SPATIOTEMPORAL MAPPING OF CULTURAL HERITAGE IN HANOI CITY

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ABSTRACT

Informatics will provide area studies with new approaches and knowledge, so researchers need to lead the way to further development of informatics through its application to area studies. In order to amalgamate both area studies and informatics, Center for Southeast Asian Studies at Kyoto University are working on creating and building up a new discipline "Area Informatics", and has started new project "Development of Area Informatics" as 5 years project (Shibayama, 2005). One of core studies in the project is "Thang Long - Hanoi Project on preservation of historical heritage and 1000th anniversary celebration" (Shibayama, 2005). In this research, a study on historical transfiguration for urban development in Hanoi of Vietnam for 1000 years is to be carried out, so that the digital preservation and restoration based on the studies can be opened to the public via the Internet. As well as the historical studies, it aims at the digital archives for preserving the Thang Long - Hanoi vestige site and the historical heritage. In order to make progress in the historical analyses, building thematic map in 4D space with collecting the feature data which includes GPS position has been carried out.

This paper provides an outline and details of case study on preservation of the Thang Long - Hanoi archeological site and historical heritage.

1. DATA COLLECTION FOR HANOI

To collect various kinds of fundamental data for the research is extremely important to push forward the research of history at Hanoi Project and the city transfiguration. Table 1 shows the collected data which were created from collaboration with Hanoi University of Mining and Geology, VAST and Vietnam National University Hanoi in 2005. It consists of the items of historical and cultural sites (150 sites) and 3D animation for 2 points. To comprehend a process of city transfiguration, the collected data have a sort order, under French rule, before it or before 1945 as shown in Table 2. Those are mainly composed of historical map, topographic map, vector image, satellite image, aerial photo and cadastral map. Also, Prof. Sakurai's group carried out a field survey in Hanoi to correct the inscription data (over 60 points) in August, 2006. And Dr. Ota carried out a survey to correct a Hanoi map in French library.

Table 1. Historical GIS Data Collection for Hanoi (2005).

A. Historical and Cultural Sites: 150 Sites	
Items	(1) SITE ID. (2) SITE Name (3) Place Name and Local Name (4) Latitude (5) Longitude (6) Topographic Elevation (7) Historical Time period (8) Description of Spot (9) Historical and Architectural Significance (10) Reference documents list (11) Still Picture (12) Motion picture
B. 3D Animation for 2 Points	
Items	(1) SITE ID. (2) SITE Name (3) Place Name and Local Name (4) Latitude (5) Longitude (6) Topographic Elevation (7) Historical Time period (8) Description of Spot (9) Historical and Architectural Significance (10) Reference documents list (11) Computer Animation

Table 2. Resources for Historical Mapping and Overlaying.

A. Historical Maps
(1) Years: 1873, 1886, 1898, 1915, 1925, 1936, 1942, 1968, 1980, 2000 (2) Scanned and Picture Maps(Raster Image)
B. Topographic Maps
(1) 1:5000 Topographic Map (2) Digitalized Numerical Maps (Vector Data)
C. Satellite Images:
(1) IKONOS 1m Resolution, Central Hanoi (2) QuickBird 0.6m Resolution, Central Hanoi
D. Aerial Photos: Williams Hunt Collection
E. Land Owner and Cartographic Data : 168 Villages

2. CREATING OF HANOI DIGITAL MAP

It is necessary to generate a digital vector map as a basis for mapping of data in Chapter 1. In this project, we generated a digital map 2000 in Hanoi by QuickBird basically as follows;

1) Vector format: ESRI Shape files with Coordinates
2) Coordinate system: Datum: Ellipsoid WGS 84, Datum WGS 84, Projection: UTM zone 48 N
3) Scale: 1:2000, (Source: QuickBird image resolution: 0.6m, format: geotif RGB fusion)
4) Map layers: Roads, Road centerline, Building blocks, Landmarks, Lakes and Ponds, Rivers and Water channels, River and Water channel centerlines

The result of the generated digital map is shown in Figure1. Back image is shown by QuickBird (2005), and front vector data represent road, river and water channel in Figure 1.

Figure 1. Digital Map 2000 in Hanoi.

	A	B	C	D	G	H	I	J	K	L	M	N	O	P	Q	R
1	ID	Site No.	Book No.	List	Site Name (Vietnamese)		沿革	祭祀	記述物	記述	創建	廃場	改修1	改修2	改修3	遺物
117	2085	0042	2_16	66	Tượng Đài Vua Lê Thá		1896年造。以前には黎王廟があった。				1896					
118	2086	0043	2~33	85	Đền Ngọc Sơn		伝、陳朝期抗元戦の犠生烈士を祀る。のち荒廃。永佑年間(1735-39)、この地にcung Khánh Thuyを嗣の東方に建築。Cungは1786年西山侵攻時に破壊。1943年碑文によると、嗣は1841年慈善会により修築、ここでは、旧cung Khánh Thuyにある寺をđền Ngọc Sơnと呼んでいる。Quan đề thánh quân, Văn Xương đề quân, Lã Tế(Lã Đồng Tân)を祀る。	陳朝期抗元戦の犠生烈士、Quan đề thánh quân, Văn Xương đề quân, Lã Tế(Lã Đồng Tân)	1943年碑文		1735	1786	1841			
119	2087	0044	2~20	71	Chùa Lý Quốc Sư		以前はđềnだった。旧Thọ Xương縣Tiên Túc總のTiên Thị村とChân Cầm、Tự Thập村との境界の地。改築繰り返し、現在の建築は仏軍に破壊された後1954年重修。嗣德八年(1855)Cúc Hiên Lê đình Duyên撰碑文にこの年の大重修事跡を記す。Minh Không禪師(-1141)を祀る。1138年、李神宗により國師となり、làng Tiên Thị に封ぜられ、村民	Minh Không 禪師(~1141)	嗣德八年(1855) Cúc Hiên Lê đình Duyên撰碑文	1855	1138		1954			十七八世紀の像

Figure 2. Example of historic places or archeological site data (150 points).

Table 3. Historic places and archeological sites distribution (Total:132).

Year	< 1000	< 1200	< 1400	< 1600	< 1800	< 2000
Number	9	18	7	18	35	45

3. MAPPING OF HISTORICAL HERITAGE AND FRENCH ARCHITECTURE

The result compiled the historic places or archeological sites (i.e. temple, pagoda etc.) are shown in Figure 2. In order to make spatiotemporal expression possible, we have to expressly set up the factors of representing time axis in Figure 2. Therefore we derived the established age from historical description, and shows in the *M* field to make it define the established age. The data of 132 cases of historic places and archeological sites distribution separated by age are shown in Table 3 except for deficiency data. We devise ways of displaying French architecture by Web browser as shown in Figure 3. Note that this paper does not cover the details of such data. Figure 4 is a displayed example overlaid QuickBird image and digital map 2000. In Figure4, TimeMap is introduced as the browsing implementation of spatiotemporal data. TimeMap allows us to search and display data by specifying time factor with Time Scale Bar under the map displayed screen. Time Scale Bar enables to search and display *n*-years data ($a \leqq n \leqq b$) by specifying the starting year *a* and ending year *b* of searching or displaying respectively. The starting year *a* of searching or displaying during *n*-years can be slid and specified in a range of *e* ($s + n$).

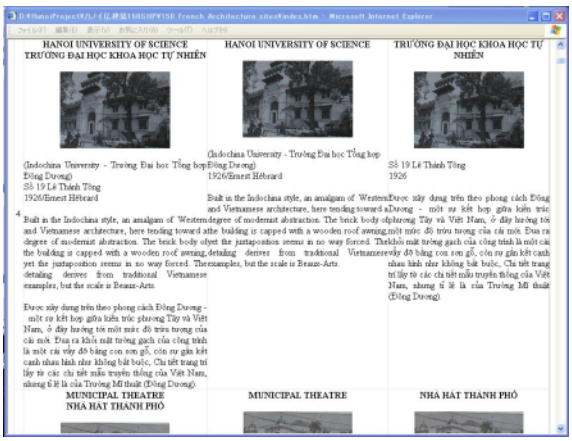


Figure 3. Displaying French architecture.

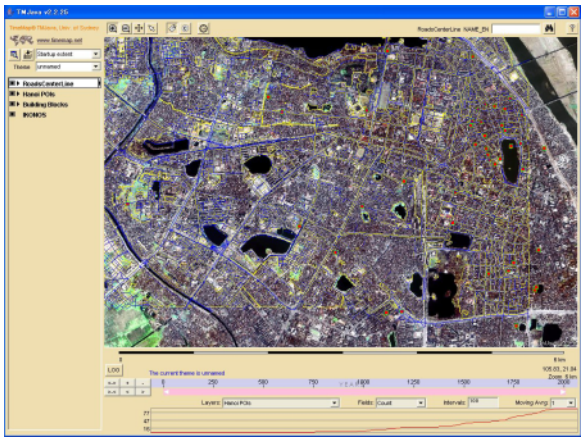


Figure 4. Example of overlaid QuickBird image of digital map 2000 using TimeMap.

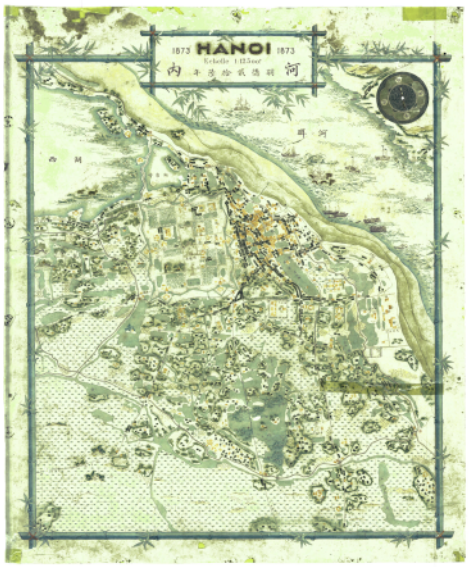


Figure 5. Village Map in Hanoi 1973.

Figure 6. Ancient villages Map.

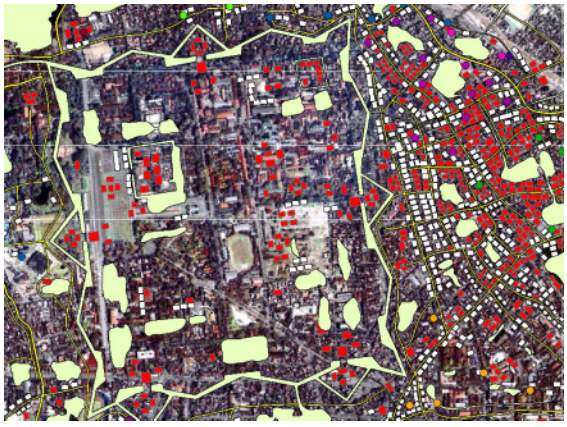
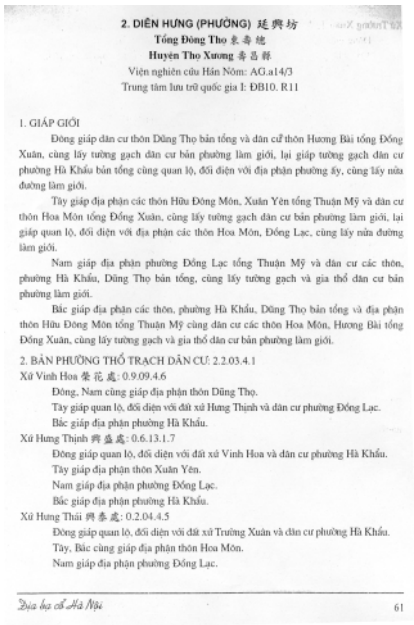


Figure 7. Result of overlaid vector digital map 1873 on IKONOS satellite image.



2. DIÊN HƯNG (PHƯỜNG) 延興坊
Tổng Đông Thọ 東壽總
Huyện Thọ Xương 壽昌縣
Viện nghiên cứu Hán Nôm: AG.a14/3
Trung tâm lưu trữ quốc gia I: ĐB10. R11

1. GIÁP GIỚI

Đông giáp dân cư thôn Dũng Thọ bản tổng và dân cư thôn Hương Bài tổng Đồng Xuân, cùng lấy tường gạch dân cư bản phường làm giới, lại giáp tường gạch dân cư phường Hà Khẩu bản tổng cùng quan lộ, đối diện với địa phận phường ấy, cùng lấy nửa đường làm giới.

Tây giáp địa phận các thôn Hữu Đông Môn, Xuân Yên tổng Thuận Mỹ và dân cư thôn Hoa Môn tổng Đồng Xuân, cùng lấy tường gạch dân cư bản phường làm giới, lại giáp quan lộ, đối diện với địa phận các thôn Hoa Môn, Đồng Lạc, cùng lấy nửa đường làm giới.

Nam giáp địa phận phường Đồng Lạc tổng Thuận Mỹ và dân cư các thôn, phường Hà Khẩu, Dũng Thọ bản tổng, cùng lấy tường gạch và gia thổ dân cư bản phường làm giới.

Bắc giáp địa phận các thôn, phường Hà Khẩu, Dũng Thọ bản tổng và địa phận thôn Hữu Đông Môn tổng Thuận Mỹ cùng dân cư các thôn Hoa Môn, Hương Bài tổng Đồng Xuân, cùng lấy tường gạch và gia thổ dân cư bản phường làm giới.

2. BẢN PHƯỜNG THỔ TRẠCH DÂN CƯ: 2.2.03.4.1

Xứ Vinh Hoa 榮花處: 0.9.09.4.6

Đông, Nam cùng giáp địa phận thôn Dũng Thọ.

Tây giáp quan lộ, đối diện với đất xứ Hưng Thịnh và dân cư phường Đồng Lạc.

Bắc giáp địa phận phường Hà Khẩu.

Xứ Hưng Thịnh 興盛處: 0.6.13.1.7

Đông giáp quan lộ, đối diện với đất xứ Vinh Hoa và dân cư phường Hà Khẩu.

Tây giáp địa phận thôn Xuân Yên.

Nam giáp địa phận phường Đồng Lạc.

Bắc giáp địa phận phường Hà Khẩu.

Xứ Hưng Thái 興泰處: 0.2.04.4.5

Đông giáp quan lộ, đối diện với đất xứ Trường Xuân và dân cư phường Hà Khẩu.

Tây, Bắc cùng giáp địa phận thôn Hoa Môn.

Nam giáp địa phận phường Đồng Lạc.

Địa bạ cổ Hà Nội 61

Figure 8. The contents of register of title deeds in Hanoi.

4. MAPPING OF ANCIENT VILLAGES

About ancient villages, Prof. Phan Huy Le published the data (168 villages) of Cadastral Map in Hanoi (Phan, 2005). Based on his data, we make an attempt to research the city transfiguration with overlaying the generated digital map 2000 and satellite image. The basis of this data, picture map 1973 is shown in Figure 5. Regarding to mapping of ancient village based on Cadastral Map in Hanoi, it is shown in Figure 6. However it is difficult to gain an understanding of location in ancient villages as shown in Figure 6. Then we try to understand the village distribution in visualized way by overlaying of the satellite image and the data of ancient villages in 1873. Figure 7 is result of overlaid vector digital map 1873 on IKONOS satellite image by adjusting a location-standard to South point of Tay Lake. Consequently the distribution of ancient villages in 1873 can be compared with the present village.

	A	B	C	D	E	F	G	H	I	J
1		府(phủ)/縣(huyện)			總(tổng)/區(khu)	坊(phường)/	東(Đông)	西(Tây)	南(Nam)	北(Bắc)
27								本總勇壽(Dũng Thọ)村民居に接し、本村民居ba		
28		壽昌(Thọ Xương)縣	1	13	東壽(Đông Thọ)總	望河(Vọng Hà)村	(Cựu Lâu)村寺地、luỹ tre xanh(青竹塁?)、東安	該湖に対面、湖岸沿い(dọc theo bờ hồ)の本村	Tả Vọng湖、本總置樓(Cựu Lâu)村佛寺土、luỹ	籍田、籍神田と、東安(Đ Yên)村地分、cửa cống(
29							安忠上(Yên Trung Thượng)村公土に接し、す			
30		壽昌(Thọ Xương)縣	2	1	同春(Đồng Xuân)總	古梁(Cổ Lương)村	大川に接し、川を界とする	(Thanh Hà)村、香腩(Hương Bài)村民居に接し、又、官路に接し、対岸向こう側は本縣香義	本縣香義(Hương Nghĩa)村、香與(Hương Bài)村民居に接し、又、蘇瀝(Tô Lịch)江と官路	潔下(Nguyên Khiết Hạ)民居に接し、又、本村民、對岸の官路に接し、本村民の地・家、と、神祠・民
31							本縣香義(Hương Nghĩa)村、勇壽(Dũng Thọ)村民			
32							官路に接し、対岸は?(đối ngạn)本村民居、本村Trần			
33		壽昌(Thọ Xương)縣	2	2	同春(Đồng Xuân)總	同順(Đồng Thuận)村	大羅城趾、本總花門(Hoa Môn)村、同春(Đồng Xuân)坊地分に接し、又、cửa cống(貢口?)、官路に接し、対岸向こう側は永暉(Vĩnh Trù)村、府祠(Phủ Từ)村村地分、城趾、小路、花門	外城濠、前中(Tiền Trung)村、安富(Yên Phú)村、清河(Thanh Hà)村地分に接し、又、官路に接し、対岸は安富(Yên Phú)村地分。清河(Thanh Hà)村の石柱・陂湖、本村磚壩沿い、	本總清河(Thanh Hà)村、Hoa Môn村、安富(Yên Phú)村、府祠(Phủ Từ)村、順美(Thuận Mỹ)總東成市(Đông Thành Thị)村地分に接し、又、官路、蘇瀝江に	外城濠、本總前中(Tiền Trung)村地分に接し、又蘇瀝(Tô Lịch)江、官路に接し、対岸向こう側は安富(Yên Phú)村、永暉(Vĩnh Trù)村民居、永順(Vĩnh Thuận)縣槐街(Hoè Nhai)
34		壽昌(Thọ Xương)縣	2	3	同春(Đồng Xuân)總	同春(Đồng Xuân)坊	本總玄天(Huyền Thiên)村、義立(Nghĩa Lập)村、前中(Tiền Trung)村地分に接し、又、官路に接し、対岸	本總同順(Đồng Thuận)村、府祠(Phủ Từ)村、花中(Hoa Trung)村地分に接し、又、官路に接し、対岸	本總花中(Hoa Trung)村、永亨(Vĩnh Hanh)坊、玄天(Huyền Thiên)村地分に接し、本坊籍を	官路に接し、対岸は永順(Vĩnh Thuận)縣上(Thượng)總槐街(Hoè Nhai)坊地分。半官路を

Figure 9. Translated register of title deeds in Hanoi.

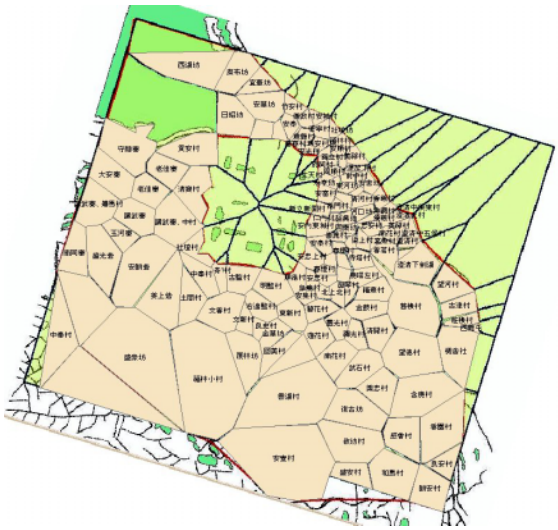


Figure 10. Voronoi Diagram of villages area of influence.

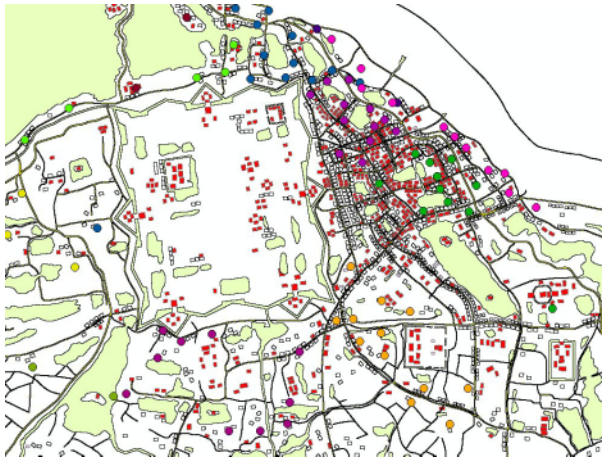


Figure 11. The ancient villages overlaid on digital map in 1973.

The contents of register of title deeds in Hanoi are shown in Figure 8. This content is translated from Vietnam into Japanese and arranged the information in table form as shown in Figure 9. The ancient villages are drown approximately in the digital map in 1873 based on Figure 8. Then the Voronoi Diagram of area of influence is drawn in Figure 10. The area of ancient villages and adjoining relation can be estimated by using the Voronoi Diagram. Furthermore, the ancient villages are overlaid on digital map in 1973 to look into the relationship between the distribution of villages in 1873 and each village. The result is shown in Figure 11. It can be recognized the fluctuation of each of village by using Voronoi Diagram. It is not possible to say that the assumption of the adjoining relation is totally accurate, so the register of title deeds in Figure 9 was used to estimate correctly the adjoining relation of ancient villages based on Voronoi Diagram. The name of ancient villages that extracted from Cadastral Map are visualized by graph algorithm. The result is shown in Figure 12. It enables to weigh the data by overlaid this result, Figure 10 and Figure 11. In addition, it can be estimated the adjoining relation or location of ancient villages and also derived the area or degree of location of villages.

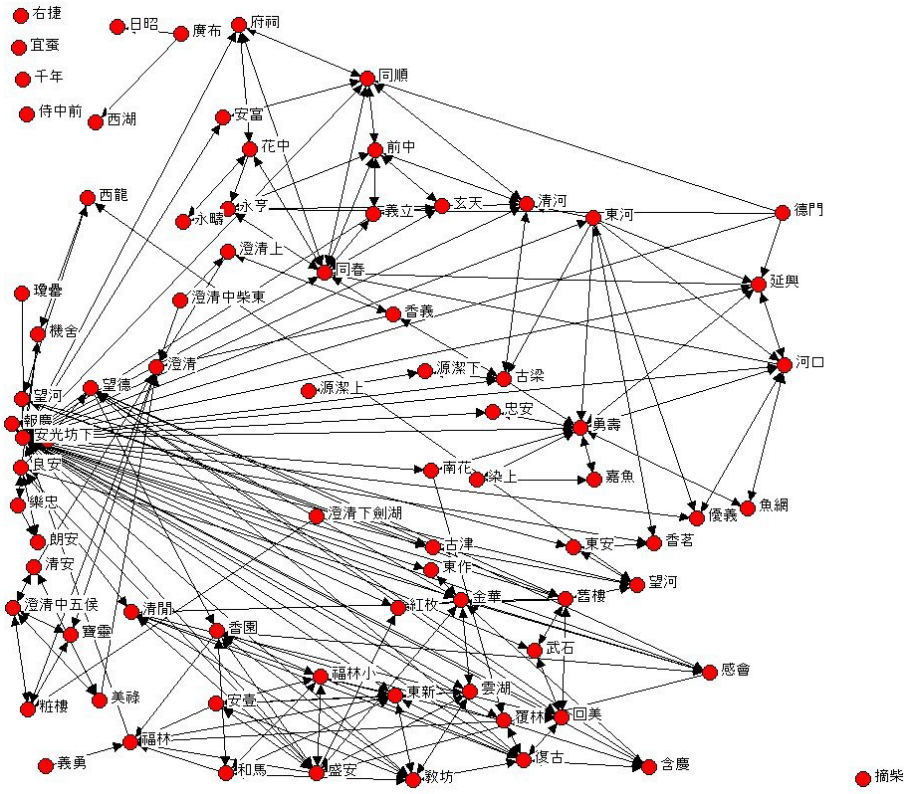


Figure 12. Example of graph for adjoining relation of ancient villages.

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TimeMap™ Project, http://ecaimaps.berkeley.edu/clearinghouse/