Computer support system for residential environment evaluation for citizen participation

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Abstract: Though the method of citizen participation in urban planning is quite well established, for a specific segment of residential environment, however, existing participation system has not coped adequately with the issue. The specific residential environment has detailed aspects that need positive and high level involvement of the citizens in participating in all stages and every field of the plan. One of the best and systematic methods to obtain a more involved citizen is through a citizen workshop. To get a more "educated" citizen who participates in the workshop, a special session to inform the citizen on what was previously gathered through a survey was revealed to be prerequisite before the workshop. The computer support system is one of the best tools for this purpose. This paper describes the development of the computer support system for residential environment evaluation system, which is an essential tool to give more information to the citizens before their participation in public workshop. The significant contribution of this paper is the educational system framework involved in the workshop on the public participation system through computer support, especially for residential environment. The framework, development and application of the computer support system are described. The application of a workshop on the computer support system was commented on as very valuable and helpful by the audience as it resulted in greater benefit to have wider range of participation, and deeper level of citizen understanding.

Key words: Computer support system, Residential environment evaluation, Citizen participation
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INTRODUCTION

Citizen participation in urban planning is crucial for satisfying the increasing demand to improve the overall city planning process (Sherry, 1969). The information exchange, opinion feedback, establishment of expert system and the development of efficient and effective participation methods has brought huge benefits and high potential for the improvement of the whole city planning (Arima, 2001).

The public participation system to evaluate the planning system for the specific segment of residential environment, however, has not coped adequately with the issue. Residential environment study in-

volves many factors that need high level and positive involvement of the citizens to participate in all stages and every field of the plan. Zhao and Ge (2004) pointed out three main problems existed due to the deficiency government information to the citizens and the way the government listens to public opinion, unsystematic method of the participation and the participating citizens' lack of specific knowledge. It seems that more specific and instant "education" is necessary to have the citizens participate effectively.

To solve these problems, we have conducted intensive public participation surveys in Saga City, Japan, with special focus on residential environment. There was a need for more specific means of public

participation. Those surveys revealed that one of the best and systematic methods to obtain greater involvement of citizens is through a public workshop which may produce more effective results if it involves well informed or "educated" citizens. To get a more "educated" citizen to participate in the workshop, a special session to inform the citizen on what was previously gathered through the survey was revealed to be prerequisite before the workshop. Objectively providing data and previous results of the participating system, without dictating to the citizen on what to voice, is essential for evaluating the residential environment participating system. The computer support system is one of the best tools for this purpose as it ensures that the citizens who participate remain active but well informed.

This paper describes the development of the computer support system for residential environment evaluation system, which is an essential tool to give more information to the citizen before the public participation workshop. The significant contribution of this paper is the educational system framework for workshop public participation system through computer support, especially for residential background. It is worth mentioning that the public participation system here is not implemented as an assessment of a large scale residential project, but as evaluation and continuing improvement of the existing residential environment. The paper is organized as follows. Multi attributes residential environment evaluation is elucidated in the next section. The framework and development of the computer support system is described next and the application of the system on the workshop is discussed.

RESIDENTIAL ENVIRONMENT EVALUATION

Residential environment is the most basic and direct factor of the quality of life. It not only affords physical shelter to protect us from external intruders and support various functions of daily lives, but also has profound psychological and social meanings in the interaction with household members and community activities. Therefore, the satisfaction of residential environment is always one of the most immediate requests of citizens and the important targets of city planning. Accordingly, the encouragement of citizen participation in residential environment development has significant importance in academic research and practical application.

To gather public opinion on how to improve the residential environment we conducted a residential environment survey in the year 2000 in Saga City, Japan. The purpose of the survey was to set up an evaluation system based on subjective opinion of the residents, as reported by Ge and Hokao (2004a; 2004b). Based on the survey, a multiple hierarchical index system of residential environment evaluation was established, which consists of two aspects of evaluation system: satisfaction degree and importance degree. Each aspect of the evaluation system included four levels, as shown partially in Fig.1. These yearly survey results served as the basis of the educational system for citizen through the computer support system.

The index system includes "overall satisfaction with regard toward residential environment" (Level-1) which depends on five factors of "convenient", "comfortable", "health", "safe" and "community" (Le-

Level-1   Overall quality of residential environment

Level-2   Convenient   Comfortable   Healthy   Safe   Community

Level-3   a   b   c   d   e   f   g   h   i

Level-4   …   …   …   …   …   …   …   …   …

a: Convenient living facilities
b: Convenient access to work and school
c: Convenient access to nearby cities
d: Comfortable natural living environment
e: Comfortable landscape

f: Healthy and sanitary
g: Healthy pollution free
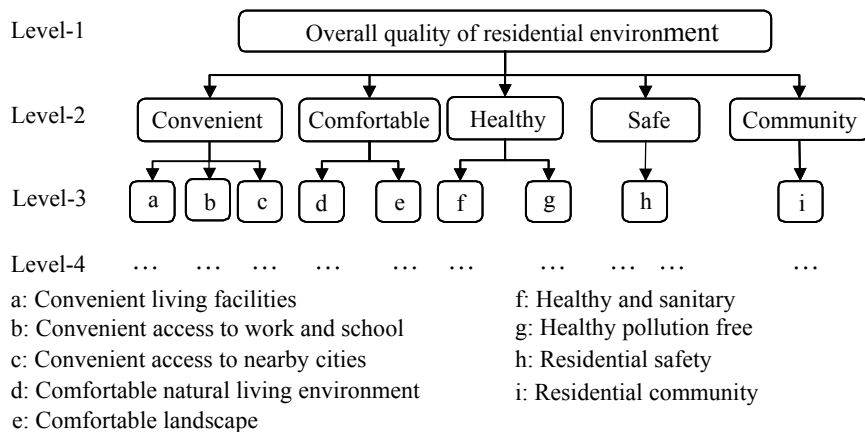h: Residential safety
i: Residential community

Fig.1 Multiple hierarchical index system of residential environment evaluation

vel-2). The five second level factors are then also linked to the satisfaction of the nine third level attributes. For example, "comfortable" (Level-2) is understood to depend on "comfortable natural living environment" (d) and "comfortable landscape" (e) in Level-3. Furthermore, each of the nine Level-3 attributes is decomposed into several fourth level attributes. For instance "convenient access to working and studying" (b) has several derivative of "distance to work", "convenient access to transportation to work", "distance to school" and "convenient access to transportation to school". Other examples for fourth level attributes are "nearby green area", "water environment", "historical and cultural environment such as shrines, temples and historical remains", "parks", "playing gardens" and "residential condition such as room number, area and so on". Those last six factors are connected to the third level factor of "comfortable natural living environment". In total, we include 61 indices for all levels of each evaluation type. This index system does not only serve as an evaluation system, but also the planning menu and target of the residential environment development.

Using the established multiple hierarchical index system of residential environment evaluation, we developed the subjective database system. The data were mainly gathered through the questionnaire survey conducted in all districts of Saga City, Japan for three consecutive years starting from 2001. The purpose of the survey was to evaluate the subjective opinions of the residents toward their own residential environment and their opinions on what kind of improvement is necessary. Altogether 3802 residents from the 19 residential areas of Saga City were randomly selected and sent a questionnaire averaging the response of 49.5%. On-site residents' survey was also conducted to evaluate the present residential situation with respect to resident's satisfaction with the multi-attributes above. Evaluations were given in terms of satisfaction and importance degree from "very much" (5 point) to "not at all" (1 point).

COMPUTER SUPPORT SYSTEM DEVELOPMENT

The established multiple hierarchical index system and the database were used to develop the computer support system aimed at providing good in-

formation to the citizens before the workshop on public participation. The citizens need to know what was evaluated by most people about their residential location and what factors have been evaluated. Though the database and evaluation system was developed specially for Saga City, we have made the computer support system as generic as possible and can be readily applied to any city, as long as the data structure remains the same. In this section, we will describe in detail the development of such system.

As shown in Fig.2, the program has two sites: office site and public site. The office site receives data and map (which can be digitized) and analyze the data. The data structure as described in this section consists of multiple hierarchical index system of residential environment evaluation data gathered from the established database. The data processing is performed automatically once the data are inputted. The statistical indices and map are then stored as a library, together with a huge amount of functional library. For the public site, the citizens attending the workshop are the target users. These users of the computer support system will see the graphical user interface.
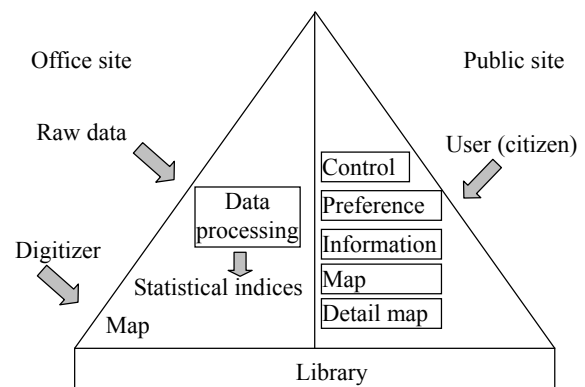

Fig.2 Framework of computer support system for residential environment evaluation

The data structures of the indices are inputted as tree structures. Each factor and location has its own key, values and descriptions. The sub factor and sub locations are referred to their parent tree using the parent key which is also stored inside each factor and location. The raw data, consisting of the evaluation of satisfaction and importance degree, are aggregated into the three dimensional matrix shown in Fig.3.

The three dimensions represent the locations, factors (and sub factors up to four levels) for each lo-
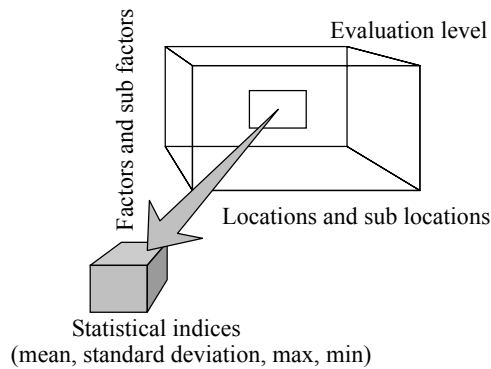
Fig.3 Structure of the database system

Fig.4 Interface of the computer support system of residential environment evaluation

cations and level of evaluation (importance or satisfaction). Each cell of the matrix consists of the aggregated statistics on the user participation in which they put the rating value for each location they know. Each time the user accesses the system, the value of the matrices is shown together with the tree structure and the map. The map is inputted as digitized points with the same key corresponding to the location. Each time the user moves the mouse over it, the system will determine the key according to the Jordan close curves principle (Cormen *et al*., 2001). Several rays are drawn from the mouse location as the ray source. If the rays to infinity cut the curve odd number of times, then the rays' sources are inside the curve. If the map is chosen, the key element and the coordinate location are determined and the detailed map plus the statistical indices are shown as information to the user. The information is then sorted so that the user may only see several best and worst factors (or sub factors) for each location, as well as several best and worst location for each factor.

Fig.4 shows the user interface of the computer support system for the citizen. The users may see the control panel to select a specific location or a factor, if they want to see the other users' previous evaluation. A detailed map is provided for guidance. Sorted information on each factor and sub-factor by location is provided as the user moves around the factors. The sorted information regarding each location is also available. The computer support system has the following functions:

(1) Providing the subjective evaluation results: Users can choose any of the residential areas, and then can obtain any evaluation results at each level as shown in Fig.4.
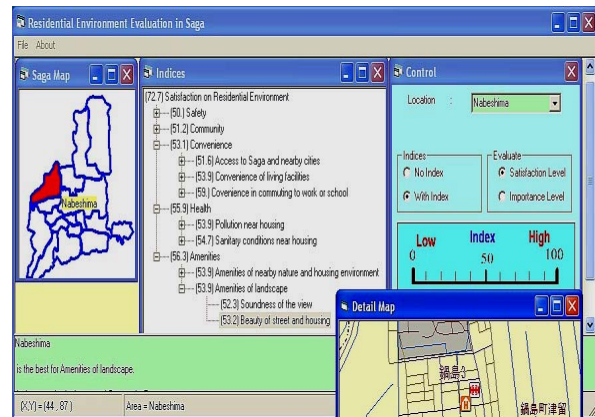
(2) Quality ranking of residential environment: Users can choose any evaluation index at each level, and then obtain the ranking result of that index of all the residential areas. They may also find the advantages or weak points of the area, and the characteristics of all the areas.

(3) Providing detailed digital maps of all the residential areas.

(4) Searching the area according to the demand of users: Users can select or input any index as well as the ranking number among all the areas, so that they can find the area according to their requirements. For example, if the users want to find an area with the three factors of convenient facility, residential safety and residential community were ranked previously as the best 3, they can use this function to search for such an area in accordance with these conditions.

(5) Providing understanding of the residential environment characteristics of each area: The computer support system may help the user to be informed of the characteristics, advantages, weak points and problems of residential environment of each residential area according to the database of the previous survey, and can give the users some references on their judgment.

APPLICATION OF COMPUTER SUPPORT SYSTEM

Workshop has played a very significant role in the practice of citizen participation and remains as the

mainstream. Various groups such as ordinary citizens, officials, designers, planners and company management meet and discuss together on the plan and try to find the optimum proposal. The well-used methods are KJ method, environmental investigation, on-site interview, map and model making. The computer support system of residential environment evaluation was utilized in a workshop involving citizens and staffs of the Urban Planning Division of Saga City Hall in January, 2004.

Workshop with computer support system was compared with similar workshop without the computer support system which was commented on as "very valuable and helpful" by the audience. Considering the whole process of the workshop, the system was regarded to have more advantages if the computer support system is used due to (1) abundance of the information content; (2) diversity of the expression; (3) ease of the operation; and (4) overcoming of the spatial and temporal limitations.

With the computer support system, the citizen can more effectively and efficiently collect data with:

(1) Abundance of the information content. During all steps of the workshop, the providing of adequate and correct information is indispensable. The subjective data of the system included the preference of citizens, evaluations of residential environment in terms of satisfaction and importance, demands and opinions on the development of residential environment and so on.

(2) Diversity of the expression of information. Figures, videos, tables, sounds, colors, animations together with texts can make the expression of information more vivid and attractive, and increase the readability, understandability and accuracy of the information, as well as enhance the interest and enthusiasm of citizen to participate.

(3) Ease of the operation. People can obtain and review large quantities of information, which can enlarge the possibility of the citizen participation. Especially with the rapid development of computer software and interfaces, the ease and freedom of operation has improved a lot. The development of a barrier free design of operation interface can also get the huge quantity of information, which is a powerful push to the citizen to participate in the program

(4) Overcoming the spatial and temporal limitations. Using the map and the information provided by the computer support system, the workshop participants can access many years of previous survey data in all residential locations of the city.

With such encouraging results from the citizen participation workshops, we also captured the current limitation of the system. The ongoing improvement on the computer support system includes at least two parts:

(1) Improvement of the database and additional models. Objective data such as environmental index, GIS data, spatial parameters, natural data, social data, and cultural and economic data should be added to the subjective evaluation. Database including only the evaluations in terms of satisfaction and importance of all of the above attributes may be supplemented with the citizen demand for residential environment improvement. Models with objective databases linked with subjective evaluation are also undergoing research. The integrated evaluation and forecast model is also undergoing development to a planning target system and a planning tool for residential environment evaluation. Upon completion of the tool, it may provide more powerful technical support for the citizen participation.

(2) Aside from the traditional workshop, the transformation of the computer support system through Internet may provide the possibility of enlarging the number of "workshop" participants. The traditional workshop is always limited by time, space, and number of participants while the methods of BBS, digital meeting, web meeting could provide a "place" for people with much more different background, concept and education to communicate together. All of the discussion process can be recorded and opened to the public.

CONCLUSION

Intensive public participation surveys of residential environment evaluation had been done for several years in Saga City, Japan. The database of such survey and summary of the analysis has been made open to the public through a computer support system in the citizen participation workshop. Workshop with computer support system was compared with similar workshop without the computer support system and the computer support system was com-

mented on as very valuable and helpful by the audience. The result of the workshop with computer support system provides powerful support for citizen participation in residential environment evaluation and development. It can realize the function of (1) optimal presentation of planning information; (2) collection of comments and suggestions; (3) interactive communications between government and citizen; and (4) effective workshop application with greater benefit to a wider range of participants as well as deeper level of citizen understanding. With such better tool, the citizen participation may have a more positive and effective role in achieving the democracy of urban planning and construction.

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