A WEB-BASED 3D GIS SYSTEM TO MANAGE AND CONSERVE HISTORICAL ENVIRONMENTS

Case Study on a historic district in Kanazawa

YUICHI SHIMOKAWA
Department of Architecture, Kanazawa Institute of Technology, Japan.
shim@neptune.kanazawa-it.ac.jp

AYAKO Fukushima
Graduate School of Design, Environmental Design, Kyushu University, Japan

TATSUO MASUTA, TOMOHIRO MIYASHITA, AKIHIKO TANI
Department of Architecture, Kanazawa Institute of Technology, Japan.
{ masuta, miya, dr-tani}@neptune.kanazawa-it.ac.jp

AND

SHIGEHIKO SAKAO, ATSUSHI SONE, MAMORU SHIROKI, DAI KAWAHARA
Digital Archive Laboratory, CAD CENTER CORPORATION, Japan.
{s-sakao, sone, shiroki, d-kawahara}@cadcenter.co.jp

Abstract. In this paper, we will discuss the system environment that supports management and conservation works for historical landscape and architecture. The proposed system enables both 3D map based spatial data management in urban scale and VR model based landscaping in street scale in one Web system. Moreover users can share their comments in those 3D spaces at any locations and any time. We set up this system for the historical City of Kanazawa. The system is gong to be assessed in the actual landscape planning project.

1. Background

Conserving historic districts has become more and more important work for governments. In order to manage and conserve historical districts and landscape, various kinds of information need to be opened. For example, when ordinary houses are included within a historic district, government officials or preservation professionals have to inform owners and residents of information clearly using visual media.

This research project initiated by Kanazawa Institute of Technology (KIT) and CAD CENTER CORPORATION (CCC) is based on our recognition that preservation professionals/officials need a better device to figure out what elements of the landscape are important for everyone, and share their ideas and conservation plans with the public for discussion. On the other hand, the public need a device to feedback their ideas and to communicate with the professionals and officials.

The project team proposes a system to improve situations mentioned above. The technology employed in the system is a Web-based 3D GIS and Virtual Reality (VR). Effectiveness of VR technology in environmental design has been reported in preceding various researches from some viewpoints: delivery of city model (Lin, 2002; Brown, 2005), real-time simulation in environmental design (Lou, 2002; Yeo, 2004), supporting collaboration (Fukuda, 2002) and conservation of historic architecture (Oh, 2005). We think that those visual approach methodologies can raise peoples' awareness towards the project strongly. On the other hand, methodology of city modeling and delivery by integrating VR and GIS on the Web is reported (Chiu, 2005). It's also important from the viewpoint that not only visible information but also invisible information about city can be shared among many people.

2. Objectives of the Study

In this paper, the Project Team proposes a Web-based 3D GIS system to manage and conserve historical environments including historic buildings and landscape. It started as collaborative project between KIT and CCC in April of 2005.

Members of KIT have been conducting survey of a historic district called Udatsu-yama in Kanazawa. There are 34 Temples and about 500 dwellings in the area of 0.17 square kilometers. Even for professionals, it is difficult to grasp the whole picture of landscape of this area due to complex landform as well as dense structures and vegetation. In case study, our purposes are to implement 3D landscape models of this area on the system for supporting understanding the landscape character, and to confirm effectiveness and

future possibility of the system. In this paper, we present the initial product and progress of the project.

3. Concept of the System and its Use

In this section we describe concept on proposed the system and its use.

3.1. CULTURAL HERITAGE MANAGEMENT SYSTEM IN URBAN SCALE

The city of Kanazawa holds many relics of its heritage as a capital, built around the principal castle of the ancient province. The city administration and the professionals are acting to preserve the historical treasures of Kanazawa for the benefit of the generations to come. In order to support and open those activities, it's important to develop cultural heritage management system in urban scale.

VR models are often created individually for local project site without compatibility with other projects in the same city. In this project, we are oriented to the system that enable both 3D map based spatial data management in urban scale and VR model based landscaping in street scale in one system.

3.2. ON-LINE COMMUNICATION FOR CONSERVATION PROJECT

The advantage of on-line communication is its convenience. Modern lifestyles don't always allow people to spare time to attend the public meetings held at the community center or else. On-line participation enables people to participate in the project at home, office or wherever with a normal-spec computer and the broadband Internet access. We believe it's worth experimenting to hold both off-line public meeting and on-line Web3D-GIS communication for the same project.

The 3D model placed on the Web will be very a good material for the public outreach. It's also effective that users can discover the stories or significance that place possesses. To achieve those, smart way of browsing data attached to 3D objects and communication support tool on 3D space are necessary on the system.

4. The Functions of the Proposed System

The system developed by CCC is designed as simple as possible so that non-professional users can use easily. Windows as OS and Microsoft Internet Explorer are required to perform the task. Advantages of the system are as followings.

4.1. REAL-TIME VIEWING URBAN SCALE MODEL

The developed Web 3D-GIS engine enables 3D maps of large area and models to display quickly. Easy viewing operations by a mouse hardly make users feel stressed. The system allows users to fly over 3D maps or walk through the VR models smoothly.

4.2. TOOLS FOR COMMUNICATION

Conservation projects must be discussed and agreed by various stakeholders. The system allows users to write and drop comments in 3D virtual space. Users can drop comments or questions on the 3D space. Other users can view those comments and make feedbacks if they wish.

4.3. LAYERS-ON-DEMAND

The system allows storing more than one layer of 3D virtual space. For example, users can view and switch from a layer of cityscape model in 2006 to another layer of the spatially same model in the past or in the future on-demand in order to compare and understand the differences.

4.4. ATTRIBUTE DATA LINKED TO 3D OBJECTS

The system allows users to view attribute data linked to 3D objects. It is possible to search attribute database using a keyword.

5. Data Implementation for a Historic District in Kanazawa

We set 3 areas as the focal area, the survey area and the peripheral area on implementing data. Landscape in the focal area is represented with elaborated VR model, and the survey area is with less elaborated model. Those levels of detail are different with each other according to our focus. The outlines of those models are as follows:

5.1. 3D MAP OF THE PERIPHERAL AREA

3D map of the peripheral area we implement corresponds the area of old castle town of Kanazawa (left of Figure 1). The 3D map has two major components in the area of about 17 square kilometers: terrain and building (right of Figure 1). It is important to preserve view corridors or vista in conserving historical environments. There are some places in the focal area, where we can see visual corridors to a center of city. Immediately the 3D map can be used to simulate and discuss such points of view.

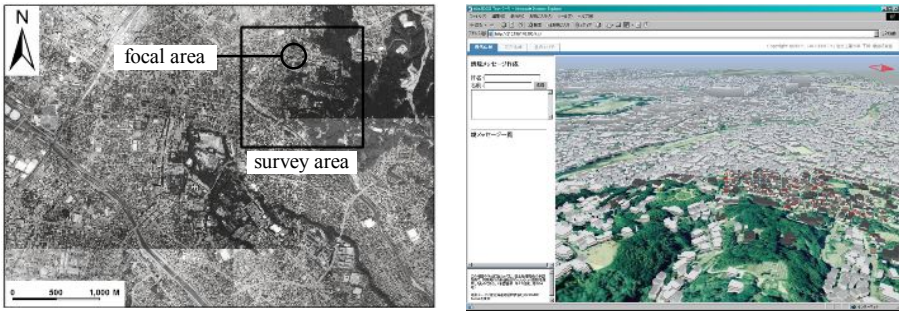

Figure 1. Aerial photograph (left) and implemented 3D map (right) of the peripheral area

5.2. 3D MAP OF THE SURVEY AREA

3D map of the survey area we create corresponds the area of Udatsu-yama mentioned in second chapter. Because of complex landforms and dense buildings and vegetation, it is difficult even for professionals to understand the landscape of this area (left of Figure 2). Therefore 3D map help stakeholders grasp characters of this area.

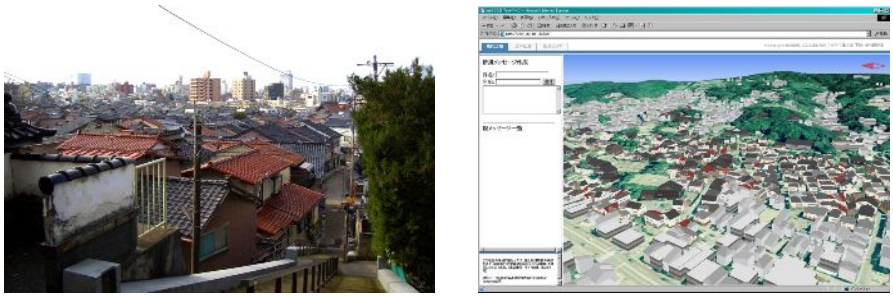

Figure 2. Skyline of roofs (left) and implemented 3D map (right) of the survey area

3D map of the focal area is created in the same layer as the peripheral area, but its accuracy is somewhat high than the peripheral area (right of Figure 2). Users can view historical information of temples by clicking the models in 3D map. As we survey more, this 3D map could develop into a portal site on the Web about historical environments in Kanazawa.

5.3. VR MODEL OF THE FOCAL AREA

The focal area is an area where temples locate much densely compared with other areas. In this area we can see many historical elements such as temples or earthen walls, hence, stakeholders often discuss preservation of this area.

Accordingly we modeled and implemented this area as VR model. This model is made as an independent and separate layer, and also it is more elaborate (Figure 3). Users can navigate the space on eye-level. When stakeholders discuss future conservation plans, planned models can be created as another layers for comparison and simulation.

Figure 3. Real space (left) and VR model (right) of the focal area

6. Test Uses

We have shared many comments on the 3D map using the communication tool about landscape characters of the survey area. It's convenient that the icons of comments can be displayed in also VR model commonly. So we can get shared information in various scales and angles freely (Figure 4).

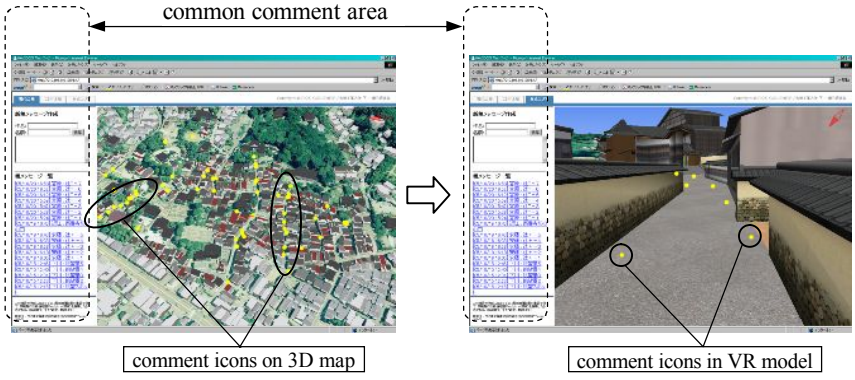

Figure 4. Use image of the communication tool

We used the system with some kinds of network band. When using narrowband network (ex. practical 128Kbps), it took approximately a couple

of minute to download 3D map data first. When using LAN (ex. practical 4Mbps), it took mostly less than 10 seconds to do so. In both cases, the system performs quite well in viewing 3D models as long as using recent normal-spec computer.

Now the system is open to concerning officials and professionals. Most of them feel that simple volume models are better than elaborated models about buildings except temples in the 3D map. Because detailed representation for ordinary dwellings prevent them from observing distribution of historic elements as temples, earthen walls. We think that the role of 3D map is different from the one of VR model in such point.

7. Conclusions

The authors designed a device to involve more people using the Web and the simple interface and operation. To sum up, the developed system is to help planning, visualization and communication for conservation of historical environments. The system is supposed to be experimented for the landscaping simulation and conservation planning of the Udatsu-yama district by Kanazawa City and KIT. After the more test use, we will re-examine the system and data, and improve them further.

Acknowledgements

We are most grateful to Daichi Miyahara, Nobuhide Andou and the other KIT students for helping creating various data. Special thanks to Kanazawa City who kindly offered various data for our project.

References

Brown, A., Knight, M. & Winchester, M.: 2005, Representation and Delivery of City Models, CAADRIA2005, India, pp.344-352

Chiu, M.L., Lan, J.H. & Sun, K.W.: 2005, City Modelling for Large-scale Urban Redevelopment Methodology and Implementation, CAADRIA2005, India, pp.317-327

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

Fukushima, A., Shimokawa, Y., Masuta, T., Miyashita, T., Sakao, S., Sone, A., Shiroki, M. & Kawahara, D.: A Web-based GIS System to Manage and Understand Cultural Heritage and Settings, Proceedings of ICOMOS 15th General Assembly and Scientific Symposium, Volume 2, pp545-549

Lin, H.T. & Chiu, M.L.: 2002, From Urban Landscape to Information Landscape, CAADRIA2002, Malaysia, pp.101-108

Lou, C.W., Kaga, A. & Sasada, T.: 2002, Environmental Design with Huge Landscape in Real-time Simulation System, pp.272

Oh, S.Y., Kadobayashi, R., Sasada, T. & Tanaka, K.: 2005, Collaborative Project to Conserve and Personalize the 3D Digital Archives of Historical Architecture, CAADRIA2005, India, pp.179-187

Yeo, W.H., Yuda, Y., Oh, S.Y., Kaga, A., Sasada, T. & Sato, R.: 2004, The Development of Environmental Design Helping System Using Real-time Simulation, CAADRIA2004, Korea, pp.947-955.