

GeoCity Beijing: Platform of Eco-City Information Visualization and Interactive Narrative Structure

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Abstract. With an aim at resource visualization of eco-city, the present paper puts forward a research framework for narrative structure of cities to enable decision makers and participants of city construction to better understand the relations of elements of eco-city.

Keywords: eco-city, information design, narrative structure, interactive design.

1 Introduction

In the premise of ecological and economic sustainability, the development pattern consisting of collaborative efficiency and mutual dependence is of great importance. Family, street, community, city, district, country and region can be not separated when problems are considered.

With rapid growth of cities, change of each factor has become a dependent variable affecting the entirety. Urban administration is no longer the work only conducted by governments. Participation of intelligent people, application of new technology, grasp of dynamic information, etc. all become the essential factors to maintain development of large cities. Systematic thinking is the only way to solve problems of cities. If an urban information system is established to enable the public to better understand cities and assist City managers in better planning the facilities and services of cities, a sustainable urban ecological system can be better created.

2 Related Works

Prior researches on urban information visualization only rest on the level of information delivery and no relevance consideration is given to data.

Urban Informatics of Marcus Foth focuses on how to use mass data generated by cities each day to develop, record and publish a Live Experience that can bear city vitality¹. The research indicates that integration of virtual and reality in urban space

¹ Marcus Foth, Christine Satchell, Mark Bilandzic, Greg Hearn, Danielle Shelton with Fiona Crawford: *Dramatic Character Development Personas to Tailor Apartment Designs for Different Residential Lifestyles*. (2011).

can be realized if effective urban planning is used in urban information design to analyze different typical personas.

In the research “Bjornetjeneste”, Jeni Paay and Jesper Kjeldskov have pointed out that when people shuttle among urban streets, buildings and squares, the entities of objective existence, they fail to interact with the cities they live in. If urban characteristics, for example, sound, vision, smell, building, and crowd, can be interacted through users and cellphones, it can provide interest and immersion-type interactive experience for daily life of urban residents².

In the project “Copenhagen Wheel” conducted by MIT Sensible City Lab, sensors installed on tail wheels of bikes are used to collect data such as air, noise and road. The data will be integrated in an information platform. This can effectively promote the behavior that individuals make contribution to public service, and collective guidance by system can provide fresh ideas for development of cities with better environment.

Above-mentioned researches all focus on how information can improve perspective of urban life in future urban districts, how information can contribute to existing public service and how information can be used.

Azamat Abdoullaev point out in the coming world, ternary human habitant environment will be formed by ecology, intelligence and social contact. Ecological resources are better used to create an appropriate environment. Technical revolution will promote informationized life style and socialized network can shorten the distance of people³. Real-time updated streaming media with a linear growth such as blog, video, sharing, comment, consumption record, check-in record, and browsing record beyond the individual records all belong to worldstream of mass data⁴. Opinions of David Gellernter have provided a powerful theoretical basis for the coming era of big data, but he failed to point out how to design information and how to use information to benefit existing society.

The paper also puts forward a new solution and its process to overcome shortcomings presented by prior information visualization and interaction. GeoCity, the prototype of designed urban information system, provides a new idea to benefit people.

3 Research Method and Design Prototype

3.1 Design Problem

An urban system of good operation is firstly to select useful information from the mass data and recombine and rearrange the information to make it clear and visualized and then the system will sent the information to different readers (City User and

² Jeni Paay and Jesper Kjeldskov: Bjornetjeneste: Using the City as a Backdrop for Location-Based Interactive Narratives. (2011).

³ Azamat Abdoullaev: Smart World: A Development Model for Intelligent Cites The Trinity World of Trinity Cities. (2011).

⁴ David Gelernter: The End of the Web, Search, and Computer as We Know It. (2013).

City Manager) in accordance with different demands and record new feedbacks accordingly so as to form an orderly information cycling chain. Organic urban operation system is the one to maintain such cycle in a dynamic way.

With such consideration, the research project “GeoCity” was commenced and its works were finally exhibited in Ars Electronica Festival in Linz, Austria in August 2012 and displayed in 2012 Beijing Design Week in Beijing in September.

What is data management of Eco-City? A city is the organic integration of human civilization development and natural bearing capacity and is provided with a unique survival operation system to skillfully balance the communication among human behavior, science and technology, living beings and information and to maintain vital cycling through cultural development, economic growth and environment protection.

Immigration has provided new energy for cities to make their core areas expand continuously.. As the behavior that is most frequently used by people in social activities, economic behavior continues to promote social development of urban area, producing more completion at the same time. Personal perspective has interwoven different social networks within complex area, but connection of those social networks has provided social adaptive system for individuals and groups.

Complexity of urban area develops the unique culture of a city, integrates internal and external energy, balances conflict of new and old culture, provides an expandable space for human civilization, and provides a multi-dimensional civilization development frame from the perspective of individuals, families, groups, societies and cities. Information feedbacks generated by operation of cities reflects survival demands of residents. Such feedbacks provide ideas for urban administration and planning and update the quality of human settlement environment.

Which Real Data of cities require to be visualized? When emergency disaster like the heavy rain comes, City users (residents) may consider whether surrounding area is safe, whether flooded areas will be dredged, and when subway and public transportation can operate again. City managers may focus on how many areas are flooded, what about the rescues conducted by rescuers and where the residents are held up. Due to different problem perspectives and immediate interests, required information and means for obtaining information are also different. Therefore, visualization of urban ecological system should design different contents in accordance with different readers.

It Requires a Visualized Framework with Good Management. Multi-dimensional perspective, equal stress on macroscopic and microscopic view, and combination of virtually and reality are the three-design principle of the project. Information visualization not only presents pictures and images but also carries rich knowledge and interest. Focus of the research and practice is to reveal relations. Through narration of city stories, users or audiences can find out focus from burdensome and enormous data quickly and establish logic and context of data.

3.2 Design of Research Method

During project initiation stage, the group has applied data for narration, infused Scenario on typical users, conducted comprehensive analysis for Stakeholders concerned in each Topic, and established the model Persona.

Through establishment of several models of Persona, stakeholders are identified. Statistics Data and Real Time Data are arranged to become topics. From macroscopic aspect, perspectives of City managers are used to observe trends of groups and from microcosmic aspect, perspectives of urban residents are used to look for personal sense of belonging.

Information Visualization: Information visualization is an interdisciplinary field, aiming at studying the visual presentation of large-scale nonnumeric information resources. Information visualization can transmit abstract information in a direct way. It connects the deep spirit through eyes so that the users can witness, explore and understand vast information immediately. The premise of information visualization is to collect vast data including statistical data, real-time data of sensors, pictures, words, video streaming, audio streaming etc. build the data structure, screen out a logical mainline, change into visual language and percolate easily comprehensive information experience through user interface, new media equipment, intelligent zone and so on.

3.3 Design Prototype

The aim of interactive narration is to explore the integration of Core Mechanics, Interactivity and Storytelling and Narrative on the story level, and to present the narrative design on the practical level. In this project, interactive narration is an interactive presentation with users as the subject and can help users understand and blend in the materials of presentation, get to know the flowing of the urban energy, and let the reader feel the beating pulse of a city.

Three Layers of Narrative Structure. Therefore, while presenting a city, three levels should be considered: physical space, personal perspective and collective behavior. Only in this way can people accurately understand the spiritual outlook and operating state of the city.

Urban data is from citizen activities of physical space. Incidents happened in some geographical location will form certain public opinion guide after transmission, then the new urban topic emerges and the landscape, crowd, streets and so on, surrounding the place become the background of the topic. On-line activities will soon gather and disperse different crowds after transmission. Off-line activities will in turn influence the physical space. And the topics will change the development of two virtual and real communities.



Fig. 1. Three Layers of Narrative Structure

The incidents, which caused the topics, may be traffic jam or air quality that can both be measured. If all data caused by urban operation can be recorded and the connection among all the topics can be found, then the urban problems will be obvious. City users (citizens) will find their own positions on this basis and have sense of belonging in this huge city. City managers (government) will observe the society on this basis, strike a balance between the positive emotions and negative emotions in the society and lead the healthy value orientation.

Three Dimensions of Narrative Structure

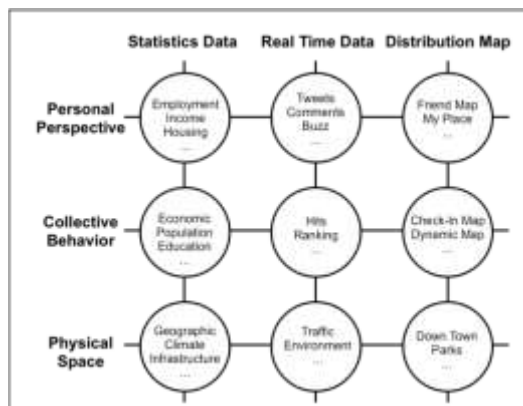


Fig. 2. Three Latitudes of Narrative Structure

Imagine the connection of the flow of real-time road and the data of environmental monitoring, and present it for the citizens in urban streets in the visualization form of dynamic map, then the causal relationship of air pollution caused by trucks will be obvious and lead the crowd to reduce the release of tail gas together through the visualization of historical data. The guide of public participation is far more economical and effective than pasting slogans and issuing policies.

Therefore, the analysis of urban data should consider three latitudes: Statistics Data, Real Time Data and Distribution Map in order to analyse the crucial reason of urban operation.

The Transformation from Narrative Structure to Information Visualization. The study analyses the formation of a city's culture from three levels: physical space, collective behavior and personal perspective and cross creates a mesh narrative structure with three latitudes: Statistics Data, Real Time Data and Distribution Map, which can understand the culture flow of a city from the perceptual perspective but also can find out the trends of a city through macroscopic and microscopic data. Find the connection among all nodes and connect, then it is possible to design a story line to lead the readers understand the pulse of a city.

For net structures, after the linear presentation of the intersection data in the design, a whole city story can be formed. This structure is different from the subjective linear logic of traditional literature, but forms different subjects like transportation, environment, green, river system, and population and so on according to different data. It can also avoid the comprehension difficulty of visualization (multifarious connecting line, intricate change of color, excessive abstract symbols and so on) in data visualization works. With such a structure, the source of driving force (energy) of urban development, the action of energy on cities, and effect of energy on direction of urban development can be better displayed.

4 Construction and Testing of Prototype

The prototype of GeoCity Beijing jointly developed by Design Beijing Lab, Ars Electronica Solution Lab and CMoDA Lab of Tsinghua University has provided new thinking for urban resource management in eco-city. Information display platform of GeoCity can change the static data of the city into dynamic charts, images and pictures through the interaction of Wisdom Pen and books, provide multilevel arrangement, distribution and hotspots according to the map, and insert change information of transportation, weather, municipal administration etc. according to geographical locations.

4.1 Geo-Referenced Interactive Platform

Geo Pulse Beijing is an urban narrative interface made by map and multiple data sets, which gathers information like population, culture, transportation and social media to a dynamic presentation platform and shows the mobility of Beijing in the method of information visualization.

This work visualizes all the numerous and complicated phenomena in the urban region in a global point of view, analyzes the dynamic trends of Beijing through many multidisciplinary perspectives of population map, cultural map, traffic map, environmental map, social map and real time data navigation. The open source system allows the public to put the newly generated data into the system and provides a new thought for the citizens and city managers to understand Beijing.



Fig. 3. The Display Scene of *Geo Pulse Beijing*

4.2 Multi-screen Storytelling System

City story is told in a dynamic way through multi-screen. It supports multimedia content like text, pictures, video, graphics, animation etc., visualize dynamic data, and is connected with Internet data. To click "start", system begins to play in a linear way according to background script. Works backgrounds of 7-screens narrative device are Beijing loop and cable road profile. Seven 21-inch LED screens are set in different geographic positions, and are strewn in well-proportioned way. There are 7 stories such as Beijinger, People Category, Ancient Gate, Foreigner in Beijing, Green Project, Urban Extending, Subway and so on, and each story is about 90 seconds. Interactive equipment is touch screen of wireless connection.



Fig. 4. 7-screens Narrative Device on Exhibition Site

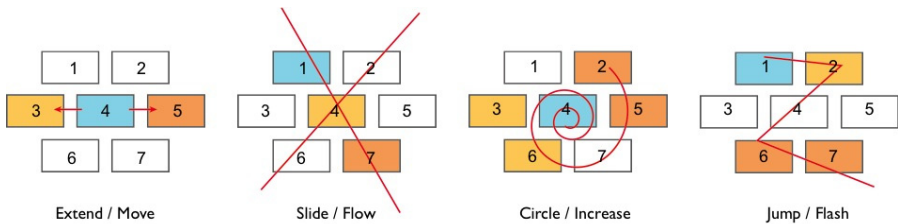


Fig. 5. Playing Mechanism of 7-screens Narrative Device

4.3 Auto-layout Based on Designed Templates

As shown in Fig.5, 7 screen narrative device playing modes can be roughly divided into four kinds: development, sliding, circulation, and jump, which choose different broadcast order according to different data, for example, in story of Urban Extending, Beijing city territory growth process since 1930s uses the developing playback modes, which expands outward continuously from center screen of No. 4, and gradually fill all seven screens.

Irregular playback modes can not only split each screen to display different data independently, but also regard seven screens as a whole picture to show a huge map, which displays in different scales to lead audience to understand macro and micro static data.

4.4 User Testing

Interactive mode of pen and book used by GeoCity Beijing system is easily understood, which can satisfy group requirements with different understanding, including children and the elderly, and has avoided the problem that information visualization system draws back distance from audience because of its complex operation.

Operation of two works' systems is stable, and popularity is larger than expected, however, there still have some regrets. As items placed in exhibition hall, intelligent pens and printing books suffer from many times of falling off and missing, which makes staff at the site replace and debug equipment for many times. If original design has a rope to trap book and intelligent pen words, above situations may be avoided ; it is a big regret that introduction words in books are small, and lamplight in exhibition site is dim, which makes reading inconvenient; the largest regret is multi-screen device; as it has no voice, many viewers did not know what the work used for even after they clicked the "start" There are few people who may leave after watched the seven stories completely, and guide design is not sufficient.

5 Next Step

Through the research project, importance of multidisciplinary overlap for information design is more highlighted. Information design belongs to a new design field, which is difficult to finish the work alone from creation to expression and then to realization. Moreover, the project data volume did not meet expected value, a lot of important data did not access to database, such as one-card data, airport inward & outward information, road surveillance video, etc., did not get API ratification by management departments due to approval procedures and security reasons, which lost more valuable visualization opportunity.

It hopes a good trust relationship will be established with government departments, and all data supporting shall be coordinated by government, to improve quality of public service, and let research results benefits for the Society.

6 Discussions

Future city shall become an interactive space, and ubiquitous sensor of city will make urban infrastructure become a real-time response system, which shall continuously upgrade to meet public use, and percept urban activity changes, and which also has reaction mechanism to deal with city information and to meet demand in real-time. the blending of virtual and reality will become city life's general environment.

An information visualization prototype has been constructed through the project, and then how to convert prototype into practical application, adding interest to life through virtual and reality interaction experience, and helping public service to improve quality shall be considered.

Traffic and atmospheric problem in Beijing now is to reach their limits, which provides a worthwhile challenge subject to design research, reveals relationship among traffic and air pollution, road safety, road congestion through information visualization, triggers thinking in emotional levels for happiness, mood, sense of belonging etc., and guides people to choose low carbon transportation. Games, and applications based on geographical positions should be develop to affect effect mobility in cities and city operating system should be established to gather and disperse city energy from a global point of view.

At the same time, to bring commercial power into research shall also be considered to make research is not only limited to solve problems, but also applied to service through design, which shall give consideration to businessman, users, environment, market other comprehensive factors to make dynamic of urban commercial visualization.

7 Conclusion

After all, urban operation still depends on arousing creativity of every citizen. To gather personal labor together to meet needs of group is the fundamental of city vigor, and packet behavior of information sharing, group wisdom, and network community shall change city innovation mode. Huge data visualization has provided multi-scale observation perspective not only for citizens to grasp the pulse of a city combined with cultural evolution, current dynamic, but also for city managers and decision makers to point out bottleneck encountered in urban development. Multilayer data structure presents relationships among traffic, environment, society, and municipal construction, which provide an idea for further upgrade of cities.

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