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A PRELIMINARY STUDY OF SPATIALIZING CYBERSPACE

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Abstract. The spatial nature of cyberspace has not yet fully defined. This paper presents both analogous and comparative approach to reveal the spatial nature of cyberspace based on a conventional architecture theory, Space Syntax. Two types of city, the physical and the virtual, are compared in order to realize the configurational properties of cyberspace. The findings of this study indicate that the theoretical assumptions of existing architecture theories need to be altered so that cyberspace can be well interpret and understand.

1. Introduction

The spatial nature of cyberspace raises issues from multidisciplinary research, such as cultural studies, sociology, media and geography (Bell and Kennedy, 2000; Jordan, 1999; Jones, 1998; Smith and Kollock, 1999; Lunenfeld, 1999; Hillis, 1999). Major concerns of these studies are virtual cultural meanings, virtual community, and virtual communication.

In architecture, cyberspace is not yet fully defined either. Cyberspace has been defined as an abstract entity. For instance, Bertol (1997 p.59) explains cyberspace as "an infinite artificial world where humans navigate in information-based space". In addition, Novak (1991 p.226) describes that "cyberspace is architecture, cyberspace has an architecture, and cyberspace contains architecture". Moreover, Anders (1999 p.4) shows that "cyberspace is a cultural phenomenon".

Cyberspace does exist in the Internet and it influences the space use of traditional physical space gradually. Design of cyberspace might base on altering existing physical space as well (Mitchell, 1999b). Other researchers further indicate that the organizing principles of cyberspace are same as that of the physical one (Donath, 1997; Dyson, 1998). Thus a better way to understand cyberspace is analogy to the physical space (Mitchell, 1995, 1999a). The scope of this paper is to analyze cyberspace by using a conventional architecture theory, Space Syntax, which is both graphical and quantitative analysis representing the configurational properties of physical

spaces such as buildings, settlements, and cities (Hillier and Hanson 1984; Hillier, 1996, 1999; Hanson, 1998).

What are the organizing principles of cyberspace? And, what kind of theory is suitable for the analysis? Obviously, there is no appropriate cyber-architecture theory. Can cyberspace be understood by applying the architecture theory that is utilized in the physical space? Therefore, a thoroughly study for understanding the spatial nature of cyberspace becomes the objective of this paper.

The first step of this research is to introduce methodology of Space Syntax. The second step comprises a case study of a physical city, Hsinchu City, based on Space Syntax. The city is located in the northern part of Taiwan, and it will be analyzed in terms of its configurational properties: organizing principal, global and local integration, intelligibility, and people's movement pattern of the city. The third step is to study a virtual city, Louis Kingdom (http://www.geocities.com/louisxxi_21/), that is an individual website in Hong Kong. Methodology and analytical contents of the virtual city are identical with the physical city. In the end, the two types of city will be compared in order to find out the spatial nature of cyberspace, and to make suggestions for the application of Space Syntax in the virtual environment.

2. Methodology

The methodology applied in this paper is Space Syntax, which has been developing by the Unit for Architectural Studies, Bartlett School of Architecture and Planning in University College London. Space Syntax is a set of techniques for the representation, quantification, and interpretation of pattern aspects in architecture and urban space. The key concept of Space Syntax is configuration, which takes into account the whole relation of a spatial system (Hillier, 1996).

There are two major analysis methods developed by the theory: axial map and justified graph. An axial map is the least set of longest straight lines that represent movement and lines of sight, and pass through the whole system of public space (figure 1 and 2). Each line has normally assigned two types of integration value. The first one is global integration which is the relative depth of each line from every other line in the system. The second one is local integration which is the relative depth of up to three lines away from each lines. In the same way, the more integrated the lines, the more shallow and darker the lines to the system. Lines, which are less integration and more segregation and depth, are progressive lighten. (Details of formula and calculation see Hillier and Hanson 1984.) The resultant representation is called integration map.

A justified graph represents each space of a building plan as a circle, and permeability or relation between spaces as lines (figure 3). A particular space is selected as the root, and the spaces in the graph are aligned above it in levels. Like axial map, integration values are calculated according to the relative depth of each space.

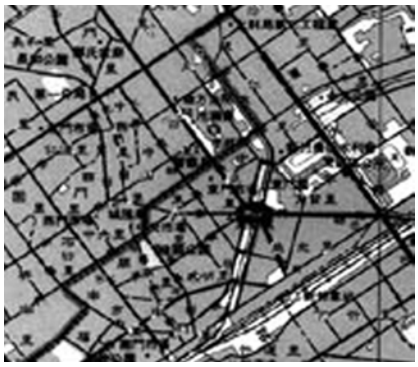


Figure 1. A partial map of Hsinchu.

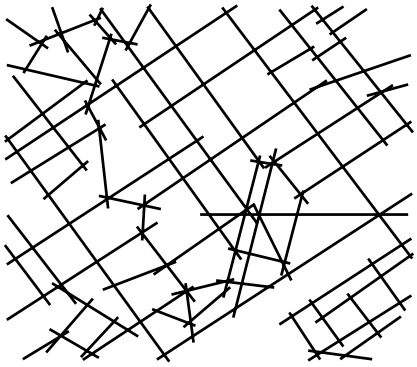
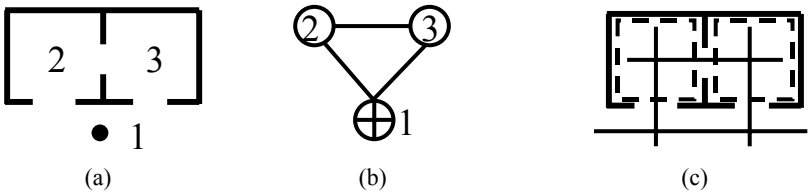


Figure 2. The axial map of figure 1.



(a) (b) (c)

Figure 3. A building plan (a) with its justified graph (b) and axial map (c).

3. Analysis and Results

3.1. THE PHYSICAL CITY: HSINCHU

As the dotted circle indicated in figure 4, the global integration core, which is consisted of more integrated lines, is located in the north of the city. This area is city centre where includes the highest land uses, building densities, and the strongest urban movement such as people and vehicle. Additionally, the largest local integration core is situated in the area (figure 5). In brief, Space Syntax well represents the city form and, most importantly, living experiences of the city.

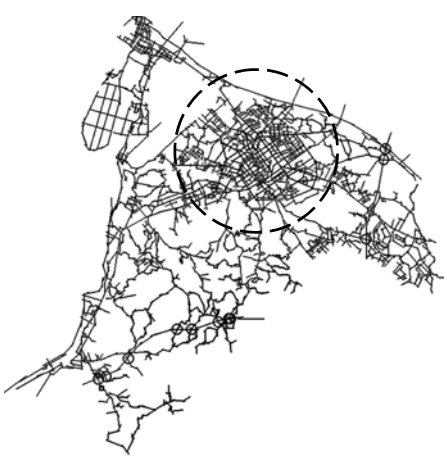


Figure 4. Global integration map of Hsinchu.

Figure 5. Local integration map of Hsinchu.

3.2. THE VIRTUAL CITY: LOUIS KINGDOM

Louis Kingdom provides two versions of city: normal and urban. The later is studied in this paper. The city map of Louis Kingdom resembles to the physical city. Different buildings construct the city into many areas that are linked by certain paths (figure 6). As depicted in figure 7, the global integration core is located in the densest building area, city centre of the city. The local integration map indicates the location of sub-areas precisely, such as Picture Museum and Theme Park (figure 8). Likewise, Space Syntax predicts the movement patterns of the virtual city map. The higher the integration value of an axial line, the stronger the movement it is. Thus, in terms of map, organizing principle of the virtual city is similar to the physical one.

However, the map is reference only, because there is no real movement on the paths of the virtual city. User's movements are absent from the street, and open spaces of the city cannot be used and experienced. Individual buildings, where offer activities and information allowing users to observe or experience spaces, turn out to be the most important components of the virtual city. For this reason, the axial map analysis of Space Syntax cannot completely represent the form and function of the virtual city.

In order to further analysis, each page of the website must be analogous to a single space so that the justified graph analysis of Space Syntax generally utilized to interpret configurational properties of buildings can apply to this study. To begin with, all pages of the website have to be seen one by one to work out spatial relations between them. This study only

focuses on the spaces within the virtual city, and the connected websites are excluded.

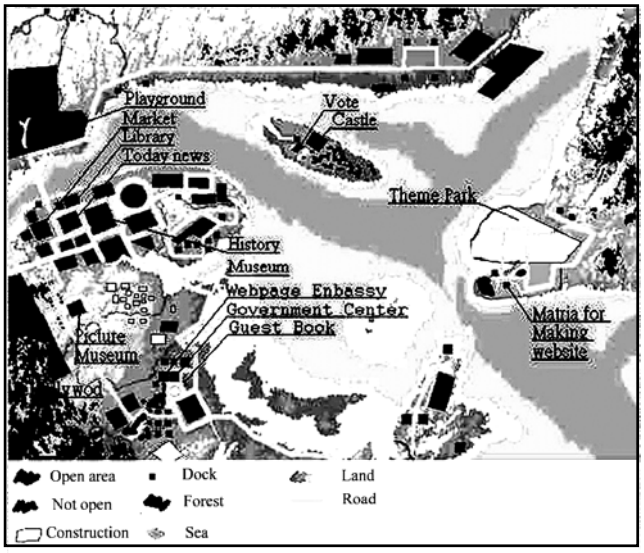


Figure 6. The city map of Louis Kingdom.

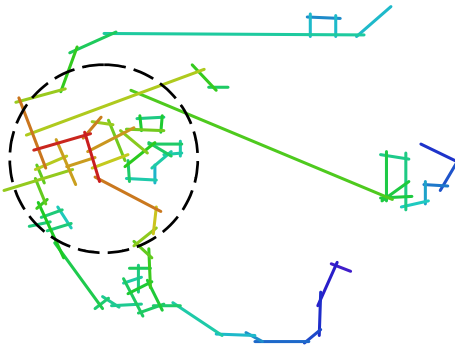


Figure 7. Global integration map of the city.

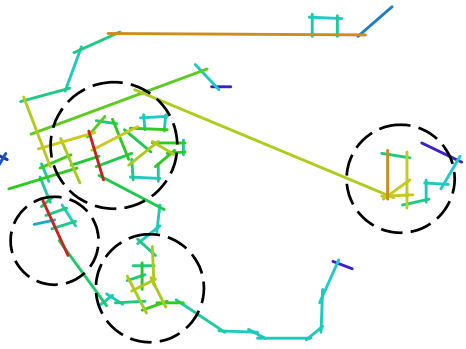


Figure 8. Local integration map of the city.

As shown in figure 9, each space of the city is represented by circle with a particular number, and relations between spaces are shown as lines. Each space number, name, and quantitative data relevant to the city can be seen from table 1. Space number and name is descended according to the order of global integration value. The order of local integration is almost same as the global ones.

Spaces that are situated in the strategy position tend to have higher integration. Properties of connectivity and control of each space might play significant roles. For example, the most integrated space is north town centre (space number 4) that connects eleven spaces and its control value is the highest. South town centre (10) is the second integrated space with seven links and the second highest control value. In addition, the third and fourth integrated space, latest news (14) and dock (8), connect to other four spaces respectively. These spaces might obtain the possibility to attract more users into the city.

North town centre (4) and south town centre (10) are the more integrated spaces of the city. Both spaces perform as entrances to other places and to construct their own district in a sense, although they are two single spaces. Other similar function spaces also possess higher integration such as dock (8) and history museum (5). Moreover, neighbors of the most integrated spaces have higher integration even though they are not the main entry spaces, such as latest news (14), map (11), and introduction (12).

The more integrated spaces are also located in the rings of the justified graph. Figure 3(b) shown the original form of a ring graph. Ring composition provides alternative routes from one space to another (Hillier and Hanson 1984). Thus, users of the city have more choices when they arrive those integrated spaces.

The deeper the spaces to the city as a whole, the more segregated the spaces they are. This means that they are located far away from the core area. They should spent more steps to reach every other spaces of the city, for instance outside (1), pictures (15), and contents (16).

To sum up, configurational properties of the selected virtual city can be revealed by the justified graph analysis of Space Syntax.

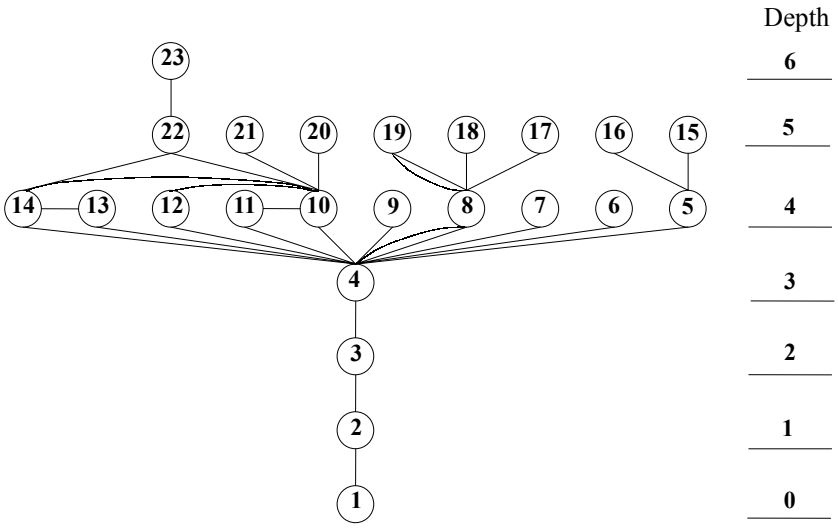


Figure 9. The justified graph of Louis Kingdom.

TABLE 1. Quantitative data of Louis Kingdom.

Space no. & name	Connectivity	Control value	Global integration	Local integration
4 north town centre	11	5.98	3.72	3.72
10 south town centre	7	3.67	2.10	2.25
14 latest news	4	1.07	1.86	1.96
8 dock	4	3.09	1.73	1.90
11 map	2	0.23	1.67	1.73
12 introduction	2	0.23	1.67	1.73
3 urban version	2	0.59	1.61	1.67
5 history museum	3	2.09	1.61	1.74
13 market	2	0.34	1.56	1.61
9 playground	1	0.09	1.42	1.49
6 library	1	0.09	1.42	1.49
7 today news	1	0.09	1.42	1.49
22 website embassy	3	1.39	1.21	1.46
21 government centre	1	0.14	1.10	1.20
20 guest book	1	0.14	1.10	1.20
2 homepage	2	1.50	0.99	0.99
17 castle	1	0.25	0.99	1.02
18 vote	1	0.25	0.99	1.02
19 material for website	1	0.25	0.99	1.02
16 contents	1	0.33	0.95	0.95

15 pictures	1	0.33	0.95	0.95
23 other websites	1	0.33	0.79	0.79
1 outside	1	0.50	0.69	0.33

3.3. A COMPARATIVE STUDY

The basic analysis requirement for the physical city is maps, while understanding of page connections in the virtual city is needed prior to analysis. Representation of the integration maps for the physical city is living experience, which can be explored by people's body movement. On the other hand, the virtual one represents unconventional spatial experiences, which are connected by virtual transportation, that is, hyperlinks. The navigation procedure is a circle of click-see-click.

Both cities have their own configurational properties, such as global and local. However, as a result of complex hyperlinks to other websites, global configuration of the virtual city is more ambiguous than the physical one. Furthermore, local integration of the virtual city is intensified by the independent property of each page that can be analogy to an individual space. In the analysis of the physical city, Space Syntax omits location and distance of individual buildings instead of a whole set of simultaneously existing relations (Hillier and Hanson, 1984). On the contrary, individual buildings are critical because users start their navigation in the virtual city through those spaces. Since lack of communication interface design such as avitars and chat rooms, user's movement does not exist in the studied virtual city. In other words, there is no social encounter. In this case, spatial nature of virtual city depends very much upon the communication interface design.

The differences between physical city and virtual city can be further understood by applying the five elements of city image proposed by Lynch (1960): paths, edges, nodes, districts and landmarks. The paths in the map of the virtual city are reference only, and they are not real accesses for the users to enter spaces. Transportation in the virtual environment implies a topological relation that is different from geometrical relation of the real world. The entrances of the city are the buildings that are nodes. Districts and landmarks are also different types of node, such as north town centre (4) and government centre (21). Therefore, nodes become the vital element in the virtual city. They substitute paths, districts and landmarks. In addition, complex hyperlinks to other websites makes the edges more confusing. The images of the virtual city challenge the concepts of the conventional one. The comparison is summarized in table 2.

TABLE 2: A comparison between two types of city

Items / City type	Configuration	Individual Buildings	Social Encounters	Paths	Edges	Nodes	Districts	Landmarks
Physical city	√	X	√	√	√	√	√	√
Virtual city	√	√	X	○*	X	√	○	○

*Items are replaced by node.

In summary, the virtual city comprises of fragment and dispersed spaces that are same as the physical city. Unlike the physical city, the virtual city presents multi-directional and noncontiguous of spatial configuration in which users can go to anywhere by simply click a space. The virtual city portrays a virtual configuration (plane) which is made of different locations (points), and hyperlinks (lines) articulate the whole spatial system. Therefore, the primary elements of cyberspace are identified: point, line and plane.

With respect to form and function, Hillier (1996) indicated that form and function in space are not independent. In the virtual city, this is not the case. The axial integration maps represent functional strength of the physical city, but they cannot fully analyze the virtual one. In addition, there are no paths in the virtual city, and topological relations substitute permeability between spaces. Functions, as well as ambiguous topological form, can be found in virtual city. In term of geometry, form and function in virtual space are independent.

4. Conclusions and Future Studies

The justified graph analysis of Space Syntax can represent configurational properties of the virtual city. However, these outcomes resulted from the adjustments of the theory. Each page of the website has to be analogous to a single space, and relations between spaces are replaced by hyperlinks. When Space Syntax is applied to the physical city, the analytical body contains public space only, such as street and plaza. In the cyberspace, city scale may be smaller, but the buildings may provide more spatial interactions between users and linking to other websites. Individual buildings can be included in the analysis for a further understanding of cyberspace. Finally, Space Syntax is only two-dimensional analysis and representation. Following pervasive adoption of three-dimensional cyberspace design, Space Syntax should improve its capacity on this aspect.

Significance of this paper is to realize the spatial nature of cyberspace by applying a comparative approach. The findings of this research also show that theoretical assumptions of Space Syntax as well as The Image of the City have to be altered for further analysis of cyberspace. As a result, this study raises a broader question: To what extent is it necessary to adapt the

relevant traditional architecture theories for well interpreting and mapping the cyberspace? The answer is obvious. Future studies will explain the ways to redefine the well-known architecture and urban theories, and will propose a preliminary theoretical model for analyzing cyberspace.

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