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Dynamic Three-Dimensional Visualization System of Sea Area Flow Field Based on Virtual Reality Technology

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Abstract

The dynamic three-dimensional visualization design of sea area flow field is carried out, and the ability of dynamic three-dimensional visualization feature analysis and visual reconstruction of sea area flow field is improved. A design method of sea area flow field dynamic three-dimensional visualization system based on virtual reality technology is proposed. The dynamic 3D visualization system of sea area flow field is based on embedded Visual C development software technology. combined with Vega Prime, the virtual reality design of sea area flow field dynamic 3D visualization system is carried out, and the visual simulation technology is used to simulate the dynamic 3D visualization system of sea area flow field. The system mainly includes the dynamic 3D visualization information acquisition module and database model of sea area flow field. The 3D reconstruction module and visual simulation module of the dynamic 3D visualization of the sea area flow field are carried out. The VR design of the dynamic three dimensional visualization system of the sea area flow field is carried out by using the VR program loading method. The 3D solid model construction and scene rendering of the dynamic three dimensional visualization system of the sea area flow field are carried out by using 3DStudio MAX software, and the optimization design of the dynamic three dimensional visualization system of the sea area flow field is realized. The simulation results show that the output stability of the dynamic three-dimensional visualization system of sea area flow field is good, and the ability of dynamic three-dimensional visualization of sea area flow field is strong.

Keywords

VR technology; Sea area flow field; Dynamic three-dimensional; Flow field reconstruction system.

Introduction

With the development of virtual reality simulation technology and image 3D reconstruction technology, the dynamic 3D visualization design of sea area flow field is carried out by using virtual simulation technology, the 3D geometric modeling of sea area flow field dynamic 3D visualization system is carried out by using VR rendering and 3D scene technology, and the optimization design of sea area flow field dynamic 3D visualization system is carried out under embedded Linux operating system. The design of dynamic 3D flow field reconstruction system is based on the multimedia information development and data processing of dynamic 3D visualization of sea area flow field (Wei et al., 2017). The dynamic 3D visualization system of sea area flow field is optimized by using artificial intelligence 3D scene simulation and computer image processing technology, and the dynamic 3D visualization reconstruction of sea area

flow field is carried out in virtual software environment. Improve the visual simulation ability of dynamic three-dimensional visualization of sea area flow field (Radenovic et al., 2016) The dynamic three-dimensional visualization information of sea area flow field is collected, and the information fusion and digital transmission control ability of sea area flow field dynamic three-dimensional visualization are improved under the environment of big data information processing. The design method of sea area flow field dynamic three-dimensional visualization system based on virtual reality technology is put forward (Gao et al., 2017; Liu and Liu, 2010). Firstly, the overall design and analysis of the system are carried out, and then the development environment of the dynamic 3D flow field reconstruction system is described. combined with the visual simulation technology, the software development and design of the dynamic 3D flow field reconstruction system are realized. Finally, the simulation test and analysis are carried out, and the validity conclusion is obtained (Azizpour et al., 2015).

Overall Design Framework of the System

In order to realize the optimal design of the dynamic three-dimensional visualization system of sea area flow field, the overall design framework of the system is analyzed at first. The dynamic 3D visualization database of sea area flow field is constructed, and the sub-module development and information conversion control of the system are carried out with the method of 3D image reconstruction and scene information sampling. The network structure of the dynamic 3D visualization system of sea area flow field is designed by ZigBee net system under the Internet of things, and the database architecture of dynamic 3D visualization of sea area flow field is designed under embedded B/S bus dispatching. Cross compilation and PCI bus protocol are used to sample the resource information of the dynamic 3D visualization system of sea area flow field. The solid model of the dynamic 3D visualization system of sea area flow field is constructed by Multigen Creator software. The data structure and 3D modeling of the dynamic 3D visualization system of sea area flow field are developed under the visual scene simulation model. In the three-dimensional design of the dynamic three-dimensional visualization system of the sea area flow field, combined with 3D information reconstruction and VR simulation technology, the virtual scene simulation of the dynamic three-dimensional visualization of the sea area flow field is carried out. According to the above analysis, the overall structure of the dynamic three-dimensional visualization system of sea area flow field is shown in Figure 1.

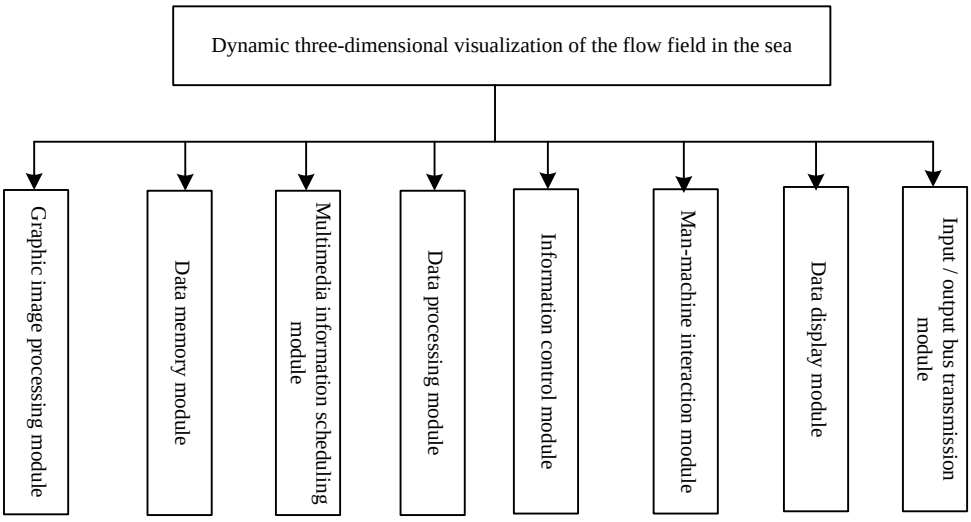

Figure 1: General framework of dynamic three-dimensional visualization system for sea area flow field.

According to the overall design framework analysis of Figure 1, the main functions of the dynamic

three-dimensional visualization system of the sea area flow field are realized, the data information processing and the virtual scene simulation of the sea area flow field are realized, the dynamic three-dimensional visualization of the sea area flow field is carried out by using the multimedia information scheduling method, the dynamic three-dimensional visualization system of the sea area flow field is built on the embedded Visual C ++ development software technology, and the virtual reality design of the dynamic three-dimensional visualization system of the sea area flow field is carried out in combination with the Vega Prime, according to the scene state information stored in the display list, and introducing relevant data (such as model polygons, textures, etc.) in the scene database into the data terminal of the dynamic three-dimensional visualization system of the sea area flow field, and then the dynamic three-dimensional visualization and the solid model of the sea area flow field are described by using the hierarchical structure and the attribute to obtain a program loading model of the system, as shown in Figure 2.

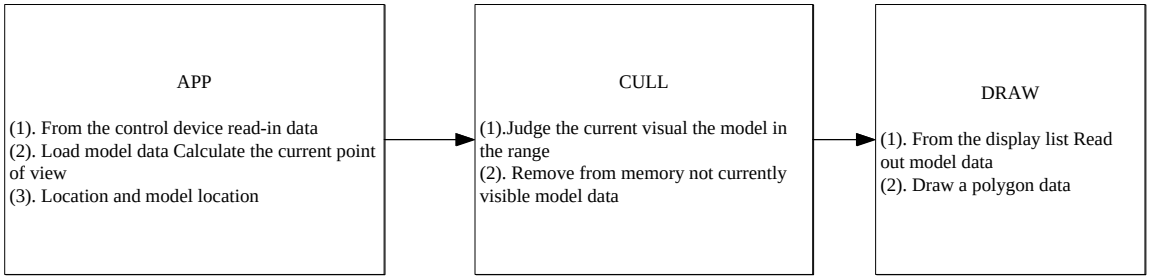

Figure 2: Program loading model of the system.

Description of System Development Environment

The invention adopts the ISA/ EISA/ Micro Channel expansion bus to carry out the command loading of the dynamic three-dimensional visualization of the sea area flow field, and the embedded modular design of the dynamic three-dimensional visualization of the sea area flow field is carried out in combination with a discrete distributed control method, The development and design of the dynamic three-dimensional visualization system of the sea area flow field by the combination of the combination networking technology and the embedded technology, based on the bus under the IEEE488.2 standard (Zhang et al., 2017), the dynamic three-dimensional visualization integrated intelligent control of the sea area flow field is carried out, The model structure of the dynamic three-dimensional visualization system of the sea area flow field is carried out by using the Multi Gen Creator software, and the Multi Gen Creator is used for creating a real-time three-dimensional model for visual simulation, and selecting a grid structure to carry out the full-area grid design of the dynamic three-dimensional visualization of the sea area flow field, The three-dimensional visualization area of the sea area flow field is constructed in four vertexes, and a quadrilateral is formed to replace the two triangles to obtain the entity module generation process of the dynamic three-dimensional visualization system of the sea area flow field (Wang et al., 2016), as shown in Figure 3.

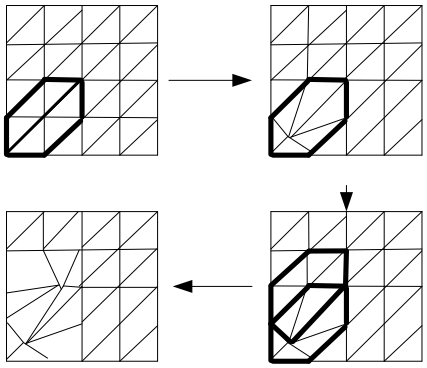

Figure 3: Entity module generation process of the dynamic three-dimensional visualization system of the sea area flow field.

In the virtual three-dimensional visualization environment of sea area flow field, the development environment of sea area flow field dynamic three-dimensional visualization system is analyzed. The designed sea area flow field dynamic three-dimensional visualization system is divided into three-dimensional information sampling module, 3D

information reconstruction module and digital interaction module of sea area flow field dynamic three-dimensional visualization. The dynamic 3D visualization system of sea area flow field adopts embedded design technology, combined with PCI bus scheduling and Unity3D simulation experiment, carries on the host information transmission control of the sea area flow field dynamic three dimensional visualization system, realizes the intelligent mode monitoring of the sea area flow field dynamic three dimensional visualization system, and carries on the system software development in the embedded Linux development environment (Hou et al., 2014; Zhang et al., 2016).

Design and Implementation of System Software

Development

The visual simulation technology is used to simulate the dynamic 3D visualization system of sea area flow field. The system mainly includes the dynamic 3D visualization information acquisition module of sea area flow field, database model, 3D reconstruction module of sea area flow field dynamic visualization, visual simulation module and so on. The VR design of sea area flow field dynamic 3D visualization system is carried out by using VR program loading method. The Terrain menu module of Creator is used to configure the components, and the engineering file configuration process of the system is shown in Figure 4.

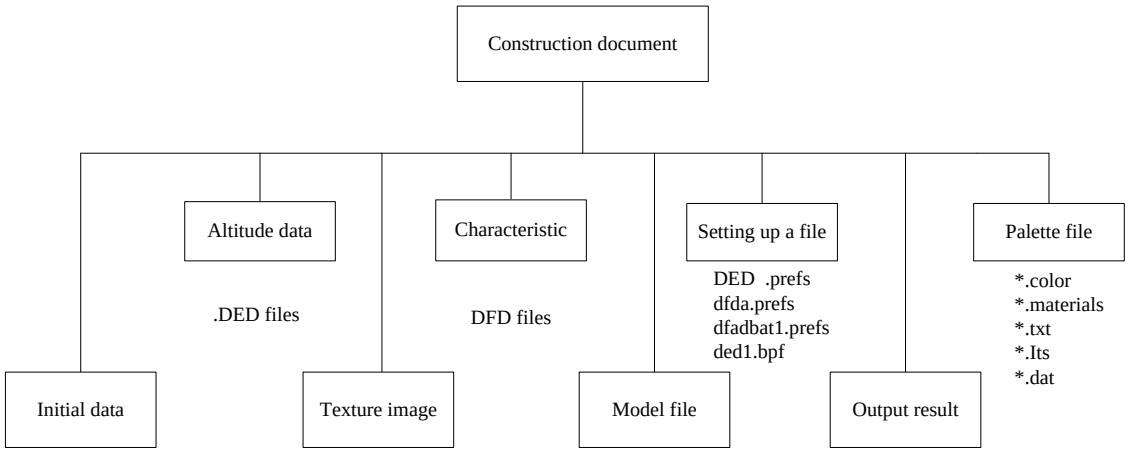

Figure 4: Configuration process of dynamic engineering documents for flow field in sea area.

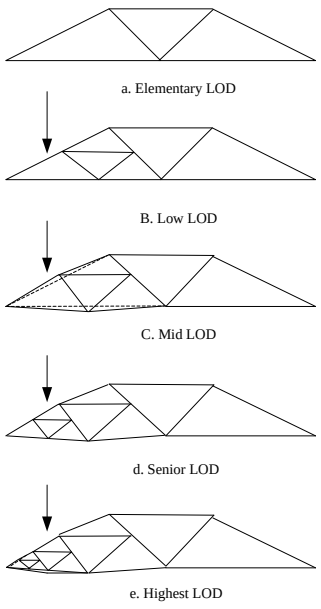

Figure 5: Texture rendering process of dynamic 3D Visualization of Sea area flow Field

The model database is established, and the geometric module of the dynamic three-dimensional visualization system of the sea area flow field is generated by using the three-dimensional deformation (Morphing) technology between the adjacent LOD. The texture rendering of the dynamic three-dimensional visualization of the sea area flow field is realized, and the texture rendering process is shown in Figure 5.

Using Vega Prime editor to load 3D program, the 3D objects of dynamic 3D visualization of sea area flow field are expressed with different precision, and the rendering module of dynamic 3D visualization of different sea area flow field is selected according to the change of observation point position. According to the

above analysis, the spatial distribution model of dynamic 3D visualization of sea area flow field is constructed to realize the optimal design of dynamic 3D visualization system of sea area flow field (Xu et al., 2015; Wang et al., 2014).

Simulation Test Analysis

The performance of the dynamic 3D visualization system of sea area flow field designed in this paper is tested by simulation experiment. Two examples of Generator FFT and Observer Centered are created for dynamic 3D visualization rendering and output bus control of sea area flow field. The dynamic 3D visualization platform of sea area flow field is developed by using Vega Prime visual simulation platform. The dynamic 3D visualization rendering output of sea area flow field is shown in Figure 6.

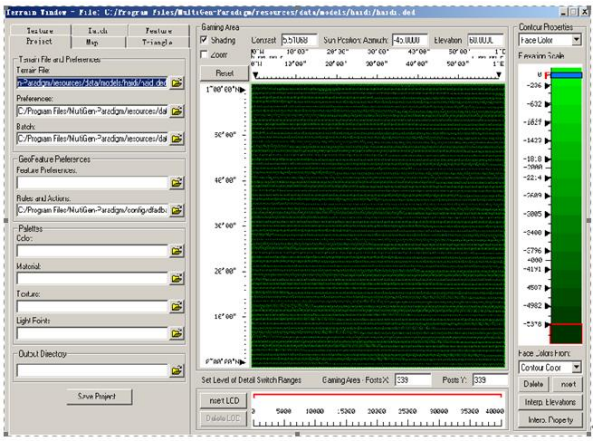

Figure 6: Dynamic three-dimensional visual rendering output of the flow field in the sea area.

3DStudio MAX software is used to construct the 3D solid model and render the scene of the dynamic 3D visualization system of the sea area flow field, and the output results are shown in Figure 7. The analysis Figure 7 shows that this method can effectively realize the dynamic three dimensional visualization of the sea area flow field, and the output stability of the design of the dynamic three dimensional visualization system of the sea area flow field is good, and the dynamic three dimensional visualization ability of the sea area flow field is strong.

Figure 7: Dynamic 3D visualization output of flow field in sea area.

It is found that the output stability of the dynamic three-dimensional visualization system of sea area flow field is better, and the ability of dynamic three-dimensional visualization of sea area flow field is stronger. The signal-to-noise ratio (SNR) of the output is measured and the comparison results are shown in Table 1. The analysis shows that the output SNR of the dynamic 3D visualization reconstruction of the sea area flow field is high.

Table 1: Dynamic 3D visualization output SNR of sea area flow field (unit: dB)

Iterations	Proposed method	Azizpour et al., (2015)	Zhu and Ren (2019)
100	45.4	23.2	12.3
200	56.4	27.3	16.1
300	62.1	32.1	21.2
400	68.4	43.2	27.3

Conclusions

In the virtual software environment, the dynamic 3D visualization of the sea flow field is reconstructed, and the visual simulation capability of the dynamic 3D visualization of the sea flow field is improved. This paper presents a design method of dynamic 3D visualization system of sea area flow field based on virtual reality technology. The system mainly includes 3D visualization information acquisition module, database model, 3D reconstruction module of 3D visualization module, visual simulation module and so on. Based on the scene state information stored in the display list, the 3D visualization system is rendered and loaded, and the 3D entity model construction and scene rendering of dynamic 3D visualization system is realized. It is found that the design of dynamic 3D visualization system with this method has better output stability and better dynamic 3D visualization effect.

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