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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.

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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 (Bulmer, 2001; Smith & Craglia, 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, Trodd, Zhang, Fernando, & Watson, 2001). Visualization tools, freely accessible to local communities on the World Wide Web through VRML and WebGIS, are appropriate for public involvement. Furthermore, Ieronutti and 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 (Matsubara & Matsumoto, 1991; Moon, 2003; Shiffer, 2001). 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, Nelson, and Cartwright (2004) proposed visualization of planning and design alternatives to encourage public involvement in bottom-up decision-making. Shen, Kawakami, and Kishimoto (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.

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As part of a planning process, 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, Plume, and Parolin (2005) reported on public participation in a spatial decision support system (PP-SDSS) project for public housing. Also, Hudson-Smith, Evans, Batty, Batty (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 (Ohura, Arima, Hagishima, & Sakai, 2001; Tanoue & Arima, 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.

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