Study on the Development of an On-line Design Collaboration System for Public Participation - A Case Study of Public Park Planning and Design

Zhenjiang Shen, Mitsuhiko Kawakami and Kazuko Kishimoto
Department of Civil Engineering
Faculty of Engineering
Kanazawa University, Japan

ABSTRACT

As a result of reviewing existing research in the field of public participation, an on-line collaborative design system can be broken down into the following four sub-systems : the planning objectives system, the discussion system, the proposals system and the design game system. Using these systems, participants can exchange their ideas and concepts, experience the present situation and give their opinions on an interactive web site. Furthermore, in the design game system, the participants can design their park plan according to their preferences and save their design to a server database. Other participants can then access the database to review another participant's design for purposes of comparing and getting consensus. In order to evaluate our demonstration system, we carried out an experiment using the design game in Yamanoue community where a park project was scheduled by the local government of the area. Through the participation of the residents and university students, we were able to analyze the design process of the park design workshop in an Internet environment. In particular we were able to examine the exchanging of participates' ideas, the process they all used in creating VRML worlds of their park design and the effectiveness of VRML for plan presentation.

1 INTRODUCTION

1.1 **On-line Design Collaboration System for Public Participation in Japan**

Internet is widely used all over Japan with about half of the Japanese population having personal computers and access to the Internet through a local area network or telephone connection. On the other hand, public participation has been an important mission for urban planners in Japan since the implementation of legal reforms in urban planning in 1992.

It is an important challenge for the future of the urban planning systems to work out how to let residents participate in urban planning by utilizing the Internet environment. This paper is an ongoing report of our research after CUPUM 2001. In this paper, an on-line design collaboration system for public participation is introduced including an outline of the system's composition. The examination of possible applications and ongoing further development of this system is necessary as is the measurement of its use to verify it's user friendliness. Therefore, part of this system was examined in a local community accompanied by a students' evaluation. An on-line design collaboration system includes four sub systems, which are *planning objectives system*, *discussion system*, *proposals system* and *design game system*. The Design game system is the on-line VRML design collaboration system, which

was described in CUPUM 2001.

1.2 **A Case Involving Public Park Planning and Design**

The Setagaya community design project (1998) represents a process of collaborative park planning and design. The process can be divided into seven steps, which are: 1.Mutual understanding between participants, 2.Definition of objectives for planning and design, 3.Reviewing problems regarding the present situation, 4.Discussion about a project budget plan, 5.Presentation of proposals for planning and design, 6.Design game, 7.Evaluation of the final plan and design.

After reviewing the seven steps, a concept model for an on-line collaborative design system can be provided for park planning and design, which includes the four sub systems also previously mentioned in this paper. In order to evaluate our system, we carried out an experiment using the design game system in the Yamanoue community where a park project was scheduled by the local government. Through the participation of the residents and university students, we were able to analyze the design process for park design on an Internet environment. In particular, we examined the participants' exchange of ideas and the process of reaching consensus.

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2 OVERVIEW OF RELEVANT RESEARCH

We have an overview of the relevant papers regarding internet-based design collaboration, especially those issued by the Architectural Institute of Japan, the City Planning Institute of Japan and the International Conference of DDSS.

2.1 **Relevant Research in Japan**

In Japan, there are some research projects regarding design collaboration based on VRML. For example, an Osaka university group (Kaga, Hosono, Sasada, 1996) discussed a network open design environment, for professionals, designers and engineers as specialists, but this was not for public participation. One research group from the University of Tokyo (Okabe, Sato, Okata, Okunuki, 1999) and Nagoya University (Okunuki, Sato, Nishikawa, 2000) used a *multi-user environment VRML server* ("Community Place Bureau", a SONY product), to test the effectiveness of VRML for design collaboration. A group from the Kanazawa University (Shen, Z., Kawakami, M., 2001) described a composition of on-line cooperative planning and design systems for public participation.

2.2 **Overview Of The International Conference**

In relevant research papers from international conferences, a Delft University group (Maren, Moloney, 2000) developed the KARMA system for the presentation of virtual reality

representation of designs based on GIS data. An Eindhoven University of Technology group (Dijkstra, Timmermans, Vries, 2000) provided a system of VR-DIS (Virtual reality – design information system), which contributes to the simulation model of pedestrian's movement in virtual reality. These research reports are enlightening and assist our project regarding 3-D presentation of park plans and designs, but most of the research reports regarding collaboration designs are for professionals, designers and engineers as specialists and are not suitable for public participation.

From the above overview of results, it is clear that the development of a VRML design collaboration system is progressive. However, many problems encountered with this system still remain, such as how participants can present their concepts, how to compare respective participant's design, how to reach consensus on design collaboration and how to make user-friendliness more effective.

3 FRAMEWORK OF AN ON-LINE DESIGN COLLABORATION SYSTEM FOR PUBLIC PARTICIPATION

As a result of reviewing the Setagaya community design center (1998), the process of collaborative design for public participation can be divided into seven steps. Therefore, an on-line collaborative design system for a public park can be developed as four sub-systems in our project according to the process of public participation, which are outlined in Figure1.

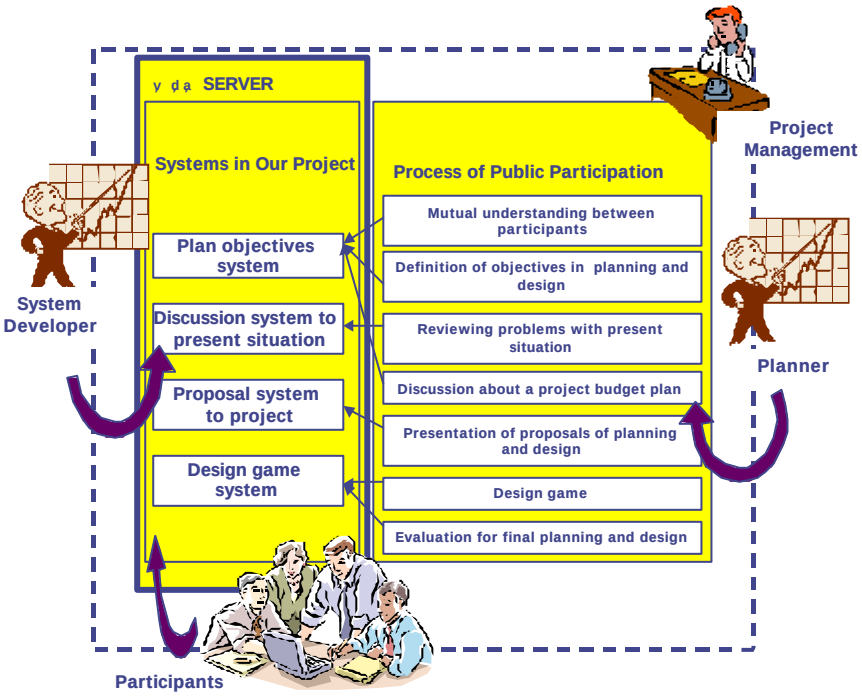

Figure 1: **Collaborative design model for a public park**

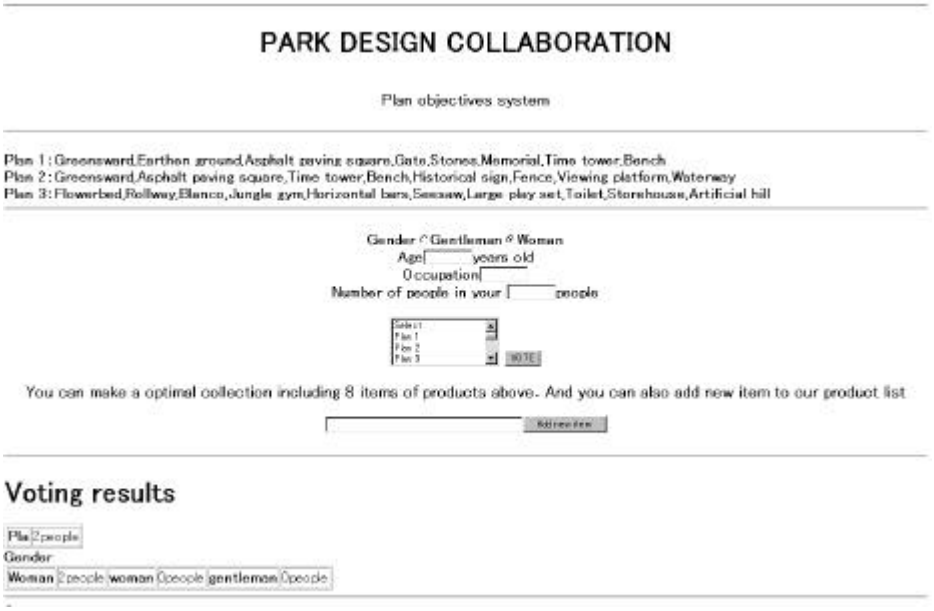

Figure2-1. **Plan objectives system**

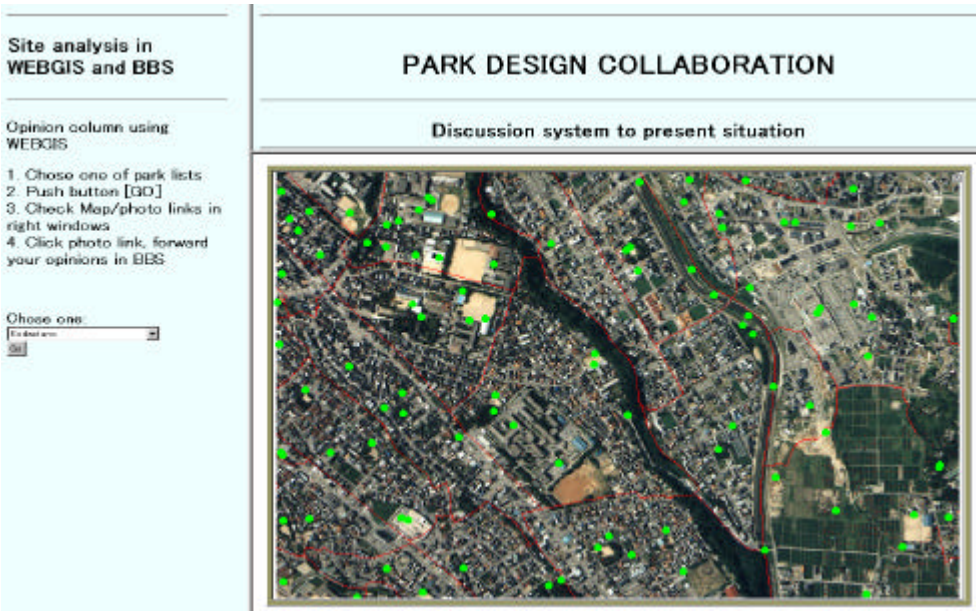

Figure 2-2. **Discussion system**

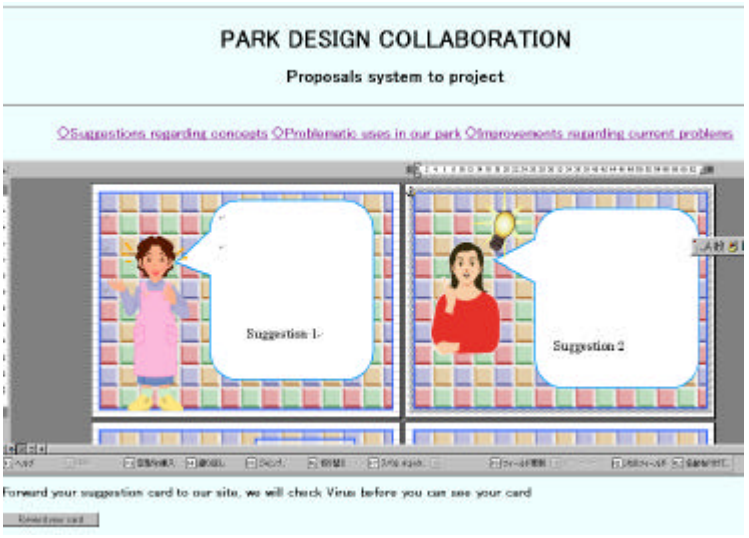

Figure 2-3. **Proposals system**

The first step is a system for planning objectives, shown in Figure 2-1. The second step is a system for discussion, shown in Figure 2-2. The third step is a system for proposals, which is represented by Figure 2-3. The forth step is a system for a design game, Figure 2-4 is the interface which has already been introduced in CUPUM 2001. Using these systems, participants can exchange their ideas and concepts in the planning objectives system, and also they can experience a representation of the present situation on a web site and give their opinions in the discussion system. Then in the proposals system, participants can make their proposals for land use accurately using planning cards. In the design game system, the participants can design their park plan according to their preferences and save their design to a server database. Other participants can access the database to review another participant's design for comparing and reaching consensus.

4 SYSTEM TEST OF EFFECTIVENESS OF DESIGN GAME SYSTEM ON YAMANOUE COMMUNITY

From Aug. to Dec.2001, a series of experiments were conducted to test our On-line Design Collaboration System. However, only the design game system was tested in these experiments. The other three sub systems will be tested in the future.

Regarding the effectiveness of the design game system in plan decisions, experiments involving the design game system were planned in three phases shown in Figure 3. Phase one is for all residents who are divided into several groups. Phase two is the collaborative design of group leaders in an Internet workshop who are chosen by design votes in phase one. Phase three is for the decision of the final plan according to group leaders and community leaders in an Internet workshop.

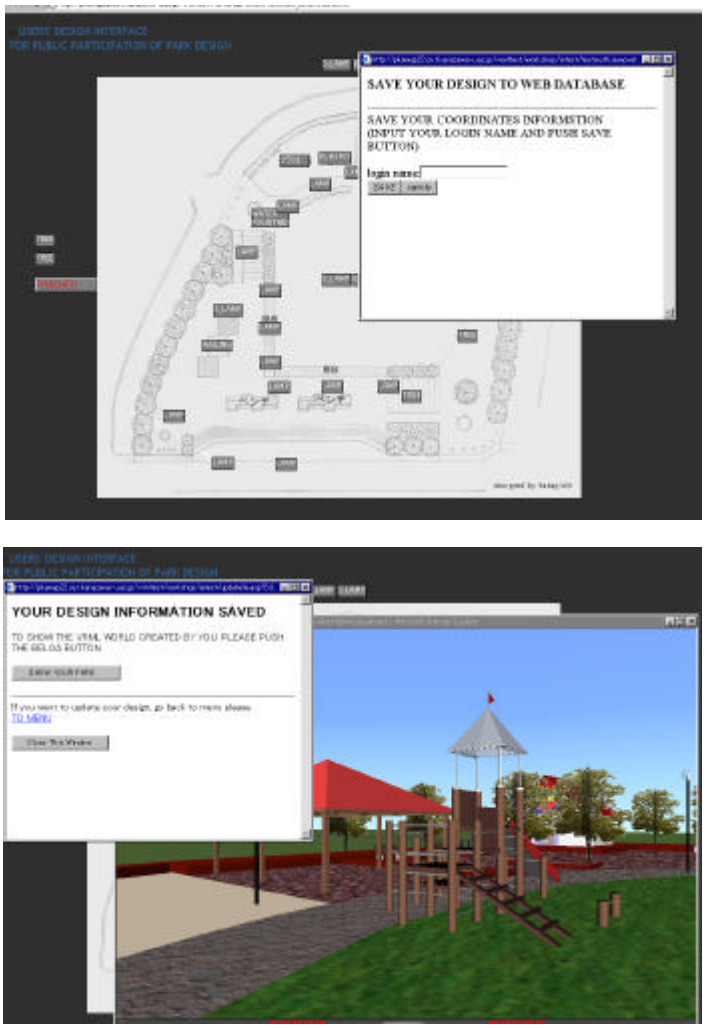

Figure 2-4. **Design game system**

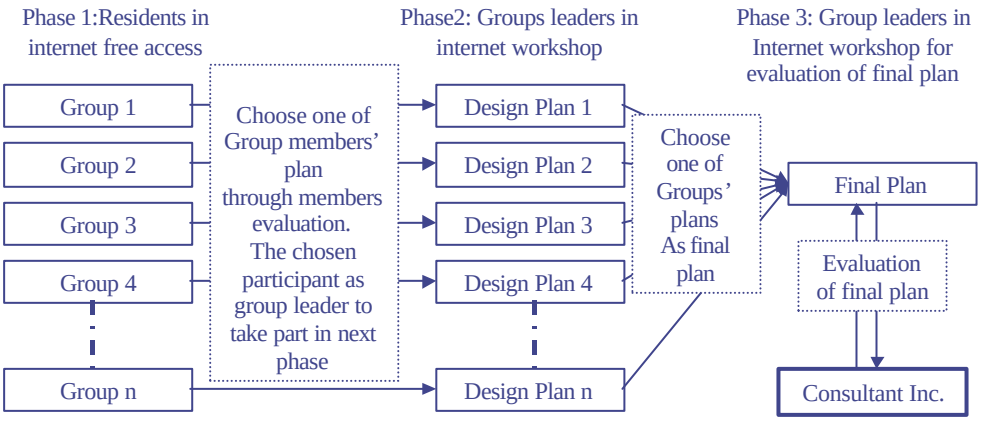

Figure3. **Three phases of design game system**

Table1. **System tests and experiments for design game system**

System test1. Effectiveness of system in plan decisions	
Time schedule	Aug. 21.2001 19 00 21 00, two hours
Participants	One Kanazawa city officer
	Two staff of Consultant Inc. as facilitators
	Ten residents from theYamanoue community
	Two system operators from Kanazawa university
System test2. System operation	
Time schedule	Aug. 2001
Participants	Five students from Kanazawa University
Experiment 1. Internet Free Access	
Time schedule	Free access during Dec. 18,2001(Tue.) to Jan. 19.2001(Sat)
Participants	Seventy one students from Kanazawa university
Experiment 2. Internet Design Workshop	
Time schedule	Dec. 7. 2001 16 00 18 30, 2.5 hours
Participants	Six Students from Kanazawa University

However, system tests of collaborative design in an Internet environment are necessary. Effectiveness of the system for participants' plan decisions and system operation should be tested before the experiments are conducted. Therefore, system tests and experiments are scheduled as Table1.Experiments are divided into two parts. The first part of the experiment is Internet free access for design collection between all participants. The second part consists of an Internet workshop for plan decisions to take place between group leaders. Test 1 was carried out in the Yamanoue community where a real workshop for park collaboration design was scheduled. We test whether the system is convenient or not for the exchanging of ideas between participants.

Table 2. **Effectiveness of the system in plan decision (System test 1)**

System test 1	Effectiveness of system in plan decision
Procedure	Step1. Consultant staff explain the final design
	Step2. Discussion about the final design
	Step3. Collection of participants opinions

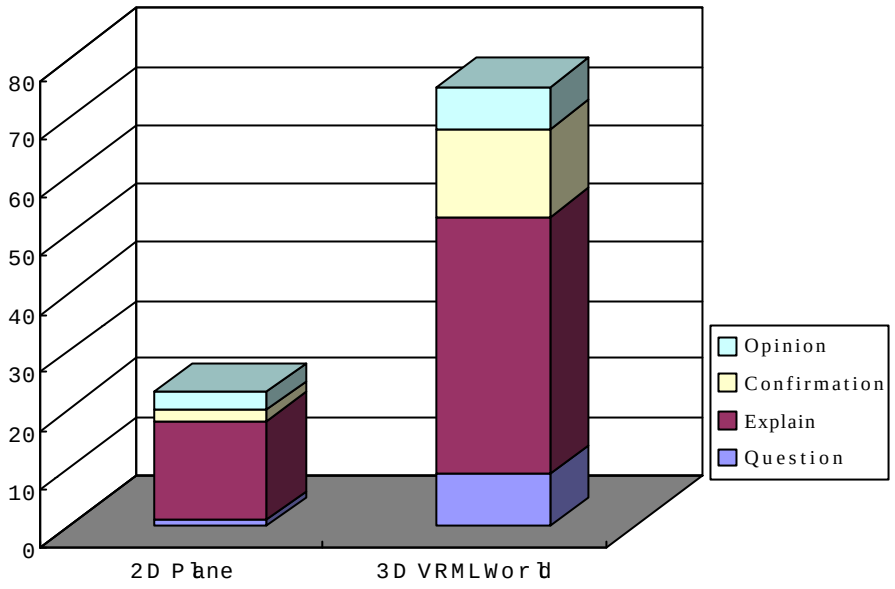

Figure 4-1. **Comparison of effectiveness between 3-D and 2-D in discussion**

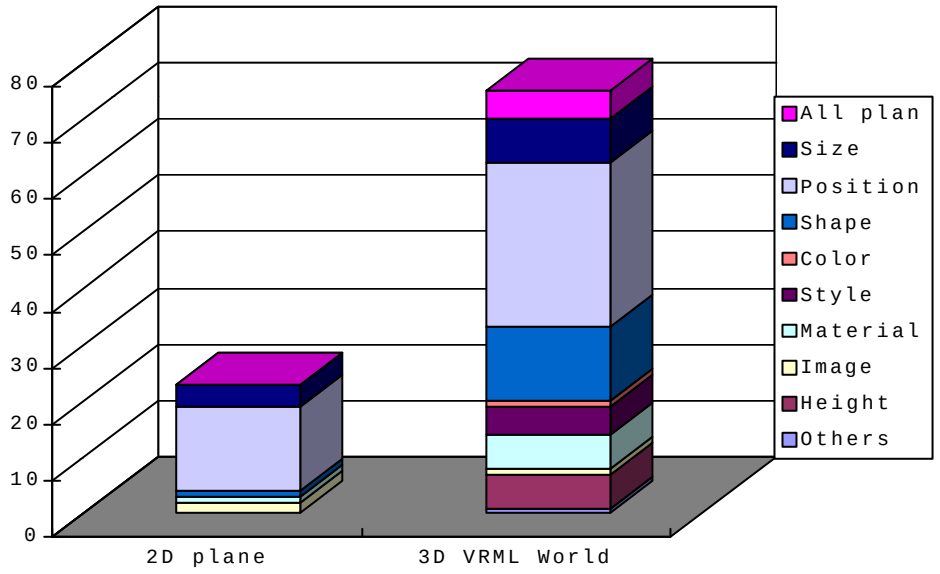

Figure 4-2. **Comparison of effectiveness between 3-D and 2-D in design elements**

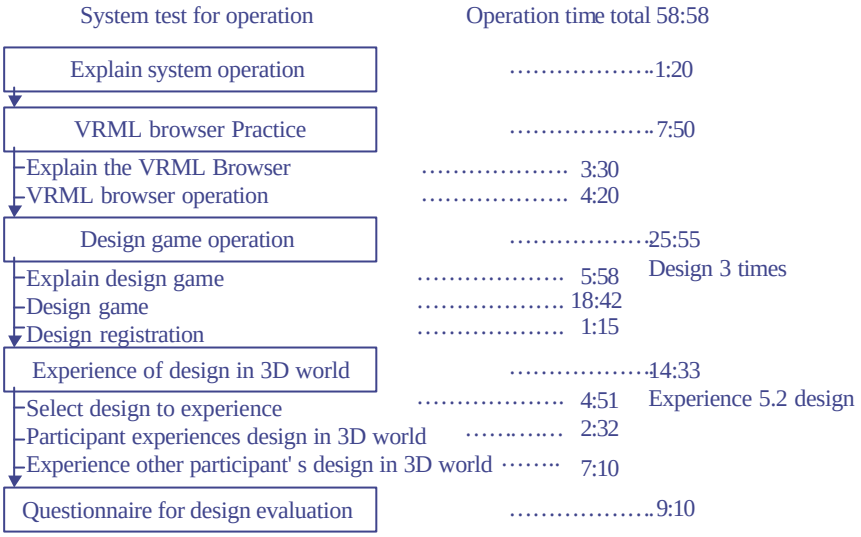

Figure 5. **System test 2 of design game system**

5 PARTICIPANTS' PLAN DECISION AND USERS OPERATION OF DESIGN GAME SYSTEM

5.1 **Comparison of Effectiveness of 3-D World and 2-D Plane for Presentation of Design Plan**

Generally, public participation in park design in Kanazawa is processed in a game style called an icon game, in which participants arrange paper icons such as benches and trees in a map of a park site. Through this method, participants exchange their concepts and make the design decision. Therefore, a comparison between experiments involving the icon game and the design game system was scheduled in the Yamanoue community. If the 3-D world used in the design game system is more effective than the icon game then the effectiveness of the design game system will be verified.

Table 2 shows the system test schedule and its participants. The effectiveness of paper icon and 3-D world can be compared in Figure 4-1 and 4-2. According to the results of this test, 3-D world is more effective than paper icon. Therefore, the design game system is more useful in exchanging opinions and making design decisions than the icon game now used in Kanazawa city.

5.2 **Probability of 3-D Design in Our System**

Through the above system test, it has been verified that the design game system is more effective than the paper icon game. However, paper icon is an easier design tool to master, as the design game system causes some difficulty for participants who are not computer savvy.

System test 2 was carried out on local citizens on a small scale, it became very clear that children will not take much time to master the system, but aged people have difficulty understanding how to work with computers. Figure 5 shows the operation time required for students using this system for the first time. According to these results, a young person can finish system operation and vote on his/her favorite design plan within one hour.

Therefore, the design game system is verified as a better system than the paper icon game. The average time for young participant's collaboration design is one hour. Children will finish the collaboration design in shorter time. Aged people find it more difficult to finish the design using a computer.

6 EXPERIMENT RESULTS OF INTERNET FREE ACCESS AND INTERNET WORKSHOP

In the system tests, we understand the design game system is more effective than the current design tool called the paper icon game. However, we still do not know how to collect and analyze the participants' opinions using our system in an Internet environment. Therefore, the Internet free access experiment and the Internet workshop experiment were carried out to verify the possibility using the design game system to make a plan decision.

6.1 **Plan Decision in Internet Free Access Experiment**

The Internet free access experiment was planned to help verify whether or not a group leader could be chosen through a design vote from the participants in the design game system. The experiment was scheduled as shown in Table 3. Participants are divided into four groups. Through the number of participants and their design registration in Table 4, it is clear that one participant will make more than one plan. Some in each group did not get to experience all the designs. However, ratios of experience are over 40%, what that means is that most of the participants see at least half of the design plans before they vote for their favorite design. Furthermore, in Table 5, we understand that about 83% of participants recognized that this design game system is available to present their ideas regarding the park design.

Table3. **Process of Internet free access experiment**

Experiment 1	Internet free access experiment
Procedure	Participants access at different times from different places Step1. Design Registration Stet2. Design Evaluation Step3. Questionnaire about best design
Other	Answer questions regarding system operation by e-mail.

Table 4. **Access situation of Participants**

Groups	A	B	C	D	E
Number of participants	15.0	14.0	15.0	17.0	10.0
Number of design registrations	25.0	16.0	21.0	31.0	17.0
Number of designs experienced	14.0	14.7	10.7	17.4	7.3
Ratio of experience	56.0	91.9	51.0	56.1	42.9

Table 5. **Effectiveness of design game system for present park design**

Is this design game system convenient to use in presenting your ideas regarding park design?	Answers	Ratio
1. Available	36	50.7%
2. Very available	23	32.4%
3. Fairly unavailable	7	9.9%
4. Unavailable	2	2.8%
5. I do not know	3	4.2%

In Figure 6, the result of the design votes from each group show that the best design can be confirmed in this experiment. In A group, 11 of 15 participants vote A1 design as the best design. In B group, 9 of 14 participants vote B1 as the best design. In C group, 7 of 15 participants vote C1 as the best design. In D group, 8 of 17 participants vote D1 as the best design. However, it is necessary to vote the best design once more in the case of E group. According to our experiment rules, designers of A1, B1, C1, D1 can be chosen as group leaders to continue onto the next Internet workshop experiment.

Additionally, design concepts can be discussed in the chat room before the design vote. When group leaders take part in the next step of the design game, the concepts from each group should be listed in the chat room.

6.2 **Plan Decision in an Internet Design Workshop Experiment**

Because a final design should be confirmed through collaborative design, the group leaders took part in an Internet workshop experiment in order to get consensus and make a final plan decision. An Internet workshop experiment was scheduled as shown in Table 6. The detailed time schedule is shown in Table 7. In practice, the time for each step was always over schedule. Participants asked their questions and exchanged their opinions without face to face contact, they always waited until the facilitator asked them to access the next step. In fact, the process control for the Internet workshop was very difficult. Table 8 shows the process for the Internet workshop experiment. According to the system test 2, one hour is necessary for the participant to finish all stages of the design game.

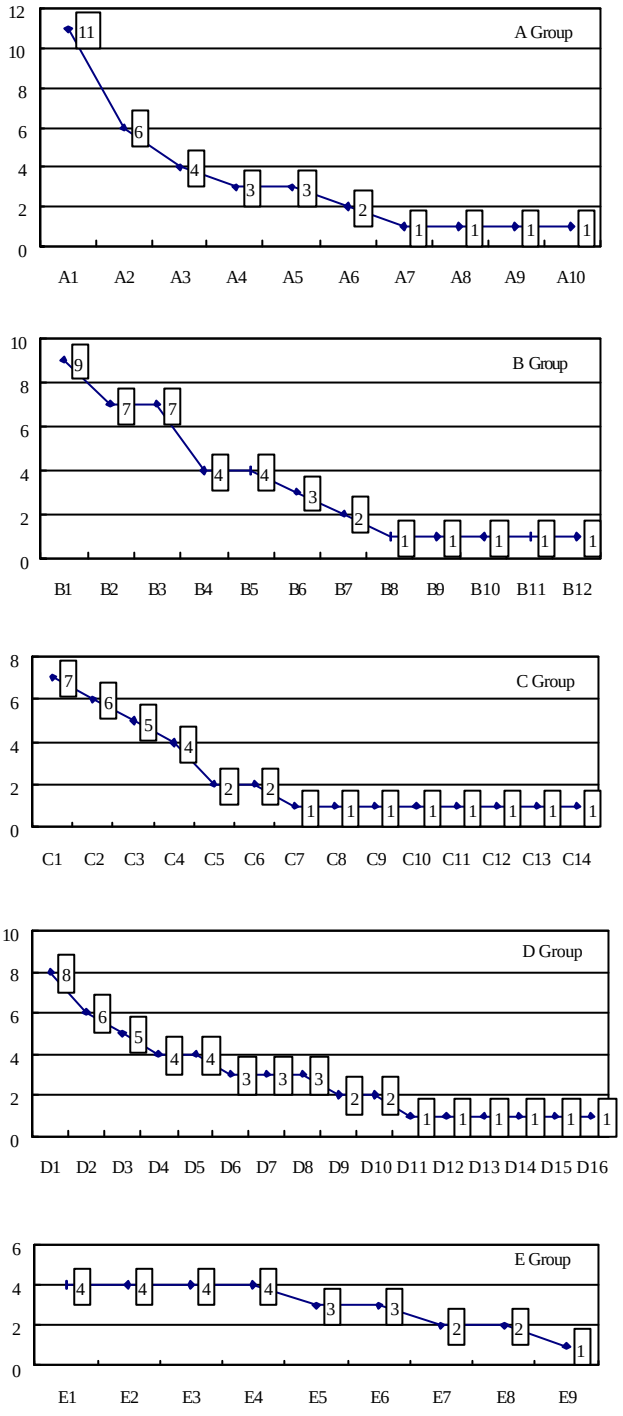

Figure 6. **Results of design votes in Internet free access experiment**

Therefore, one hour and forty-five minutes was scheduled for the experiment. The process is divided into 7 steps. The last step was not carried out because participants thought

the design game was finished after they made a final design decision. However, the facilitator had not announced that the design game was over. Even though the facilitator was informed of the time schedule and mentioned to the participants what was going happen and when the experiment should finish, the experiment was still not finished properly. The design process control technique still remains an issue for future research. Additionally, participant E was late to start his experiment because of technical difficulties.

In the Internet workshop experiment, we also wanted to check how participants make design decisions. However, because it is an experiment all of the problems in park design can't be discussed so we checked the process and the discussed it carefully. We chose one discussion topic and analyzed its structure model in Figure 7.

Figure 7 shows an interpretive structure model for one particular discussion topic. The topic is about where to place a children's playground and parents' resting space. It is verified in Figure 7 that the Internet workshop was useful for participants to exchange their opinions and make design decisions.

Table 6. **Internet workshop experiment**

Experiment 2.	Internet Design Workshop experiment
Procedure	Participants access in same time from different places Step1. Explanation system operation in Chat Step2. Design game lead by facilitator Step3. Questionnaire about best design

Table 7. **Time schedule of Internet workshop experiment**

Process for Internet workshop experiment	Time schedule	Actual time
Explain design game	5:00	13:46
Experience VRML world	15:00	
Design game and registration	10:00	1:42:00
Experience designs in VRML world	15:00	
Discussion for all designs	20:00	32:43
Decision for final design plan	20:00	27:18
Confirmation of participants' opinions	20:00	no
Total	1:45:00	2:24:40

Table 8. **Process for Internet workshop experiment**

Timetable		Process	Participants				
			A	B	C	D	E
16pm	00min						
	05						
	10	Explain the desigan game					
	15	0:13:46					
	20						
	25						
	30	Experience VRML world				0:08:41	
	35	0:31:53	0:04:59	0:07:08	0:10:32		
	40	Design game					
	45	0:53:13					
	50						
	55		0:25:11	0:20:56	0:37:36		
17pm	00min					0:11:45	
	05	Experience designs in VRML world					
	10	1:09:39					
	15		0:19:20	0:53:25			
	20						
	25				0:30:07	0:26:00	
	30						
	35						
	40	Discussion of all designs					0:39:13
	45	0:28:39	0:21:22				
	50						
	55			0:06:22	0:05:13		
18pm	00min	Decision of two out of all design plans					
	05	0:04:04					
	10	Decision of final design plan					
	15	0:27:18					
	20		0:20:56	0:19:17	0:19:42	0:16:01	0:21:10
	25						
	30						
	35						

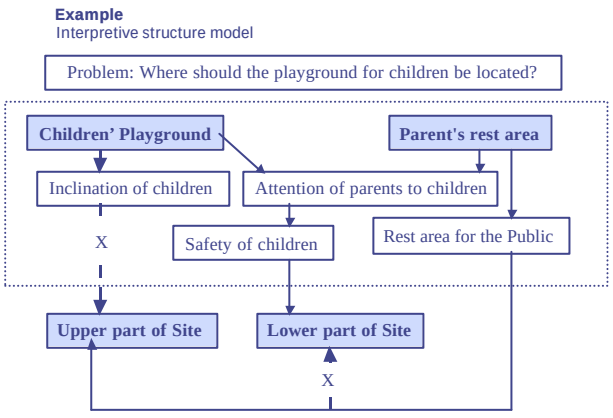

Figure 7. **Example of ISM (Interpretive structure model) in Internet workshop experiment**

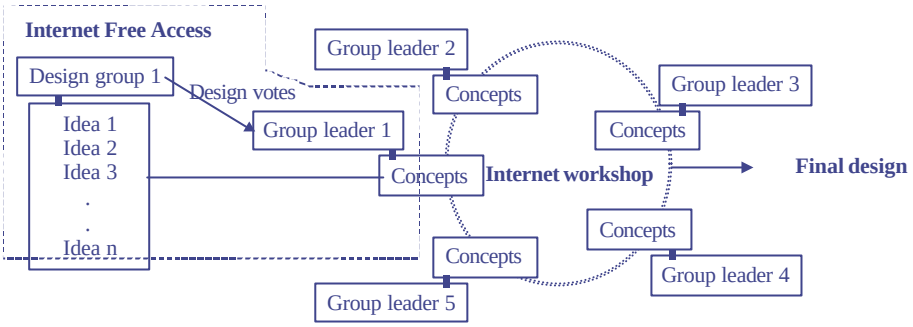

Figure 8. **Decision process model**

6.3 **Decision Process Model in Our Project**

According to system tests and experiments introduced above, the design game system can be utilized in the way shown in Figure 8. Firstly, Internet free access can be carried out to collect all participants' designs and the group leader can be selected through a design vote in each group. Secondly, group leaders take part in a collaborative design Internet workshop with other group leaders according to each group's concepts. A design decision regarding the final design can be made through exchanging opinions and getting consensus between each of the group leaders.

7 CONCLUSIONS

According to existing research in the field of public participation, the process of collaborative design for public participation can be divided into seven steps. As a result of reviewing the seven steps, an on-line collaborative design system can be divided into four sub-systems. The first sub-system is a system for planning objectives. The second sub-system is a system for discussion. The third sub-system is a system for proposals. The forth sub-system is a system for a design game.

Using these systems, participants can exchange their ideas and concepts in the planning objectives system, and also they can experience the present situation on a web site so they can give their opinions in the discussion system. In the proposals system, participants can make their proposals for land use in an accurate manner using planning cards. In the design game system, the participants can design their park according to their preferences and save their design to a server database. Participants can access the database to review another participant's design for comparing and reaching consensus.

In order to evaluate our demonstration system, we carried out experiments using the design game system in the Yamanoue community where a park project was scheduled by the local government. Through participation of residents and university students, we were able to analyze the design process for park design using an Internet environment. As a result, a

decision process model could be built up for park collaborative design, including two steps that involve Internet free access and an Internet workshop.

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