주민참여를 위한 환경디자인 지원 시스템 개발에 관한 연구

The Development of an Environment Design Supporting System for the Participation of Residents

여 욱 현 ▌Yeo, Wook-Hyun

정회원, 연세대학교 밀레니엄환경디자인연구소 연구교수, 공학박사

김 미 연 ▌Kim, Mi-Yun

정회원, 서울디지털대학교 디지털디자인학과 교수, 이학박사

Abstracts

환경디자인은 건축, 도시, 조경 등 서로 다른 분야의 전문가 및 대상 지역 거주하는 일반시민 등 많은 참여자를 가지는 특징이 있다. 이러한 협조설계 단계에서는, 시행착오를 최소화시키기 위해서 디자인 초기단계에서부터 각 분야의 전문가들이 계획에 관해서 협의하여 디자인 내용을 변경해 나갈 필요가 있다. 또한 대상지 지역을 누구보다 잘 이해하고 있으며 계획 후 이 지역에 살게 될 주민들의 참여도 환경디자인 단계에서 고려해야 할 중요한 요소 중 하나이다.

여러 분야의 전문가 또는 비전문가들이 서로 커뮤니케이션하고 협조하기 위해서는 누구나가 쉽게 디자인 내용을 이해 할 수 있는 커뮤니케이션 툴이 필요하다. 이러한 필요성을 만족시키기 위해서는 빠른 구축속도, 대화형 기능, 빠른 표현속도, 사실적인 표현기술 등이 필수 조건이라고 할 수 있다. 본 연구에서는 이러한 환경디자인 분야의 전 분야에서 의사결정을 지원하고 디자인 안을 검토할 수 있는 3D CG 시스템을 개발하고 이 시스템을 실제 프로젝트에 적용시켜서 활용하면서 개발된 시스템의 기능강화를 추진하며, 실제 프로젝트 적용을 통한 시스템의 평가를 진행하여 본 연구에서 개발한 시스템의 유용성을 증명하는 것을 본 연구의 목표로 한다.

Keywords

Environmental Design, Design Supporting System, Real-time Simulation, Design Analysis, Citizen Participation

키워드

환경디자인, 디자인지원시스템, 실시간시뮬레이션, 디자인분석, 주민참여

* 본 연구는 2012년도 서울디지털대학교 학술연구비 지원 연구의 일부임

1. Introduction

The environmental design belongs to the new field of designing surrounding environments extensively, and covers various fields in design, including architecture, urban planning, civil engineering, and landscaping. In covering these extensive fields, designers, specialists in each field, clients and the general public will participate in the project, and it is important for all these people to communicate and cooperate. A collaborative system among the participants in the initial stages, which will determine the overall design policy, is creative and holds the major position in the whole process of design, is a key factor in the successful implementation of the overall project.

Thus, it is essential that the participants share their ideas, opinions, and values to progress the project in a collaborative system. Especially, in the initial stage of the design, it is necessary to visualize the common ideas of the participants for the plan.

The existing tools of communication include maps, sketches, pictures, etc. However, it is not easy to understand details by using existing media, such as maps or pictures. Especially, it is more difficult for the general public or clients who do not have the expertise in certain fields to interpret the details in the planning through maps, sketches, etc. Even among experts, only a small minority understands the natural environment of the target development area by using such data.

Thus, with the existing media, it is sometimes impossible for experts, as well as non-experts, to understand the contents of the plan. Therefore, a streamlined communication among the participants was hardly achieved, and a greater length of time is required to express their opinions. With the rise of the computer system as a tool in resolving such problems, computer graphics have been utilized in various environmental design projects in the last 10 years. Owing to the development in computer technologies and software, the environmental design using a real-time simulation system was enabled recently.

2. Urban regeneration

The rise of suburbanization in the U.S. and British metropolitan areas was initiated in the 1950s, stepped up in the 1980s with urban restructuring, and has brought about many of urban problems as metropolitan districts proliferate. First, waste of energy and resources occurs as a result of long distance commuting. Second, such social problems as urban alienation, crimes, and unemployment are soaring. Third, sparse utilization of urban land and the destruction of the ecosystem have surfaced, and thus, with reurbanization in the late 1980s, policy changes and practical research have been led for urban renaissance in cities where sustainable developments are required.

Peter Roberts (2000) defines urban regeneration as “a comprehensive vision and action to solve problems caused by economic, physical, social, and environmental conditions in a city.” That is, urban regeneration curbs a disorderly expansion of a city and urban center decline, instead promoting the regeneration of urban areas “to strike a stable balance between the economic development and natural conservation.”[1] Urban regeneration is significant in that it helps form a strategic stronghold for urban exchanges, conserve and foster local communities, revitalize urban industry, and finally rebuild urban structures. As such, local residents’ eager participation is required to accommodate these needs.

As mentioned in the book written by Henry Sanoff(2000), technologies such as Awareness methods, Indirect methods, Group interaction methods, Open-ended methods, and Brainstorming method are used for supporting residents′ decisiom making process. He(2006) asserts that the

1) Roberts, P. and Sykes, H. (ed).:2000, Urban Regeneration: A Handbook London: Sage Publication

satisfaction level of users in the participation designing process differs according to how much the users think their opinion has made influence in the process of decision making rather than how well their needs have been fulfilled. Therefore, Decision Support System easy enough for the public, not just experts, to use needs to be developed.[2] Also, in the research of Han(2007), resident's participation is classified into systematic participation and nonsystematic participation according to the method and range of participation. The form of the decision making system needs to be changed according to the method and range of resident's participation in the process.[3]

Besides, to enhance intellectual productivity needed in this information age, it is required that humanism be respected and agreeable living environment be maintained. Generally, 'sustainable development,' as defined in the 1987 WCED (World Commission on Environment and Development), necessitates a citizen-led environmental, developmental, social, and economic council rather than a government-initiated organization holistically combining environmental protection, care for the future, quality of life, and equality.

As mentioned by Detlof and Ward, DDS(Decision Support System) includes a wealth of techniques for model construction, such as methods for elicitation of model structure and probability distributions that allow minimization of human bias, methods for checking the sensitivity of model to imprecision in the data, computing the value of obtaining additional information, and presentation of results.[4] In Marek and Roger's research, it says " A good user interface to DSSs should support model construction and model analysis, reasoning about the problem structure in addition to numerical calculations and choice optimization of decision variables."[5] With this research goal, this study, to reflect local residents' opinions in the planning process, seeks to develop a communication tool in which local citizens easily participate, and thus better establish a means of environmental development.

In this study, it was aimed to develop a system that can utilize such real-time simulation as a supporting tool in the early stages of the design, instead in the checking stage of the design, which has been utilized so far. Specifically, the main objective of this study is to develop a system where the designer can correctly understand the status of the surrounding environment and other necessities before the designer can proceed with the design, can easily check the existing plan or his ideas, and can easily explain his plan to clients and the other people concerned.

3. Participation techniques

Participation techniques involved as a result of the criticism of citizen involvement as being time-consuming, inefficient, and not very productive(Rosner, 1978). The key to making community design work effectively is a range of techniques for enabling professional and lay people to collaborate creatively. The techniques for decision making of people are classified in five major categories: awareness methods, indirect methods, group interaction methods, open-ended methods, and brainstorming methods.[6]

In particular, as digital media is well advanced now, citizen participation includes digital technology,

2) Henry Sanoff, 2000, "Community Participation Methods in Design and Planning", New York: John Wiley & Sons

3) Sang-wook Han, 2007, "The Method for Enhancing the Participation of the Residents for the Effective Urban Maintenance and the Promotion of Urban Renaissance Project", Chungnam Development Institute, p.19

4) Detlof von Winterfeldt and Ward Edwards, 1988, "Decision Analysis and Behavioral Research". Cambridge University Press, Cambridge

5) Marek J. Druzdzel and Roger R. Flynn, 2002, "Decision Support System", Encyclopedia of Library and Information Science, Second Edition, Allen Kent (ed.), New York: Marcel Dekker, Inc.

6) Henry Sanoff, 2000, "Community Participation Methods in Design and Planning", New York: John Wiley & Sons, pp.67~76

and digital media may have a significant and strategic role to play in facilitating communication and collaboration in a variety of settings. Following are the examples of citizen participation using digital technology.

3.1 Video conferencing

It is a one-to-one communication, which means that all participants have equal status and no one person is in control of the conference. CU-SeeMe is a real time, desktop videoconferencing program at Cornell University that provides the ability to transmit and receive digital audio and video on personal computer.

3.2 Simulation modeling

It uses technology immediately useful for participation practice combining video, CD-ROM, and computer. SimCity(Bremer, 1993) is a CD-ROM city simulator game that allows the player to design and build small rural towns or large megalopolises. Maps of cities from all over the world are available to allow the participant to improve on a favorite city.

The VisionDome, a collaborative virtual environment, is an interactive digital display that enables group interaction around a shared application. The Center for Housing Innovation Initiated the Net Energy Communities(NEC) project to creat computer-based decision support for public participation in neighborhood planning and design(Kellett, 1998) NEC develops four tools: Site Modeller, Elements of Neighborhood, Scenario Modeller, and Scenario Calculator. They helps charrette participants define site-specific issues and circumstances influencing their development choice, increase the generation of acceptable alternatives, and measure alternative scenarios against common indicators of energy, environment, community, and cost.

In urban regeneration, the civil participation, utilizing these techniques, may be taken in a variety of ways, and the level of citizens' influence is realized differently on how to participate. The level of the civil participation is determined by professional- autonomous planning, representative expression, inquiry, regionalism, conversation, presentation of alternatives, collaborative decision-making, self-decision, and user-autonomous decision-making, among which Wulz (1999) indicated the user-autonomous decision-making as the most important factor in creating a proper environment for local residents. Considering their unique characteristics, cities around the world have tried to make multiple urban regeneration programs, extended partnership with the organizations interested in urban revitalization and the quality improvement in urban life, and therefore underscored the role of communities where there occurs an eager civil participation. Likewise, when local residents make plans for an environment suitable for their own interests and are given a corresponding role, an active civil participation is made possible with a high level of satisfaction.

The primary goal of this research and development includes the creation of a participatory tool where diverse digital information may be optimally processed, and as such it may be required that an active participation of local insiders be needed. A passive civil participation technique involves circulation, and its active counterparts contain public hearing and workshop (Reference). However, when communication, one of the most critical factors of these techniques, is not clearly provided, information sharing, opinion collection, and its reflection can hardly be made. To iron out this problem, this tool, as a communication tool that utilizes multimedia, comes up with a new civil participation technique incorporating 'mesh-up' to better support the participation by citizens as well as professionals.

4. Online-based civil participation service

To foster an eager participation by citizens, as described above, with the use of the Internet the Web-based civil participation tool is required to be

developed and put into a wider use.

Interactive community services have been widely available since the Web 2.0 came into service. First, as in the case of Google Earth , local information is shared by using Google Sketch-up that generates 3D models and thus local images are uploaded by the users. Second, WikiMapia, based on Google Map, is made available by the worldwide users that upload tags to the local information. Its service has made global information possible.

Figure1. Visualizing urban information by Google Earth(Left) and a district tag of Wikimapia(Right)

Many in this globalized world upload their own user-created contents and concurrently share information with other users real-time. Noticing this worldwide trend, this study aims to develop a civil participation tool equipped with the Web-based annotation system.

5. Methodology

In our research team, the e-sketch was proposed recently as a design method in the initial stage of the design, and the study on the collaborative activities among the participants was implemented using a 3-D system that was visualized from the initial stage of the design. This study is a part of such study and it was possible to reduce the modeling time by using a modeling method that could reduce the time required to visualize the concept. Using the model based on the said method, a 3-D real-time simulation was designed.

As an example for this study, the actual project in my laboratory was used, and the real-time simulation system was established, based on the e-sketch method. The project that was used as an example for this study is as follows.

The China Qingdao Industrial Area Project: This is a project aimed at developing an area of 64 Square kilometer, which is currently being utilized for agricultural and residential purposes. In this area, a plan was made to construct a massive industrial complex to house the plants of foreign companies. The overall scheme of the project is to determine the location and design for the plant section, the residential section for 300,000 plant workers, and the central section as the center of business and administration. In this project, the aim is to construct an industrial city that is in harmony with the surrounding natural environment, specifically, in line with the residential sector, considering the flowing river and the central commercial sector in the intersection of such flow.

The China Qingdao University Area Project: This is a project that is aimed at constructing the centralized area of twelve (12) universities within the existing agricultural area. In this project, the plan was to locate three main roads in the total area of approximately 50 Square kilometer, and to locate the university sector, the industrial exchange sector, the commercial sector, the business sector, the centralized university facilities sector, and the residential sector near these roads. In this project, the design focused on the utilization of the mountain and island sceneries. Specifically, the plan was to plant two (2) million trees on the axis to the islands to see the island at the center of this axis from any angle.

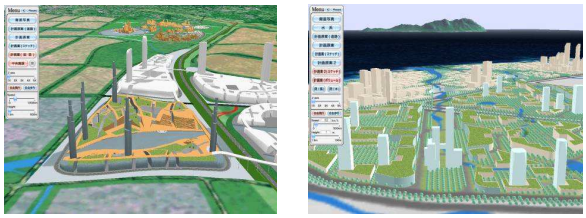

Figure 2. Industrial Area Project in Qingdao China(Left) and University Area Project in Qingdao China(Right)

The China Qingdao Langyatai Resort Development Project: This is a project to develop a resort area near the 14 km-coastline near Langyatai, a famous and historically meaningful tourist attraction. The two projects involved

planning to remove existing residents. However, it was decided that existing residents need not vacate the area, and private rooms would be utilized. While maintaining the existing facilities, sports facilities, lodging facilities, recreation facilities, and central facilities will be designed accordingly. The area spans a total of 25 Square kilometer. In this project, the design is aimed at utilizing the existing natural environment, as well as to allocate facilities based on the expected demand after this resort area has been developed.

The China Qingdao Jiaonan Administrative Central Area Project: This is a project aimed at developing the existing town area, including the city hall that is at the center of Jiaonan City.

This area is important in designing as it is a portal to Jiaonan City. It was designed to create a natural park near the city hall, to locate a wetland park in where the nature experience is available in the confluent area between freshwater and seawater areas, and to plant trees in the surrounding residential areas to ensure a coordinated image.

Figure 3. Langyatai Resort Project in Qingdao China(Left) and Jiaonan Administrative Central Area Project in Qingdao China(Right)

6. Key Technology

Various tools, including the existing modeling tool and the image edit tool, were utilized in the development of this system.

Among them, the main technology used was the real-time simulation. As can be seen in the papers written by Lou and Yeo, this real-time simulation uses the Microsoft© Direct3D® technology of existing game development environments. With the help of this technology, a high-speed rendering was used, despite the use of massive polygon and mapping materials. Specifically, it was used in rendering with the speed of 10 FPS in the industrial complex project, in which 900,000 polygons of data and 54 MB of mapping materials were used. In this study, the interface for a real-time simulation system was developed and added to the function by using Microsoft© Direct3D®-API based Software, an authoring tool in the game development environment.

7. Development of Design Supporting System

7.1 The Existing Facilities Status Check Function Including Natural Environment

One of most important things in the environmental design is to correctly understand the existing natural environment, roads, and facilities in the target area. Once the correct analysis on the natural environment and the existing status is made, the proper design for the target area can be implemented. In this system, the function used in finding about the natural environment, existing facilities, projects, and other necessities was added. First, the 3-D topography model of the target area was made correctly, and as well as the mapping of satellite images. Then, the data model on roads and facilities and mapping were made by using the images on the site for easy checking of the current status.

Figure 4. Examples of Understanding the Current Status on Natural Environment(left) Five-folded Height Topography(right)

Though it was visualized through correct inputs in the topography, it was still difficult to grasp the height compared to the overall area, as this project covers a large area of 64 Square kilometer. Therefore, the function to enlarge and analyze the height of the topography up to five (5) times was

added in this system. With the help of this function, problems that were not detected by visual inspection were found.

7.2 The Comparative Check Function of The Existing Plan by using the Overlay

The comparative check function was added to compare the analysis results on the location of rivers and lakes, the flow of the river, and the gradient of mountains, which are the major design factors in this project, as well as the satellite images on the existing status of the project. With this function, it was possible to compare and analyze the various plans by overlaying the existing plans, as well as the location of rivers and lakes, the flow of the river, and the gradient of mountains.

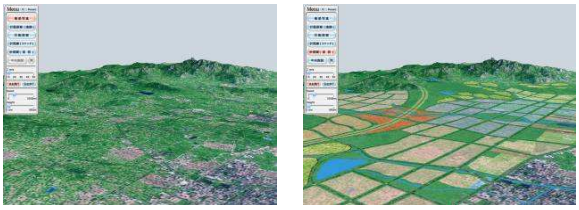

Figure 5. A Review of the Existing Plan by Using the Overlay: Current(left), plan(right)

7.3 The Visualization Function of the Concept

One of the most important design concepts in this project was the flow of water. It was difficult to explain verbally or in writing, and thus it was not easy for the designer to explain this to another person. In order to explain this concept easily, the function to visualize and to show the flow of water was added, enabling other people to understand the designer's intentions easily.

Figure 6. A visualizing and expressing the "flow" in real time

7.4 The Check Function of the Design's Concept

The real-time analysis system was established to check the existing plan and the new design concept (Figure 8). In this system, the new function was added to enable 3-D checking between the designer's design concept and the design concept obtained by real-time simulation by simply clicking the button. With the help of this function, the designer was able to make progress with the design while checking his design and other circumstances.

7.5 The Arrangement Function Based on Human Activity

In the Lanyantai Resort project, it was aimed at arranging the facilities, based on human behavior. In order to ensure this, we have added functions that enable the arrangement of human behavior on real spaces. With the help of this function, a plan was based on human activity.

Figure 10. The Arrangement Function of Human Activity(left), The Arrangement Function of City Information(right)

8. Conclusions and Future Directions

This system was utilized in the analysis of natural conditions and the plan in the China Qingdao project, and was also utilized in the topographic analysis and the facilities layout in the actual design process. By utilizing this system, current problems were detected by understanding the exact status of the target area, and a plan was devised to deal with these problems. In the aspect of design, checking various parameters, such as topography, scenery, etc., and smooth communication among participants became possible.

In the case of urban renaissance in China, the decision making of the residents is induced and applied to construction projects led by administrative institutes, without any presentation or public hearing. It lacks of reflecting resident's opinion for the regeneration of their residental area and inducing active participation in the decision making process with actual participation of the residents.

Since this system can exactly analyze existing topography, and can support the designer's concept, it can be said that it was advanced to a system as a communication tool in the initial stages of the design after many opinions were heard. However, it can be said that the system developed in this system is specialized in its function to fit in this project. In further studies, it is necessary to develop a universal system, and not only one designed for a special project. The system developed for this project can only play a supportive role in the design, and it will be impossible to continue with the different design activities using this system. It will be necessary in further studies to develop this system as a tool that can be utilized in the various stages of the design, including the initial stage, and especially in particular design activities.

This study, to have citizens more involved in the planning process, visualizes planning contents by utilizing citizen-friendly media, thus helping them to understand what is needed before its implementation. Moreover, following the understanding of the contents, interactive functions have been developed to easily reflect individuals' opinions, and the developed system, made public on the Web by using the Internet, is thereby used in the civil participation workshop. It is likely that this system will be used as a useful tool that reflects the residents' opinions in recent urban regeneration.

Reference

1. R Sato. Yeo W., Yuda Y., Oh S., Kaga A., Sasada T.,: 2004, Dynamic visual reference system(netu system) for assisting environmental design, CAADRIA2004, Korea, pp. 483-491.

2. Lou, C.W., Kaga, A. & Sasada, T.:2002, Environment design with Huge Landscape in Real-time Simulation System: real-time simulation system to real project, CAADRIA2002, Malaysia, pp.265-272.

3. Yeo, W.H., Lou, C.W., Kaga, A., Sasada, T., Byun, C.S., Ikegami, T.:2003, An Interactive Digital Archive For Japanese historical architecture, CAADRIA2003, Thailand, pp.513-522.

4. Fukuda, T., Nagahama, R., Kaga, A.& Sasada, T.:2002, Collaboration Support System for City Plans or Community Designs based on VR/CG Technology, CAADRIA2002, Malaysia, pp.257-264.

5. Sasada, T.:1999, Computer Graphics and Design, CAADRIA99, Shanghai, pp.21-29.

6. Roberts, P. and Sykes, H. (ed).:2000, Urban Regeneration: A Handbook London: Sage Publication

7. Henry Sanoff : 2000, Community Participation Methods in Design and Planning, pp. 67~76

8. Fredric Wulz : 1990, "The conception of Participation", Henry Sanoff, Participatory Design, pp. 39~48

9. Sang-wook Han, 2007, "The Method for Enhancing the Participation of the Residents for the Effective Urban Maintenance and the Promotion of Urban Renaissance Project", Chungnam Development Institute, p.19

10. Detlof von Winterfeldt and Ward Edwards, 1988, "Decision Analysis and Behavioral Research". Cambridge University Press, Cambridge

11. Marek J. Druzdzel and Roger R. Flynn, 2002, "Decision Support System", Encyclopedia of Library and Information Science, Second Edition, Allen Kent (ed.), New York: Marcel Dekker, Inc.

논문접수일 (2012. 5. 11)
심사완료일 (1차 : 2012. 5. 25, 2차 : 해당 없음)
게재확정일 (2012. 5. 31)