aims and Objectives

The DSR project tries to link advanced information technology with cultural studies in order to further enhance interest in the precious cultural resouces along the Silk Road.

The project seeks to establish a new approach to Silk Road studies, featuring the fusion of cultural sciences and information technology through digital archiving and network collaboration.

The objectives of the Digital Silk Road project are to create a digital archive of the geographically dispersed Silk Road heritage and develop a system to facilitate the use of the digital archive. This means we want to conserve the Silk Road heritage in digital form and make it available to for retrieval and sharing world-wide through Internet. Following this, the project started to digitize rare books related to the Silk Road that are in Toyo Bunko's possession and digitize them to develop a information infrastructure aimed at fully utilizing such contents. (Ono al. 2005). In addition, the Citadel of Bam destroyed by the earthquake was digitally reconstructed using a 3D-CG technique. Based on the results of these attempts, the project will expand its scope to include other major Silk Road cultural heritage with a view of completing the Digital Silk Road Museum in the future. (http://dsr.nii.ac.jp)

2.3 Project theme and organization

The followings are the typical subprojects inside the DSR project.
1) Digital archiving of the Toyo Bunko's Rare Books related to the Silk Road.

Figure 2. Portal of Digital Silk Road Project

2) 3D-VR restoration of the Citadel of Bam destroyed by the earthquake.

3) Digitizing some old maps of the Silk Road drawn by M.A.Stein about 100 years ago. By browsing old maps on Google Earth, we created an error distribution of maps by comparing old maps with satellite images on Google Earth.

4) A DSR Imaginary Museum portal that provides a digital Library, Museum, Cinema and Panorama of the Silk Road. Silk Road route map and chronological map were developed to submit and share the multimedia contents of the Silk Road images and videos in public and group domains.

5) ASPICO(Advanced Scientific Portal for International COoperation) : Web-based portal that hosts DSR project members to create and manage a metadata for resources on Silk Road.

The project is mainly organized by NII researchers from multi-disciplinary fields, such as informatics, architecture, history and archaeology. In cooperation with relevant organizations, the project is conducted by a number of scholars and experts from various disciplines who have taken an interest in digitally archiving Silk Road heritage (Ono et al. 2005). They are Toyo Bunko, Research teams at Tsinghua University and Beijing University in China, Iranian Cultural Heritage and Tourism Organization (ICHTO). Waseda University, the University of Tehran, and Espace Virtuel de Conception Architecturale et Urbaine (EVCAU) of a laboratory of the Ecole Nationale Supérieure d'Architecture de Paris-Val de Seine (ENSA PVS) in France.

3.   DSR Imaginary Museum

The DSR Imaginary Museum is a web museum site where the public can access multimedia resources in an academic database, such as the "Cultural Online System" and "Digital contents of DSR project". The DSR Imaginary Museum provides live, user-friendly, and graphically rich cultural information about the Silk Road. (http://dsr.nii.ac.jp/imdsr/)

The cinema site of DSR Imaginary Museum can show some short videos of the Bamiyan Heritage. The panorama site shows the photos viewed from different angles of the Bamiyan Valley. On the other hand, the library site of the DSR Imaginary Museum exhibits Toyo Bunko's Rare Books, a documentary heritage, manuscripts, and other valuable materials as Digital Library contents.

The DSR Chronological Map is a unique map where everyone can participate to create the Silk Road contents. Contributors can share their information about the Silk Road. Information is collected and categorized by country as currently organized, which is published regularly. Silk Road travelers, Silk Road fans, researchers, scholars, or anyone who owns photos, music, and/or videos of the Silk Road are encouraged to share their information on this site. They can become one of the creators of the DSR Chronological Map. In order to share the Silk Road resources among specific group members, Group domains are allocated for registered members. Using Group maps, users can submit their multimedia resources to specific sites to exhibit their contents on this map place, comments on the bulletin board, and share contents among the group members.

4. ANALYSIS OF SILK ROAD MAPS USING GOOGLE EARTH

4.1 Digitization and utilization of Toyo Bunko Rare Books

Books are important resources for dealing the cultural heritage of the Silk Road. Some of the heritages can only be seen in books, because the original objects were destroyed and lost after recorded in books. To provide books in a digital form, we created a website called the "Digital Archive of Toyo Bunko Rare Books". The important features of this digital archive are three fold. (http://dsr.nii.ac.jp/toyobunko/) (Kitamoto et al. 2006)
1) The collection of academically essential resources.
2) Rich choices of navigation methods including a full text search.
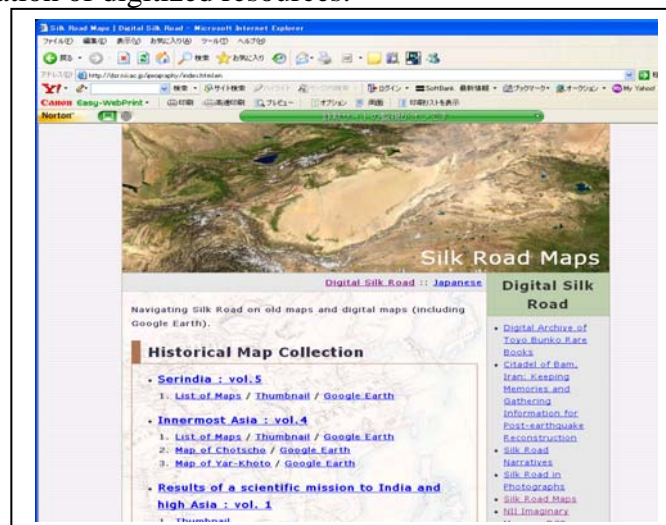3) Multipurpose utilization of digitized resources.

Figure 3. Silk Road Map Collection.

From the collection in the library of Toyo Bunko (the Oriental Library), we carefully selected books in the public domain that have significant academic value. Since 2002, we have digitized 92 volumes (43 titles) from cover to cover (total 19,242 pages) essential for Silk Road studies.

Maps are useful tools for representing and analyzing geographical information. To take advantage of these digitized maps, we use Google Earth as a convenient tool for browsing and analyzing old maps and for integrating information.

4.2 Using Google Earth for Browsing Stein Maps

Among several old maps on the Silk Road, the most valuable ones were made by M. A. Stein, who was one of the most important persons in the expeditions of the Silk Road in the beginning of 20th century. He went to central Asia four times including his first expedition in 1900, and published a series of reports including the Serindia (5 volumes) and Innermost Asia (4 volumes) that included surveyed maps.

Although these maps were made about 100 years ago, researchers still regard them as the most reliable maps of the Silk Road. There are only 94 of these maps in Serindia, and 47 in Innermost Asia, so researchers can only use them sheet by sheet, not as a whole. For this reason, the comprehensive analysis of those maps has not been done, such as evaluating the overall accuracy of the maps.

We use Google Earth to improve the usability of Stein Maps, for the following reasons. Firstly, it has a built-in mechanism for browsing large maps with a level-of-detail control. Secondly, by having the latest satellite images for background, we can directly compare the old maps with the present layout of Earth to compare the changes and evaluate the accuracy.

Figure 4 Old Maps on Google Earth

Since the Stein maps were surveyed, georeferencing is made in a straightforward manner by referring to the intersections of the latitudinal and longitudinal lines drawn on the maps. The images of the maps are then organized in Keyhole Markup Language (KML) format with a level-of-detail control. Those maps are now available on our website (http://dsr.nii.ac.jp/geography/) and can be viewed like Figure 4.

Google Earth drastically improved the usability of old maps. Any parts of the maps can be magnified easily, and all map sheets are connected. Moreover, Stein maps can be easily compared with the current satellite image by changing the opacity of Stein maps. The improvement of usability led to the evaluation of Stein maps for all across Silk Road.

Google Earth can also be used for integrating information on maps. The basic way of integrating information is to annotate maps with place marks on the ruins, oasis, and other important places to help researchers and people more conveniently use maps.

5.   3D-VR MODELING OF THE CITADEL OF BAM

Under the DSR project, we have been conducting a research project on the virtual revival of the Citadel of Bam, a UNESCO world heritage site in danger that was destroyed in an earthquake in 2003. The key approach to 3D modeling of the destroyed buildings is simultaneous usage of heterogeneous data such as 2-D maps, photos, cartography maps, and sketches in collaboration between different teams. The tasks of evaluating the historical, architectural, and technical details of the 3D buildings are done in parallel with the modeling by a team of CG and architecture experts in order to increase the precision of the 3DCG

reconstitution so that it can be used as a reference for the physical restoration. We plan to open the outcomes of the project, such as the QTVR movies and rendered snapshots of the 3D-VR digital reconstituted buildings, open over the Internet in order to permanently preserve this lost heritage for access of unlimited users.
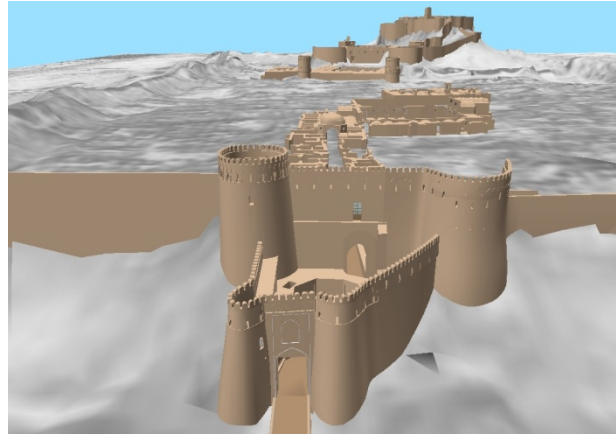

Figure 5. General view of 3D-VR reconstructed Citadel of Bam

6. CONCLUTION

We plan to make the entire system accessible via the Internet, so that users around the world can share and utilize these precious cultural resources. Furthermore, we are working to develop a system to store Silk Road related information and documents together with images and videos so that such information can be referred to quickly and easily. Digital archiving technology allows heritage materials and sites thought to be beyond saving to be restored, enabling us to pass on such assets to the future.

The Digital Silk Road project will provide us with a new paradigm of collaboration in the digital age, establishing a route for digital information exchange among the countries along the Silk Road and encouraging the creation of a new cultural form, just as the Silk Road did throughout their history. There is no doubt that the DSR project will have a significant impact on the enhancement of cultural diversity around the world.

7. REFERENCES

Andaroodi, E., Matini, M.R., Abe, N., Ono, K., Kawai, T., 2007. 3-D Reconstitution and Virtual Reality of the World heritage in Danger, Citadel of Bam, Proceeding of the Virtual Environments 2007 (poster and short papers). *13th Eurographics Symposium on Virtual Environments*, Editor: Dieter Fellner , ISBN 978-3-905673-64-7

Kitamoto, A., Onishi, M., Ikezaki, T., Deuff, D., Meyer, E., Sato, S., Muramatsu, T., Kamida, R., Yamamoto, T., Ono, K., 2006. Digital Bleaching and Content Extraction for the Digital Archive of Rare Books, *Proceedings of the 2nd International Conference on Document Image Analysis for Libraries (DIAL)*, pp. 133-144,

Nishimura, Y., Onishi, M., and Kitamoto, A., 2007. Analysis of Silk Road Old Maps Using Google Earth, *IPSJ SIG Computers and the Humanities Symposium 2007*, pp. 155-162, 2007 (in Japanese).

Ono, K. (Editor), 2002. *Proceedings of the Tokyo Symposium for Digital Silk Roads*, Tokyo, Japan, ISBN:4-86049-007-X

Ono, K. (Editor), 2004. *Proceedings of the Nara Symposium for Digital Silk Roads*, Nara, Japan, ISBN:4-86049-024-X,

Ono,K., Yamamoto, T., Kamiuchi, T., Kitamoto, A., Andres, F., Sato, S., Andaroodi, E., 2005. Progress of the Digital Silk Roads project, *Progress in Informatics*, ,National Institute of Informatics, No.1, pp93-141

Ono, K., Andaroodi, E., Einifar, A., Abe, N., Matini, M., Bouet, O., Chopin, F., Kawai, T., Kitamoto, A., Ito, A., Mokhtari, E., Einifar, s., Beheshti, M., and Adle, C., 2008. 3DCG Reconstitution and Virtual Reality of UNESCO World Heritage in Danger, the Citadel of Bam, *Progress in Informatics*, National Institute of Informatics, No. 5. 99-137