

THE SYSTEM OF COLLABORATIVE URBAN PLANNING AND DESIGN BASED ON 3D-GIS AND VR

Xi'an ZHAO^{1,2}, Ping XIAO³, Changhua LI⁴

¹Architecture College, Xi'an University of Architecture and Technology, Xi'an, P.R. China

²National Lab. for Information Engineering in Surveying, Mapping and Remote Sensing,
Wuhan University, Wuhan, P.R. China

³Shaanxi Provincial Geomatics Center, Xi'an, P.R. China

⁴Computer College, Xi'an University of Architecture and Technology, Xi'an, P.R. China

Commission II, WG II/6

KEY WORDS: Virtual Reality technology, 3D-GIS, Collaborative Urban Planning

ABSTRACT:

Based on Geography Information System and Virtual Reality technology, a new system of collaborative urban planning and design is established by publishing the future urban developing and planning information in the urban government Website. With the help of the plug-ins supplied by the system, the citizens concerning with public affairs can interact easily with the server in 3D virtual environment. It is greatly of benefit to change the traditional, centralizing decision-making approach of the urban planning and design into a new decision-making process, by which common citizens, researchers in different fields and decision-makers in the government department can directly participate in. Once the collaborative urban planning system has been achieved, the project about urban planning and design will be more effective, the process of decision-making in government affairs will be more transparent, and it will ensure the urban development in the steady and rapid progress.

1. INTRODUCTION

Over the past few years, Cyber City has become a key issue crossing in multi-subjects leading to the information globalization process. As the politic and economic center of human life, urban greatly affect and prompt the development of the districts around it. After long-term investigation by researchers in different fields, many urban development models such as ecologic urban, globe urban, digital urban etc., have been put forward. Because the limitation of the theory, technology and method in urban study, still some of problems upsetting city progress in all countries, such as explosive population, environment pollution, traffic jam, water resource shortage, urban hot island, culture heritage losing, etc, which need to be dealt with seriously, during the process of urban modernization. In order that our urban can be developed fast and stably, and the process of decision-making in government affairs is more scientific, it is very important that a open, collaborative system of urban planning and design be investigated and established, which will be participated by many experts in multi-fields integrating GIS, virtual reality (VR) and internet technology.

Lots of application research results integrating 3D-GIS with VR have been reported in modeling urban and predicting future city. On the basis of 3D-GIS and VR, Bill Jepson et.al (Bill Jepson, 2000). developed and established Los Angeles' virtual urban environment, which has been used to investigate Los Angeles future urban modal and its environment change among 3D-virtual world. In this paper, it is emphasized that Cyber city is not only to develop relative programs and realize 3D-virtual world, but also should be focused on modeling urban and solving the urban problems by integrating CAD, GIS and VR technology. Recent years, considerable interest has been paid in 3D-GIS and visualization. Danchy et.al developed Toronto virtual city, which is used to study the problems of urban circumstance. Arnard Dela Losa put forward the idea about 3D

topologic model of GIS for realizing 3D visualization. Gruber (1999) constructed the multiresolution management frame relative to the graphics and image data in large city. However, 3D-GIS and visualization are new fields, there are still many key techniques which need to be studied, including 3D visualization, data-sharing and data-translation of multi-platforms among GIS, VRML and CAD.

Computer visualization and simulation are used to graphically represent data and to make its implication clear. Virtual reality, virtual environment, cyber space and tele presence all refer to new technology that creates computer-generated worlds, in which the users can freely walk or fly through virtual space and select the objects of interest by touching, moving or manipulating them. The VR technique used to urban planning and architecture design mainly focuses on the application about VR simulation system. Volker Coors (Volker Coors, Uwe Jasuoeh, Volker Jung, 1999) studied "walking through" frame of 3D virtual world in three different view points. Edward Verbree, et.al (Edward Verbree, Gert Van Maren, Rick Germs, Frederik Ja, Menno Jan Krak, 2000.) present the multi-views virtual interface of 3D-GIS, as well as linking and walking through strategy between GIS and VR. (Fu chen, Peng qunsheng, 1998) investigated the design approach about architecture environment and landscape in the VR table. There is no doubt that the application achievements mentioned above may greatly affect the methods and theory of future urban planning and design. However, high quality and compact VR system should be developed for urban researches.

Base on discussing above, a collaborative system of urban planning and design is proposed. Main function of the new system is to publish the future urban's development information (text, chart, vector graphics, images, maps, and so on.) in government website, which can be interacted by multi-users, walked through in 3D virtual world, and viewed

from multi-views points. After that, the traditional and centralizing system of urban planning and decision-making in government affairs can be reformed into new, open, collaborative system participated by common citizens, officers in government sectors and specialists in different fields.

Main focuses of the paper include three points:

1. The collaborative system of urban planning & design interacted suitably by multi-users in website.
2. The application researches in urban planning and design integrating GIS, VR and CAD, and browser plug-in in VRML.
3. Based on wavelet packet, graphics, images and maps compression technique in internet, and the evaluation methods about the compression property.

2. THE SYSTEM OF COLLABORATIVE URBAN PLANNING AND DESIGN BY WEBSITE

The traditional approach of urban planning and design follows below steps. Firstly the officers in related government sectors put forward the ideas about urban future development. Then, the specialists in urban researches begin to plan and design works according to the ideas. After that, the more specialists, called on by the officers in the government sectors, discuss, revise and improve the project. Lastly the government officers make decision whether the project is adopted or not. Because those officers and specialists participated in urban planning and making decision are limited by their knowledge and ideas, it is impossible that the all problems, which impede urban progress are recognized and avoided in this planning project. There were a lot of unsuccessful examples in urban developing process in the world, which have produced unfavorable influence for the cities' progress. Especially in urban architecture, often we may see such phenomena that a single or several buildings designed are smart, but they are not harmonious evidently with environment and landscape around them. Therefore, based on GIS, VR and WWW, the establishment of a new collaborative system of the planning and design is necessary that the project of urban future is viewed in 3D-virtual environment, and meanwhile all citizens concerning to urban affairs can collaborate the process of urban planning and making decision using internet. The collaborative system of the urban planning & design established in internet consists of three different levels, which are database level, server level and agent level. The figure 1 is showed as follow.

2.1 Structure of Database Level

Database level includes urban GIS, graphics and image database about the planning & design, and the text database of planning scheme. First of all, the interactive manipulation among urban GIS, graphics and image database and CAD data should be seriously settled. It can be said that open geodata interoperability protocols will be a promising way to solve the interaction in multi-platforms. To realize the virtual reality environment in WWW, The data in VRML should also are interacted with GIS, CAD, and so on.

2.2 Function in Server System

Main functions in server system are to publish future information of urban planning and design in special government website, manage, maintain and update the data related to urban future development (including to chart, graphics, image and text in CAD, GIS and VR). In order to fulfill the virtual urban environment and fly through 3D virtual

world, the relative software package is developed in VRML. The distributing information belonging to the different urban departments (land sector, real estate sector, municipal development sector, and so on) is linked by the program in Java language. How can the CAD data in the planning and design be positioned onto urban 3D-GIS environment is a vital problem, which needs to be investigated further.

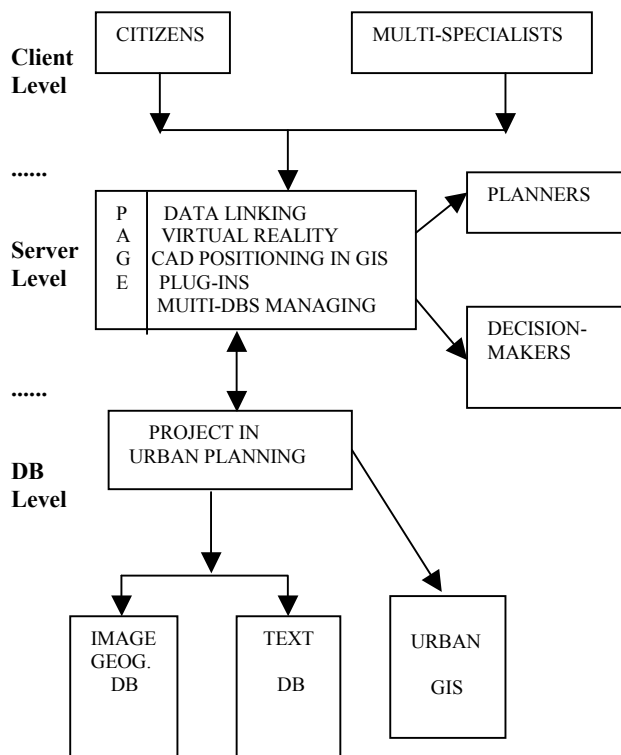


Figure 1.

2.3 Fulfillment in Client Machine

The user interface on the client level includes Web browser built in Java and the special plug-in in VRML. Two kinds of plug-in bestowed the different authority level are supplied to different users in client side. Both plugs-in can be downloaded on the homepage of the special government website. With The plug-in, the common citizens caring for future urban progress can easily browse the urban design & planning schemes and future urban development information among 3D virtual environment, walk-through in virtual urban and view the urban landscape from multi-views, and put forward their opinion in internet. The users that are specialists in different fields can not only view those schemes in this VR environment, but communicate directly their ideas with the planners & decision-makers. Which is to say, they can amend the schemes, then send their new ideas to the server system using the special authorized plug-in.

3. INTEGRATION OF VR AND 3D-GIS AND APPLICATION IN URBAN PLANNING

For the sake of the common citizens understanding and participating easily the process of urban planning and design, 3D virtual urban is built in the relative website, in which one can walk and fly through this virtual environment, inspect this

future city from multi-view points. With the help plug-ins downloaded from the government website, the citizens can interact with the server and express themselves ideas, and directly take part in planning and design urban future.

3.1 Virtual Reality Modelling Language: VRML

The Virtual Reality Modeling Language (VRML) is a standard data description language that allows the definition of the geometry, display attributes and motion of 3D world. The origin of this standard is related to the interaction of developments in the fields of advanced computer graphics and virtual reality with accompanying spread of the internet as a means of communication. (Phyne, 1999, Edmund Sides, 2000). Although it enables to convert 3D-GIS data and geological models into VRML format, and view the urban information in 3D virtual world with a VRML browser, the DWG format of CAD data in planning and design, TIFF, JPEG, GIF, etc in image data, Arc/Info, Geostar, etc in urban GIS, as well text data, how those data are transformed each other is still not solved completely. More difficulties are in identifying object, positioning, orientation and scale in GIS system, which are key issues for realizing the system of collaborative urban planning design.

3.2 Browser Plug-in Realizing the Collaborative System of Urban Planning and Design

With the help of browser plug-ins downloaded from the urban government website, clients can view and recognize the development information of future urban in 3D virtual environment. In order to the security of the system, the visit authorization should be granted according to different user level. The highest visit level is given to the specialist in city research fields, so that they can view the information of urban future, also exchange their ideas with the planners and designers who have participated the planning process, and revise directly the planning project in the virtual urban environment in website. Other users can only view future urban from different view points, walk through 3D virtual environment and send their ideas to the main server system. On the other hand, key issues solved are how distribution geography data, planning information, text data of the planning project are linked and different scale geography data, planning and design plots are integrated, when the browser plug-ins are developed.

4. IMAGE AND GEOGRAPHIC COMPRESSION IN INTERNET BASED ON WAVELET

The urban virtual environment realized in WWW involves the bulky data process in graphics, images, charts, text and so on. Those graphics and image datum files commonly contain a considerable amount of information that is redundant and much that is irrelevant, making them prime candidates for modern compression techniques. Image compression techniques exploit the inherent redundancy and irrelevancy by transforming image file into a smaller file from which the original image file can be reconstructed exactly or approximately. The ratio of the two file sizes (compression ratio) specifies the degree of compaction. The wavelet compression is a new technique investigated widely in recent years. The wavelet transform or the multiresolution analysis decompose an image into the detail part in high-frequency and the smooth part in low-frequency. The better way of wavelet image compression is the wavelet packet. On the process of filtering farther the both parts above-mentioned, the results filtered are stored. Then, the

optimization base is selected from the wavelet packet, based on the principle of the destination function equals the least. By experiments, the wavelet packet technique is more effective than the general wavelet transforms on image compression.

The image quality is another issue that should be studied, when image is restored from the compressed image. There exists always a trade-off between the compression ratio achieved and the amount of information lost. Normally, the human eye is the ultimate judge of whether the information loss is acceptable or annoying. Often the quantitative measures of image degradation do not agree well with the preferences of the human eye (Kenneth R.C. 1996). The farther work needs to be investigated in the image quality.

5. CONCLUSIONS

Utilizing VR and 3D-GIS technology, the collaborative system of urban planning and design is investigated and developed. During the planning and design, the planners and urban designers can communicate with different persons concerning to the urban future by plug-ins in 3D virtual environment. If citizens, multi-subject specialists and decisionmakers participate easily in urban planning and design, the many drawbacks in the projects of urban design can be found and improved in time, before any new project in urban start to be constructed. The project about urban planning and design will be more scientific, the process of decision-making in government affairs will be more transparent, and it will ensure the urban development in the steady and rapid progress.

ACKNOWLEDGEMENTS

We are grateful to support from the Natural Science Fund of P.R.China (No. 49971069), Science Fund of Shaanxi Province, P.R. China (No. 2001D09), and Science Fund of Education Committee of Shaanxi Province, P.R. China (No. 00JK212).

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