

An application of super-high-definition free viewing technology for viewing ancient documents

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The application of computer technology is ideal for exhibiting a large collection of ancient Japanese documents to the public. In most viewing systems, a user chooses a document from a menu, a group of partitioned images of the selected document is presented, and the user selects the desired image. But when the selected document is long, partitioned images are not suitable for viewing the document continuously.

The National Museum of Japanese History has developed a super-high-definition free viewing system capable of displaying large, high-definition digital images larger than 100,000 x 100,000 pixels, allowing the image to be scaled for viewing from any location at an appropriate size. An application of the free viewing system for the viewing of ancient documents is proposed in this paper.

Super-high-definition digital materials of Seishû and Zokushû of the Shôsô-in Monjo were made using the proposed method. The size of each document is about 80,000 x 30,000 pixels. The documents were made available to visitors of the National Museum of Japanese History in a special exhibition that demonstrated the usefulness of such materials called “Ancient Japanese writing symbols” (Mar 19~Jun 9, 2002).

1. Introduction

Hard copies and microfilm are mainly used to allow researchers to view an enormous number of ancient Japanese documents. However, the application of computer technology is preferable when exhibiting these documents to the public. In most document inspection systems, a group of documents that satisfies a given criteria is extracted and is presented as thumbnail images. The user selects a thumbnail and gets an enlarged image of the requested document. These inspection systems are inconvenient for continuous reading of a volume of documents with a width of about 30cm and length of about 10m.

The National Museum of Japanese History has developed a super-high-definition free viewing system[1] capable of displaying large, high-definition digital images larger than 100,000 × 100,000 pixels, allowing the image to be scaled for viewing from any location at an appropriate

size. An application of the free viewing system for the viewing of ancient documents is proposed in this paper.

2. Problems with digitizing ancient documents

Ancient Japanese documents are classified under several categories, for example, MONJO (文書; a letter or a deed), KIROKU (記録; a diary), and TENSEKI (典籍; a story). Some documents are written on a large piece of paper, and some documents are edited as a scroll. It is difficult to digitize these documents, which are actually a form of written text. Many are written in cursive style using old Japanese grammar or classical Chinese. Only a few experts in deciphering this kind of text can read these documents.

To utilize ancient documents with no indices, images of documents are reproduced in several forms, such as EIIN-BON (影印本; a book of hard copies), microfilm, microfiche, etc. A user can read

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reproduced images one by one and eventually find what he or she is looking for. While not providing any indices for reference may be inconvenient, it is better than providing nothing at all.

The goal of digitizing reproduced images of ancient documents and making them available to many users should be actively pursued as an efficient method of utilizing a large body of documents as materials for historical research and other purposes. In this situation, the most critical challenge is to develop an effective method of browsing a large number of document images without any indices.

3. Method of freely viewing digital images of historical objects

Japanese drawings and paintings such as BYOBU (屏風; folding screens), KOCHIZU (古地図; old maps), and MAKIMONO (巻物; scrolls) include particularly large or long objects on which extremely minute images are drawn. To utilize these objects effectively for historical research and exhibition in our museum, the National Museum of Japanese History has made a number of very large digital images of our museum's holdings, and has developed a super-high-definition free viewing system capable of displaying these images and allowing the image to be scaled so that any part of the image can be viewed at an appropriate size.

Figure 1 shows the screen layout. It has a main screen for displaying a magnified partial image, the whole image as a map, an area for explanation of the image displayed, and buttons for moving the image and for zooming in and out. There are two sets of magnification buttons. One set is for doubling or halving the size, and the other set is for slight changes in magnification.



Figure 1: Super high-definition free viewing system

The large image is split into partitions of appropriate sizes, and the partitioned image data is stored into files. As shown in Figure 2, lower resolution images with sides $1/r_0$, $1/r_0^2$, $1/r_0^3$, ... times those of the original image are made in advance to enable high-speed changes in magnification while maintaining the quality of the displayed image. To display a partial image, the system is told the location of the center of the partial image, and the magnification required. The image with the next higher magnification to the required magnification is selected and loaded into main memory. Next, the necessary parts of the image are extracted and reduced to the required magnification. Finally, the extracted images are joined and displayed. (See Figure 2.) The amount of image data required for the display doesn't depend on the size of original image, but the size of the partial images and the main screen.

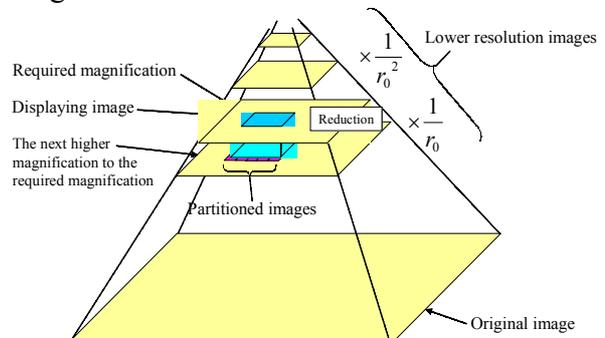


Figure 2: Data structure and handling method for displaying image data

4. Application of free viewing technology

to browsing of ancient documents

Figure 3 shows the usual method for browsing document images. For example, in the case of a volume of ancient documents in the form of a scroll, which has great lateral width, partitioned images of the volume are taken with common area in their left and right borders. When one volume is specified from a list of volumes, the usual browsing system shows thumbnails of these images and lets the user choose one of them. This enables him/her to see a partial image of the volume. (See figure 3.) This method is inconvenient, however, because the user cannot read the volume continuously. He/she must repeat the task of selecting a partial image and deciphering it.

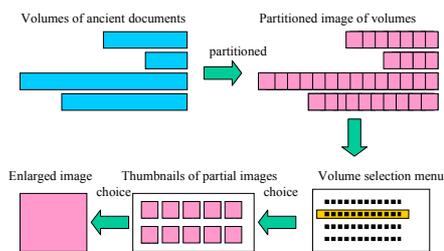


Figure 3: The usual interface for browsing ancient documents

One way of resolving the problem of interrupted reading is to combine partitioned images of a volume into one seamless scroll image and to browse this using the super-high-definition free viewing system. However, each volume must still be selected when the user wishes to continue reading from one group of volumes to another.

Our new idea is to combine a group of volume images into one super-high-definition digital image. Each volume image is arranged on the super-high-definition image with an arbitrary layout. By browsing the super-high-definition

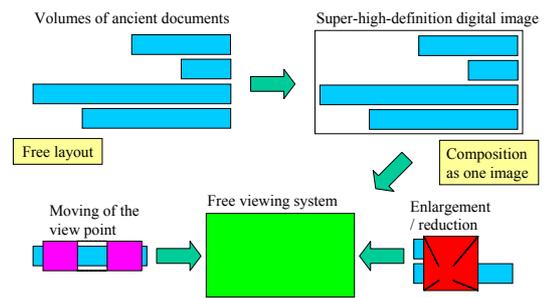


Figure 4: Proposed interface using super-high-definition free viewing system image using the free-viewing system, free, continuous viewing of any part of any document is possible. (See Figure 4.) Difficult query operations are not required.

5. Exhibition of digitalized ancient documents: Shôsô-in Monjo

Shôsô-in Monjo (正倉院文書) is one of the oldest set of Japanese documents in Nara era. The original is owned by the Kunaichô (宮内庁; Imperial Household Agency). The Shoso-in Monjo has 667 volumes in total and consists of 6 groups:

- Seishû (正集): 45 vols.
- Zokushû (続修): 50 vols.
- Zokushû-kôshû (続修後集): 43 vols.
- Zokushû-besshû (続修別集): 50 vols.
- Zokuzokushû (続々修): 440 vols.
- Zinkai (塵芥): 39 vols.

The project for the precise reproduction of the Shôsô-in Monjo has been conducted by the National Museum of Japanese History since 1982 in order to provide information to historical researchers on precious documents and record the current condition of documents. Digitization of about 250 volumes has been completed so far. The project will be completed over 50 years from now.

Three super-high-definition digital images of the Shôsô-in Monjo were made using the proposed method. One is an image of volumes of the Seishû group, another is an image of volumes of the Zokushû group, and another is an image of Shôzeichô (正税帳),

a portion of the Seishû group. The size of each document is about 80,000 × 30,000 pixels. These three documents were made available to visitors of the National Museum of Japanese History in a special exhibit called “Ancient Japanese writing symbols” (Mar 19~Jun 9, 2002), which demonstrated the usefulness of such materials.

Figure 5 shows Shôsô-in Monjo as displayed by the super-high-definition free viewing system. Figure 5(a) is the entire Seishû group image and 5(b) is an enlargement of that image. Figure 5(b) represents a part of a Keichô (計帳), a collection of records on the status of numerous families submitted to authorities by each household. Figure 5(c) is the entire Zokusyû group image and 5(b) is an enlargement of that image. Figure 5(d) represents a document written by the historical figure Dôkyô (道鏡), a monk of the mid-8th century. Each volume of these images is arranged as if it were displayed in a large room. The user navigates the virtual room and chooses the document that he/she wants to read. He/she can recognize the relationship between the current document and the previous or next document in the document group.

Figure 5(e) is the entire “Tenshō 10-nen Suō-no-kuni Shōzeichō (天正十年周防国正税帳)”, which is an extract from the Seishû group. This image represents both the front side (below) and the back side (above) of the document. The descriptions on each side are quite different. The front side of the paper was initially used as a Shōzeichō (an official report of accounts of a province) by the government in ancient Japan. After this document became obsolete, the paper was reused as a checking sheet of working on reproductions of sutras at the national sutra-transcribing center. Figure 5(f) is an

enlarged image of 5(e). The relationship between the two sides is represented clearly. The meaningful arrangement of documents is quite useful for gaining an understanding of them.

6. Conclusion

This paper describes the application of super-high-definition free viewing technology for browsing ancient documents. The result demonstrates that the new method we propose is useful for providing access to ancient documents.

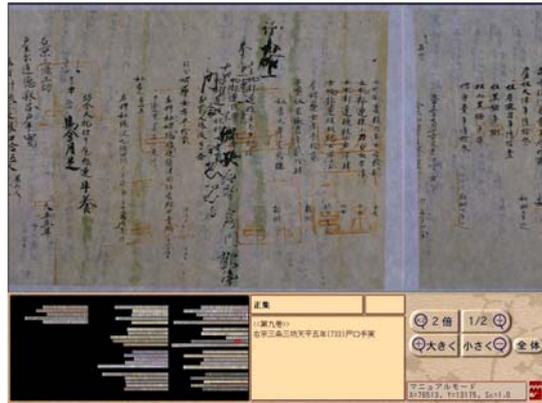
Several technologies have been developed for using ancient documents efficiently on a computer. For example, there are techniques to assist in the deciphering of documents [3], structure ancient documents in order to provide syntactic information and deduce typesetting information for clear printing. Our method is applicable with these technologies and makes them more usefully.

References

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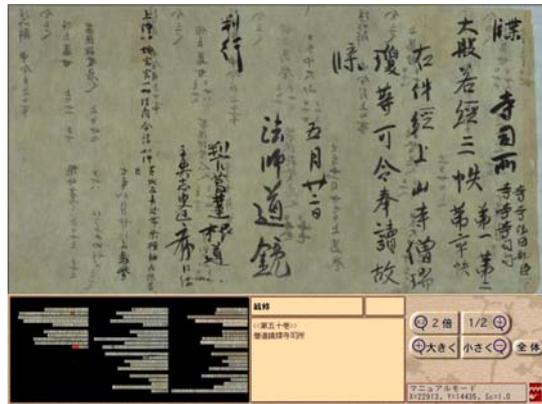
(a) Seishû (entire document)



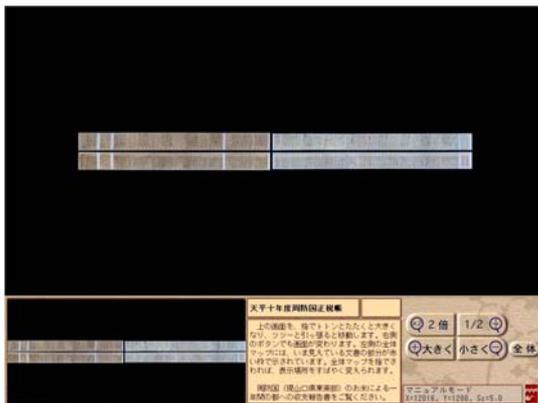
(b) Seishû (zoom in)



(c) Zokushû (entire document)



(d) Zokushû (zoom in)



(e) Shôzeichô (entire document)



(f) Shôzeichô (zoom in)

Figure 5: Super-high-definition digital images of Shôsô-in Monjo

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