Participatory Comprehensive Plan based on Virtual Geographical Environment

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ABSTRACT

Comprehensive plan, as a participatory plan-making process, would involve a genuine and efficient communication between planners, citizens, decision makers and other professionals. In this system, many new technologies have been employed. This paper, introduces Virtual Geographical Environment (VGE) into this field tentatively. VGE, set up to simulate and then resolve the geometrical and physical modeling of the real world in cyberspace, makes Web-based 3D visualization feasible. Through Internet, distributed users can participate in the VGE, and browse, analyze as well as discuss same geo-referenced phenomena and process at the same time. Based on this idea, this paper first reviews the current techniques applied to public participation, especially some information and communication technologies, such as geographical information system (GIS), virtual reality (VR), and Internet, then systematically examines the salient problems in current public participation, and lastly, preliminarily presents the methodology of the solution based on VGE.

1. INTRODUCTION

Comprehensive plan refers to the most basic plan prepared to guide the development of the community (Levy, 2000). One characteristic of the comprehensive plan is its physical covering of the entire community, including all subject matter related to the physical development of the community: land use, transportation, water and wastewater, drainage, parks and open space, school sites, other public and institutional activities, floodplains, and wetlands (Kelly and Becker, 2000). This reflects that, to make the plans, several disciplines are included, such as: planners, geographers, economists, environmental scientists, architects, civil engineers, and public administration and policy specialists, who need to communicate and collaborate with one another during the planning process. Another characteristic of the comprehensive plan is that local governments carry it out – the level of government that most directly interacts with most citizens most frequently (Kelly and Becker, 2000). Thus, the comprehensive plan process should open to the citizens of the community, so that they can be involved to the process to know, understand, accept, or object the plan, even recommend solutions or make final decisions.

For the above reasons, the comprehensive plan should be a participatory plan-making process. A genuine communication between planners, citizens, decision makers and other professionals must be built up. The goal of the paper is to illustrate some preliminary steps toward incorporating the theories and technologies of VGE in the area of participatory comprehensive plan. The hypothesis of this paper is that the public includes citizens, decision makers and other professionals.

The remainder of this paper is divided into 5 sections. The next section introduces the definition and features of VGE and analyzes the relationship between VGE and comprehensive plan. The third section reviews the current techniques for public participation, especially some information and communication technologies, such as GIS, VR, and Internet. The forth section systematically examines the salient problems in current public participation, and preliminarily presents the methodology of the solution based on VGE. The last section gives the Conclusions.

2. BACKGROUND: VGE AND COMPREHENSIVE PLAN

2.1 Virtual Environment and VGE

The concept of VGE is derived from virtual environment, which is digital simulations of situations, real or fictional, and in which users are able to participate (Batty, Dodge, Doyle, and Smith, 1998). The main difference between traditional VR and virtual environment is that traditional VR focuses on the connection of single user through some VR hardware to their virtual worlds, while virtual environment focuses on the interaction among multiple users located in distributed places of real world in a virtual society. Thus, virtual environment can also be called online VR.

Virtual environment to date has been used in many kinds of research field, for example games industry, anatomy, urban planning, and so on. Base on virtual environment, somescholars (Gong, Lin, 1999) presented the concept of VGE. They thought if virtual environments simulate or represent geographical environments in reality or in possibility, or if virtual environments describe geographical phenomena and processes, the virtual environments will specially be the VGE. There are two ways to understand virtual geographical environments. From the perspective of tools, as application systems, geographers can use it to compute, analysis, interpret, verify, and discuss on geo-referenced data and phenomena, for example, spatial planning and decision-making. From the perspective of system, as evolving and self-organization systems, VGE can provide the humans with space and places to live in social, economic, and political ways. The interaction between virtual geographical environments and real ones and their gradual integration and fusion will greatly remake our humans, and reshape this world. In this paper, I prefer to the first perspective, because although providing the simulations in virtual worlds for rapidly changing real worlds is essential, but it is really very difficult, even impossible, at least with the current information technologies.

2.2 The Main Features of VGE

As application systems, a fourfold paradigm is central to the construction of VGE, representation, connection, interaction, and spatial analysis.

- Representation

Visual and non-visual information of real geographical environment are represented in VGE. Visual information includes geo-entities and users. Geo-entities can be embodied with 2-D (map-based) or 3-D models. But in order to give the users an immediate sense of visual realism, 3-D models are employed in the majority of VGE. Distributed users usually appear in visual terms as avatars, which are usually scaled to the 3-D scene and are more commonly use to represent many users in remote contexts. Non-visual information embraces any kinds of attribute data of geo-entities and users, for example, users' names. Labels, symbols, hints, memos, and some other issues attached with geo-entities and users can be used to display the non-visual information.

- Connection

VGE comes from virtual environments, which are based on online VR. Thus, network, particularly Internet, becomes a key part of VGE. It provides multiple users with the virtual space that can be accessed from distributed locations with or without permissions.

- Interaction

Based on connection and representation, users from different locations, after logging in, can interact with each other, and interact with the virtual geo-entities in VGE. Through avatars representing different users, they can "see", hear, talk to other users. Also, users can explore and manipulate the virtual space and objects through human-machine interface. Thus, the interaction in VGE is a twofold concept; one is avatar-avatar (human-human) interaction, and the other one is avatar-virtual environment (human-environment), just like in real world.

- Spatial analysis

To date, GIS can be used to do some 2-D or 2.5-D spatial analysis, while VGE will implement some functions, which are more suitable for 3-D space. In VGE, 3-D spatial analysis is more straightforward, and the result is more understandable, for example, 3-D cross-section analysis. Furthermore, Benefit from the interaction of VGE, the way of analysis will dramatically change. Different geographers can be involved into the same analysis, choose the fitting algorithms collaboratively, adjust the parameters and discuss the results.

2.3 The Relationship Between Comprehensive Plan and VGE

Traditional urban planners use maps printed in paper to explore urban environments, understand urban problems, and design new urban structure. In VGE, real urban environments are simulated. Urban information will be able to be accessed and understood more scientifically, conveniently, and quickly. Planners can get the immediate sense of city, freeing from the limitation of space, time, and human natural abilities.

With urban models in VGE, where a lot of spatial and non-spatial data have been organized and managed in place, many complicated planning models which is formerly impossible to be built up because of the lack of advanced information technologies, will be realized to support the decision of planners.

Furthermore, the result of planning will be virtually implemented in VGE, just like in real world. Everyone can get correct understanding about the planning, and decide whether it's feasible for real practice.

Thus, it can be said, VGE provide comprehensive plan with a platform integrating latest information technologies, tools, and geo-reference data. The relationship between them is the infrastructure and superstructure. For the perspective of application, VGE finish the work of geometry modeling and physical modeling, while comprehensive plan deals with behavioral modeling. Figure 2.1 describes the relationship between Comprehensive Plan, VGE and real world. The entities of real world become informationlized 3-D models in VGE, which bring these spatial information and non-spatial information into an integrated platform. Based on it, comprehensive plan can be analyzed, designed, and virtually practiced. After checking the effect of the planning result in VGE, planners can apply it to real world.

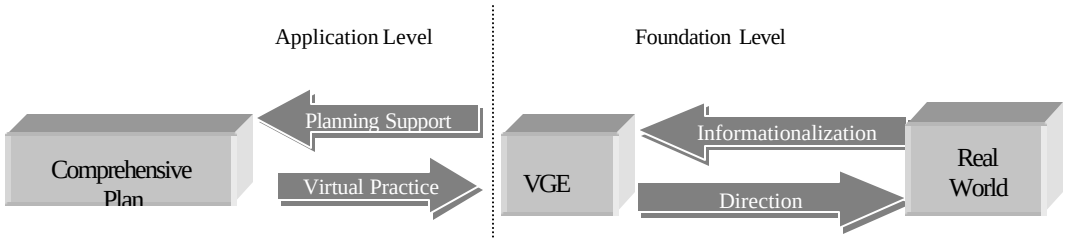

Figure 1. The relationship between Comprehensive Plan, VGE and real world

There are many facets in comprehensive plan that can benefit from VGE, from information collection to analysis to design to practice. In this paper how to apply VGE to public participation will be discussed at the following part.

3. REVIEW: PUBLIC PARTICIPATION IN CURRENT COMPREHENSIVE PLAN

According to Vindasius (cited by Weidemann and Femers, 1993), public participation in plan can be classified into 6 levels, just like fig. 3.1. In the first or bottom level, public has only the right to know what the plan is doing. In the second level, the concerned government has the responsibility to inform the public what the plan is doing. In the third level, public may only say yes or no to some planning action. Hereto, there is no real participation yet. The forth level is the very first level of participation (Laurini, 2001). Since this level to the highest level, public may have the right to react and amend plan, including defining interests, actors, determining agenda, assessing consequences, recommending solutions, and even final decision.

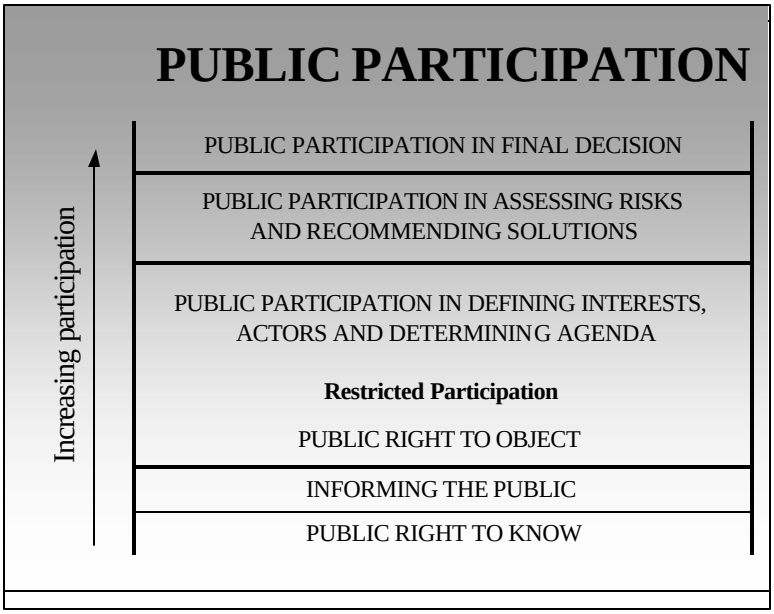

Figure. 2. The public participation ladder (*Source: After Weidemann and Femers, 1993*)

Before information technologies were applied in planning practice, there are four types of public participation (Kelly and Becker, 2000):

- **Public meetings** include public hearing, community-wide meetings, and neighborhood-meetings, at which citizens can voice their concerns and views. It is the most traditional kind of public participation. It occurs early or late in the process.

- **Stakeholder group meetings** are held at the beginning of a planning process. Known stakeholder groups include neighborhood associations, environmental organizations, chambers of commerce, homebuilders, bankers, economic development groups, leagues of taxpayers and interested citizens, and other known interest groups. These meetings are particularly useful for issue identification.
- **Focus group** typically involves a group intended to be reasonably representative of a community, to which the planning agency poses one or more questions on which it would like to assess the larger community's probable views.
- **Survey** is the best way to get representative views. Survey techniques vary significantly and produce different sorts of results. Planners are more likely to use the open survey, which is often cheaper and easier to administer and involves more people.

More or less, all above manners of participation have two major disadvantages. One is the cost of time and effort to attend and handle multiple meetings or discussion. The other one is the composing of attendees, whether they can represent the majority of the community. Thus, over the past decade, some planners begun to apply some advanced information technologies to public participation, especially GIS and Internet.

With the rapid growth in accessible and affordable geo-data, and the nature of the developments in GIS, moving the field from being primarily technology-driven to being more user-driven (Geertman, 1999), the application of GIS within planning practice has increased. The situation that only professionals can use GIS has been changed. Now GIS has become more accessible with the emergence of relatively cheap and easy-to-handle Windows-based tools (Geertman, 2002). With these tools, lots of planners and even general public can explore geo-data and use spatial analyzing facilities immediately without long-time training. Furthermore, with the tremendous development of communication technology, especially Internet, more public information can be accessed more conveniently and quickly. The integration of Internet and GIS has given birth to Web-GIS, which makes the application of GIS more wide. Some authors (Nyerges, Barndt, and Brooks, 1997, and Jankowski, 1998) have brought out the idea of "Public Participation Geographic Information System" (PPGIS), which can be used and understood by the general public, and is accessible to all sides of policy debate through Internet (Barndt, 1998).

Based on Web-GIS, at the University of Leeds, UK, an interesting planning exercise has been performed in liaison with the village of Slaithwaite (http://www.ccg.leeds.ac.uk/slaithwaite/). It is a Web-based and 2D PPGIS. All Users can explore (zoom, pan, and full view) the planning map of Slaithwaite in this web site, and present their comments about the planning. The system can save all the input for future analysis and feedback into the planning process. Another typical example is the "Openspace" of Salford University (http://www.ties.salford.ac.uk/pg/xiao/openspace-main.html). In order to represent the real urban environment better, Virtual Reality Modeling Language (VRML) and Java programming languages are employed in this model. A 3D environment was built up in their website. Different viewpoints and exploring speeds are provided, and once users enter the virtual environment, then can "walk" or "fly" to visit the virtual city. Just like the former one, users can leave their comments in any spatial location. If there is a comment left, an icon will appear. Users can check all the comments left by previous users.

Including above ones, there are a number of good examples where Web-based 2D or 3D PPGIS has been used in an experimental guise for research purposes, but there still seem to be a number of new barriers to widespread institutional adoption (Carver, 2001). There are two major barriers. The first one is the feasibility for general public to handle so many information technologies. Not all citizens have the ability to access Internet, to understand those virtual models and signals. The second one is to realize the real public participation in detail. To date, most models can make users to explore the virtual urban in 2D or 3D view. But users can't get the feeling of being involved, because they are alone in the virtual environment and map space without discussion, which is a most essential point of

participation, and can be implemented easily in traditional public participation, like public meeting. Furthermore, the roles of different users have not been defined and maintained. Each comment, no matter from trained professional or general public, has to be regarded in the same priority, which would inevitably result in waste of resource to certain extend. Everyone can express his or her comments, no matter trained professional or general public. In traditional public participation, it is very obvious to distinguish public, professionals, stakeholder, and planners. Thus, the following sections will try to patch up these hiatuses.

4. PROBLEMS AND SOLUTIONS: THE PUBLIC PARTICIPATION SYSTEM SUPPORTED BY VGE

4.1 The Requirements of the Public Participation System Supported by VGE

The traditional town-hall meeting or public hearing at least have two obstacles: the dominant vocal few and the inflexibility of meeting time, while Web-based PPGIS has overcome them partially. But it's still very difficult to totally replace the traditional methods with the new one, because the hiatus exists between technological possibilities on the one hand and the practical realities of the planning system on the other. So in order to really replace and enhance the current public participation, the requirements of the public participation system supported by VGE should included the following five points:

- It should be Web-based to ensure that most public could get the right to participate the planning process fairly and freely.
- It should use intelligible virtual models to represent the actual and the planned city. As well as professional planners, most users of the system would be general public, who maybe understand the planning differently from one to one. In order to reduce the difference as possible as it could, the virtual environment composed with virtual models should be presented just as real one. Thus, 3D models with texture must be employed.
- It should provide flexible and easy methods for untrained public to explore the virtual environment and participate the planning process. A friendly user-machine interface is necessary.
- It should provide a platform based on which users can discuss with others at the same time as looking around the virtual city, just like the traditional town-hall meeting, except more flexibly and directly than it.
- According to users (attendees), different types of virtual meetings should be hold in it, and different functions and access rights should be designed and developed.
- It should be able to rationally and efficiently organize the left comments and discussing records to support planners to make decisions.

4.2 The System Structure

According to figure4.1, the system can be divided into three levels.

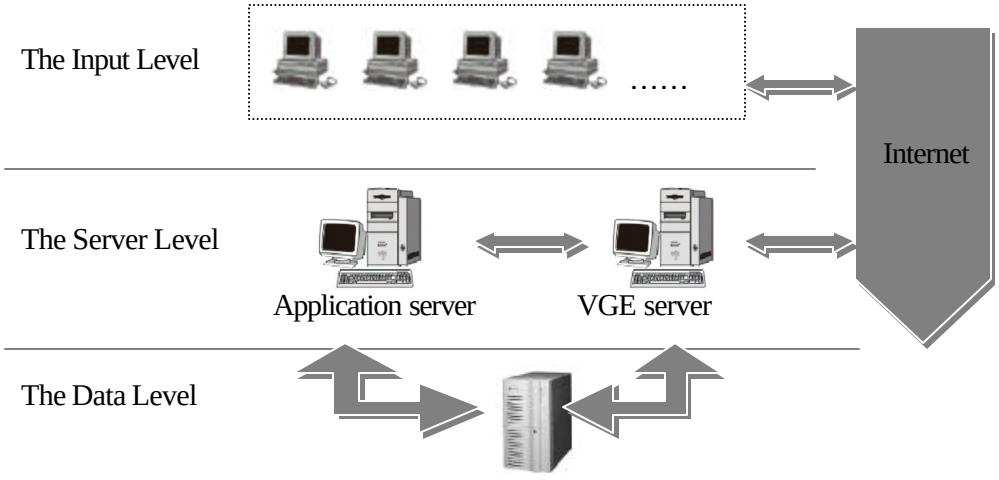

Figure 3. The system structure

- **The input level**

In this level, citizens directly explore the virtual city, discuss and participate the planning process through user-machine interface under the network. The hardware used to access currently is personal computer, but in future, it may be digital television (Carver, 2001). At first, citizens sign in the system with username and password, which can be applied from government. Then the system can get some personal information from users' input, including career, age, gender, living place, interests, and so on. According to the information, the system can distribute them into different virtual meeting rooms. The citizens can select or use the default avatars to represent themselves in virtual city. The input level enable citizens to sign in, explore, discuss, and leave comments.

- **The server level**

There are two kinds of servers in this level, VGE server and application server. VGE server is responsible for the basic functions, including building the virtual city, accepting users login, processing users input, providing communication between users. Some users' input will be executed by VGE directly, for example exploring orders (walk, zoom, locate, and so on), and some other input will be transferred to application server through VGE server. Application server is for public participation especially. The major functions of it are defining and maintaining virtual meetings, analyzing and managing the meetings' result or the comments. In order to guarantee the responding speed of servers when the number of users increases tremendously, more servers need to be added in this level, no matter VGE server or application server.

- **The data level**

Geo-reference data, users information, and participating result are saved and managed by database management system in this level. Based on these data, VGE server and application server can do something about modeling, analyzing, and so on.

4.3 Preliminary Study on Implementation of the methodology

Although it seems as if this system is similar like PPGIS, there are still a lot of differences between them, for example the system platform. This system is based on VGE. Thus, how to build VGE is the first thing to be done. To date, in most cases, VRML and Java are employed. VRML is a modern 3D presentation language, has the strength of concise expression, includes 55 operators (both graphical and interactive), and is supported natively in Netscape Communicator (Pesce, 1997). However, VRML is more like a modeling language rather than a programming language. Thus, some tasks are difficult to be done with it, for example, to get users' input from a form or a server-side script into a VRML world. Thus, Marrin, one of the chief architects of VRML 2.0, defined an API, a set of routines collectively known as the External Authoring Interface (EAI), that provides a mechanism for connecting Java applets and applications to VRML worlds (Pesce, 1997). So thus, the co-operation of VRML and Java makes VGE feasible. Java is to date the most popular language for Internet programming. VRML is used to create and maintain the models, and Java is used to do the rest things. A good example of them can be found in JLGIS (http://www.jlgis.cuhk.edu.hk).

Based on VGE, the part of public participation will be implemented. Generally, it is three-fold. Firstly, compared with PPGIS, discussion groups are added in this system. Thus, only getting the comments left by users is not enough. The discussing process must be managed, and then the discussing result will be captured. Secondly, the information and comments will be saved into database. Basic data

operations should be implemented. The most important one is data query. Thirdly, some thematic application should be built up. It will be useful for planners to integrated isolated points into some meaningful ones.

5. CONCLUSIONS

This paper demonstrates that VGE is a suitable technology to realize public participation in cyber space. For the two major problems existing in traditional public participation, the dominant vocal few and the inflexibility of meeting time, PPGIS has resolved them partially. But the correct representation of real and planning urban environment is still difficult to reach. Furthermore, the users can't get the real involved feeling. Thus, VGE, according to its features, could be considered to employ in this field. This paper has given some very preliminary ideas. A three-level system structure is designed. But, more detail working need to be done in the future, for example to build up the VGE platform, to define the business logic, to develop the application system, and so on.

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