CROSS-CULTURAL ISSUES IN CONTEXT BASED MAPPING

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Abstract

Concepts of ubiquitous mapping involve creating maps anywhere at any time and for anybody. The context awareness of the user is the keyword, and the application system should adapt to different contexts in a variety of social infrastructures in different regions of the globe. In this paper, we discussed similarities and differences of map use and mapping contexts with the aim of wayfinding, comparing three cities; Washington D.C., Paris and Tokyo. The result shows the necessity of understanding the existence of different cultural traditions.

Key words: cross-culture, context, awareness, ubiquitous, mapping

1. Introduction

Concepts of ubiquitous mapping involve creating maps corresponding to the objective, anywhere, at any time, and for anybody. The context awareness of the user is the keyword and the application system should adapt to different contexts in a variety of social infrastructures in different regions of the globe.

In this paper, we discuss similarities and differences of map use and mapping context with the aim of wayfinding, comparing different countries namely the USA (Washington D.C.), France (Paris) and Japan (Tokyo).

For comparative studies, it is necessary to establish the point of view of comparison. To this end, four categories [(1)] including some sub-categories were set up after the preliminary survey:

1. Real World (geographical, historical and cultural environment): (i) topographical landmarks, (ii) urban fabric, (iii) transportation infrastructure, (iv) national language, (v) writing system, (vi) address system, (vii) sign system.

2. ICT Infrastructure (availability of advanced ICT): (i) wireless network system (ii) location sensor system.

3. Mapping System (mapping style using contemporary technology): (i) map type, (ii)

scale, (iii) graphic symbols, (iv) lettering, (v) routing method, (vi) apparatus.

4. User (condition of map use): (i) task, (ii) experience.

2. Comparison of three cities

After the on-site observations, similarities and differences in each category for three capital cities were summarized as follows (Table-1):

Categories	Items	Places		
		Washington (USA)	Paris (France)	Tokyo (Japan)
1. REAL WORLD				
	(i) topographical landmarks	rivers, parks	river, parks	rivers, bay, parks
	(ii) urban fabric	streets, buildings, blocks (large size), highways	streets, buildings, blocks (large size), highways	streets, buildings, blocks (small and various size), highways
	(iii) transportation infrastructure	metro, railway, bus, taxi, parking, (simple transfer)	metro, railway, bus, taxi, parking, rent a cycle, (simple transfer)	metro, railway, bus, taxi, parking, mono-rail, (complicated transfer)
	(iv) national language	English	French	Japanese
	(v) writing system	Alphabet (phonogram)	Alphabet (phonogram)	Kanji (ideogram), Hirakana (phonogram), Katakana (phonogram)
	(vi) address system	(1) quadrant zone name (NE, NW, SE, SW) (2) street name (alphabetical order in N-S, numerical order in E-W, state name in diagonal avenue) (3) house number (4 digits, first two digits for block number, last two digits for house number)	(1) zone number (20 arrondissements) (2) street name (3) house number (odd numbers on the left hand side, even on the right hand side, from upper to down stream, and according to distance away from the river Seine)	(1) district name (23 ku) (2) zone name (3) block number on two levels (4) house number (increasing clockwise around the border of a block)
	(vii) sign system	mainly lettering	words, symbols and pictograms	words, symbols and pictograms, many commercial billboards
2. ICT INFRASTRUCTURE				
	(i) wireless network	GSM (2G), CDMA (3G)	GSM (2G), CDMA (3G)	PDC (2G), CDMA (3G)
	(ii) location sensor	GPS, cell phone signal	GPS, cell phone signal	GPS, cell phone signal, RFID, QRCode
3. MAPPING SYSTEM				
	(i) map type	street map, aerial photo, satellite image	street map, aerial photo, satellite image	street map, aerial photo, satellite image
	(ii) scale	>1:10,000	>1:2,000	>1:2,500
	(iii) graphic symbols	Usually green for parks, light blue for rivers, yellow for main roads, brown for highways, red for hospitals, grey for railways	Usually green for parks, light blue for rivers, yellow for main roads, brown for highways, red for hospitals, grey for railways	Usually green for parks, light blue for rivers, yellow for main roads, green for highways, no special color for hospitals, red for railway stations, black broken line for railways
	(iv) lettering	English	French	Japanese
	(v) routing method	shortest way using street names	shortest way using street names	shortest way using intersection names and distance
	(vi) apparatus	2G, 3G (smart phone)	2G, 3G (smart phone)	2G, 3G (smart phone)
4. USER				
	(i) tasks	actual position, wayfinding, spatial information retrieval	actual position, wayfinding, spatial information retrieval	actual position, wayfinding, spatial information retrieval
	(ii) type of user	visitor, resident	visitor, resident	visitor, resident

Table-1 Comparison of three cities

1. Real World

(i) Topographical landmark: Large rivers and parks with green mass exist in all three cities (Fig.-1, Fig.-3, Fig.-5). Tokyo has a bay (Fig.-5). These elements constitute the basic spatial frame of the city. There are hills and slopes in the three cities but it is difficult to observe their topography because of the buildings covering them.

(ii) Urban fabric: A basic structure composed of streets, buildings, and blocks is common, but the sizes, shapes, and rules of arrangement of these elements are different (Fig.-2, Fig.-4, Fig.-6). Thus, some experience of spatial articulation, especially on the first visit, is required to become familiar with the place.

(iii) Transportation infrastructure: Railways, subways, buses, and a taxi network for public transport are common, but visitors need to learn how to use monorail lines (Tokyo), rent-a-cycle shops (Paris), taxi stations (Paris), and exchange information

Fig.-1 Washington D.C. (1km grid) Fig.-2 Washington D.C.(50m grid)

(source: Google Map)

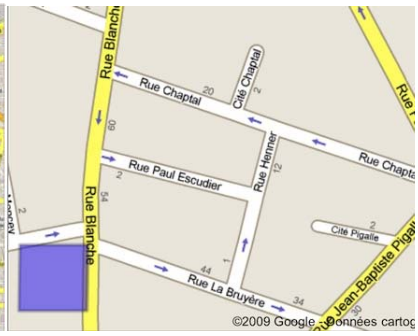


Fig.-3 Paris (1km grid) Fig.-4 Paris (50m grid)

Fig.-5 Tokyo (1km grid) Fig.-6 Tokyo (50m grid)

about them.

(iv) National language: English is spoken in the USA, French in France, and Japanese in Japan. English is a foreign language for France and Japan, thus English communication is limited in these countries.

(v) Writing system: The Roman alphabet is used in English and in French (with special signs for accents, Fig.-4), but Japanese uses a set of letters (Fig.-6) composed of Kanji (Chinese characters, ideogram), Hiragana (phonogram), and Katakana (phonogram).
(vi) Address system [(2)]:

Washington (Fig.-7) - It has a rectangular grid with a diagonal road pattern (cf. 1). The address is composed of a quadrant zone name (NE, NW, SE, SW (2) with the Capitol at

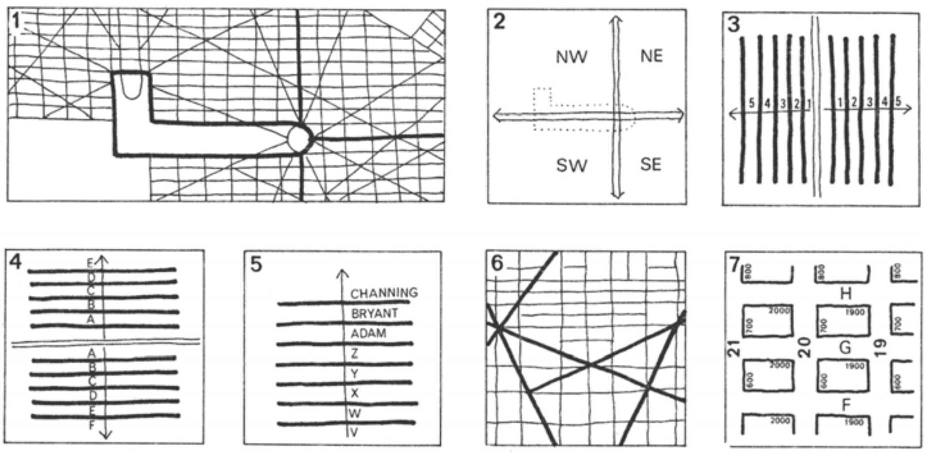


Fig.-7 Address system of Washington D.C.

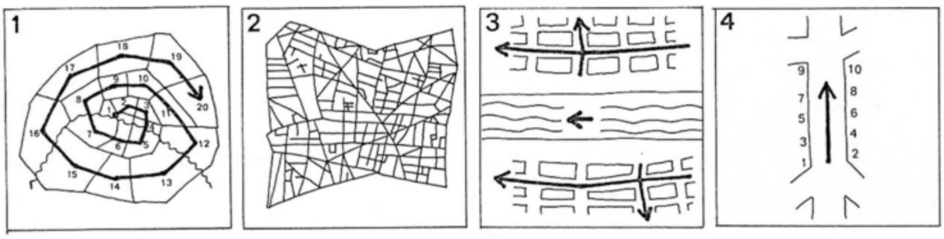


Fig.-8 Address system of Paris

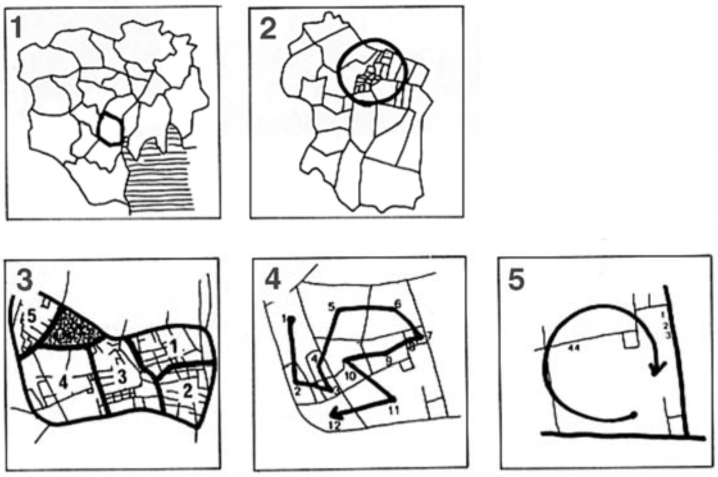


Fig.-9 Address system of Tokyo

the center), a street name (numerical order from east to west (3), alphabetical order from north to south from the origin (4)(5), names of U.S. states for diagonal avenues (6)), and a house number (4 digits from the origin, first 2 digits for block number then house number (7)).

Paris (Fig.-8) – It has an irregular road pattern with 20 zone numbers increasing in a spiral shape (1), street names (2), and house numbers (the number increases with the distance from the river Seine for streets heading away from the river, and from the upper stream to down reach for streets running parallel to the river (3), even and odd numbers on the right and left hand sides respectively (4)).

Tokyo (Fig.-9) – The address is composed of 23 district names (1), zone names (2), block numbers in two levels (3)(4), and house numbers increasing as they move clockwise around the border of a block (5). Tokyo does not use street names in the address.

Thus each system has a different logic for the designation of an element of urban space.

(vii) Sign system: As with names and lettering on a map, there are many signs in real spaces especially in urban areas. Public signs such as traffic control signs and address signs (Fig.-10)) are common in the three cities. Use of symbols and pictograms instead of lettering is more frequent in Paris and Tokyo than in Washington (Fig.-11). Billboard signs are useful for verifying the destination but if they are installed only for advertisements they may create some confusion, and make it more difficult to find really necessary information even if they create a more animated atmosphere (Fig.12).

2. ICT infrastructure

(i) Wireless network system: The system is moving from second generation (2G) by GSM (Global Standard for Mobile) for USA and France, and PDC (Personal Digital Cellular) for Japan, to the third generation (3G) by CDMA (Code Division Multiple Access), which enables true international standardization of transmission protocols and quick display of maps in PDAs (Personal Digital Assistant) and cell-phones.

(ii) Location sensor system: GPS can be used everywhere to find one's actual position but it is not stable in urban areas when surrounded by tall buildings. Triangulation using cell phone signals from relay stations can be used to address such difficulties. Location detection using reference points such as RFID (Radio Frequency Identification) and QRCode (Quick Response Code, 2D bar code) is possible in the Japanese cell phone system.

Fig.-10 Street name in Washington Fig.-11 Pictogram in Paris Fig.-12 Billboard in Tokyo

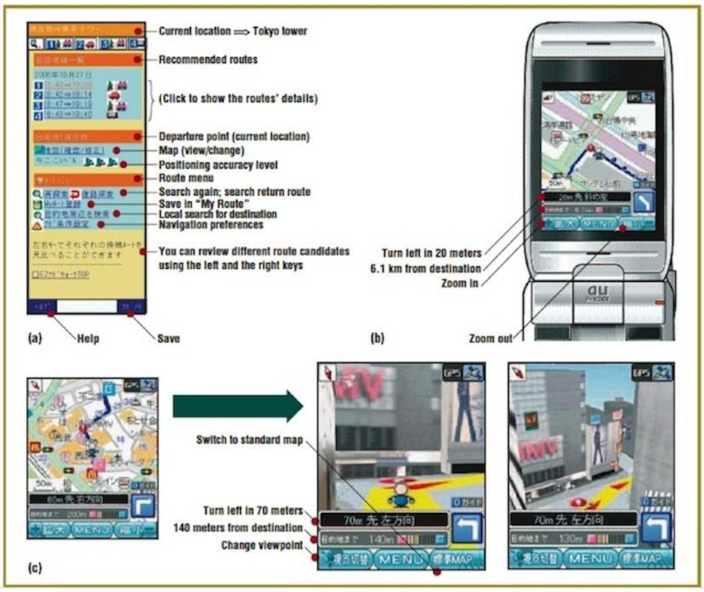


Fig.-13 Google Map

Fig.-14 Map of NAVITIME with 3D view

3. Mapping system

(i) Map type: Google Maps and Google Earth are available with the iPhone G3 (Fig.-13) and are usable in all three cities. They offer maps that zoom seamlessly from world maps to street maps including aerial photos and satellite images. But the 3D image usually available with PCs is not provided for mobile devices. In the Japanese cell-phone system, some systems (e.g. NAVITIME) incorporate vertical view shapes of buildings in some parts of their basic map (Fig.-14).

(ii) Scale: If a user of context-based mapping is in an urban area, the size and the composition of the urban fabric may influence spatial articulation. City blocks are relatively small and heterogeneous in Japan in comparison with European and US cities (Fig.-1 ~ Fig.-6). Thus, normally a 1:2,500 scale map showing the shape of houses and the main landmarks with their names is used for urban areas in Japan (Fig.-13).

(iii) Graphic symbols: The history of cartography has shown that it is difficult to standardize the symbology because geographical phenomena vary in each region of the

Fig.-15 Route in Washington D.C. Fig.-16 Route in Paris Fig.-17 Route in Tokyo

(source: Google Maps)

Fig.-18 Car navigation system with multilingual voice guidance

world (Fig.-15 ~ Fig.-17). As for colors, red is used (a red H) for hospitals in Washington, for hospitals and highway numbers in Paris, and for railway stations and landmarks in Tokyo. Green is used for parks commonly in the three cities, but in Tokyo it is also for urban expressways (toll roads) and for the imperial palace. Brown is used for highways in Washington and Paris, but for main inter-city roads (toll-free) in Tokyo. Thus adaptation of symbols occurs on a case-by-case basis according to the context of the user.

(iv) Lettering: Language selection is available at the level of system settings. However, a true multi-lingual dual lettering system has not been realized yet because it is very

complex task to build a complete multi-lingual place name dictionary.

(v) Routing method: In car navigation systems and cell phone human navigation systems, it has been recognized that voice guidance is very efficient and helpful. Translation between different languages by voice is easier than by lettering using different characters. Car navigation systems already have multi-lingual voice systems (Fig.-18). The route is explained using street names, intersections, distance, and direction such as go straight on, turn right or left, and so on. In Tokyo, as the streets usually have no name but many intersections have their own name based on a nearby zone name or a landmark, intersection names are used with directions, north-south-east-west, and the distance to the intersection, and an indication of whether to turn right or left.

(vi) Apparatus: For the second generation of transmission protocol we utilize different types of apparatus in different regions for mobile devices. The third generation of common devices in the world includes the iPhone G3 as well as various other smart phones. These still realize the basic function of showing the shortest way to the destination and they do not provide voice guidance. It seems that localization adapting to local needs will be the next development to be realized.

4. User

(i) Task: Identification of actual position, wayfinding, and retrieval of information related to the place are the main tasks for users. In these giant cities, the need for spatial queries is high, since the cities are too large for anyone to know everything about them in detail.

(ii) Experience: Visitors (non residents) are the initial target but these devices are also useful for repeaters and residents as explained above, and furthermore places are always changing and people want to know not only about the present condition of a place but also about the past and the future. The place exists as the accumulation of spatio-temporal phenomena. This is why context-based mapping is necessary. These elements are common to city life everywhere.

3. Common basic structure and interface structure

A comparison of the three cities in terms of the four elements of real world, ICT infrastructure, mapping system, and user, shows us there are more similarities on the technical side including user's tasks than regarding the real world itself which represents its own characteristics physically and culturally as seven items of the table. Thus, one idea is that a mapping system may have a common basic structure on a technical and theoretical level and then this would be adapted to different cultural conditions in detail through the interface structure. If this is agreed, the next question is what the common basic structure should be. To resolve this question, inclusion of a basic frame of cartographic theory might be essential.

At first it is necessary to discriminate between the external and the internal information of a map (3). Before entering map information itself we should know how the map is built and how it can be manipulated. These are the external information of a map. Subject list, symbol list (legend), location window, time scale bar, direction dial, tilt dial, scale selection bar, and distance measure are examples of such information (Fig.-19).

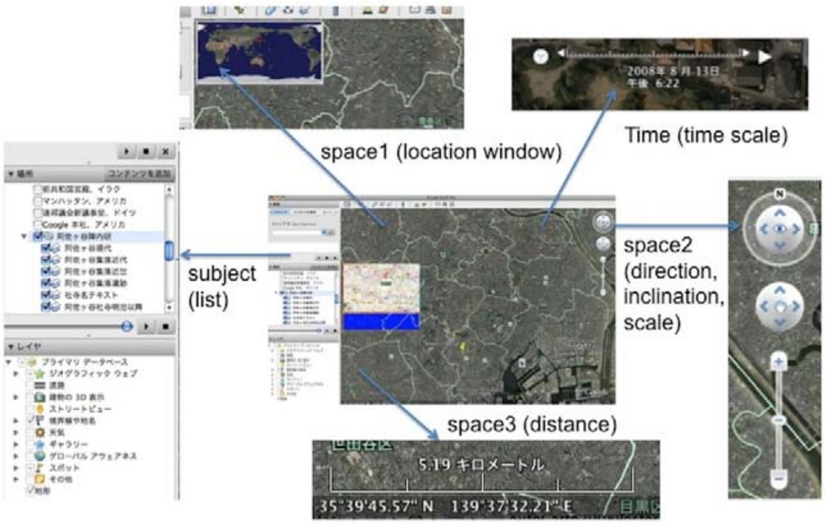
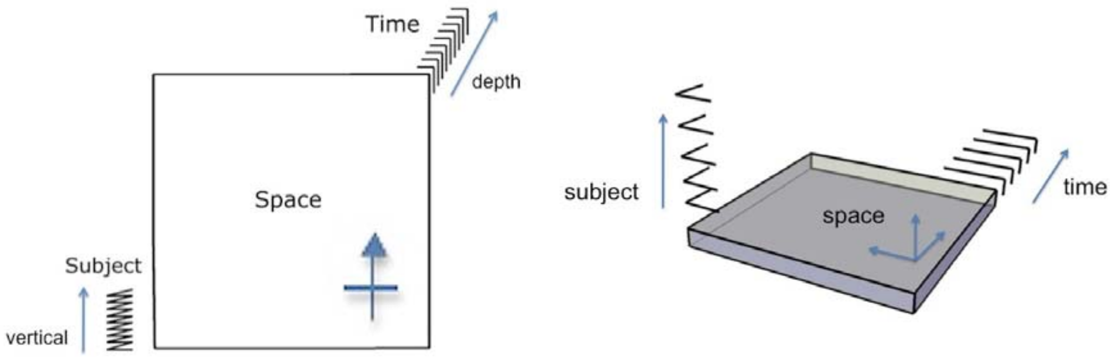


Fig.-19 External and internal information of a map
(source of screen image: Google Earth)



(a) Orthographic representation (b) Perspective representation

Fig.-20 Visual model of combination of axis

Among these, a clear indication of spatial and time axes, is essential. A printed map is fixed but in an interactive digital system we manipulate the view on the screen after selecting a subject. We can zoom in, zoom out, pan, rotate, and fly through by tilting, rolling, and spinning using the notion of the axis. Furthermore, changes and differences of the geographical phenomena in the time series can also be arranged following an axis. But these axes are generally given separately, which can lead to confusion, especially when the user does not have much time. To address this problem, a simple visual space-time-subject model (Fig.-20) may summarize these different axes in the form of a cube. For spatial representation, an orthographic projection (a) using xy coordinates with north up is the traditional method used in mapping systems. But in mobile devices it may be possible to select a head-up function where a map rotates following the direction of movement. In this case, if there is no axis showing the north or the distance it is difficult to verify the directional precision which is necessary to decide whether to continue to advance or not. This map image may be shown by a 3D perspective view (b) where the height is normally exaggerated and the distance is compressed for the depth in the perspective view, which is effective for getting a general view of the site, but the distance is difficult to estimate in this view. For time representation, the changes may be represented by sequential images in sequential scenes in a movie. If it is a real time observation it is enough to continue to look at actual scenes. But if the observation will go back to a certain period of time it is necessary to have an axis for the time reference to match an appropriate period. This axis is represented here in depth. Since these elements of axes are common to many different subjects, it is preferable to add another axis to facilitate the retrieval of subjects arranged in some order. This axis is represented here in vertical direction. Finally, the axis may be converted into a matrix table which has two axes with rectangular coordinates. Thus a relational multiple matrix may contain information on multiple axes (e.g. list of attributes of places based on geographical coordinates).

The internal information, the map information itself, is represented by map symbols and lettering (+voice in some cases). As mentioned in the previous paragraph, color symbology, for example, is different from one city to another. Thus the map representation should be adapted to different cultural traditions set up in the interface structure. If this interface structure is for dynamic map use, route guidance, for example, it is more complicated because the composition of the real world varies with different cities. As people do not use street names in addresses in Tokyo, a European system using street name would not function. In such cases, it would be necessary to go back to the basic structure.

4. Conclusion

As a result of our experiment, we could reconfirm the necessity of listing the differences and the similarities of general conditions of context-based mapping. Even in simple wayfinding, there exist more differences than similarities. These will probably not be resolved by monopolization but by a good collaboration of interpretation/translation systems derived from a common basic structure. Collaboration might require a good where/when/who dictionary between systems. The notion of order by axis and matrix is also a fundamental structure for such systems. A deep, common, and basic structure for a mapping system might be composed of the notion of a set of space-time-subject axes applied to an interface structure adapted to each cultural tradition.

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