NARS - Nabunken Aerial Photograph Retrieval System – A Way to the GIS

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Abstract

The Nara National Cultural Properties Research Institute (Japanese abbreviation: Nabunken) houses an important historic collection of aerial photographs. The collection originates after World War II when private companies began to take aerial photographs for mapping or exploratory purposes. Unfortunately, private companies do not have the capacity to preserve this data, so Nabunken archives these records for the whole of Japan. This collection does not include aerial photos taken by the government for national mapping. The total number of these photos is about 1,800,000 and Nabunken maintains a database of the entire archive. The original film is 10 inch format and difficult to treat. Microfilm is made from the original. About 900 thousand pictures have been processed to date. Whilst the data entry system provides coordinate data for the map image, the retrieval system was separated from the entry system. However, a new system is now being created incorporating the digital map image, the digitised image of each aerial photo and data entry and data retrieval. The system also acts as an intranet and as data entry and digitisation proceeds the data will become available for use within true GIS analyses.

Key words: Nabunken, aerial photo, microfilm, database, retrieval system, digital map, high resolution

1. The origin of the collection

Nabunken (The Nara National Cultural Properties Research Institute) is a national organization for the study of archaeology in Japan. It was founded in 1952 at Nara, the ancient Japanese capital city of the 8th century. Nabunken operates as part of the Agency for Cultural Affairs under the Ministry of Education.

Nabunken possesses an important collection of aerial photographs. After World War II private companies began to take aerial photographs for cartographic purposes. However, these private companies did not have a enough space to preserve this data and it was intended that the photographic archive should be disposed of in c. 1970.

Nabunken believed that that these aerial photos were cultural property and that their loss should be prevented. The photographs have considerable historic value. They are material evidence for past land use and provide evidence for a variety of sites and monuments. In Japan there are very few ancient structures made of stone or brick, and evidence for past settlement is rare. Despite this, through the aerial photographic record we are able to distinguish, for example, ancient tombs from 3rd to 7th century AD and the reorganisation of agricultural land from the 7th century to the medieval periods. This is possible because these aerial photos were taken before the development and the demolition of the historical landscape.

Nabunken therefore decided to preserve these primary records for the whole of Japan. The total number of air photos is about 1,800,000 and comprises c. 25,000 rolls of film. Nabunken provides an air-conditioned storage facility specifically for these films. It should be emphasised that this collection does not include aerial photos taken by the government office for national mapping (the Geographical Survey Institute).

2. The history of the database

NARS Generation 0 (before 1981)

Prior to his retirement in 1998, Mr. Taisaku ITO developed a computer aided system - NARS (Nara national cultural properties research institute Aerial photo Retrieval System). Within this system, he arranged the original documentation and, in-between 1973 to 1977, placed a location mark for each picture on a paper map. This was not a convenient system. Sometimes there were too many pictures on the same map. Consequently, around 1979, Mr. Taisaku ITO tried to introduce a database system. Unfortunately, there were so many errors in the original documentation that the photos themselves had to be re-checked (figure 1).

NARS Generation 1 (figure 2)

As the original photographic film is 23 cm square negative roll film format it is difficult to use. To provide imagery that is accessible this is transferred to positive 16 mm microfilm from which it is possible to check individual aerial photographs. One roll of microfilm includes approximately 4,500 pictures. About 900 thousands pictures have been processed to date. Some original films had attached data about the picture, but about a half of them had no original documentation, and the image itself is the only data source. We check each microfilm to determine the place where the photograph was taken. Detailed features, such as the direction of shadow, lines of railways or roads, vegetation etc. assist in this task. This process is difficult and requires expert involvement.

The text database of the aerial photo has the following fields for each picture:

- orientation map ID,
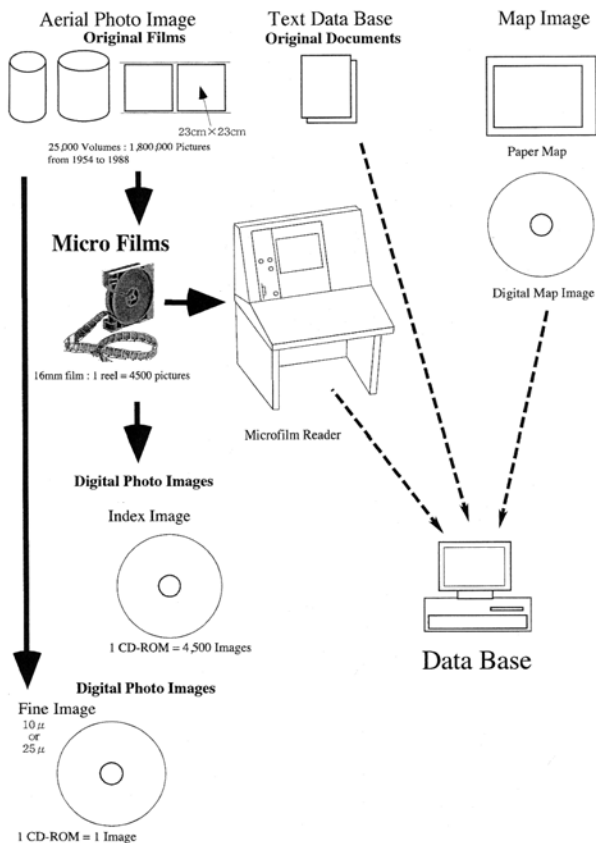- title,
- photograph date,
- photograph scale,

Figure 1: Data entry of the database.

- photographic company,
- type of photosensitive materials,
- microfilm magazine number,
- original roll number,
- number of points in the photographic course,
- photograph point list,
- photograph point number,
- longitude of the point,
- latitude of the point.

The data entry system includes coordinate data from the map. For this a paper map was digitised and the coordinate taken from a PC. The data retrieval system was originally separated from the data entry system. The host computer, an IBM mainframe, was situated at the National Museum of Ethnology at Osaka and was connected to Nabunken by an exclusive line and modems. Aerial photographic images were checked via a microfilm reader.

NARS Generation 2 (figure 3)

Each aerial photographic image was checked to determine location. The data entry system was on a stand alone PC and the map image was stored on optical disks. 1291 tiles of the national map drawn at a scale of 1 to 50,000 for the whole of Japan were digitised as black and white images and stored on 3 optical disks. Map images were connected to each other and a seamless map image for 1/3 of Japan was provided on a single optical disk. Positional data from each map was selected via a mouse on the display: the software then calculated the longitude and the lati-
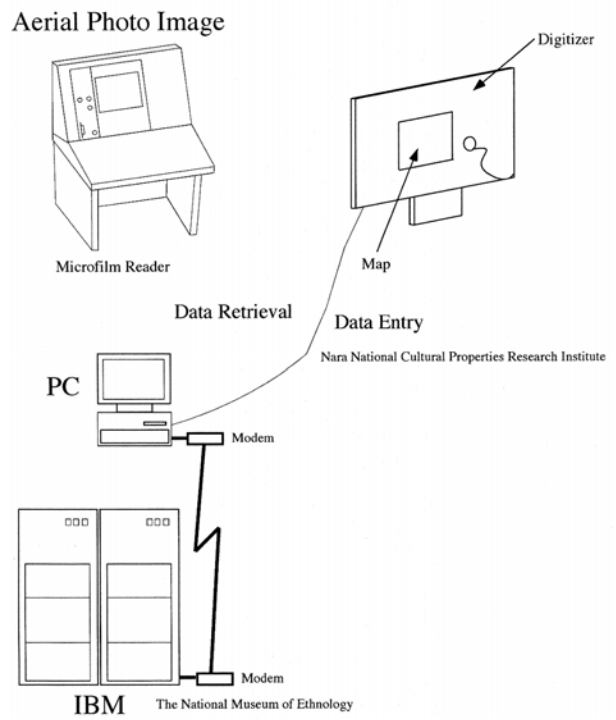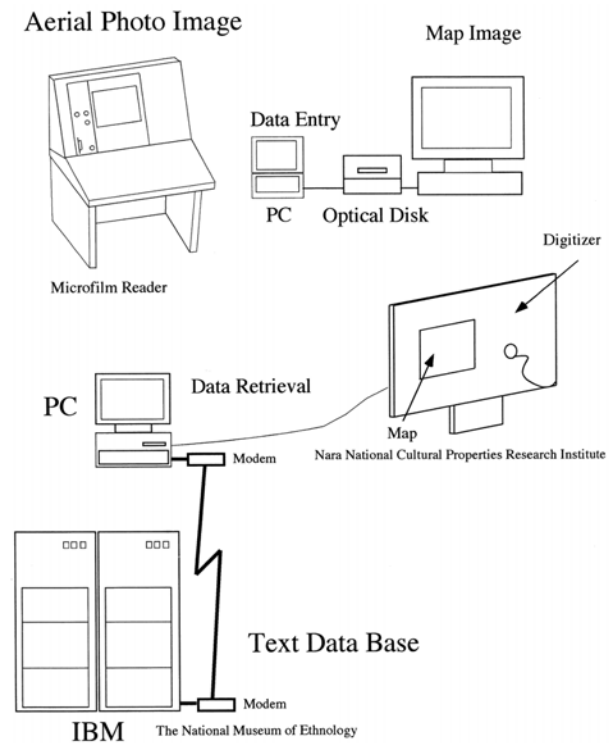

Figure 2: NARS Generation 1.

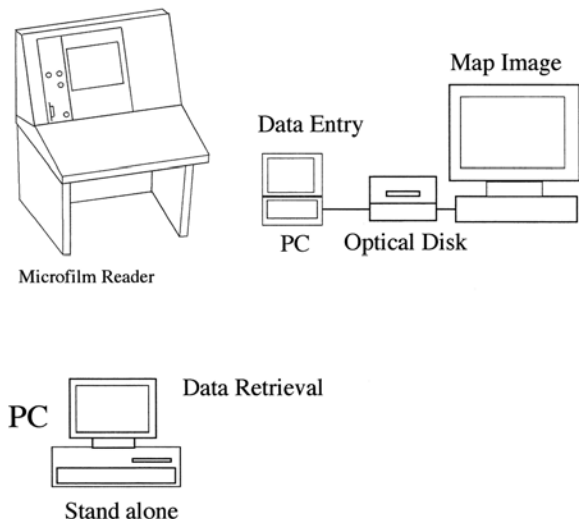
Figure 3: NARS Generation 2.

tude of the point and stored them in the PC which then sent the data to the host computer.

For data retrieval, we used a digitiser to select coordinate data object point in the same manner as for NARS Generation 1. The text database was stored on the host computer was situated at the National Museum of Ethnology.

NARS Generation 3 (figure 4)

The microfilm reader was still used as the primary tool to view aerial photographic data. Data entry was achieved through a stand

Figure 4: NARS Generation 3.

alone PC with map images on the display. There was no real change here from NARS Generation 2. Data retrieval system was at this time achieved via another stand-alone PC with a text database of about 500,000 records stored on a local hard disk. The mainframe was abandoned, as it was not quick enough. After NARS Generation 3 all the components of NARS were stored and maintained within Nabunken itself. Unfortunately, there were problems with this new system. There was still no on-line connection between the data entry system and the data retrieval system. The data retrieval software was also designed for more general use and was not truly convenient for our purposes.

NARS Generation 4 (figure 5) in 2000

Today we use NARS Generation 4. To check and confirm aerial photo images, we always use the microfilm reader. This part of the system still uses analogue data.

We have a database server within the Institute which provides the topographical map image, based on a national map scale: at 1:25,000 scale the system uses 4356 maps, and also stores the text data of each aerial photograph. This system is also intranet compatible. The user accesses the system via a PC for data entry and also for data retrieval. The server computer is a PC running Windows NT. The data retrieval software is Cach (Inter Systems), and the application software has been specially written for NARS. Using this system we can at last locate photographs quickly and easily from any PC in the Institute and at any time. NARS Generation 4 allows us to make efficient use of our aerial photographic collection for the first time.

NARS Generation 5 (figure 6)

Recently we have begun to digitise the aerial photo collection for use as index images within the database. Images from microfilm are stored as index images requiring c. 200 kBytes in JPEG format. To date some 120,000 photos have been digitised in this manner. The NARS system will be totally reconstructed using these images. Ultimately, three types of data; the aerial photograph, the
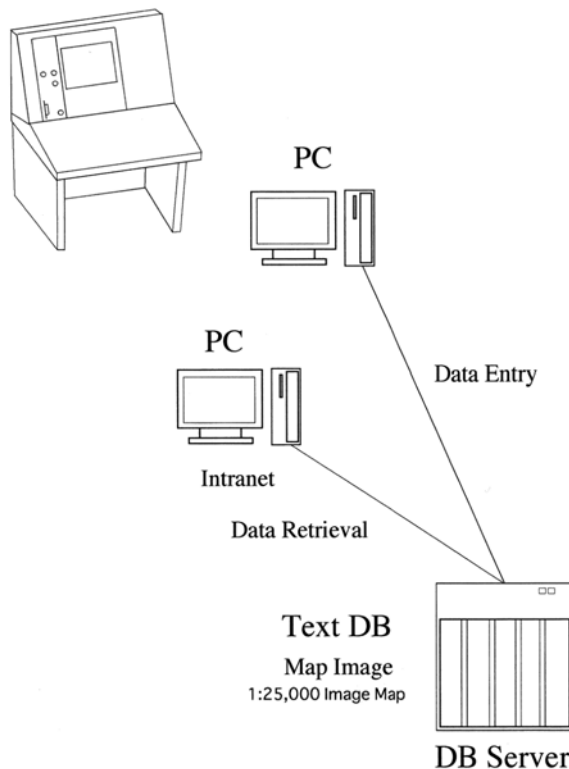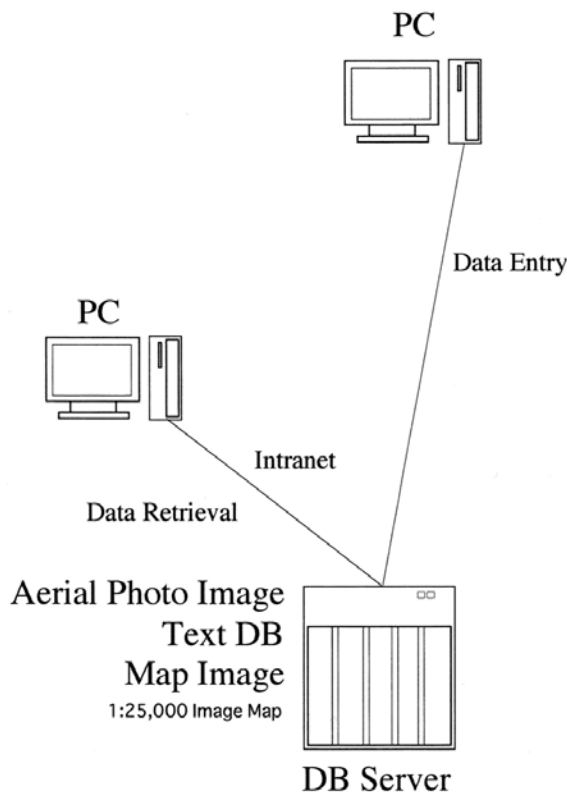

Figure 5: NARS Generation 4.

Figure 6: NARS Generation 5.

map and the text data will be incorporated within the computer system within the next couple of years. Storage in microfilm is expensive so an all-in-one PC system is a necessity.
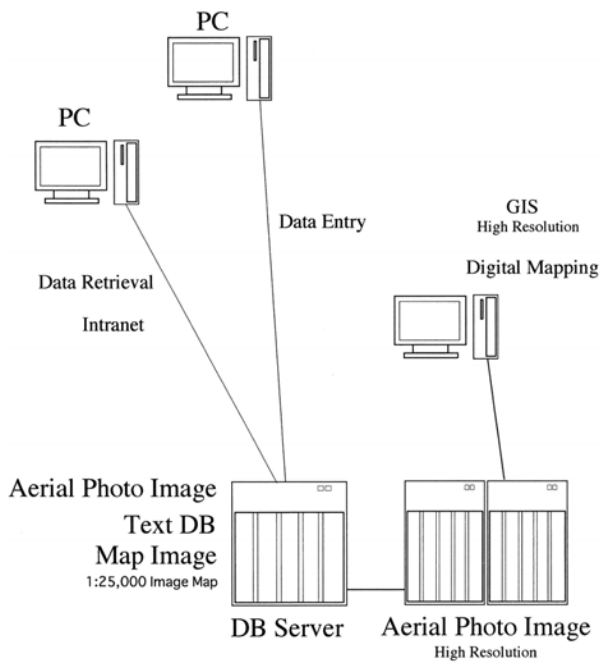
Figure 7: NARS Generation X.

NARS Generation X (figure 7)

Within our collection are photographs which cover the greater past of the Nara basin covering 13 km from east to west and 30 km from north to south. Within this area is the ancient capital as well as a series of palace sites, many imperial and powerful clans' tombs and also prehistoric sites. This series of photographs, numbering c. 2,000 in total, was taken in 1962 just before the urbanization of the area. Recently we have begun to digitise and make an orthophoto of the series. To date we have digitised the original film. Scanning resolution is about 25 microns. The scale of the original photographs is 1 to 6,000 and the resolution is 15 cm. Soon we will be able to use the whole of this photographic series to study this important historical region. When stored digitally, the entire landscape will be available for study within a true GIS-based analysis.