Study on Decision Support System for District Planning in Public Participation

A case study in Kanazawa City, Japan

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Abstract: In this paper a design tool for promoting consensus between people within a decision support planning system at a district level in Japan is proposed. While opening necessary planning information to the public using WEGIS, VRML and other medias, the design tool is employed to exchange design elements in VRML world. These design elements are likely to be adopted by a local planning committee on making a decision of a district plan according to the Japanese legal system.

1. INTRODUCTION

1.1 Situation of public participation at the district level planning

In recent years many types of public participation has been introduced for district level planning. Visual images reflecting planned or discussed contents could be very effective for participants to clearly understand and review the design elements as well as documents and drafting materials. That kind of visual image needs to reflect planning variables discussed between participants.

In recent years, introduction of multimedia tools is growing to include planning field due to the wide spread of the Internet and the development of computer technology. Various public participation systems have been
developed and applied to provide support in the discussion of planning and design.

This paper provides a decision support system that promotes a high level of consensus between all the people involved at a district level in Japan. While opening necessary planning information to the public using WegGIS, VRML and other medias, the design tool is employed to exchange design elements in VRML world. These design elements are likely to be adopted by a local planning committee in making a decision for a district plan according to the Japanese planning system.

The existing relevant systems are reviewed as follows. Regarding a design tool, the possibilities for each user to build his/her owned space and their communication in a virtual city have been proven successful by the Alpha world project (Smith, Andy, et al., 1998), which is a pure virtual world without any design regimes. However, it is not built for a real construction project, so it is very freely accessible virtual environment in the initial step for practice in urban planning and design.

In the context of urban planning and design, the Ryoanji project (Okabe, Atsushi, et al., 1999) was carried out for examination of possibilities of cooperative remote design while sharing the same virtual space, which is developed according to certain needs from a real site of Ryoanji. The Ryoanji project discussed the possibilities of remote design game, but they did not provide a useful design tool.

An on-line design collaboration system was proposed (Shen, Zhenjiang, et al., 2003) for collecting participants’ designs on the Internet environment, in which participants can make their new ground surfaces, and arrange design or select elements on the planning space in the VRML world.

The design tools can serve a visualization tool of planning and design alternatives (Bulmer, Daniel, 2001) that are suggested by the participant in the planning process and facilitate better public participation. In addition, Andy Smith (Hudson-Smith, A., et al., 2002) discussed a design tool to generate alternatives for public participants in the Woodberry regeneration project.

However, there are few research projects in the context of providing a design tool for a decision support system of a district plan. In our project, planning and design elements of townscape rules are obtained from relevant ordinances in the Japanese legal system. There are several planning elements relating land use rules for land lots, building volume, building design and other elements for a townscape. For example, the design rules regarding townscape are height, colour, roof type and latticed window of buildings and so on. Land use rules for land parcels include parking locations, number of stories and FAR for buildings along the street, which are likely be defined in the district plan. In addition, residents themselves could also agree to have
a more detailed design elements based on their requirements. The design tool, that can simulate these design elements with VRML for discussing and evaluating the district planning, can also be opened to the Internet environment and the local planning committee for reaching a consensus between all parties involved. Users will be participants consisting of residents, experts and administration officers.

In this paper a system is proposed that could reflect districts level Planning variable and be used for supporting public participation. This system creates 3D images reflecting multiple Planning variable. Using this system district level planning could be reviewed and discussed.

1.2 Effectiveness and demand of public participation using computer system

A system is needed for public participation where participants can grasp the actual conditions and planning themes, have common relating information and can reflect on variables that have been discussed. The traditional method in which specialists such as planners prepared alternative plans and explain them at an ad hoc meeting requires participants to gather at a specific place and time. This kind of restriction limits the number of participants and the types of members. Explanations at this type of meeting using documents and physical models tend to be complicated because the contents could be enormous and complicated according to the amount of information.

On the other hand a computer system could express 3D images with multimedia such as literal expression, visual image and sound expression. It is then possible to have variable expression reflecting Planning variable for district level planning. It also utilizes the Internet for exchange opinions and reach to the final plan.

If the system is formulated to be manipulated by participants using the interactive function of VRML they could change proposed plans according to their ideas. In this context the function of the system should be designed for residents who are not familiar with this special field so they can easily understand contents and manipulate the computer at a minimum level skill.

2. VARIABLES FOR DISTRICT LEVEL PLANNING

Planning variables for district planning are related to building form, the appearance and the site.
### 2.1 Selecting Planning variable for the situation

In Japan there is an institution of District Planning for district level planning. It is one of the planning systems based on the City Planning Law of Japan. Based on this institution a specific district is designated and selected Planning variable are settled on this district. Selecting the Planning variable public participation is necessary. Planning variable are public facilities such as roads and parks at the district level, building form regulations such as building height, building coverage ratio and floor area ratio, architectural design such as roof design and wall colour, and recent years many types of public participation has been introduced for district level planning. Visual images reflecting planned or discussed contents could be very effective for participants to understand and review them clearly as well as documents and drafting materials. That kind of visual image needs to reflect planning variables discussed between participants.

**Table 1. Planning variable of the District Plan.**

<table>
<thead>
<tr>
<th>Categories</th>
<th>Planning variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Usage of Land and Building</td>
<td>Restriction of building usage</td>
</tr>
<tr>
<td>Building form regulation</td>
<td>Limitation on floor area ratio</td>
</tr>
<tr>
<td></td>
<td>Limitation of building coverage ratio</td>
</tr>
<tr>
<td></td>
<td>Limitation of building height</td>
</tr>
<tr>
<td></td>
<td>Limitation of building area</td>
</tr>
<tr>
<td></td>
<td>Limitation of site area</td>
</tr>
<tr>
<td></td>
<td>Restriction of building position</td>
</tr>
<tr>
<td>Regulation of architectural design</td>
<td>Restriction on roof and eave</td>
</tr>
<tr>
<td></td>
<td>Restriction on outside wall</td>
</tr>
<tr>
<td></td>
<td>Restriction of advertisement</td>
</tr>
<tr>
<td>Others</td>
<td>Restriction of gate and fence</td>
</tr>
</tbody>
</table>

### 2.2 Case study area and selected simulation planning variable

A case study area, which is showed in Figure 1 and called Zaimoku-cho in Kanazawa City, is selected for the 3D simulation. This area is one of the most historical areas where some traditional townhouses and street structures have survived and relatively new houses also built along the historical street. A Neighbourhood Commercial District is designated on this area as land use zoning, where a maximum building height of 12m is also designated.
Table 2 shows selected planning variable for 3D simulation of this study. They are minimum distance of building wall setback from the road line, maximum building height and restriction of storey. Table 2 also shows actual figures used for simulation.

**Table 2. Selected planning variable and their simulated parameters.**

<table>
<thead>
<tr>
<th>Planning variable</th>
<th>Regulation</th>
<th>Simulated figures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall position</td>
<td>Minimum distance of setback</td>
<td>0.5-2.0m</td>
</tr>
<tr>
<td>Building height</td>
<td>Maximum height</td>
<td>10m or 12m</td>
</tr>
<tr>
<td>Restriction of storey</td>
<td>Number of storeys</td>
<td>2 storey or 3 storey</td>
</tr>
</tbody>
</table>

**Figure 1. Case study area (Zaimoku-cho in Kanazawa City).**

3. **FORMULATION METHOD OF PLANNING VARIABLE USING VRML**

In order to visualize the results using applied planning variable for participants who manipulate the system on interactive circumstances, a simulation system should show 3D images of the result as well as the original townscape. For this purpose an animation using an “Interpolator” function of VRML is applied.

Table 3 shows types of VRML fields that are related to planning variable, which are “Scale” and “Translation”. As for the wall position “PositionInterpolator” can be used to change the distance of wall setback by
translation and scale field. In this function “PositionInterpolator” should be given for showing position change because the starting point for change is the centre position of building. If the direction should be changed in simulation, the “OrientationInterpolator” is necessary too.

Building height and storey can also be changed by “PositionInterpolator”. Change of storey is simulated by the change of “Scale” field through “PositionInterpolator”, which can eliminate a storey.

Table 3. Selected three variables relating building and interpolator.

<table>
<thead>
<tr>
<th>Planning variable</th>
<th>Regulation</th>
<th>VR parameter</th>
<th>VR fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wall position</td>
<td>Minimum setback</td>
<td>Scale of XY direction</td>
<td>Translation and scale</td>
</tr>
<tr>
<td>Building height</td>
<td>Maximum height</td>
<td>Scale of Z direction</td>
<td>Scale</td>
</tr>
<tr>
<td>Building storey</td>
<td>Maximum storey</td>
<td>Storey</td>
<td>Scale</td>
</tr>
</tbody>
</table>

In this study 3dsmax is used for 3D modelling. In order to create dynamic 3D images on the web, data of 3dsmax is needed to exchange to VRML. When 3D space is modelled using 3dsmax and exported to VRML, a file containing all 3D data is output. As this generates a heavy load on the computer system, part of 3D objects that are created in 3Dmax are saved separately to be integrated as one file, in which coordinates of these objects are described.

In order to visualize change of building forms an animation procedures are recorded using 3dsmax. After exporting to VRML these animation procedures of 3dsmax should be controlled by a design tool in order that the alternatives of planning variable can be dynamically visualized through users’ operation. Values of time such as “key” and “keyvalue” are used to control the animation function through “ROUTE”. A system is developed to visualize building regulations using “PositionInterpolator” and “OrientationInterpolator”, which can be employed to adjust buildings’ scale and translation value (Table 3). In order to visualize 3D images reflecting planning variable each 3dsmax data is given relating animation function.
4. VARIABLES FOR DISTRICT LEVEL PLANNING

4.1 Selecting planning variable for the situation

As the developed system in this study deals with building wall position, number of storeys and building height as indices of building forms, each main component of building form such as roof and each storey is filed by being grouped. Then it is possible to change the 3D images reflecting these indices. Using this system each building can be changed in terms of its wall position, building height, number of storeys and height of each storey. Figure 4 shows an example of the 3D images.
Figure 3. Components of building form.

Figure 4. An example of townscape images from the eye-level view.
4.2 Outline of the system

In this study a system is developed, which can reflect changes of building wall, height and number of storeys. Figure 6 shows an interface image, on which a right-hand side image is VRML of the study area and participants could be browsing in the studied area where planning variable have not yet been applied through VRML. Left-hand side image shows interface image to select planning variable, on which a red sign on the map is showing a specified site. White letters under the map shows a name of the specified building and three below columns are buttons to select planning variable. If any of these buttons is selected an animation started to show image change of the corresponding planning variable. Then participants can easily understand the change comparing before and after application of the planning variable.

Figure 7, 8 and 9 shows examples of the image after applied planning variable. Namely figure 7 shows the setback of the building wall as 2m compared to the original one, figure 8 shows an image of building storey change as three to two, figure 9 shows an image after building height change from 10m to 12m.
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Figure 6. Interface image of the system.

Figure 7. An image of building wall setback.
4.3 Development design tools for reviewing application of planning variable

Framework of the system is shown by figure 10. “3D objects” in the VRML are formulated using buildings by 3dsmax and 3D environmental data, and gif type data is indicated in VRML space and set as an interface of the system. Then, each of them is given by “TouchSensor” and by selecting between them participants can change alternatives to be considered using “JavaScript (ScriptNode)”. In order to express 3D data of VRML the system uses “blaxxun Contact 5.1”.

Figure 8. An image of building storey change from three to two.

Figure 9. An image of building height change from 10m to 12m.
Participants follow procedure to use the system as follows.
1. Selecting a building to be studied; after selecting a specified building on a HTML form object, “Switch node” of VRML is changed to match the selected item of the HTML form object, whereas a function coded in “JavaScript” makes the specified building appeared on CRT.
2. Manipulation of “2Dlayer panel” describing building names; after clicking panel a menu of applied planning variable begins to appear, which is reviewing of building wall position, number of storeys and building height in this study.
3. Using popped menu and visualization of planning variable; after clicking a planning variable on the menu, visualized image can be reviewed in VRML.

Figure 11. Diagram of the system.

Figure 12 shows function diagram for visualization. As selecting function between planning variable is formulated on interface used 2D layer, animation function is needed to be connected to the interface using 2D layer. To do this both animation control using “TouchSensor” and “Script” of VRML.
1. Manipulation of “key” and “keyValue” in “Interpolator”

As exported animation using 3dsmax, the “key” values are given from 0.0 to 0.9, which is utilised to make corresponding to “keyValue” for interpolators including position and orientation. Each of these is given “TimeSensor” and animation is divided into three parts.

Figure 13 indicates an example in which translation and scale values can be changed through a, b and c-1, c-2 procedures. For example, “PositionInterpolator” and “OrientationInterpolator” can be used to change value of scale, thus it has two interpolations indicated in Figure 13 and 14 as c-q and c-2.

2. Setting animation by “ROUTE”

Animation is controlled by using “eventIn” and “eventOut” of functions in “ROUTE”. “Loop” in “TimeSensor” which is “Node” of VRML should be also discharged, otherwise animation will repeat and does not stop and repeat.
As shown in Figure 13 “fraction changed” is “eventIn” and “set fraction” is “eventOut” function. An animation starts to move by linkage of both of them, “TimeSensor” and “Interpolator”. Parameters such as “Translation”, “scale” and “scaleOrientation” are changed to control wall position, number of storeys and building height relating defined building indicated by a, b or c procedures. However because the orientation values are not changed in this system, b and c-2 process can be omitted actually.
Figure 14. Routine of animation.

5. CONCLUSION

In this study a system is developed, which can represent a townscape and review planning variable. Considering existing planning regulations at district level this system deals building wall position, number of storey and building height. A system is developed using Blaxxun3D and 3dsmax, which can review a combination of planning variable comparing between them.

The developed system is applied to a case study area, where is one of the historical areas in Kanazawa City, and simulated images and animations are presented.

A further study is needed to review other planning variable that are not dealt with this study.

6. REFERENCES


Ohura, H., et al., 2001, “Development of the multimedia town planning support system using WWW – Application of the card type workshop technique in the town planning support
system", Proceedings of the 24th symposium on computer technology of information, systems and applications, Tokyo, p.61-66.
Shen, ZJ., et al., 2003, “Study on development of on-line cooperative planning and design system using VRML and JAVA - A case study on a public park planning and design “, CUPUM’ 03, Sendai (Japan).