

Application Research of Computer Aided Design in Environmental Art Design

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Abstract. Computer-aided design technology has certain improvements and enhancements to the planning of environmental art. This paper proposes a conceptual model of parametric virtual vegetation landscape planning and design and virtual display by using new technologies such as virtual reality, virtual plants and geographic information systems. In this way, the parametric plant modeling method and the plant spatial layout method are integrated.

Keywords: Computer; Art Design; Garden Landscape Design; Scene Element Rendering; Model Reconstruction.

1. Introduction

Since the 1990s, with the development of information technology, the world economic structure has undergone tremendous changes, and a unified integrated market has gradually formed. It is no longer the most important factor in consumers' decision to buy. Product innovation, appearance, pleasantness, environmental protection and other factors have been paid more and more attention, occupying a prominent position in the competition.

Garden landscape design needs to use landscape architecture design theory, based on garden planning, and comprehensively use scientific, technological and artistic means to create and protect the outdoor environment. Design works must not only be visually beautiful, but also coordinate with the surrounding environment. It covers urban greening, community greening, square design, road environment, scenic spot planning, etc. It not only emphasizes the integration of garden landscape with life, region, and culture, but also considers the sustainable development of ecological vegetation, protection and utilization of natural resources. Because garden landscape design, no matter the scale, hopes to achieve the effect of one scene at a time, and the scene moves with each step in the space organization, so how to express the design works in an all-round, real and even dynamic way is very important for designers. This will help to accurately express the design concept of the garden designer [1]. We have developed a three-dimensional garden landscape design simulation system with garden design as the core and integrating architecture and planning on the completely self-developed pure Chinese three-dimensional graphics platform, which closely integrates two-dimensional design and three-dimensional performance, and provides professional Planting design, professional construction drawing, production of domestic-oriented plant database, terrain design suitable for garden landscape, parametric design of garden auxiliary facilities, etc., well meet the needs of professional designers and fully fill the blank of domestic garden professional software.

2. Computer System Design for Environmental Garden Landscape Design

The three-dimensional garden landscape design simulation system is first of all a computer-aided design system. It has comprehensive functions and can help designers to quickly complete the early-stage design and later stage results display. The system takes garden landscape design as its main purpose, takes terrain design, planning design, and planting design as its main contents, and integrates architectural modeling and road design. While completing the graphic design, OpenGL dynamic browsing of the scene can be performed, and photorealistic renderings can be made in real time. And three-dimensional simulation animation, the scene is displayed in all directions and from all angles [2]. The system can be roughly divided into several modules: modeling and editing, terrain design,

planning and design, planting design, sprinkler irrigation design, data statistics, construction drawing production, rendering and animation production. The overall architecture of the system is shown in Figure 1 (the picture is quoted from Technical System Landscape).

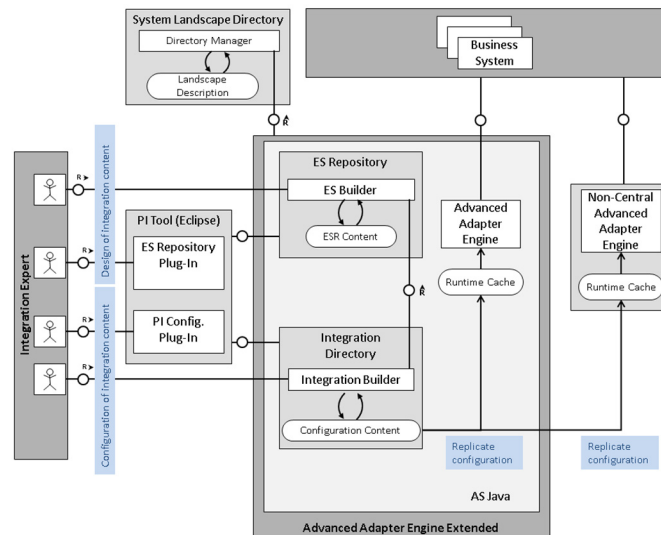


Fig 1. Architecture of environmental garden landscape design system

The designed system, as a computer-aided system for landscape design, can assist landscape designers to realize the whole process of landscape design from early-stage design to later stage results display. Use the professional rendering technology of virtual reality technology to render the produced scene in real time to improve the authenticity of the garden landscape design results. Vega Prime software is selected to realize the output of the designed garden landscape model [3]. Vega Prime software has the advantage of reducing source code writing and effectively improving system maintainability and real-time performance.

3. 3D Modeling of Garden Landscape Elements

We collect the parameterized data of garden tree species, scene terrain point cloud data and building parameter data in the area as the basic data of scene construction to realize the construction of the overall garden scene [4].

3.1 Construction of 3D Model of Garden Trees

As the most important component of garden vegetation landscape, tree simulation is the focus of all kinds of garden landscape planning and design software. The construction of fine tree models can greatly improve the realism of virtual garden landscapes [5]. Common plant modeling methods include pure mathematical methods, such as fractal geometry methods, iterative function systems, particle systems, and parametric methods combined with botanical knowledge, L-systems, and so on. Many three-dimensional garden landscape display software uses a simple Bill board structure model to represent trees. Although the simple cross structure model has a small amount of data, the scene display effect does not conform to the concept of "as realistic as possible" in virtual reality [6]. In this paper, a parametric tree modeling method is used to perform 3D geometric reconstruction according to the morphological characteristics of the branches and trunks of the trees, combined with the real pictures of the trees, to highlight the morphological and structural characteristics of the trees, such as the hierarchical relationship between the branches and the specific canopy structure. Wait. Based on this method, the tree modeling in Para Tree software is controlled by a visual interface, which abstracts the tree as a whole into different components, mainly including: trunk, branches, flowers, leaves, fruits, etc., to build the hierarchical topology of the tree. Adjust the shape of branches at all

levels, build 3D models of branches with different shapes, supplemented with different texture maps and leaf models, set global parameters of the tree model, such as lighting, materials, etc., and preset LOD (level of detail model) levels, Finally, a more realistic three-dimensional garden tree model based on real data is constructed. Figure 2 shows the three-dimensional model of some green trees in the study area, which are the A frangipani in Figure 2, the Jacaranda B in Figure 4, and the Terminalia C in Figure 2.

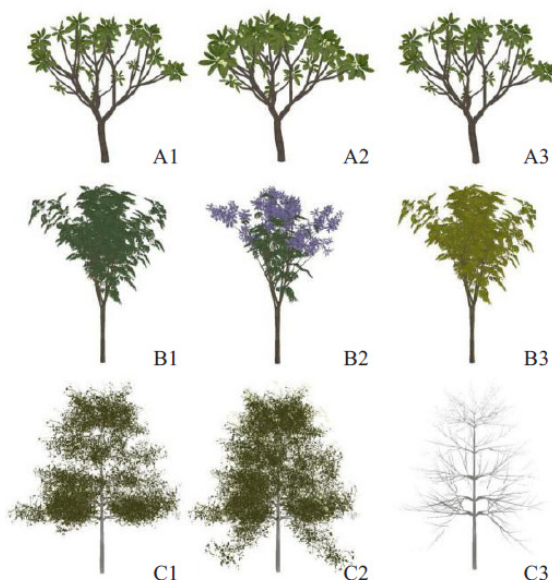


Fig 2. 3D models of greening tree species in different phenological stages

3.2 Construction of Terrain 3D Model

Terrain is the basis of the entire garden landscape or geographic scene, and all scene information needs to be organized and presented through terrain. The terrain data adopts the point cloud data of terrain and landscape in some areas of the Science and Technology Park obtained by the fixed-wing sense Flye Bee drone [7]. The average ground sampling resolution (GSD) of the data is 9.89cm, covering an area of 5.958km², and the geographic coordinate system is WGS84/UTM zone 50N. Using this as basic data, a digital surface model (DSM) is generated. Point cloud data has the characteristics of high precision and detailed sampling, which can accurately obtain the elevation of a certain point on the ground and express the undulating characteristics of the garden surface. Using Pix 4D mapper software, the 3D point cloud image data was generated as shown in Figure 3. A digital orthophoto map (DOM) of the experimental area was generated as the 3D terrain landscape texture data.

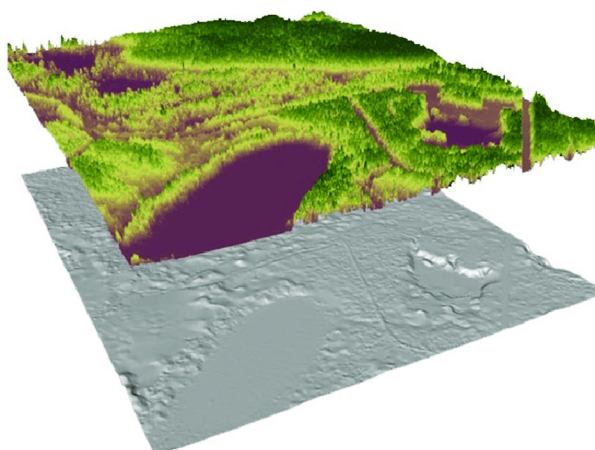


Fig 3. Terrain digital surface model based on point cloud data

3.3 Building 3D Model Building

According to the floor plan of the building parameterized vector type, it can be automatically and quickly generated in batches with the building height information (Figure 4 refers to the Completely Customizable Graphical User Interface). The specific implementation steps are as follows: (1) Import the building vector layer to the scene through ArcGIS Engine. (2) Query the floor information corresponding to each polygon in the building vector layer through Osg Earth, and generate the "white model" of the building model by automatically "pulling up". (3) Map the roof and wall textures, and set the positional relationship between the building model and the 3D terrain surface, such as whether it is attached to the ground. (4) Build a building group node and add it to the OSG scene terrain root node.

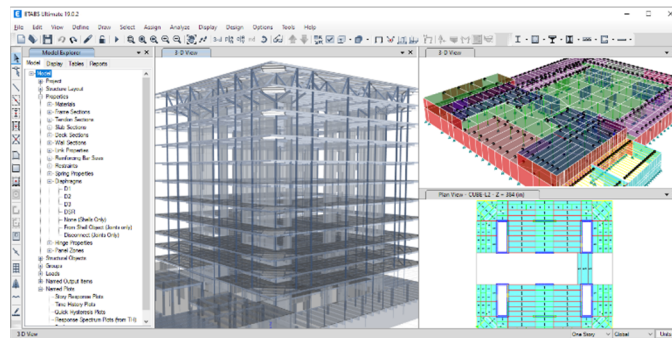


Fig 4. Batch automatic generation of 3D models for buildings

This method can generate buildings in modern gardens in batches, and can control the texture maps of buildings through XML files, without the need for positioning and texture maps for specific buildings.

4. Virtual Reality Module Integration

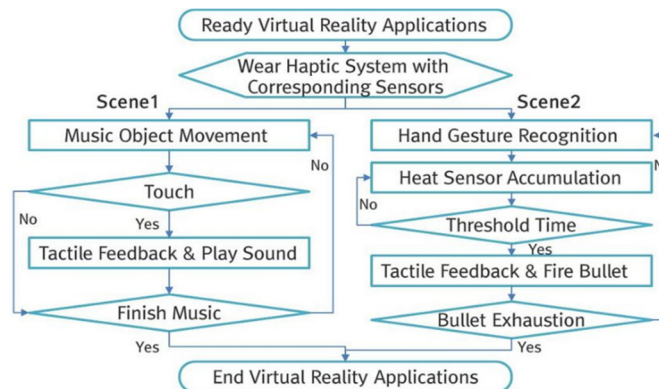


Fig 5. Flow chart of virtual reality scene rendering technology

The virtual display on the host side can be rendered and displayed in real time through OSG along with the data input and processing [8]. On the virtual reality helmet display device side, the display devices are two high-definition monitors that are close to the human eye. The 3D scene is rendered twice, and the matrix offset of the helmet based on the scene space position is calculated. Through a series of space transformation and texture rendering, the garden landscape display on the virtual reality side is finally realized. For garden vegetation landscapes with many elements and a large amount of data, the module integrates LOD methods, scene occlusion, Billboard, and field clipping methods to reduce program rendering consumption as much as possible. The domain range is small, and the above method can better ensure the real-time rendering of the scene in the virtual reality display. In addition, by integrating the multi-sampling anti-aliasing (MSAA) method, the scene model

details aliasing and rough texture are overcome, and a more detailed display effect is provided for virtual reality display. The specific module function implementation process is shown in Figure 5 (the picture is quoted from A Study on Immersion and Presence of a Portable Hand Haptic System for Immersive Virtual Reality).

5. Conclusion

This paper takes the conceptual model of parametric virtual landscape design and virtual display as the starting point, combines virtual reality, parametric modeling method, geographic information system and other technologies, and uses the OSG three-dimensional graphics engine to realize the virtual vegetation landscape based on spatial parametric layout. Build and Virtual Showcase.

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