An online visualization tool for Internet-based local townscape design

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Abstract

In recent years, designers have used various types of spatial multimedia, including text, video, photographs, virtual reality (VR) and WebGIS, to allow for Internet-based participation in planning. For planning in Japan, we developed a visualization tool to attain consensus on townscape design within local planning committees. Participants can select design elements to visualize different alternatives in real time, and experience dynamic scenes of generated virtual townscapes in the VRML world. In our case study, this visualization tool were successful in sharing a common image, and participants were motivated to become involved in deliberation on various aspects of planning and design during committee meetings. However, we found that it is difficult for stakeholders to reach consensus on privately owned properties: they feel apprehensive in local open planning committees. Otherwise, participants had to check the discussion results by reviewing the chat history; audio devices and web cameras are better for online deliberation. A knowledge-based database system, combining similar design experiences from other regions, will be beneficial.

1. Introduction

Our contribution in this paper is the validation of a visualization tool to be used in planning and reaching a consensus on townscape design in Japan. We developed the visualization tool on a multi-user platform to represent design alternatives and to supplement traditional presentation materials (such as planning documents, plan drawings and perspective sketches). We examined how stakeholders shared their images through design coordination using virtual reality (VR) during the deliberation process, how the visualization tool helped stakeholders understand planning alternatives, and how stakeholders improved the alternatives and reached a consensus.

1.1 Visualization for urban planning and design

Researchers in urban planning and design have studied visualization as a tool to both advance technology and aid in planning. During planning, visualization eases the public participation process by helping stakeholders to understand the alternatives that planners propose. Digital democracy (Daniel Bulmer, 2001, Smith R. S. and Craglia M. 2003) encourages public involvement through visualization with CAD, 3DGIS and VRML. Planning and design consensus is a learning process, and aspects of learning systems have been related to features of the Internet, VR, and GIS technologies. Participants have the potential to change attitudes and decision making regarding urban lifestyles and urban policy (Hamilton A, Trodd N et al., 2001). Visualization tools, freely accessible to local communities on the World Wide Web through VRML and WebGIS, are appropriate for public involvement. Furthermore, Lucio Ieronutti and Luca Chittaro (2008) work with virtual education and present a software architecture that allows Web3D content creators to integrate interactive H-Anim virtual humans acting as teachers and assistants into virtual environments, allowing for distance-learning models that meet Web standards. Researchers have used spatial media including text, video, photography and VR WebGIS in the Internet environment in order to better understand public participation in urban planning and design (Michael J. Shiffer, 2001; Moon, T. H., 2003; N. Matsumoto, 1991). However, the interactive usability of these sources falls short. Zamenopoulos and Alexiou (2003) presented a multi-user prototype for human or artificial design agents in a distributed network to coordinate planning and design.

Design tools are also available for participants to coordinate alternatives based on different scenarios and explore a virtual world. Such tools encourage stakeholders to be involved in the planning process. For public park design, Pettit et al. (2004) proposed visualization of planning and design alternatives to encourage public involvement in bottom-up decision-making. Shen and Kawakami (2003) introduced a public park visualization tool as an online design collaboration system to collect designs submitted over the Internet. In this system, participants can make new ground surfaces and arrange the design or select elements on the planning site in the VRML world.

As part of a planning process, Luca Caneparo (2001) implemented a system of Shared Virtual Reality (SVR). On the Internet, Caneparo applied SVR to a new railway junction of Porta Susa and a surrounding urban area in the city center of Turin, Italy. SVR was developed for a long-term investment of the Municipality and the State

Railway. SVR offers an effective approach to the Construction Data Model and Computer-Supported Collaborative Work, as it integrates collaboration-enhancing tools with a distributed environment to process information across networks. However, there is no direct evaluation of the effect of the SVR system on the actual project.

Langendorf (1999) evaluated VR technologies for public involvement, emphasizing that the virtual image's persuasive powers build trust more effectively than traditional measures such as planning documents. VR technology also brings together developers, planners, citizens and government officials, especially in cases where mutually distrusting parties must collaborate. The technologies are readily accessible; however, the implementation process has substantial social and political obstacles. Major obstacles include the level of detail of spatial identifiers, unverifiable and malicious information on a geographic area associated with a group or individual, and an inoffensive environment without pre-defined standards for moderation and censorship.

Moreover, Barton et al. (2005) reported on public participation in a spatial decision support system (PP-SDSS) project for public housing. Also, Smith et al. (2002) reported on the Woodberry regeneration project. Both of these studies examined visualization tools to help public participants generate alternatives. Additionally, there are research reports about the Dazaifu project (Oharu, H. and Arima, T. et al., 2001; Tanoue, Y., Arima, T., 2005) conducted in Japan, which showed a future image of the Dazaifu townscape with a visualization tool.

1.2 Research objectives: visualizing the townscape

Neighborhood design guidelines are one of the local planning regulations for townscape design, at the level of the urban district. These guidelines are based on the urban law system in Japan, which includes building volume, building design, street furniture and other guidelines for both private properties and public facilities. Stakeholders must agree on design guidelines; however, it is difficult to present a common image of the townscape in the planning committee to achieve this consensus among stakeholders. Townscape design requirements for neighborhood design guidelines include the form, color and style of street furniture, building reconstruction and layout of lots. Designers consider these criteria when creating harmonious places. Even though land use differs in an urban district, with houses, shops and business offices, stakeholders must maintain a harmonious design within the entire townscape during reconstruction.

Neighborhood guidelines for townscape design can be enacted for different kinds of urban projects, such as main street projects, urban redevelopment projects, and housing development projects. Usually, a neighborhood design guideline is endorsed as a planning document with some illustrators, most of whom reach consensus through public involvement in a local planning committee. Visualization of the neighborhood design guidelines would help a local community share a common image of their townscape, which, in turn, would facilitate design coordination and help stakeholders find solutions for diverse planning problems. Certainly, it would be more understandable than illustrations inserted into planning documents presented at planning committee meetings.

In this study, we focus on how to visualize neighborhood design guidelines for a main street project in a local city center in Japan. Local residents hope for harmonious townscape design, known as "*Matsudukuri*" in Japan, in which local residents hold workshops with public institutions to agree on the design of building and street furniture to improve urban amenity after a road extension project. The structure of this paper is as follows. In Section 2, we will discuss how to promote the use of visualization tool according to the needs of the deliberation process in planning. In Section 3, we will present a VR platform that allows users to share and coordinate different design alternatives on the Internet. In Section 4, we will come to the implementation and evaluation of the visualization tool while investigating how the visualization tool can foster consensus on townscape design guideline and design review. Finally, in Section 5, we will complete the paper with conclusions and discussions.

2. Research approach

To promote the use of visualization tools in planning, we present a case study of a road extension project for land readjustment that reforms the shapes of lots and blocks on both sides of a main street in Nanao City, Japan.

We developed a visualization tool for design coordination in planning committee meetings so that participants can share common images and solve planning and design problems. Participants can understand planning and design alternatives and reach mutual understanding, or common awareness. Committees can also avoid conflicts about substantial planning problems. Furthermore, committees can determine whether the composition of alternative design elements through design coordination in the virtual world is the final solution according to the deliberation of planning committees.

As previously described, we attempt to develop a visualization tool for presenting neighborhood design guidelines for a townscape for a local planning committee. In this study, we propose making effective use of the tool from the important perspective of in-field use, according to the needs of the deliberation process scheduled in the agenda of the local planning committee. The agenda is divided into the consensus of the neighborhood design guidelines and the design review, and the latter is based on the design guidelines agreed upon for individual construction. We also consider how to use the visualization tool on the Internet to improve online participation. When considering a system framework to visualize design guidelines for a townscape, these two processes should be taken into account. Finally, to examine the effectiveness of this tool, we distributed questionnaires and did interview surveys after the committee meetings.

2.1 Workshop for townscape neighborhood design guideline consensus

Workshops with local residents are conducted, usually within several months, to attain consensus on design guidelines among stakeholders and administrative officers and developers. The visualization tool will help committee members who need to have a clear perspective on planning alternatives, and to share a common image while coordinating townscape design guidelines in a planning meeting.

It is possible for participants to experience a virtual townscape using VRML technology in order to share a common image of proposed design guidelines during deliberation to reach a consensus. Both consensual validation and participant inter-

calibration between design elements that are defined in the neighborhood design guidelines are possible for coordinating a design within the VRML world, a multi-user environment on the Internet. Moreover, using VRML, participants can explore from the Internet without spatial and temporal limitations.

In the planning process, a neighborhood design guideline is directed at property that is privately owned, and stakeholders should agree on the proposed design guidelines. After stakeholders agree on neighborhood design guidelines, they should make planning information available to the public, who must follow the design guidelines. If planning sites include public spaces, such as public parks, the planning information is easily made available to the public because there is no private information; however, neighborhood design guidelines are always associated with privately owned properties. Participants may mistrust authorities and be apprehensive during deliberation on private properties, or individuals may upload false and unverifiable information if there are management hurdles (Tanoue, Y., Arima, T., 2005; Barton, J., Plume, J., and Parolin B., 2005). Accordingly, deliberation on the design of privately owned properties may be difficult during a public committee meeting, even though a public institution plays a main role in the deliberation process.

Therefore, a visualization tool may be a heteropathic solution if the visualized targets, such as private properties, act as a disadvantage during deliberations of the public committee. We are deeply interested in how the visualization tool supports the deliberation process and helps stakeholders in the local planning committee attain consensus.

2.2 Design review board for private building design alternatives

The townscape is formed through a long period of continuous construction by both landowners and developers, who are obligated to understand and follow substantial points of the neighborhood design guidelines. Consequently, a design review board should be established to ensure that reconstruction or the design of a new building effectively follows these neighborhood design guidelines. More specifically, a design review board can check the design of all buildings, case by case according to the design guidelines, to maintain a harmonious townscape. We expect that the ability to visualize alternative designs will help committee members ensure compliance with neighborhood design guidelines, by allowing common images to be shared in meetings of the design review board and by coordinating design requirements with architects and owners. Successful precedents will help new builders plan in accordance with neighborhood design guidelines, and 3-D building models that pass the design review can be added to a database and be made available for reference on the Internet.

Most visualization tools have been developed for attaining consensus or making planning information available; however, few of them are useful as design review tools for design coordination among building owners, architects and a design review board, in a long-term management process. Residents in the planning site can use the tool from the Internet without spatial and temporal limitation; however, in the planning process, the tool has been developed as a supplement to traditional methods.

3. Traditional planning and the visualization tool

In Japan, attaining consensus on neighborhood design guidelines is known as *Machidukuri*. Recently, local residents have started their *Machidukuri* projects from a local standpoint, with more and more residents unwilling to depend on the central government. Most projects are started by local residents, and may only be catalysts to promote local economy.

Traditionally, the methods of *Machidukuri* involve participants presenting their concepts by preparing documents and drawing illustrations; however, the degree of consensus is limited because the participants have to imagine the entire townscape. Shinobe (2005) focuses on the effectiveness of learning and reaching a consensus on neighborhood design guidelines through field surveys, questionnaires, votes and other means. Physical models (H. Shimura and S. Satoh, 2001) can be used as visible guides for sharing images; however, physical models need permanent exhibition space and storage space, and model materials must be replaced to present design alternatives. Today, these traditional planning materials can be prepared as HTML documents using Web services.

The Alphaworld Project allows visualizing both planning and design; this project shows that it is technologically feasible for individuals to build their own space and communicate in a virtual city (Smith, A. and Dodge, M. et al., 1998). Although the Alphaworld Project is not a real construction project, it is a pure virtual world without any design regimes, and can be considered an initial step for urban planning and design. In an attempt to use the VR technology in practice, the Ryoanji Project (Okabe, A. and Sato, T. et al., 1999) examines cooperative possibilities for remote, coordinated design while sharing a VRML world, and was developed as a design game for assigning the position of stones in a Japanese garden.

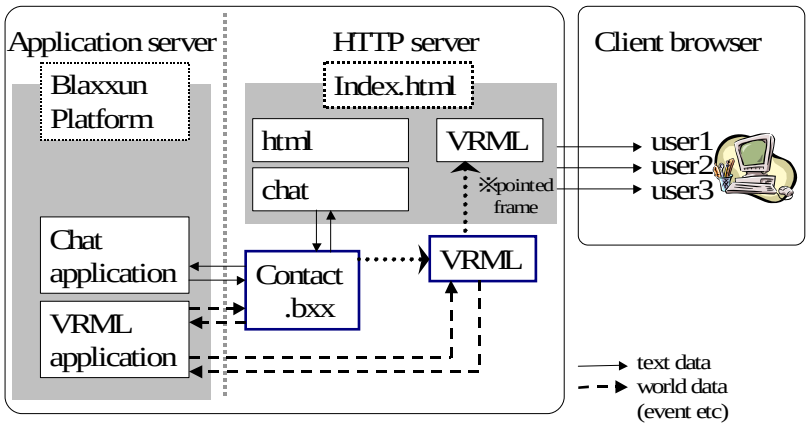

Fig. 1. System framework with the Blaxxun platform

Google Earth and Sketchup are recently developed tools for representing urban planning and design, and integrate both VR and geographic information (Choi and Lee, 2007; Wansoo Im, 2007). For a planning committee, Google can provide comprehensive Web 2.0 technologies, including “blogs”, “sites”, “calendars” and “readers”, for making agendas, announcements and comments from committee meetings available to the

public on the Internet. However, Google Earth does not provide a multi-user environment, or VR, on the Internet. On the other hand, Second Life provides virtual communities for users to explore, but does not integrate all the Web 2.0 functions. Presently, Multiverse Network is working on integrating Google Earth with multi-user virtual environments. We did this study when Google Earth and Second Life were not as prevalent (2004 to 2006), and both have since shown more possibilities for improving net participation in planning and design.

In this case study, we consider a Web application to be the core part of the tool, similar to the work of the Ryoanji Project, and it is shown in Fig. 1. An application server of a VR platform (www.blaxxun.com), based on a Web service, allows users to share and coordinate different design alternatives on the Internet. Using this Web application, committee members can discuss different alternatives using the "share event" function of the Blaxxun community server in the virtual world, and remote access is freely available to all residents in the planning site. Similar VR platforms, such as Second Life and Activeworlds, are available; however, Blaxxun Inc. provides a free license for researchers to use the Blaxxun community server as a VR platform for pure research and social experiments. This VR platform allows multiple users, within virtual communities, to share and coordinate design alternatives freely while remotely visualizing a townscape.

We expect that stakeholders will be able to share a common image of their townscape within a VRML world, and that the online visualization tool will make the current townscape available to the public so that local residents can understand both the design guidelines and the types of designs the design review board will accept when considering reconstruction. Therefore, this tool may foster consensus on design guidelines and aid the design review process.

4. Planning process for townscape design using a visualization tool in Nanao City, Japan

4.1 Townscape design with a road extension project in Nanao City

An urban project for improving the townscape in the central area of Nanao City (Nanao Project) included a road extension project implemented by the local government in 2004 (Fig. 2 and Fig. 3). The local government set up a planning committee to encourage consensus among central residents as to the readjustment of their private land parcels and the reconstruction of their buildings to finalize the road extension project and improve the townscape.

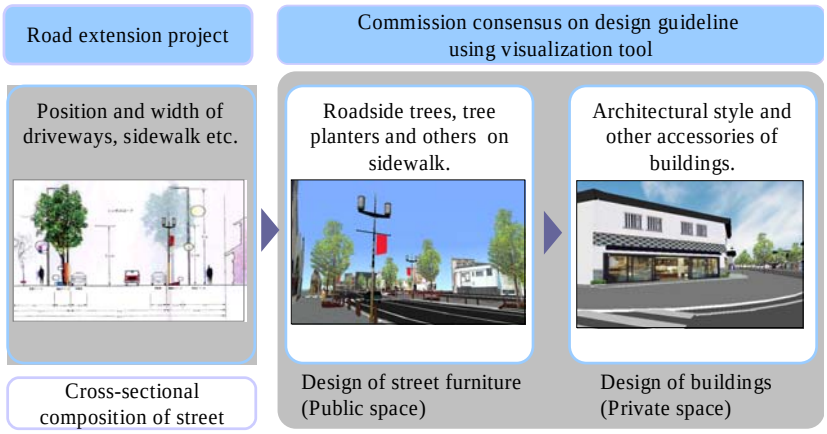

Fig. 2. The three steps of an urban project in Nanao City

The road extension budget only includes the extension of the road, the design of street furniture, land acquisition funds, and compensation for both land reshaping and the reconstruction of private houses. The road extension is a project of the local government; and both the readjustment of land lots and the reconstruction of private houses are the responsibility of local private owners in conjunction with the provided compensation. Public spaces on both sides of the main street and the façades of the buildings are targets of the neighborhood design guidelines and require attaining consensus on townscape design alternatives through public participation.

A local planning committee is necessary for attaining consensus among stakeholders on neighborhood design guidelines for the reconstruction of private houses and street furniture on the public space along pedestrian roads, as the road extension has already been finished.

Fig. 3. VRML world of the main street in the Nanao Project area

4.2 Consensus for neighborhood design guidelines in the Nanao Project

4.2.1 Committee for neighborhood design guidelines

A local committee was launched to reach a consensus on neighborhood design guidelines in the Nanao Project (Fig. 4). Ten residents, landowners and leaseholders were invited to be members of the committee, and one staff member from a local non-profit organization (NPO) was selected as the facilitator. Four officers of the local

government, four planners of a consulting company and four experts in landscape design (color coordination and urban planning and design), including one of our faculty, were organized into a working group to develop alternative street furniture and building design codes. The working group transferred requirements from the committee to the system developers and the VR data editors (our research team), who developed a visualization tool and updated VR data for the local committee.

The local committee meetings were held three times, from 19:00 to 21:00 in the evening, during September to December 2004. To examine the effectiveness of the visualization tool, the VR dataset was edited according to requirements presented during the local committee agenda, so that deliberations on meeting topics could be based on the VR representation, and members could share common images during the discussion. A tool to exchange design alternatives accompanies the VR representation and allows real time feedback on committee member requirements during the meetings.

One result of committee consensus was the decision to use alternative street furniture. Moreover, the design codes for private buildings were chosen as part of the neighborhood design guidelines for long-term townscape management after the committee meetings.

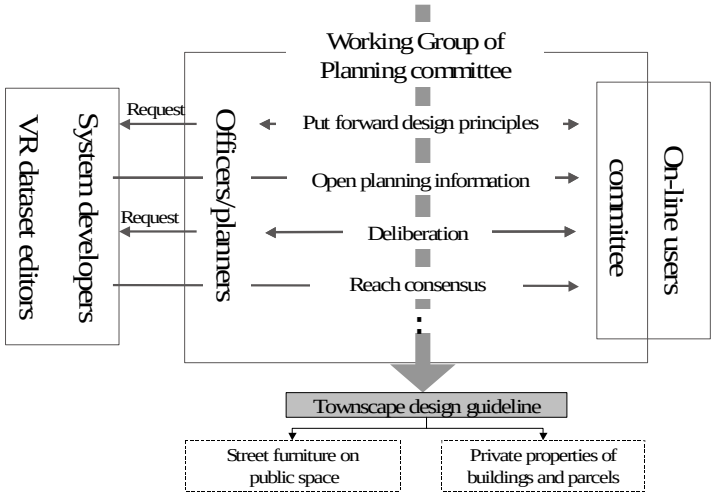

Fig. 4. System developers and VR dataset editors in committee meetings

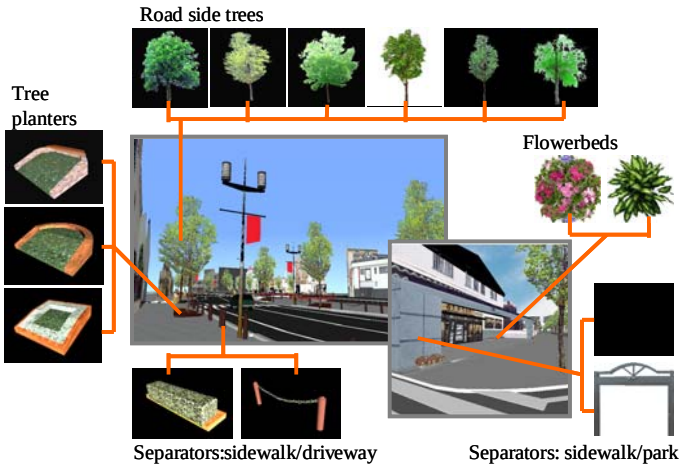

Fig.5. Design elements for street furniture on public space

4.2.2 Neighborhood design guideline consensus using the visualization tool

As previously described, the committee discussed the design alternatives for street furniture on the public space along pedestrian roads and the design principles of private buildings. The visualization tool used for deliberation in the committee displayed the design elements of street furniture as shown in Fig.5. One of the design alternatives for street furniture is shown in Fig. 6.

All the comments of the committee meetings in the deliberation process are reviewed and reorganized as shown in Fig. 7. In the first meeting, residents confirmed the contents with planners to share a common image using the VR world. After developing a clear idea of the alternatives, they discussed the associated guidelines from different perspectives, such as cleanup, local festivals, parking, climate, sightseeing, design, while referring to and walking through the VR world. At this first meeting, a new requirement for sightseeing sign guidelines was presented to the committee. During the second meeting, the facilitator required members to agree on separators, tree planters and chain link fences. During the third meeting, the committee discussed the suggestions from the first meeting and made a decision. The visualization tool successfully allowed participants to deliberate on a common image and to compare different design alternatives while making decisions. The visualization tool was also available to judge whether the points being deliberated were reflected in the revised plan presented using the VRML.

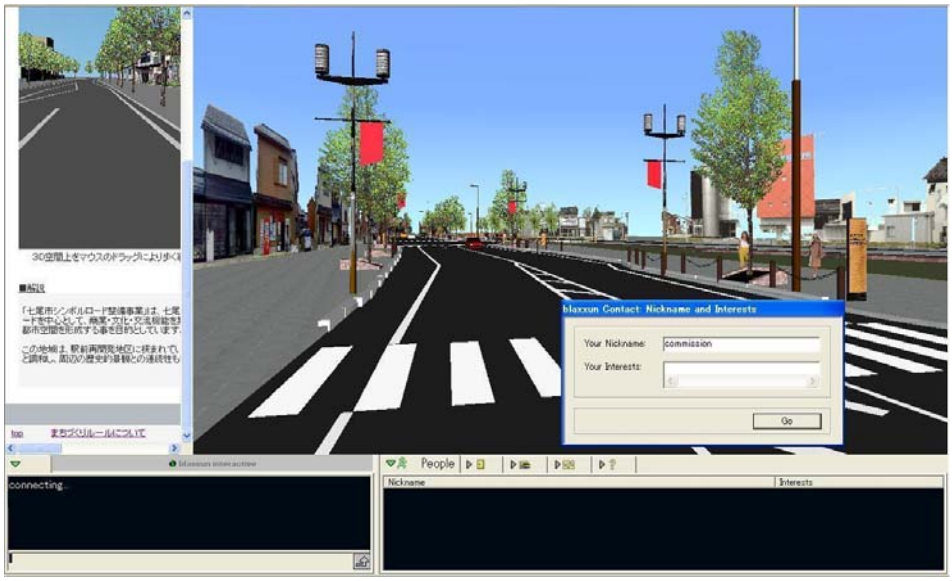

Fig. 6. Street furniture presented using the visualization tool

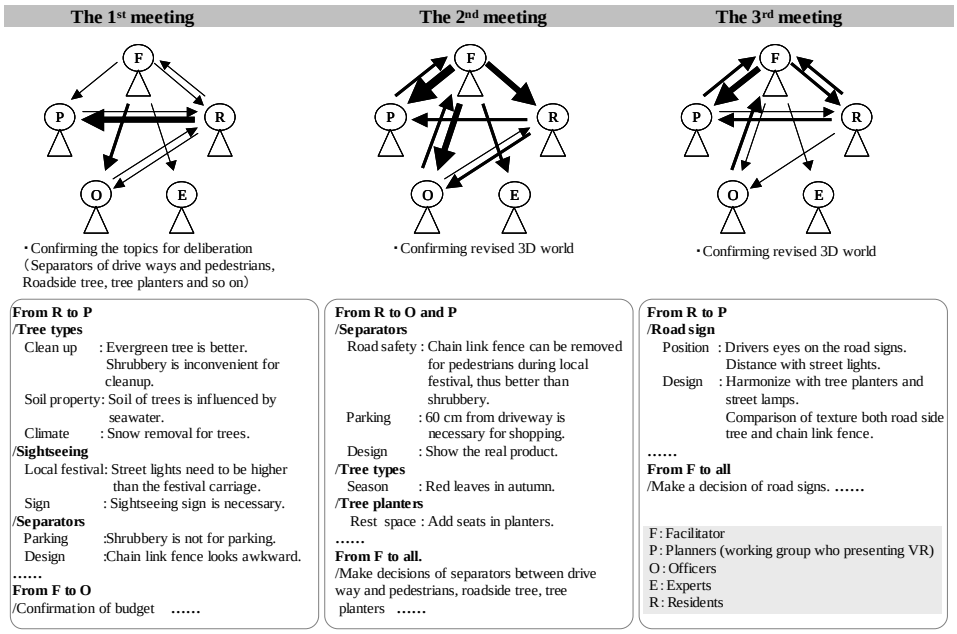

Fig. 7. Deliberation of street furniture in committee meeting

In the present study, property ownership affected the effectiveness of the visualization. More specifically, committee members achieved consensus on the design elements of public spaces, but deliberations on design alternatives for private buildings occurred without actual images of the buildings. Private buildings can be prepared as background and can be replaced completely with new buildings to visualize some design concepts concerning land use and architectural design. During the committee

meetings, the design alternatives for private buildings, showing different architectural styles, were presented; however, stakeholders did not discuss them during the deliberation, as a precaution against deliberating on their private buildings in a public meeting. As a result, the private buildings were presented as background for the deliberation of the alternative design elements for public space. One important issue remains for the committee: how to counsel private building owners, for whom reconstruction plans and designs should be reviewed case-by-case, on architecture design.

Consequently, reaching a consensus on public spaces is easy, but openly discussing privately owned properties through public involvement is difficult, and only leads to abstract design codes for private buildings. To attain consensus on neighborhood design guidelines during the open committee meetings, the tool is necessary for visualizing street furniture in public space, and it is only necessary to express the private buildings as background. Otherwise, to present new townscape design concepts, the visualization tool is available to present a complete new dataset of virtual buildings in the virtual world and ignore the current townscape.

Although the tool visualized the design alternatives presented by the working group of the local planning committee, it is a supplement to traditional methods and cannot replace all of them in the present study. For example, field survey is necessary whether or not the workshop uses a new visualization tool.

4.2.3 Evaluation of the visualization tool in committee meetings

After the meetings, committee members were asked to complete a questionnaire evaluating the effectiveness of the visualization tool during the deliberations, and results of the questionnaire are shown in Fig. 8 and Fig. 9. More than 11 out of 23 people in the committee agree that the VR dataset is a good representation of the design alternatives, because the operator, using the visualization tool, can freely coordinate different design options and present the design guidelines according to the requirements of the committee members. Otherwise, a new VR dataset with different alternatives could be created according to the requirements from the previous meeting and presented in the following meeting. Over 15 people asked the operator for a walk-through around different places in the virtual world to review each design element carefully. In the discussion, the planners explained design alternatives with the help of documents and visuals, and 11 people reported that they attempted to understand some points using the VR representation. For example, an oral explanation of whether the color of streetlights harmonized with the color of the separators between driveways and sidewalks was more easily understood using the VR representation. During the deliberation, eight people reported that they were motivated to ask planners to explain some of the design points in detail.

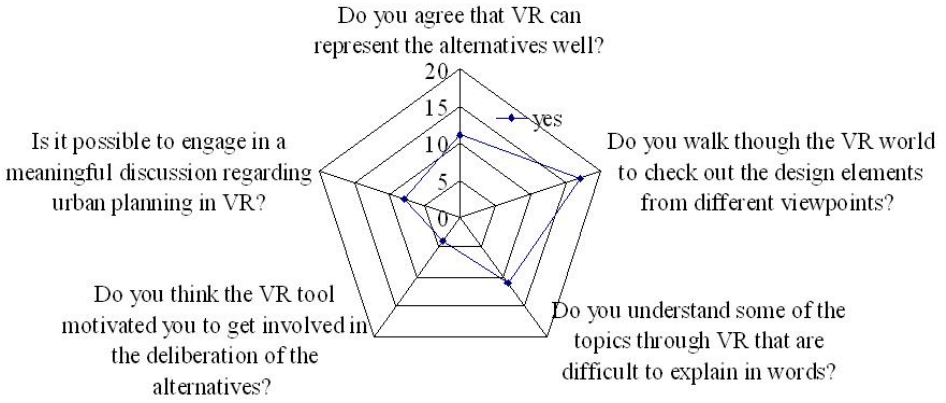

Fig. 8. Effectiveness of VR representation and deliberation (1)

Further evaluation of meeting deliberation is shown in Fig. 9. Nearly 20 respondents reported that the visualization tool was effective in formulating a common image among stakeholders, and almost the same number of people responded positively when asked whether the visualization tool helped them understand the concepts of the design alternatives. Over 15 respondents believed that the visualization tool improved the deliberation process during meetings. Moreover, over 15 people confirmed that the tool helped confirm the improvements made by the alternatives, and nearly 15 people reported that the tool helped them effectively evaluate the design alternatives. Overall, the tool has received a positive response, indicating that it had a positive effect on sharing a common image of design alternatives among stakeholders and was helpful when comparing and discussing these design alternatives. The visualization tool is effective for helping meeting participants better understand design guidelines, and motivates the public to participate in and deliberate on various aspects of planning and design.

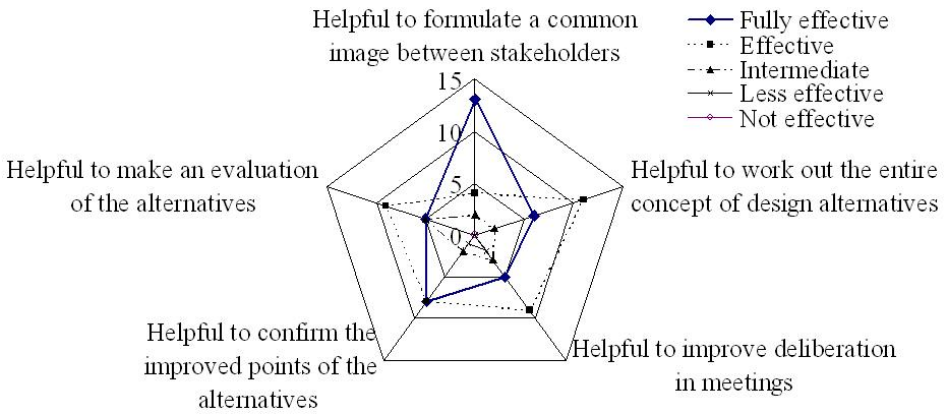

Fig. 9. Effectiveness of VR representation and deliberation (2)
Note: No respondents selected “Not effective”

However, only four people believed it is possible for the virtual world to encourage a meaningful discussion of urban planning, as shown in Fig. 8. The remaining respondents felt that merely a shared image of the virtual world is not enough to agree on townscape design guidelines. In addition, a lack of expertise on product performance evaluations of the design elements to be constructed on the planning site was cited as another reason that may prevent broad adoption of the visualization tool.

4.3 Design review for private buildings in the Nanao Project

As previously described, stakeholders agreed on the design guidelines during the committee meeting scheduled in December 2004. When the design guidelines were presented for the design review in 2005, a design review board was convened to evaluate the design of private buildings to be reconstructed in the urban district. However, the design review for private buildings in the urban district is a long process, and it remains difficult to evaluate the visualization tool for design review.

4.3.1 Design review board

The design review board, up until December 2007, did three design reviews. During the review process, architects first apply for construction permits, at the local city hall, for the owners of private buildings. After an architect applies for construction permits at the local city hall, officers transfer the necessary documents to the design review board for review before formal authorization is given to the local government. During the design review process (Fig. 10), an architect, who designs the reconstruction plan for a local owner, submits the design alternatives for review, which is usually after a meeting with an advisor (officer) in local government. The design review board can ask to check building drawings and reviewers can ask for a revision of the building plan, concerning areas such as building volume, neighbor land use and public space in front of the building. However, it is difficult to comment on the layout of a building plan because it describes private space. Most of the comments issued by the design review board are about elements in the façade or street furniture in front of the building, which are located on the boundary between the private lot and the pedestrian road. Otherwise, the design review board will meet at least two times before issuing a letter verifying the requirements for design modification.

Architects usually submit sketches of a site plan and façades of a building to the design review board, and the board then holds review meetings and make decisions after examining these drawings according to the design codes listed in Table 1. Committee members reported that it was difficult to evaluate the architectural design while only imagining the entire expanse of the townscape, and a visualization tool is necessary to determine whether the façade of a new building harmonizes with the townscape. The design review board should edit virtual building data based on the submitted sketches, as these are drawings from the initial step of the building plan and design. However, it may be more helpful to edit virtual data based on 3-D CAD drawings and actual photographs of the buildings' materials.

Table 1. Neighborhood design guidelines for private buildings and parcels

Design review codes (Authorization of local planning committee is necessary before construction)			Necessity	Consideration in design
A	A1	Roof shape 1) Roofs with a pitch of 4.5 - 10.	Yes	
		2) Parallel to the road	Yes	
		Front façade 1) Traditional painting and traditional window design		Yes
		2) Natural materials (wood and brick)		Yes
	A2	Color of exterior wall 1) Harmony with the colors of natural materials		Yes
		2) The brown, beige color or white and black design if not using of natural materials	Yes	
		3) Only using black for roofs	Yes	
B	B1	Green spaces		Yes
	B2	Shopping store on the first floor		Yes
		Show windows facing the road		Yes
		Easy for tenants to open stores if owners do not open stores	Yes	
		No adult entertainment shops	Yes	
	B3	Advertisement considering the townscape 1) No other advertisement beside owners' advertisement	Yes	
		2) Advertisements stand under the eaves	Yes	
		3) Design for covering air condition and other machines	Yes	
		4) No parking spaces occupying pedestrian roads	Yes	

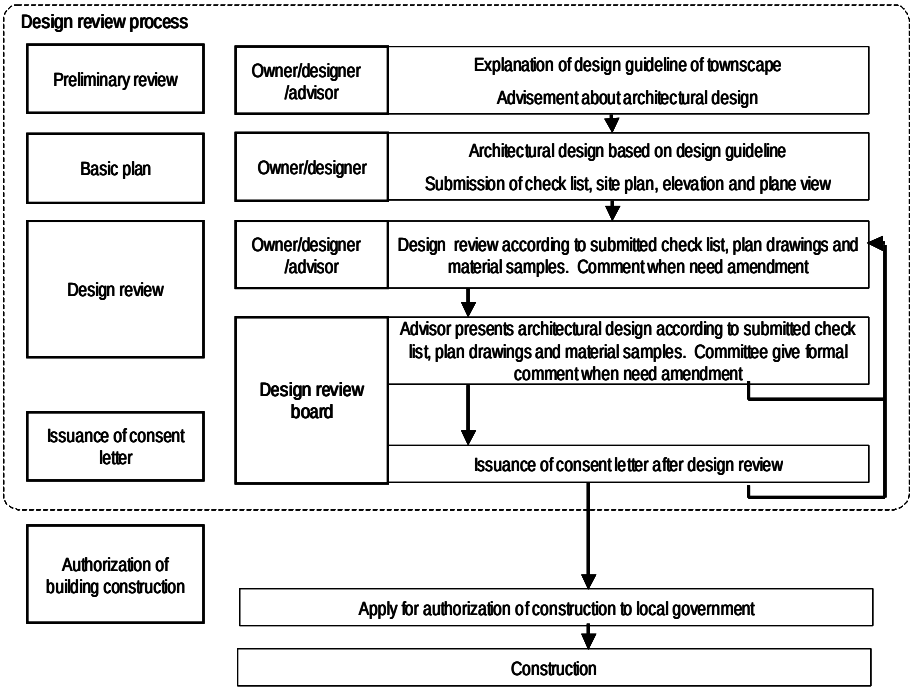

Fig. 10. Design review process

4.3.2 Evaluation by committee members of visualization tool for design review

A case study examined the effectiveness of the visualization tool, and the original review of the paper drawings was used as the main measure in the real review meetings. After these meetings, we developed a visualization tool for design review as a social experiment in the Internet environment. The experiment was conducted in one hour in February 2008, and five people who have experience with committee meetings (three of whom organized or attended the real design review board) participated.

We selected the drugstore reconstruction, shown in Fig. 11, for the social experiment, which used conditions identical to those used in the real case. An advisor explained the design codes in the guidelines to the designer of the store in the preliminary review, shown in Fig. 10. In the basic plan stage, the designer submitted a checklist of design codes, the elevation and the plan view of the store to the design review board. After a meeting of the design review board, comments about the front space and the façade of the store were delivered to both the designer and the store owner. Design elements are shown in Fig. 11 and Fig. 12, and the comments concerned the color of the wall, the color of the commercial signboard on the façade of the building, the green design in the parking space and the flowerbeds in front of the building.

Fig. 11. The tool with a panel for switching and coordinating design alternatives for review

Fig. 12. Deliberating the drugstore design in a meeting

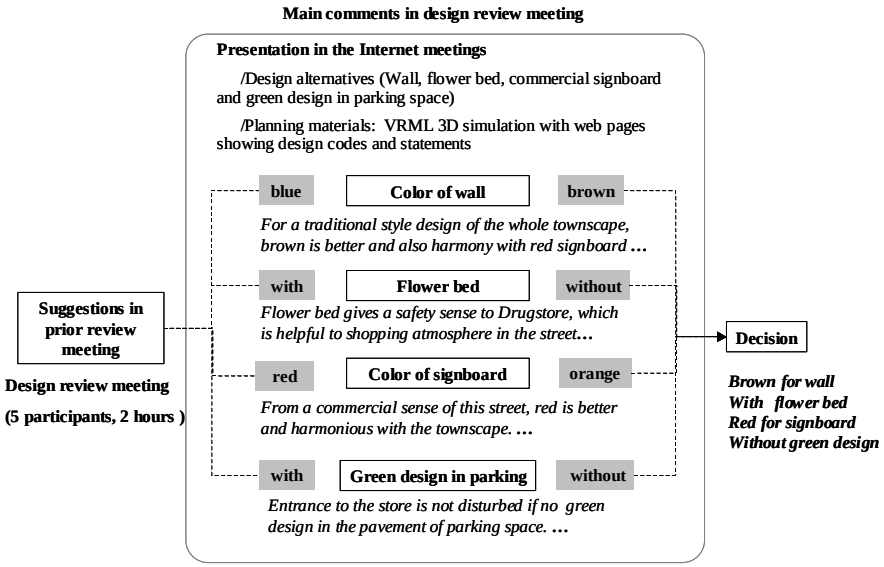

Fig. 13. Deliberation process in the design review meeting

Participants held a review meeting on the Internet, in which the alternatives submitted by the architect were presented in a virtual world and on some Web pages for planning the statement of alternatives (Fig. 12). To coordinate design and reach a consensus, four design elements (“color of wall”, “flower bed”, “color of signboard”, “green design in parking”) could be exchanged in real time as a response to user requirements in the multi-user environment. The main comments from the meeting are listed (Fig. 13) to understand what was discussed in the Internet meeting, and participants gave comments from the perspective of the entire townscape. The visualization tool was a solution for replacing traditional paper drawings, and was very effective for exchanging different design alternatives and evaluating the different designs by walking through the virtual street. However, to maintain identical conditions to those used in the real design review meetings so that participants could compare those meetings to the Internet experiment, we needed to use the paper drawings provided by the designer as texture maps for rendering the front wall, as the graphics looked cartoonish. Consequently, the virtual dataset without proper texture mapping was a problem for the design review in the case study, as shown in Fig. 11 and Fig. 12.

We did an interview survey with individual committee members who attended both the real design review meetings and the experimental meeting on the Internet. The committee members reported that “the evaluation during the design review is how to judge whether or not the building design is harmonious with the whole townscape”. Using the traditional method, “it was very difficult to properly judge whether or not the design is harmonious with the whole townscape based on the paper drawings”. The tool for visualizing private buildings was helpful in the design review, and when the design alternatives were presented in the virtual world, the committee “could review the design using a bird's-eye analysis, a human scale analysis and other analyses standing on the different viewpoints prepared in the virtual world”.

However, some committee members commented, “The line of sight to distant landscapes should be prepared for evaluating designs”. One solution is to create virtual data on the entire city, but long-term management of the VR database containing virtual data on the entire city is necessary. Moreover, the speed of movement in the virtual world is different than in real life, and respondents commented, “It was difficult to keep walking with the same sense as in real life”.

A screen capture of members' comments during a review meeting is shown in Fig. 12. As participants commented on alternatives for the exterior wall, the commercial signboard, the green design in the parking space and the flowerbeds in the front of the building, these design elements could be freely combined through the shared visual world on the Internet. Therefore, “it was easy to find a better combination of alternatives for design coordination”, and, “it was also helpful to judge whether or not the revised design was an improvement in the virtual world for the next meeting”.

Furthermore, participants mentioned that “the visualization tool was effective for reviewing façade designs in detail by exchanging different design elements and finding a solution using all the combinations of elements, such as roofs, windows, doors and walls”. The project area is a site containing traditional-style buildings, and although there were no cases in the planning process, the visualization tool will be important for discussing traditional-style buildings.

Online communication had an input delay, and for this reason, “participants had difficulty understanding whether other reviewers finished inputting comments”. Therefore, “it is a problem as to whether or not the decision-making can be conducted using the Internet”, and a possible solution includes “using an electronic conferencing system in place of a chat room”.

Although professional experts attended the meeting, it was difficult to exchange and share necessary information using only the chat room. It is necessary to help participants understand both relevant information about the products they are willing to buy and the basic functions of these products. Moreover, experiences in other neighborhoods, including solutions to problems in planning and design, spatial management and maintenance, are also helpful if made available using a knowledge-based database system. Finally, the feasibility of making a decision on the Internet remains to be seen, and further case studies of in-field use are needed. A student experiment was done as a supplemental evaluation and is presented in the following section.

4.3.3 Supplementary evaluation of the ability to communicate using the visualization tool for design coordination

As a supplemental evaluation of the effectiveness of communication using the visualization tool, 80 students studying in the urban design course at Kanazawa University were organized into eight groups and participated in an online review meeting based on identical conditions used for the drugstore from the planning site. There were ten students in each group, and one student, selected as a facilitator, coordinated consensus on design alternatives.

The visualization tool received high scores in the following questions (Fig. 14), “Do you exchange ideas with other members in the deliberation process?”, “Do you understand other members’ comments? ”, “Do you think the conclusion is acceptable?”,

"Do you think that the deliberation is well done in the meeting?" and "Do you think that a consensus was reached in the deliberation?". Results shown in Fig.14 suggest that this tool is effective for exchanging opinions and reaching consensus among participants.

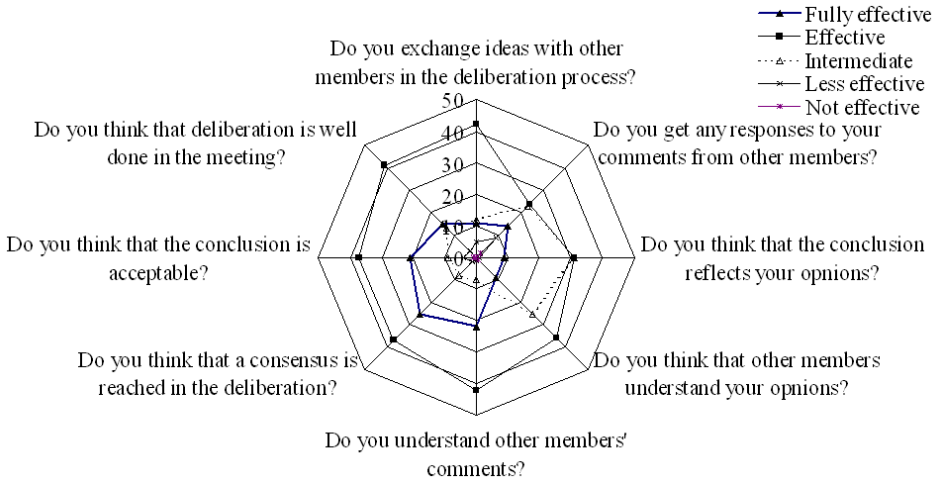

Fig. 14. Evaluation of a supplemental meeting on the Internet (80 students, 8 groups)

However, students gave low scores to the questions, "Do you get any response to your comments from other members?" and "Do you think that the conclusion reflect your opinions?". This suggests that students understood other participants' opinions and accepted the conclusion arrived at during the meetings; but they were not sure whether others accepted their own opinions. The chat system had a time delay between all the opinions entered for a particular topic during deliberation. For instance, the responses from others always emerged later and mixed with other topics, and although students could check the discussion results by reviewing the chat history, they could not immediately receive responses from other students after making suggestions. The facilitator related this obstacle to members while coordinating design alternatives, and it suggests that audio devices and web cameras are better for online deliberation.

4.4 Formative years and long-term database management

The townscape is a gradually forming landscape that needs long-term management for controlling the design and reconstruction of private buildings, and this design and reconstruction will be conducted after a design review. The VR data of the buildings that are reviewed can be made available to the public for reference. Therefore, management of the VR database is necessary for the long-term management of townscape design, and will be considered in future studies. For this, Google Earth has great potential if users import the VRML dataset using Sketchup.

From a walk-through of the virtual townscape, residents can understand the requirements endorsed in the neighborhood design guidelines, and all construction activities will have common objectives if residents take measures to protect their neighborhood design guidelines during the design review process.

5. Conclusion

Virtual reality and the Internet are advanced information technologies, and their application to urban planning and design is a challenging topic. There are many existing research reports on visualization for different types of urban projects. If substantial social and political obstacles hinder implementation, then we can conclude that the technologies themselves are not a direct means for planning and design consensus, but only tools used to support planning and design.

In the present study, we use the Blaxxun platform to develop a visualization tool for presenting a townscape and discuss the possibility of attaining consensus on neighborhood design guidelines for public space design and private buildings. Planning documents endorse neighborhood design guidelines, and a visualization tool helps local planning committees because participants can deliberate based on a shared common image. Moreover, the virtual world can be used in place of illustrations, in traditional documentation, and be made available to the public in electronic documents on the Internet. According to interview surveys from our case study, deliberations were successful in sharing a common image, and participants were motivated to become involved in reaching consensus and to confirm whether the points of deliberation were reflected in the revisions presented using the VRML. The virtual world also motivates the public to participate in and deliberate on various aspects of planning and design during committee meetings.

It was easy to reach consensus on street furniture in public spaces in the present study using the visualization tool, because these design elements do not interfere with private spaces. In contrast, local residents are apprehensive of using the tool to visualize the reconstruction plan for their private buildings during meetings open to the public. Therefore, a design review board does design reviews of each reconstruction plan to evaluate the use of neighborhood design guidelines, and although the design information of a private building during the design review process is difficult to make available to the public, the information available after the design review can be placed on the Internet, for reference.

In the drugstore design review case study, design alternatives, including the exterior wall, the commercial signboard, the green design in parking space and the flowerbeds in the front of the building, can be freely combined through the shared visual world using the multi-user environment on the Internet. As participants mentioned, the visualization tool is effective for coordinating designs through the exchange of design alternatives, and finding a solution using combinations of all the elements. It was helpful for committee members to be able to evaluate the architectural design while sharing the image of the entire townscape using the visualization tool, and to decide whether the design of new buildings harmonizes with that townscape.

The chat system used during the deliberations had a time delay between the entry of opinions and the receipt of responses to them. The opinions always emerged later and were mixed with other topics, and although participants could check the discussion results by reviewing the chat history, they could not receive immediate responses from others after entering suggestions. The current limitation of 3-D visualization is the lack of tools to understand deliberations during committee meetings. The development of a knowledge-based database system, combining similar design experiences from other

regions, including spatial utilizations, management and maintenance, will be beneficial. Furthermore, for the long-term management of a townscape design and design review VR database from the viewpoint of entire city, Google Earth has great potential if importing the VRML dataset using Sketchup.

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