CONSTRUCTION OF DIGITAL CITY IN PHYSICAL CITY

Cyberspatial Cognition Approach to the project of HsinChu digital city in Taiwan

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Abstract. The cyberspace upon physical space forms a new spatial structure to increase the influence on the urban fabric and the concept of space in architecture. Today, digital cities are being developed all over the world. By using a city metaphor, digital cities integrate urban information and create public spaces. How do digital cities directly connect to physical cities and become an imaginable city? Therefore, we argue that a new spatial analysis theory must be established for digital city, comparing with theories of disciplines, to find the explicitly spatial structures and relations in digital city upon physical city.

1. Introduction

The cyberspace upon physical space forms a new spatial structure to increase the influence on the urban fabric and the concept of space in architecture (Mitchell, 1995, 1999; Liu 2001). Researchers from other field, such as geography (Dodge and Kitch, 2001; Kwan, 1999; Batty; 1997), sociology (Weber, 1995; Castells, 1998) and urban logy (Hall, 1998) studies, identify different overall frameworks of cyberspace to interpret the relation between the place we live in and the cyberplace we also live in. In architecture, the concept of design emerges a tendency to define, create and construct the digital architecture or space, not yet virtual, for the digital age (e.g., the 2000 and 2001 Far Eastern International Digital Architectural Design Award). The digital concept is already causing traditional building types to fragment, and form startling new landmark or skyline in cities (Mitchell, 2000).

More and more architectural scholars attempt to well define and inter-pret the nature of cyberspace (Huang, 2000, 2001; Wong et al, 2001; Liu, 2001).

Expecting to explicitly redefine architectural theory and interactively reconstruct the city space to be the digital city. Today, digital cities are being developed all over the world. By using a city metaphor, digital cities integrate urban information and create public spaces for people living in the cities (Toru Ishida, 2000), and provide an opportunity to people to create a new information space for their everyday life. How do digital cities directly connect to physical cities and become an imaginable city? We need map not just to navigate but to define and control new territory. The cyberspatial cognition approach in studying spatial structures of cyberspace and digital cities is an important access. Interestingly, the most studies of cyberspace and digital cities are influenced by the spatial knowledge of cognitive mapping (Theresa Duncan, et al, 2000; Kheir Al-Kodmany, 2001; Dodge and Kitch, 2001; Kwan, 1999), which has developed by Lynch (1960).

A more subtle point is that we need to consider the mappings of the digital to the physical and the physical to the digital. According to Mitchell (1999), the physical city and digital city also can combine together and convolution to form a new urban topology. But how to analyze and combine digital city and physical city, and how to describe the spatial structures of digital city, this is unknown knowledge domain, not like digital architectural designs. Therefore, we argue that a new spatial analysis theory must be established for digital city, comparing with theories of disciplines, to find the explicitly spatial structures and relations in digital city upon physical city.

The first step of this research is to introduce the four type theories of interpreting spatial structure on the physical and digital cities. The second step comprises an existing digital city Kyoto (http://www.digitalcity.gr.jp/) and the project of HsinChu digital city in Taiwan. In the end, the two types of digital city will be compared in order to find out the relation between digital city and physical city.

2. Methodology

In order to understand the spatial phenomena in the cyberspace represent an important challenge for urban scholars and architectural analysts. We will refer to different theories on physical and digital city. Then we will visit the two types of digital city and emphasize how the projects each relate to the urban fabric and image.

2.1. THE PERSPECTIVE OF DIFFERENT THEORIES

In this section, we combine four types of describing spatial structures, like the following (table1), to explore the influence upon spatial structures between physical city and digital city. Lynch's (1960) analysis of the city rested on five

different elements: paths, edges, landmarks, nodes, and districts, to image the physical city form as the mental map. Lynch provided a theoretical framework for studying cognitive maps, urban form, and the spatial relationships of cities. This included an exploration of how regular citizens use and visualize city spaces. An imageable city helps residents and visitors better to orientate themselves spatially, to navigate through the city, and to find their way. In Lynch's framework, Kheir (2001) argue that one could view a city as a web of paths and nodes that are surrounded by edges and contain districts and landmarks.

On the social view, describing the so-call space of flows to gain the spatial imagination by three layers of material: a circuit of electronic impulses, computer processing and high-speed transportation; the nodes and hubs of Networking; and the spatial organization of the dominant elites (Castells, 1992). The theory of Mapping-Cyberspace emphasizes the physical infrastructure, traffic flows, the demographics of the new cyberspace communities (Dodge and Kitch, 2001), to the perception and visualization of these new digital spaces. The recent research as Liu (2001) on digital space found that the three core elements of both verbally and visually constructed virtual space: movements, interactions and acoustic effects. We explore the relation among different theories. Then we base on cognitive map to synthesize and find out the network of their spatial concept (figure1).

Table 1.Theories of the spatial structures about physical space and digital space

| Kevin Lynch (The Image of the City)	Manuel Castells (Space of Flows)	Martin Dodge (Mapping-Cyberspace)	Yu-Tung Liu (Digital Space)
1.Paths 2.Edges 3.Landmarks 4.Nodes 5.districts	1.A circuit of electronic impulses, computer processing and high-speed transportation 2.The nodes and hubs of Networking 3.The spatial organization of the dominant elites	1.The physical infrastructure 2.Traffic flows 3.The demographics of the new cyberspace communities	1.Movements 2.Interactions 3.Acoustic effects
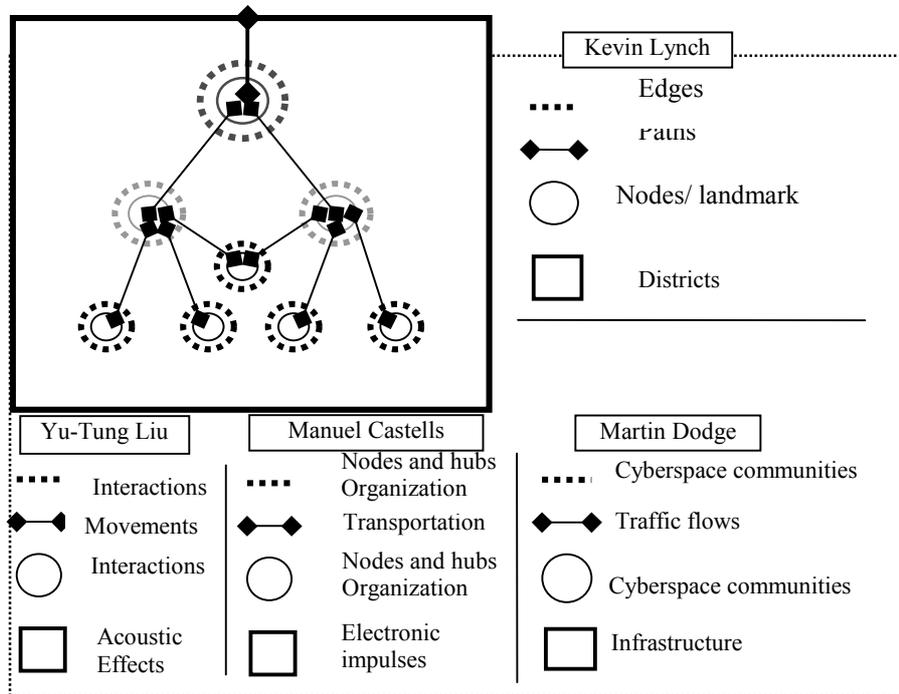
Figure1. Figure the network of their spatial concept

2.2. VISITING THE TWO TYPES OF DIGITAL CITY

2.2.1. The Digital City Kyoto

This project developed a digital city prototype as a social information infrastructure for Kyoto in 1998. The Digital City Kyoto (Figure 2) performed a city metaphorical form: a 2D map and a 3D virtual space. A large number of WEB pages (2600 in September 1999) are being collected and linked to the 2D/3D city (Toru Ishida, 2000). Real-time mapping data from the physical city is also mapped to the digital city. As the human interface, a whole Shijo street (2Km long) has been implemented to simulate the city environment in a 3D virtual space. Citizens or visitors can get information related to the physical city such as traffic, weather, parking, shopping, and sightseeing. Digital City Kyoto had the social interaction among residents and tourists. For oversea visitors via the Internet, Digital City Kyoto had provided a digital bus tour with a guide agent that supports cross-cultural communication.

Figure 2. Digital City Kyoto   http://www.digitalcity.gr.jp/.

2.2.2. The Digital City HsinChu

This project initially started to develop the Hsinchu Art Museum in 1999. But the key planner, Liu (2000), hope to create a masterpiece encompassing historical heritage at the digital age for the city of Hsinchu, with her 170 years of history and strength of computer technology. Therefore, the Digital City Art Center had being form to conduct the future of Hsinchu city. The project emphasized how to translate the urban underlying traffic and building into the digital city underlying network and digital media. At the digital era, this project developed a digital city prototype as a new spatial structure and landmark for Hsinchu. Digital City Hsinchu makes available different city image and percept: by building a physical and digital architecture to expand the spatial image of digital city and connect the network of new urban fabric environment (Figure 3). Thus the Digital City Hsinchu perform a hierarchical network of spatial structure to drive the digital development of architecture and urban.
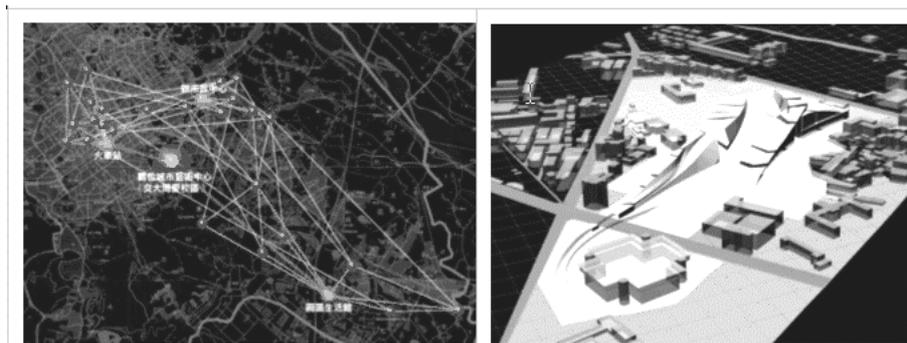

Figure3. The Digital City HsinChu   http://www.arch.nctu.edu.tw

3. A comparative analysis

The concept of digital or information cities is the flows of network. From the compare and synthesis of the four different theories, we can map the most important spatial concepts, which are paths, nodes and landmarks, of digital cities and cyberspace. Anyway, the physical, digital or cyberspatial cities all need a cognitive map of spatial concepts for the visitors and residents. The greater part researches of cyberspatial cognition usually quote the Lynch's research of the mental map theory to find orientation. Besides, the impact of digital concepts on architecture, a new startling form by computational design and manufacture, has evolving and liberating concept of space and form. In digital era, the new architectural form have impacting on the past image of spatial cognition and urban fabric (Liu, 2000). When the phrase of digital city emerge, not alike information city, it imply the two above-mentioned digital concepts. However, the most so-call digital cities are based on cyberspace (web-space) to simulate the image of physical environment and the relation of interaction. There has a tendency toward (Lin, 2001): the definition of Digital City is based on the hardware and software of information, telecommunications and network to lay special emphasis on urban infrastructure. The definition of Informational City is to provide the citizen-oriented information service and content about urban. Otherwise, combining with the above both to develop cybercities or virtual cities, as Helsinki Arena 2000 Project. However, all of the above can not let people to exactly perceive the special impact on the physical city in digital era, as modernism formed the image of a city. The cyberspatial concept between The Digital City Kyoto and The Digital City HsinChu both have the components of hierarchical nodes, paths, landmarks, edge and district by two or three dimensional maps images (Figure 4 , 5).
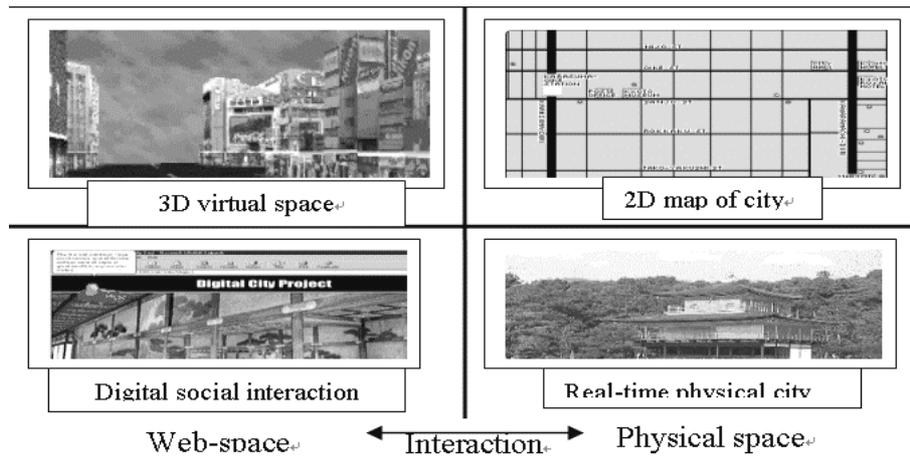

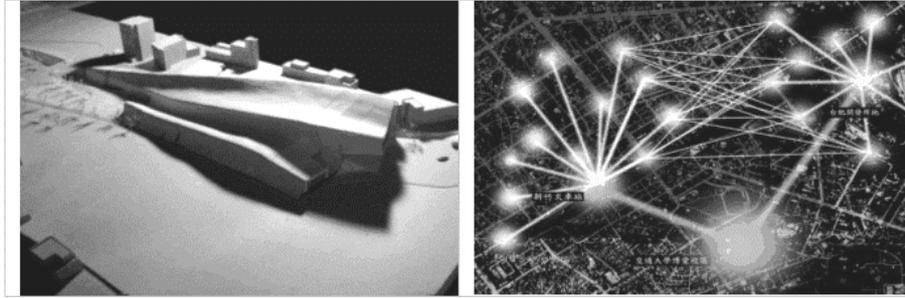*Figure4. The metaphors of the Digital City Kyoto*

Figure5.   The new fabric environment of The Digital City HsinChu.

The difference of both digital cities is that The Digital City Kyoto performed digital concepts that simulated, and virtual Kyoto city to create the duality of Kyoto city. However, the urban fabric and the image of space are almost constant. The Digital City HsinChu performed digital concepts have attempted to create a new cognitive image of urban space. By arranging the buildings of digital design on different nodes, The Digital City HsinChu have changing and forming a new image of the city and spatial structure to let residents perceive the meaning of urban space in digital era. In addition, this project had proposed a concept of virtual city to co-construct the digital duality from physical and virtual cities.

4. Conclusion

The results of this research indicate that the relation between digital city and physical city is not a dichotomy but extending the definition and boundary of city space by interacting and constructing in each other. At the same time, providing architectural and urban designers might benefit from the outline of analysis framework. In addition, a theoretical comparison among the five elements of the city, the space of flows, mapping-cyberspace and digital space interpreted space are explored for constructing the digital city in the physical city. Finally, further studies related to the construction of digital city in physical city are how to study the impact on the spatial cognition of urban fabric by digital concept, not only the cyberspace.

Acknowledgements

References

Batty, M.: 1997, Virtual geography,Future,No.4/5,vol.29,pp.337-357.

Batty, M.: 2001 Contradictions and conceptions of the digital city, Environment and Planning B: Planning and Design, 28(4), pp. 479-480.

Chen, C. N.: 2000, Changing spatial imaginations in modern Taiwan and postmodern geography: A preliminary survey, *Manuscript at NCTU*, Hsinchu, Taiwan

Castells, M.: 1998, THE INFORMATION AGE: ECONOMY, SOCIETY AND CULTURE, VolumeIBlackwell, USA.

Dodge, M and Kitchin, R: 2001, Mapping Cyberspace, Routledge, London and New York.

Feng-Tyan Lin, 2001: Formulating an informational city: a case study of Kaoshiung, the urban planning conference, Korea.

Huang, C.H.: 2001, A Preliminary study of specializing cyberspace, Gero, J.S., Chase, S.and Rosenman, m. (Eds), CAADRIA2001, Key Centre of Design Computing and Cognition, University of Sydney, pp.27-37.

Kwan, M.P.:2001, Cyberspatial cognition and individual access to information: the behavioral of cybergeograghy, Eviroment and PlanningB: Planning and Design, vol.28, pp.21-37.

Kheir Al-Kodmany: 2001, Supporting imageability on the World Wide Web: Lynch's five elements of the city in community planning, Environment and Planning B: Planning and Design 2001, volume 28, pages 805 ^ 832

Lynch, K.: 1960, The Image of The City, MIT Press, Cambridge, MA.

Liu, Y. T.: 2000, The evolving concept of space: From Hsinchu Museum of Arts to Digital City Art Center. *ACADIA Quarterly* 19, no. 4.

Liu, Y. T.: 2001, Defining Digital Architecture: The 2000 FEIDAD Award. Taipei: Dialogue.

Maher, M. L.: 1999, Design the virtual campus as a virtual world, *Proceedings of CSCL 99*, Standard University, pp. 376-382.

Mitchell, W. J.: 1999, Replacing place, *in* P. Lunenfeld (ed), *The Digital Dialect: New Essays on New Media*, MIT press, Cambridge, MA. pp. 112-128.

Mitchell, W. J.: 1995, *City of Bits*, MIT Press, Cambridge, MA.

Hall, P.:1988, CITIES IN CIVILIZATION: Culture, Innovation, and Urban Order, London, WC2H9EA.

Strate, L.: 1999, The varieties of cyberspace: problems in definition and delimitation, *Western Journal of Communication*, 63: 382-413.

Wong, C.H., Liu, Y.T., Chen, S.C.:2001, Is Cyberspace A Space? A preliminary exploration of the spatial phenomena in the internet, Gero,J.S.,Chase,s.and Rosenman,m.(eds),CAADRIA2001,Key Centre of Design Computing and Cognition, University of Sydney,pp189-194.

Webber, F: 1995, Theories of the Information Society, Routledge.

Toru Ishida: 2000, Understanding Digital Cities, In T. Ishida and K. Isbister Eds. Digital Cities: Experiences, Technologies and Future Perspectives Lecture Notes in Computer Science, Vol. 1765, Springer-Verlag, 2000.