

Moving Architecture and Transiting Landscape

Interactive Rendering System for Animated Assessment

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Abstract: In this paper, an Interactive Rendering System for Animated Assessment (IRSA2) is proposed. Using IRSA2, different to the usual process that the respondents are allowed only to select alternatives designed by planners, they are allowed to participate in the design process and create alternatives as proposals in a web-based collaborative environment. This gives roads to an autonomous process in landscape planning and design. The system efficiency was verified by a case study of its use in a wind farm project in Japan.

1. PROLOGUE

If we clip landscape as “Scene Landscape” that resembles photos taken from any section of time, there is no transformation or variation. However, before one’s very eyes, even if landscape is viewed from the same viewpoint in the same direction, it comes in difference faces. This change of landscape can be conceived and classified broadly into “Transformation due to Fluctuating Factors” such as time, season and climate, and “Transition due to the Change of the Subject” in the passage of a long period of time. When we talk about the change of landscape due to time, in addition to the sky color and the luminous intensity, the transformation of the shadow and change in the level of refraction due to the change of the direction and position of the sun has to be considered. Especially at night, in addition to the natural light sources such as the moon and the stars, artificial light sources are important factors to be considered. For the seasonal changes, the introduction of trees and flowers, which embody the seasonal change, in landscape design is necessary. And for the climatic changes, the lowering of visibility due to rain

and fog, the change of sun condition due to movement of cloud by wind, and the covering of the subject by snow, visually change our perception of landscape. Besides, by including objects in motion, literally termed "Dynamic Landscape", in the framework of landscape, the landscape is becoming intimate and natural.

1.1 Objective of Study

Attempts to visually express the above "Transforming and Dynamic" faces of landscape by computer animations are successful. However, since animations are produced usually for viewing purpose according to the plots of the producer, it was not possible to change the condition of animation interactively by the observant. This presentation-oriented use of animation is not suitable for interactive assessment of landscape variables such as colour, textures that are too numerous to handle. Generally, perspectives, models, and recently CG are used to predict the result of architecture and landscape. Alternatives are made till a desirable solution is attained. In large-scale project, especially in public design projects that government sector and many specialists are involved, the above design process is very time consuming and thus costly. To response to the above problems, an overall strategic system to support the "Interactive Manipulation of Animated Landscape Assessment Constituents" is necessary.

Past studies of animation using information technology can be classified into 2 main categories, namely "Simulation of Architecture or Landscape for Assessment", and "Evaluation of the Reality and Cost performance of Simulation Techniques". The former is concerned mainly with the use of animation in the design and working stage (Mc Cartney, et al., 1997) of architectural (Ai, Tang, et al., 2000) or landscape planning (Clayden, Szalapaj, 1997), and the latter is concerned mainly with the quality (Bermudez, et al., 1998) and cost performance (Burry, 1997) of the display media. As a continuation to the authors' study on the utilization of Internet in interactive interdisciplinary design, the possibility of the latest computer game supporting technology and web technology to support the "Interactive Manipulation of Animated Landscape Assessment Constituents" in architectural and landscape design is examined. In this paper, an internet-based system, IRSA2 (Interactive Rendering System for Animated Assessment) is proposed. Different to the usual process that the respondents are allowed only to select alternatives designed by planners, they are allowed to participate in the design process by interactively manipulating the landscape assessment constituents and create alternatives as proposals.

1.2 Method of Study

As shown in figure 1, in regard to IRSA2's use in Internet, web-based Interactive Landscape Stimulation Supporting Tools are included to response to the main criteria of "Visual and Corporal Assessment" of "Scene and Sequence Landscape" in the stage of Object Design (namely "Nature of Objects", "Relation of Object and Viewpoints", "Mutual Relationship of Objects" and "Change of Landscape"). Web-based Interactive Data Management & Display Supporting Tools are included to response to the human perceptibility, share of information and the collaborative activities in landscape planning. To verify the efficiency of the IRSA2, as case study, attitude survey for the color planning of a wind farm was undertaken.

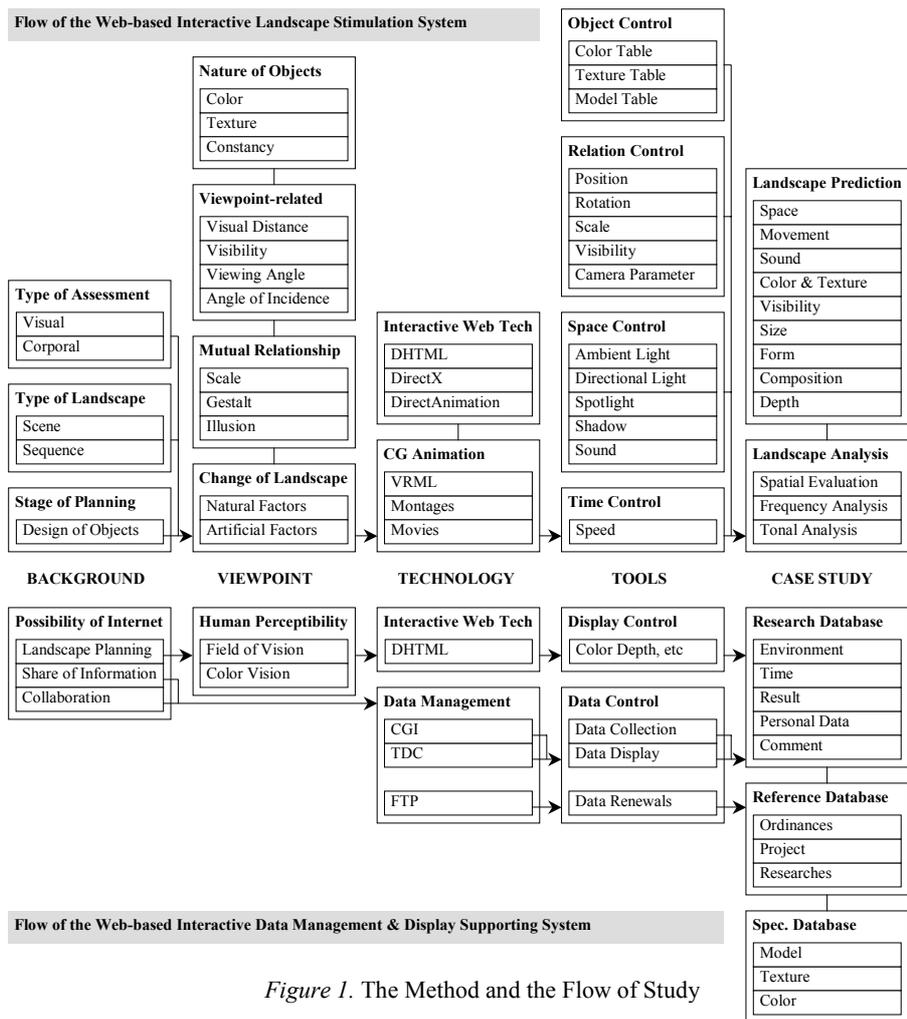


Figure 1. The Method and the Flow of Study

2. CONSTRUCTION OF SYSTEM

IRSA2 is constructed in a multimedia platform of DirectX technology, with the integration of Structured Graphics Control of DirectAnimation, interactivity of DHTML (Dynamic HyperText Macro Language), TDC (Tabular Data Control), CGI (Common Gateway Interface) and FTP (File Transfer Protocol). With the insertion of montages, movies and VRML models, "Moving Architecture and Transiting Landscape" can be simulated. Real time interactive movement and rotation of model parts, instantaneous change of environmental factors such as light source, display of shadow and setting of audio effects, sorting and filtering of database, etc. are possible.

2.1 Specification

As shown in figure 1, in regard to the Reality, Precision, Extendibility, Manoeuvrability and Cost of Simulation, the following specification are considered in the construction of IRSA2.

2.1.1 Interactive Data Management & Display Supporting Tools

- a) Artificial Intelligent: Evaluation of display suitability (color depth and screen proportion, etc.) by DHTML.
- b) Pool Style: Collection of environment parameters (operating system, duration of assessment, participant's personal details, comments, etc.) and selections of alternatives (color and texture used, camera parameters, etc.) by TDC.
- c) Library Style: Synchronous sorting and referencing of data by TDC. Renewals of reference and specification database by FTP.

2.1.2 Interactive Landscape Simulation Supporting Tools

- a) Adjustment of animation speed and visibility (Kawasaki, 1998), and change of background (movies, geographical models) by DHTML.
- b) Real time color simulation, texture mapping and change of opacity of models for change of the "Nature of Objects" by DHTML
- c) Real time simulation of visual distance, viewing angle, scale, etc for adjustment of "Mutual Relationship of Objects" and "Relation of Object and Viewpoints" by DirectAnimation.
- d) Real time simulation of environmental parameters such as directional light, ambient light, spotlight, shadows and sounds by the integration DHTML and DirectAnimation.

2.2 Structure of IRSA2

Landscape Desktop is an interface for the application of the user-friendly IRSA2. As shown in figure 2, Landscape Desktop consists of 2 parts, internal and external. For the control of interactive simulation and database display, collection and management, Landscape Desktop is composed of 5 parts, namely, Dialogue Box (System, Palette, Texture, Model, Cost), Rendering Frame, Pop-up Frame, Side Frame and Information Display Tools. Interactive tools formerly devised by the authors, ITAS (Lee, Iki, 2000a), ICPS (Lee, Iki, et al., 2000b), IRSCD (Lee, Iki, et al., 2000c), IRSC3D (Lee, Iki, 2000d), IRSCP (Lee, Iki, et al., 2000e) are included.

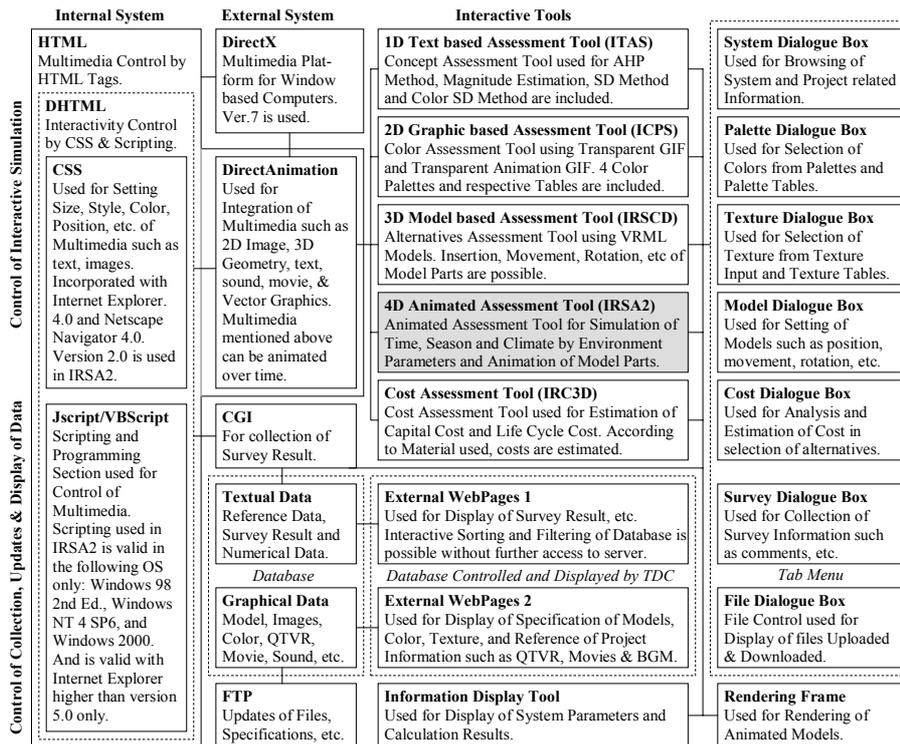


Figure 2. Structure of Landscape Desktop and the Position of IRSA2

2.3 Interactive Web Technology

IRSA2 is constructed using the following interactive web technologies with scripts compatible for use in Windows 2000 and Windows 98 2nd edition, with Internet Explorer 5.5 as the browsing environment. In addition, CGI is used for data collection and FTP is used for data updates.

The various interactive functions of IRSA2 during the result evaluation mode of IRSA2 are shown in figure 3.

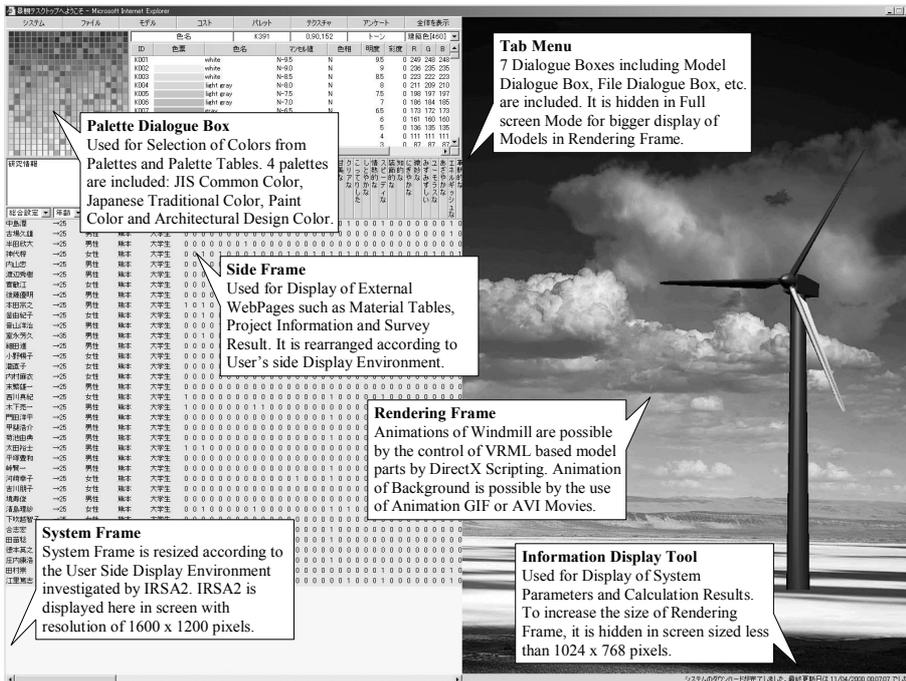


Figure 3. Result Evaluation Mode of IRSA2

2.3.1 DirectAnimation

DirectX is a family of high-level multimedia controls and application program interface. DirectAnimation is the DirectX component that provides support for animation, streaming, and integration of different multimedia. DirectX version 7 and DirectAnimation version 6 are used for rendering and animation of models in IRSA2.

2.3.2 DHTML

DHTML is an extension to HTML. Interactive WebPages can be constructed with the present HTML tags, by inclusion of CSS (Cascading Style Sheets) and scripting such as JavaScript Version 1.2 and VBScript. As shown in Figure 4, since all contents of WebPages are downloaded all at once, reloading is not necessary to response to user's demand.

2.3.3 TDC

TDC is an extension of DHTML. It allows the display of textual and multimedia database in tabular format. As shown in Figure 5, once downloaded, the database can be sorted and filtered at user’s side without further access to the server and the load of server can be cut significantly.

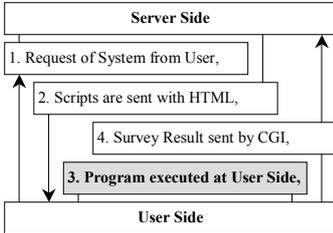


Figure 4. DHTML

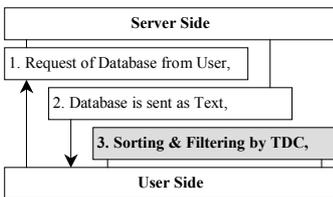
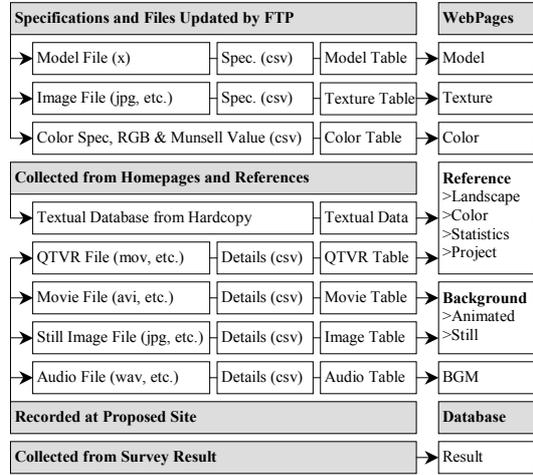


Figure 5. TDC



NB. File Format of Files in Brackets

Figure 6. Mechanism of External WebPages & Database

2.4 External Databases and WebPages

Figure 6 is the mechanism of external database and WebPages. They are used for reference and simulation during assessment. Figure 7 is an example of external WebPages of color specifications.

2.4.1 Project Database

The following 3 types of project database are included. They are recorded at the proposed site.

- a) QTVR Files: for reference of site environment.
- b) Movie Files: as animated background image.
- c) Audio Files: as audio effects.

2.4.2 Reference Database

The following 6 types of reference database are collected for reference.

- a) Ordinances related to landscape and townscape planning.

3. CASE STUDY

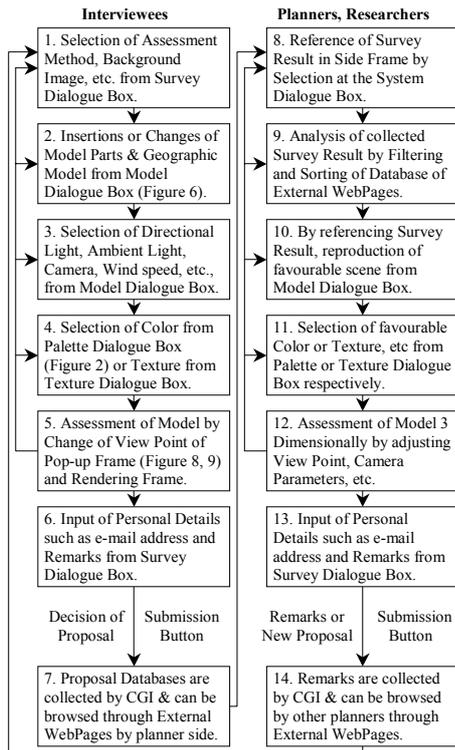


Figure 8. Flow of Case Study



Figure 9. Still Image & Top View Pop-up



Figure 10. Geographic Model & Color Pop-up

3.1 Selection of Subject of Assessment

Propeller windmills, being high in energy conversion performance, are usually used in wind farm projects. They are classified generally by size into the following 4 categories: Micro (diameter < 3m), Small (3m < diameter < 20m), Middle-sized (20m < diameter < 45m) and Big (diameter over 45m). In introduction of middle-sized and big windmills, for high-energy conversion performance and for convenience of repairing, windmills are usually placed in areas with no wind-breaking obstacles and in areas with good road access. In addition to the problem of noise, being big in size, their visible territories are so large that inevitably leads to the detrimental effect on natural landscape. As a result, it is necessary to devise methods to minimize their damages to the landscape and evaluations from interested parties are necessary before construction. In this research, as an example of “Moving Architecture”, using IRSA2, a VRML model of a 76m high propeller windmills is selected as the subject of assessment in the color planning of a windmill in Japan.

3.2 Flow of Case Study

The flow of case study using IRSA2 is shown in figure 8. Regardless of the limitation of time and space, respondents, researchers and planners, using a common browser, in the same platform, share the same information for landscape assessment. Respondents can assess the model by changing color, texture and size of the models and evaluate the result in different viewpoints by changing the camera settings. The above process can be repeated till a suitable solution is attained. The researchers and planners can reference the result collected for feedback in the actual planning purpose. Favourable design can be re-simulated by inputting the relevant parameters used during the assessment.

3.3 Details of Case Study

The VRML model of a propeller windmill was constructed for assessment purpose. To consider the influence of moving wind-blade of the propeller windmill in the assessment process, the rotation of wind-blade is animated by adjustment of the rotation velocity according to the setting of wind speed parameters. 32 university student specialized in architecture are requested for the assessment. To consider the actual application of color, a paint color palette of 343 colors (JPMA, 1999) is constructed for the assessment.

Using IRSA2, to relieve the psychological stress, respondents are requested to choose UNFAVOURABLE color of the propeller windmill with respect to the background environment (sky and mountain), and restrain from choosing favourable color because of one's personal preference. To grasp the band of individual difference, number of color chosen is not fixed and the assessment time is limited to approximately 20 minutes. The following is an explanation of the assessment environment: 1. Operating System: Windows 2000, 2. Browser: Microsoft Internet Explorer version 5.5, 3. Available Width of Screen: 1600 pixels, 4. Available Height of Screen: 1172 pixels, 5. Color Depth of Screen: 32 bits.

3.4 Overall Analysis

Since the number of color chosen is of wide band (33 to 339 colors), it is necessary to consider the personal difference (average number of color chosen: 204). In this research, analysis based on the Average Deviation (absolute deviation of data in respect to the average of the same group, an indicator of the dispersion of the data) of color chosen in respective Hue and Tone are undertaken. The results are as follow.

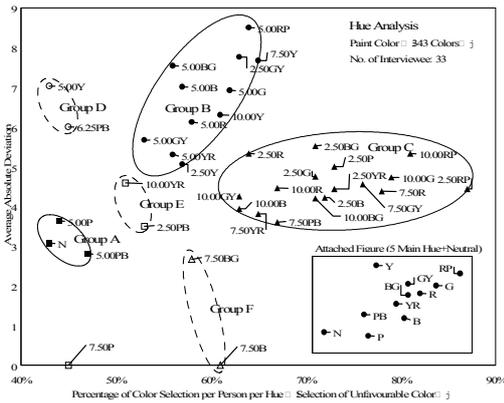


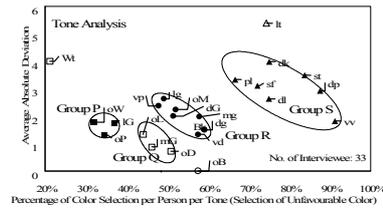
Figure 11. Result of Hue

3.4.1 Result of Hue

As shown in the attached figure in figure 11, being low in personal difference and least selected as unfavourable color, the most favourable Hue is Neutral (N). Being high in personal difference and highly selected as unfavourable color, it is advisable not to use Red Purple (RP) in the planning of windmill. As shown in figure 11, according to the dispersion, the colors are grouped in 6 different Hue Groups (A, B, C, D, E and F) for analysis. Being low in personal difference and least selected as unfavourable color, Group A is considered as the most favourable group. And with the same reason, Group E and Group F are considered as the candidate groups. Being high in personal difference, the use of Group B and Group D should be with attention. Being least selected as unfavourable color, it is advisable not to use Group C.

3.4.2 Result of Tone

As shown in figure 12, based on ABC Method used for Paint Color Tone Classification in Japan, the colors are divided in 24 groups for analysis. Though least selected as unfavourable color, being high in personal difference, the use of White (Wt) should be with attention. With high personal difference and being highly selected as unfavourable color, the use light (lt) is not advisable. According to the dispersion, the colors are grouped into 5 main groups (P, Q, R and S) for analysis. Being low in personal difference and least selected as unfavourable color, Group P is considered as the most favourable group and Group Q and R are considered as the candidate groups. Being highly selected as unfavourable color, the use of Group S is not advisable.



re 12. Result of Tone

4. EFFICIENCY OF IRSA2

The system efficiency is verified under the following 5 viewpoints.

4.1 Reality

- a) Environment quality such as angle of incident of the sun, vanishing point, and model characteristics such as texture can be simulated.
- b) Movies and still images used as background are photographed at the eye-level of an average 20-year-old Japanese man with 50mm lens.
- c) Geographic models are made with 50m meshes. With texture mapping, realistic rendering is possible.
- d) By adjustment of the level of ambient light and the 3 axial directions and angles of directional light, the change of time can be simulated.
- e) By adjustment of the above light settings, and the use of movies and still images as background, the seasonal changes can be simulated.
- f) By animating the wind blade rotation of windmill and the use of movie as background, the simulation of wind is possible.
- g) By adjustment of the visibility of the environment, the simulation of climatic change such as fog and rain is possible.
- h) By using audio clips collected at site, the simulation of realistic acoustic environment is possible.

4.2 Precision

- a) Models made from working drawings by CAD are converted to VRML models. High precision is possible regardless of the scale.
- b) In regard to its use in Internet, the tolerance due to the difference of color space definition in Munsell-RGB conversion is considered acceptable (Newman, 1995). Since the range of human color perceptions is 6 to 7 million colors, with the use of high-resolution monitors, simulation of high precision is possible.

4.3 Extendibility

- a) In regard to its use in Internet, the file size of the system is limited to 50 KB. The system is extendible through the use of Landscape Desktop.
- b) Incorporation with other multimedia contents such as Chat and Net Conferencing is possible using Direct Play.
- c) Color and texture tables and model parts can be incorporated as extension, according to the type of assessment.

- d) By extension, the use in other field of design such as interior design, product design is possible.

4.4 Manoeuvrability

- a) By the use of TDC, interactive sorting and filtering of database is possible without further access to server once downloaded.
- b) Instantaneous change of model characteristics and environmental Settings are possible during animated assessment in the same screen.
- c) Since the subject of assessment is considered as an assembly of model parts, insertion, deletion and updates of model parts are possible.
- d) By the use of FTP, sharing of database by updates of model parts, texture images, color specifications, etc is possible.
- e) System frames are rearranged and resized according to the user-side display environment and operating system investigated by IRSA2.

4.5 Cost

- a) Being application-independent, unnecessary software updates for data management software for example can be cut.
- b) Reuse of databases such model parts, color specifications, texture Images and project information saved in server libraries is possible.
- c) Survey results are collected as numerical and textual data in tabular format that can be used for evaluation and analysis directly.

5. CONCLUSION

With the use of IRSA2, “Interactive Assessment of Moving Architecture and Transiting Landscape” is possible with instantaneous simulation of high reality during change of the various landscape elements, independent of time and space. The favourableness of each element and the band of individual difference can be grasped for further reference in landscape planning. In the above process, different to the usual process that the respondents are allowed only to select alternatives designed by planners, respondents are allowed to participate in the design process and create alternatives as proposals, which gives roads to an “Autonomous Process” in landscape planning. And since the systems proposed are internet-based, they can be used in Web and in standalone basis. Even without connection to server, it can be used for insitu investigation and education purpose, which is effective for citizen-participation-oriented landscape planning. As a future prospect, with the improvement of transfer speed of Internet and polygon rendering capacity of

the browser environment, the incorporation of other element of transiting landscape, such as animals, people, cars are also in consideration and the reality of the seasonal changes can be improved.

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