COLLABORATIVE DESIGN SYSTEM FOR CITIZEN PARTICIPATION IN PLANNING PUBLIC ROAD PROJECTS

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Abstract. The realization of smooth execution of public street enterprise and good communication with inhabitants needs the way of easy and right explanation which the inhabitants understand the street planning, and the scheme of administration and inhabitants make the nice housing environment together. In this paper, the street planing presentation system for inhabitants established by using computer graphics. The applicability of the presentation system is made clear using in the real project.

1. Introduction

Citizens are becoming increasingly aware of the issues involved in public utility projects. Therefore, it is becoming important for public works departments of local governments, specifically departments involved in municipal road construction projects, to obtain consent from the residents concerned. Reaching an agreement with the residents is now required at various stages of each project, e.g., during the municipal planning process, before authorization of the project, and before construction work is actually begun. Presentation meetings are held in order to obtain the citizens' informed consent. Information is provided through lectures, drawings, diagrams, numerical data, views from several perspectives etc.

However, the citizens attending these meetings often do not have expert knowledge of engineering, and have difficulty understanding this kind of information. The difficulty can be attributed to the following factors : (1) Since drawings, diagrams and verbal explanation provide information in symbolic form, the images invoked in the mind are different for each individual; and (2) Perspective views, depicted from a limited number of angles, do not provide adequate information for people to develop a three- dimensional understanding of the complex structures to be constructed. If the local residents are to understand and cooperate with public work projects, we think it necessary to make a lucid presentation of detailed and accurate information to the citizens

involved.

This paper will describe an information system designed to support public works departments in obtaining the consent of citizens concerning a wide variety of projects. This system uses Computer Graphics. These are easy to understand visually, allow objects to be viewed from any desired angle, and can combine various communication elements such as still images and animations.

2. Concepts underlying the system design

The following requirements were made of an information system for citizen participation concerning road projects.

2.1. HIGH RESPONSIVENESS (HIGH INTERACTIVITY)

The system is to provide orientation for the citizens. Since it is to help obtain their consent, it is essential that the system allows effective presentation of the data. It is therefore desirable that the system allows a choice of Computer Graphics based communication tools tailored to the purposes of facilitating orientation, and that it can be used in an interactive manner by public works departments and inhabitants.

2.2. HIGH OPERABILITY

This system will be primarily operated by the public works departments. In some cases, it will also be used by the local residents themselves. The system must therefore be accessible without expert knowledge of computers or CG, and it is essential that the interactive functions can be used by everyone.

2.3. HIGH PORTABILITYTY

Since the public works departments are to carry the system to various places for the information of the local inhabitants, it is essential that the system is easy to carry and stable enough to function reliably.

2.4. ACCEPTABLE COST

The system is to be available at a sufficiently low cost that it can be widely used in our municipalities. For this reason, it is desirable that the system hardware is standard equipment (like personal computers) and uses software compatible with different OS (operating systems).

3. System configuration

3.1. HARDWARE

In view of the above-mentioned requirements, we designed the functions of the system to be implemented on two hardware components: CG equipment and a presentation set. The computers used to create CGs are linked by Local Area Network (LAN) to make distributed processing and file sharing possible. The presentation equipment is based on an easily portable notebook type personal computer (PC) which allows graphics presentation in at least 64,000 colors. Various methods of presentation are needed, depending on the number of participants attending an orientation meeting or the location of the meeting. For example, when orientation is provided at a private residence, the notebook's display can be watched directly. When the presentation is given to a group of several people, the information can be displayed on a T.V. monitor via an NTSC converter. When the presentation is given to a larger audience, it can be projected onto a wide screen.

3.2. SOFTWARE

The software for the information system corresponds to the two components, software for the rapid creation of CGs and for uncomplicated presentations using a Graphical User Interface and hyper-linking functions.

3.3. CG-BASED COMMUNICATION TOOL

The CG-based communication tool for citizen participation will be presented below from two aspects: first, its use during presentations, and then the method of creating the CGs. This will detail the characteristics of the system's functions.

3.3.1. Method of presentation

CGs can be presented as still images, animations, QTVR(QuickTimeVR) or walk-through scenarios. These image types are listed in Table 3.1. A type of image for presentation is chosen in each case according to the features required by the intended application.

3.3.2. Method of creation

The available methods of creation can be divided into two types: (1) creation of a three-dimensional model of the project's object, and (2) superimposing photographic images. These methods are listed in Table 3.2. When creating animations, three-dimensional models are always used. Photographic imaging ("photo montage") is used for special purposes such as illustrating the relationship between the planned structure and the surrounding environment.

TABLE 3-1. Computer graphics features.

	Details	Features	Purposes
Still images	Images using fixed viewpoints	Skilled presentation of viewpoints, perspective representations, etc., are needed to create three-dimensional, conceptual images for the audience	Promote understanding of the entire project; compare proposals with the current situation; compare proposals with alternative plans
Animation	Image presentation by certain viewpoint transfer	Makes it easier to conceive of three-dimensional images; can be presented only according to the scenario; allows simulation of a continuously changing viewpoint	Simulate an operation; build understanding of an entire project
Panoramic animation	Image presentation by certain viewpoint transfer	Although the viewpoint is fixed, the observer's position can be changed continuously, in an interactive manner.	Checking the view of a planned road; comparing alternative plans
Walk-through scenarios	Image presentation by viewpoint transfer at the user's intention	High-function hardware is needed for reproduction on the system	Checking the view of a planned road

TABLE 3-2. Features arranged by methods of image creation

	Advantages	Disadvantages
CG totally dependent on 3-dimensional models	- Can easily present various and changing viewpoints. - Animations Can be prepared easily. - Can be switched easily to simulation media - The complete picture gives a sense of wholeness	- Time needed for preparation increases as the amount of data increases. - Data concerning surrounding environments, etc., must be abstracted to some extent.
Photo montage	- Can show natural objects, etc., with a high degree of realism - Since only the specific data required are prepared, the data needed at any given time can be selected easily.	- The time needed for preparation increases in proportion to the number of photos that need to be prepared. - Lots of time is needed to prepare animations - Background pictures are indispensable (they are sometimes difficult to take when a new road is to be constructed)

3.3.3. Presentation of alternative plans

Alternatives showing different surface textures can be demonstrated immediately during a presentation, but plans involving modification of the road structure need more time to prepare. Possible alternative plans should therefore be graphically illustrated in advance and saved in the system in order to have them ready for presentation immediately when required.

3.4. PROCESS FLOW FOR OUR SYSTEM

The operating systems used to run the software for creating still images and panoramic animations in our CG system are Windows 95/98, Windows NT and Macintosh OS. These are all popular OSs for personal computers. The OS used for the creation of non-panoramic animations in our CG system is UNIX. The process flow under this system is as follows (Figure 3-1).

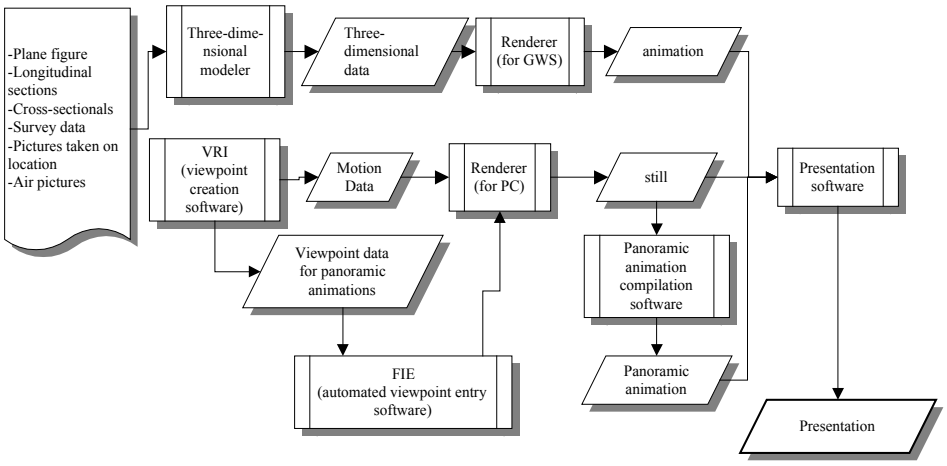

Figure 3-1. Process flow for our system.

We attempted to create a system applicable to various purposes by using the functions of existing programs and developing new programs when needed. Existing commercial programs were utilized to draw the three-dimensional shape model, displaying it on the PC, compiling the panoramic animations (to be later described), and for making presentations. New programs were developed for the graphics animation program on the GWS, specifying the observer positions for the panoramic and other animations (VRI), and automated observer position entry (FIE).

4. Case study

4.1. OUTLINE

We will cite the case of the Yamate Trunk Road (a road constructed according to a municipal development plan) as an example where the above-mentioned prototype system was actually applied to a construction project. This road was designed as a trunk road running through the seaside areas of the Hanshin district, including Amagasaki, Nishinomiya, Ashiya and Kobe cities, and was designed to serve as a road to replace two major existing roads (National Routes 2 and 43).

When the National Route 43 was closed and the use of the National Route 2 was restricted immediately after the Great Hanshin-Awaji Earthquake, traffic congestion in the surrounding roads was aggravated. The Yamate Trunk Road had not been completed yet and could be used only partially. The necessity to

finish construction of this road as soon as possible was therefore recognized.

The land along the uncompleted parts of this road was residential lots whose location was considered preferable to that of many other residential areas in the Hanshin district. It was therefore an important issue to harmonize the completion of the Yamate Trunk Road as a major road with the surrounding excellent residential lots. We used this system to draw up detailed plans, decide on the road structure and other details pertaining to the three construction sites of the Yamate Trunk Road.

4.2. THE PROCEDURE FOR CITIZEN PARTICIPATION

When applying the prototype system to obtaining the residents' agreement with the road project, we adopted the following procedure for citizen participation in planning a public project. The procedure basically involves two parties: the administrative body responsible for the project and the residents of areas affected by the project (Figure 4-1). On the part of the administrative body, employees from the section in charge of studying, devising and implementing the plans of the local governments had contact with the residents. Experts were called as consultants when the procedure was determined for use of the prototype information system to facilitate citizen participation and obtain the residents' agreement, as well as for the information system itself. On the part of the local residents, their self-government associations functioned as a window during the citizen participation procedure. Self-government associations are organized by the residents of the same area or housing apartment complex or by private sector organizations for the purpose of organizing their community life. The officers of this kind of association are elected by its members. In the present case, the self-government association was well organized. We were therefore able to contact individual residents, officers or sub-committee members through the this association.

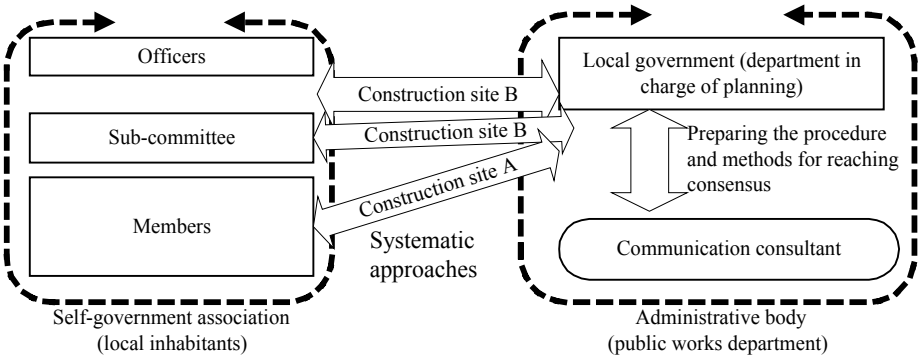

Figure 4-1. Consensus building system.

4.3. CONSTRUCTION SITE A

4.3.1. Features and history

Site A had the following characteristics. First, an orientation meeting for the residents using the CG system was conducted soon after the project was authorized. Second, the project for this segment was the construction of a new road instead of renovating an existing road. Third, there was a steep slope between the residential area and the construction site, resulting in a difference in level of about 2 m. We first explained the entire plan to all members of the self-government association in this area, using the conventional method. Subsequently, a more detailed explanation was given to smaller groups of residents, using CGs.

4.3.2. Time, subjects, purposes and materials of the presentations

The information meetings were held soon after the project was authorized. The residents attending the meetings were the members of the self-government association. Presentations was given to small groups of residents at some occasions and to larger groups at others. The information presented focused on two major points: (1) presenting the outline of the project and (2) presenting the structure of the construction area with a large height difference from the residential lot. CG-based still images and drawings were used to present the project's outline. CG-based still images and panoramic animations were used to show the terrain adjoining the residential area.

4.3.3. CG data

The information prepared with the system concerning the project outline pertained to the features of the planned road, current topographic features, existing houses, roadside trees, and scenes involving automobiles and humans. To describe the structure of the border area, more detailed information concerning the structure of the footway-roadway border of the planned road was entered, while roadside trees were omitted to make the height difference between the residential area and the road more visible.

4.3.4. Method of presentation

Presentations were given using plane figures and a presentation system incorporating CG-based still images and panoramic animations. The presentation system was run on a portable personal computer. When the presentation was given for a small number of residents, the information was presented on the computer display. When it was demonstrated for a larger number of residents, the information was presented on a projector or a large T.V. screen.

4.3.5. Information provided

To give an overview of the project, three-dimensional images of the construction site were presented. To describe the structure of the border area, three-dimensional images were presented showing: (1) the slope of the steeply inclined segment, (2) access to existing roads from the planned road, and (3) alternative plans for the retaining wall and blind fence of the planned road (Figure 4-2).

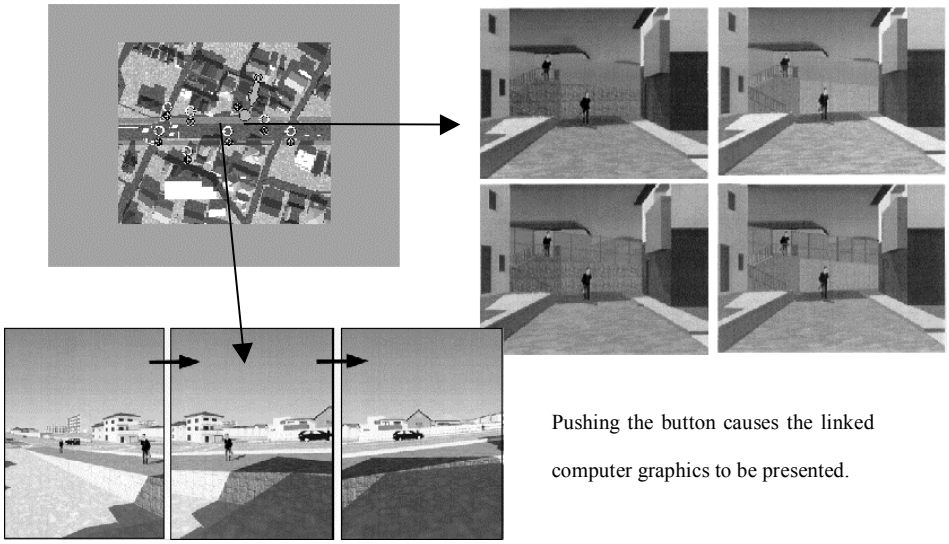

Figure 4-2. Perspectives around the intersection at Construction Site A.

4.4. CONSTRUCTION SITE B

4.4.1. Features and history

The project involving Site B was started immediately after the great earthquake. Prior explanation to residents concerning this project was not adequate. Furthermore, the project on this road began to attract people's attention just when a regional post-earthquake recovery plan was being devised. Under these circumstances, the residents in this area were opposed to this road project. The city government therefore postponed starting the construction work in this area. The residents organized a sub-committee concerning this road project within their self-government association and offered as a counterproposal their own plan concerning the structure of the road, including measures to protect the environment. The residents' counterproposal focused on placing a separator along the center of the roadway and installing sound-insulating walls in the separator. In response to this counterproposal, the city government began reviewing the plans jointly with the local self-government association. The

residents' plan concerning the road structure was found to cause problems concerning traffic safety, making it necessary for the city government to provide an easy-to-understand explanation to residents concerning possible problems arising from installment of sound-insulating walls within the central separator.

4.4.2. Time, subjects, goals and materials for the presentations

An information meeting was held after the purchase of the construction site, immediately before the start of construction work. The presentation was given to members of the sub-committee of the residents' self-government association. Emphasis was laid on providing information on how car drivers would see the central zone of this road if it were built according to the residents' plan. CG-based animations were used for this purpose.

4.4.3. CG data

Information fed into the system pertained to the features of the planned road, current topographic features and existing houses. The CG data for the existing houses were prepared by processing the data obtained for Construction Site A.

4.4.4. Method of presentation

The presentation was given using plane figures and a presentation system incorporating animated graphics. The presentation used a combination of computer graphics (created on a portable computer) and videotape images, both of which were displayed on a large T.V. screen.

4.4.5. Information provided

Animations showed how drivers of cars running at a speed of 45 km/hour on the planned road would see the central separator if either the municipal government's or the residents' plans were realized (Figure 4-3). The animations included a child running across an intersection at a speed of 8 km/hour and showed under which conditions this child could be seen by the driver or not. The point of time at which the driver first identified the child in each scenario was shown by a red flash light during the animation. In this way, the traffic safety at the intersection in both plans was simulated.

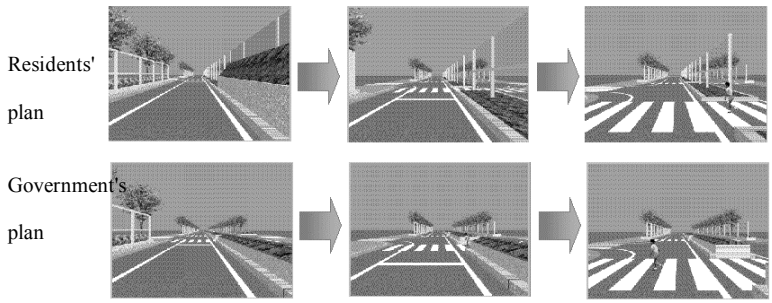

Figure 4-3. Plans devised by area residents and the local government.

5. Results and Conclusion

The attendees of the orientation for Site A understood our explanation of the outline of the project well. Concerning the structure of the border area, they recognized the images we provided concerning the steep slope area and made requests to reconsider the retaining wall, green belts and the height of the blind fences under the aspect of environmental protection. A number of residents asked questions, requesting details about topics such as the height difference between each individual residential lot and the planned road. Regarding Site B, it was possible to check how the driver could see pedestrians crossing the road, depending on the structure of the central separator in the residents' or the city's plans. These results suggest that this system is useful as a means of obtaining the consent of the local residents.

6. Open questions

During the present case study, the residents made some requests which would require the system to have the capability of providing images seen from any desired vantage point on a real-time basis, or of immediately preparing an alternative plan in response to an unexpected proposal from the residents. The current system could not satisfy these demands for technical reasons. One possible means of resolving these problems will be the use of a general-purpose three-dimensional model describing language such as VRML (virtual reality modeling language). We will include this in an improved system, adopting the latest CG techniques such as VRML browsers and Fahrenheit (expected to serve as a standard graphics API). But VRML has the problem which shadowing. We can make VRML data using Radio city algorithm, but this algorithm isn’t good at wide area, for example road planning. Therefore, we search the rendering algorithm which satisfies the above-mentioned.

The current system, which basically combines commercial programs, did not allow the location of the viewpoint of animations to be presented simultaneously with the presentation of the plane figure. In such cases, it will therefore be necessary to adopt multimedia authoring software as our presentation software.

References

Sakakibara et al.: 1997, Computer graphic presentation of urban and public, Gakugei Shuppan, 142-172

Kaga et al.: 1997, Development of a system for orientation of inhabitants on street projects, Collection of papers on civil engineering information systems, 157-165