WebGIS-based Application

for Compering *Rakuchū rakugai-zu* Folding Screens

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Abstract

Rakuchū rakugai-zu is a folding screen that depicts a birds-eye view of scenes and landscapes in and outside of Kyoto city during the Middle Ages (Muromachi period; 16th century) and Pre-Modern Era (Edo period; 18th century) of Japan. These folding screens show actual buildings and structures found in Kyoto in those times, as well as vividly depicting the life of the people back then. The purpose of this paper is to create the WebGIS-based application more than browsing a folding screen; it allows the comparison of multiple folding screens, as well as between the folding screens and old picture maps, current maps and satellite images that corresponding to the folding screens.

1. Introduction

Rakuchū rakugai-zu folding screens depict a birds-eye view of scenes and landscapes in and outside of Kyoto city during the Middle Ages and Pre-Modern Era of Japan. These folding screens show actual buildings and structures found in Kyoto in those times, as well as vividly depicting the life of the people back then.

As a result, the study of *Rakuchū rakugai-zu* has developed into an interdisciplinary field where researchers from different fields can participate and work together. The linking, fusing and unifying of different academic fields can open up anticipated possibilities for the creation of new knowledge (Kuroda 2010). In particular, the development in digital measurement technology in recent years has made it possible to take digital and infrared images at higher resolutions, while the acceleration of Internet connection now allows anyone to freely view these digital images wherever they can access the Internet.

This paper aims to build a WebGIS-based application that will allow viewing and comparing the images of *Rakuchū rakugai-zu* folding screens at high resolutions. First, in regard to the technical problem, it is ideal to have an application that allows the comparison of

illustrated landscapes by overlapping various folding screens as maps using a geographic information system (GIS). The Leaflet (a JavaScript library for interactive maps) is used to build a system for displaying *Rakuchū rakugai-zu* folding screens, old picture maps, and up-to-date maps in several windows at the same time. In the case of a Web system using GIS, the subject locations must have coordinates that correspond to the actual longitude and latitude shown on an actual map. Geographical references can be placed over distorted maps such as old maps to ensure they match actual maps, but this is not realistic when it comes to illustrated spaces such as *Rakuchū rakugai-zu* folding screens that do not correspond to actual geographic spaces.

2. Selected *Rakuchū rakugai-zu* folding screens

For this project, we created a list of all *Rakuchū rakugai-zu* folding screens based on the list made by Ōtsuka (2015).

Base on this we then made a comprehensive list of about 170 *Rakuchū rakugai-zu* folding screens that have been confirmed to exist in and outside of Japan (Figure 1). Each owner of *Rakuchū rakugai-zu* folding screens is requested to make or provide digital images of the folding screens at high resolutions. There are three main ways to obtain these images. The first is for the Art Research Center (ARC), Ritsumeikan University, to make its own high-resolution digital images of folding screen in the ARC's own collection or in the collection of other institutions and organization. The second is to add links to websites that have already made images of folding screens available for public viewing. The third is to request permission from owners of digital images already taken at relatively high resolutions but are not provided for general access for the use of their images. At the moment we have high-resolution digital images of around nine *Rakuchū rakugai-zu* folding screens as shown in Table 1.

Figure 1. Portal site of *Rakuchū rakugai-zu* folding screens

Table 1. Contents in the system

Picture Maps				
Contents	Years or Eras	Holders	Scale or Form	Artists
Kunai-cho *Rakuchū-ezu* （宮内庁洛中絵図）	1637	the Imperial Household Agency	1:1,500	Nakai Family
Kyoto-dai *Rakuchū-ezu* （京大洛中絵図）	1642	Kyoto University	1:1,368	Nakai Family
Folding Screens				
Contents	Years or Eras	Holders	Scale or Form	Artists
Uesugi Screens （上杉本）	Muromachi (1336-1573)	Yonezawa city Uesugi Museum	One pair of six-folded screens	Kano Eitoku
Rekihaku Ko Screens （歴博甲本）	Muromachi (1336-1573)	National Museum of Japanese History	One pair of six-folded screens	Kano Motonobu
Rekihaku Otsu Screens （歴博乙本）	Momoyama (1573-1603)	National Museum of Japanese History	One pair of six-folded screens	Kano Shoei
Kyohaku Screens （京博本）	Momoyama (1573-1603)	Kyoto National Museum	One pair of six-folded screens	Kano Mitsunobu
Funaki Screens （舟木本）	Early Edo (17C)	Tokyo National Museum	One pair of six-folded screens	Iwasa Matabei
Shokoji Screens （勝興寺本）	Early Edo (17C)	Takaoka City Museum	One pair of six-folded screens	unknown
Sakaishi Screens （堺市博物館本）	Early Edo (17C)	Sakai City Musum	One pair of six-folded screens	unknown
Butsudai Screens （佛大本）	Early Edo (17C)	Bukkyo University	One pair of six-folded screens	unknown
Seigan-ji monzen-zu Screen （誓願寺門前図屏風）	Early Edo (17C)	the Museum of Kyoto	Two-folded screens	Iwasa Matabei (or his workshop)

3. A system for viewing and comparing *Rakuchū rakugai-zu* folding screens

Under the current project we built an application for viewing and comparing *Rakuchū rakugai-zu* folding screens using Leaflet allows the displaying of multiple contents in four windows. As shown in Table 1, we use nine *Rakuchū rakugai-zu* folding screens and two old picture maps: the "Imperial Household Agency *Rakuchū-ezu*" and "Kyoto University *Rakuchū-ezu*" which were drawn around early seventeen century.

The WebGIS-based application consists of three parts; *Rakuchū-ezu* (picture maps) and current maps (Topographic maps provided by Geospatial Information Authority of Japan) (Figure 2).

This WebGIS-based application implements the following functions (Figure 3); 1) Selecting *Rakuchū rakugai-zu* folding screens and maps from Table1. Each of holding screens and maps have many red circle markers which suggest the specific locations (land marks such as temples and shrines) on them; 2) Selecting the specific locations as red circle markers. When you crick one marker, the specific landmark is zoomed up on the four windows at the same time; 3) Synchronization of screen scaling and movement. We can do zoom-in, zoom-out and move the screen freely as well as can change the folding screens and maps any time. And 4) Description of landmarks. We provide a title and its description of the specific location on the folding screens.
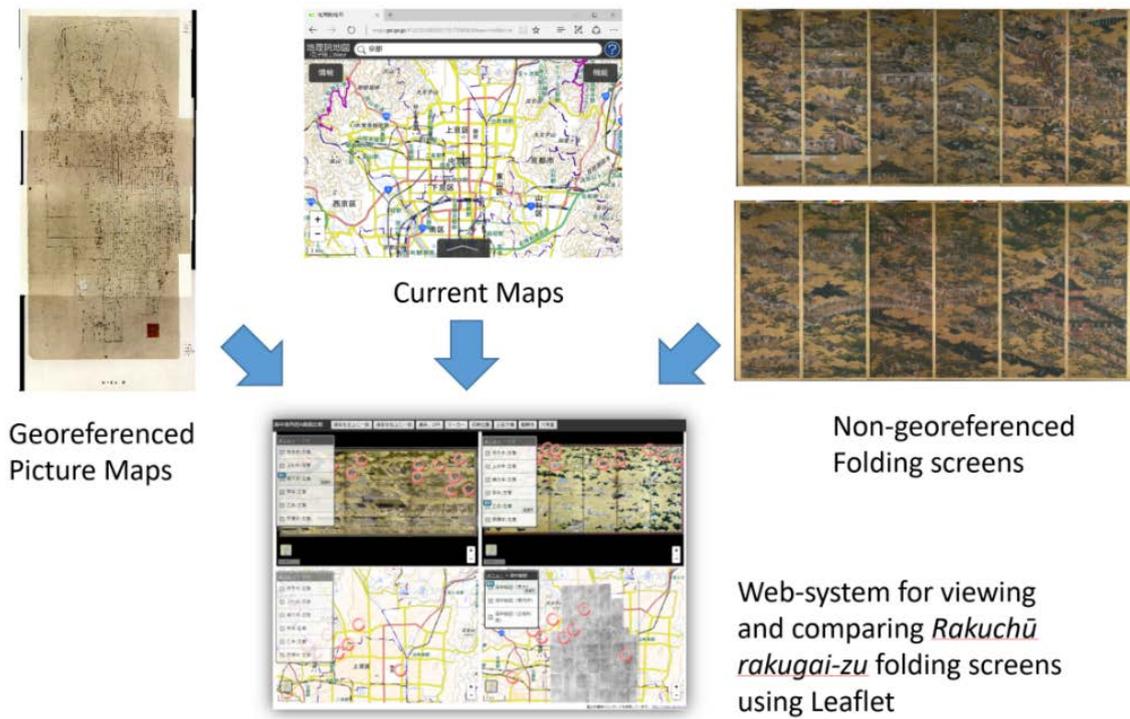
Figure 2. Conceptual schema of the WebGIS-based application

Figure 3. Functions of the WebGIS-based application

The WebGIS-based application allows to compare the landmarks drawn on the different *Rakuchū rakugai-zu* folding screens interactively.

4. Comparison of modern maps, old picture maps and *Rakuchū rakugai-zu* folding screens

1) Comparison *Rakuchū rakugai-zu* folding screens with "*Kyoto University Rakuchū-ezu*" and a modern map

Many *Rakuchū rakugai-zu* folding screens are from the period between late medieval and early modern periods. We have two *Rakuchū-ezu* (picture maps) from the Nakai Family (whose ancestor was a purveying carpenter foreman from Kyoto to the Edo shogunate) that are accurate. "Funaki Screens" (upper-left) and "Seigan-ji monzen-zu Screens" (upper-right) are displayed over a modern map (lower-left) and a picture map (lower-right), with three red pins showing the locations of *Sanjō Ōhashi* bridge, *Sanjō Kobashi* bridge, and *Seigan-ji* temple (Figure 2). Zooming in or out and shifting of the modern map above and the "*Kyoto University Rakuchū-ezu*" below can be synchronized by clicking the SYNCH ON/OFF button. In addition, clicking on the red pins marking objects on the maps or buttons of objects provided at top-left allows the user to zoom in on the clicked object.

Figure 4: Comparing *Rakuchū rakugai-zu* folding screens with a modern map and "*Kyoto University Rakuchū-ezu*"

2) Comparison between four *Rakuchū rakugai-zu* folding screens

Let us next take a look at the viewing system comparing four sets of *Rakuchū rakugai-zu* folding screens. In this case we compare the "Funaki Screens" (upper-left), "Kyoto Museum Screens" (upper-right), "Shoko-ji Screens" (lower-left) and "Bukkyo University Screens" (lower-right). Each of them has one red marker, which shows Nijyo Castle (Figure 5).

Nijo Castle was built in 1603 as the Kyoto residence of Tokugawa Ieyasu, the first shogun of the Edo Period (1603-1867). In Edo period, *Rakuchū rakugai-zu* folding screens divide the capital east-to contrast Nijo Castle on the west side, representing the Tokugawa Shougunate (the last feudal Japanese military goverment), with the Great Buddha Hall of the Hokoji temple on the east side, representing the Toyotomi family, who held power before the Tokugawa.

At that time Nijo Castle had been a remarkable landmark which all people can view in Kyoto. However The central keep was struck by lightning and burned to the ground in 1750.

Using the Web-based application system, we can easily view overall of several *Rakuchū rakugai-zu* folding screens and compare them in detail.

Above: "Funaki Screens" (left panel) and "Funaki Screens" (right panel); below: "Shoko-ji Screens" (left panel) and "Bukkyou University Screens" (right panel)

Figure 5. Comparison between *Rakuchū rakugai-zu* folding screens

6. Web viewing system development

There have been several image viewing systems for the viewing of individual sets of *Rakuchū rakugai-zu* folding screens, but our system not only allows the zooming in and out of maps and *Rakuchū*

rakugai-zu folding screens, but also facilitates the comparing of 2D modern maps or old picture maps from the same era of the folding screens with *Rakuchū rakugai-zu* folding screens that have a 3D depiction of Kyoto. The system goes further to allow the comparison between different sets of *Rakuchū rakugai-zu* folding screens.

As a result, new insights from researchers of different fields can be anticipated. Not only that, this system can also be used at places like museums and art museums. Using this system at exhibitions in conjunction with the showing of actual *Rakuchū rakugai-zu* folding screens can promote better understanding of the folding screens being shown and even improve the quality of the exhibition space.

We plan to include more *Rakuchū rakugai-zu* folding screens, while adding various functions such as memo and multi-window switching, as well as improving the interface to provide better usability of the system.

7. Conclusions

The aim of this paper is to build a user friendly WebGIS-based application to allow the displaying landmarks depicted in a variety of *Rakuchū rakugai-zu* folding screens for comparing with old picture maps and modern maps including satellite images.

The development in digital archive technology in recent years has made it possible to take digital images at higher resolutions, while the acceleration of Internet connection now allows anyone to freely view these digital images wherever they can access the Internet. In the case of humanities research whose subject is often delicate historical documents which, from the viewpoint of document preservation, are sometimes only available to certain people. However, developments in information technology can remedy this problem. The transformation in humanities research where researchers from various field can work together by sharing such digital contents, known as Digital Humanities, has drawn much attention in recent years (Kawashima et al. 2009; Yano 2015). This is expected to further develop as technologies advance.

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