Hydraulic Engineering Visualization Simulation System Based on VR

Henian Bao

Water Conservancy and Civil Engineering College, Inner Mongolia Agriculture University, Hohhot 012000, China

bhn001@hotmail.com

Keywords: Virtual Reality; 3D Visual Simulation; Digital Models; Hydraulic engineering

Abstract. Hydraulic engineering visualization simulation increases the predictability of engineering design work, engineering design and construction to reduce costs, and reasonable arrangements for construction projects of important guiding significance. This paper studies the three-dimensional visual simulation based on VR major water conservancy projects, the establishment and consolidation method describes the terrain and surface features digital models, finally introduced to interact with three-dimensional digital model and actual project can develop a scientific, intuitive, vividly show the construction of large water conservancy visualization simulation system, the proposed water project by the data acquisition simulation system structure, composition data management, simulation and virtual reality four parts, provide the basis for the construction management decisions.

Introduction

Due to rapid economic development has led to increased energy consumption for water this clean, renewable resource development growing demand, coupled with a better project design and construction standards, large-scale water conservancy projects around the country are and will continue to launched a large scale due to water conservancy projects, mostly in the mountains and canyons, water flow needs, the engineering design and decision-making is a very complex task, and water conservancy building types, arranged complex, interrelated and both between the various parts of its interior mutual restraint relations are complicated, often involving various aspects of the construction, it is difficult with a simple chart or mathematical model to describe. The current construction program design too dependent on design drawings, design results are generally expressed as two-dimensional plans, sections other forms, not visually, and it is difficult to do the entire contents of the macro intuitive grasp of construction [1,2].

Therefore, how to use scientific and effective design methods to improve design efficiency, and how to provide designers with an interactive friendly visual design environment is key to improving engineering productivity and decision-making paper virtual reality (VR) and 3D simulation phase proposed by combining a CR-based three-dimensional visual simulation technology for water conservancy construction performance and analysis system which digitally intuitive visualized as a starting point, showing temporal relationship between the construction unit logically complex construction, the use of powerful computer data processing capabilities and efficient graphical display capabilities, reveals the internal construction of the system and the dynamic behavior of the spatial arrangement of the static characteristics, auxiliary engineering design and analysis of hydraulic engineering personnel to help them achieve the desired purpose or made innovations to improve the computer aided design level, but also improve the efficiency and quality of project design.

Virtual reality technology overview

Virtual reality (VR) technology in real-time performance capabilities of three-dimensional space, natural and man-machine interactive operation environment brings immersive experience, change boring, stiff and passive current situation between man and computer fundamentally, people with vision, hearing, touch and other human habits and natural way to feel and recognize the virtual

world of computer-generated, to promote the exchange of people and the environment, and thus more in-depth development of human intelligence [3]. Project design in virtual reality technology, a virtual water conservancy system, with good interaction, provides any angle, roam speed; visually, water conservancy between professional and non-professional designers provide a bridge. As a result of digital means, it becomes very easy to maintain and update.

In the VR system, the core content is to build 3D virtual scene, the three dimensional modeling is the foundation [4]. The first, it must carry on the modeling of virtual environment, and then based on the real-time rendering and stereo display, forms a virtual world, 3D modeling process is shown in figure 1. First for 3D virtual scene area, collect related basic data needed for 3D modeling, and then build scene 3D model by 3D modeling technology. Second, 3D model needs to be done to further processing, as a distinct and smooth 3D virtual scene, not only must have the realistic model, and need to have a smooth running effect, this is the 3D scene model has more stringent requirements, the model to optimize and does not affect the overall effect, three-dimensional scene optimization technology has played a key role in this process. The last, 3D virtual scene after baking process, through 3D interactive simulation platform for real-time rendering drawing and stereo display, interactive roaming, and other functions.

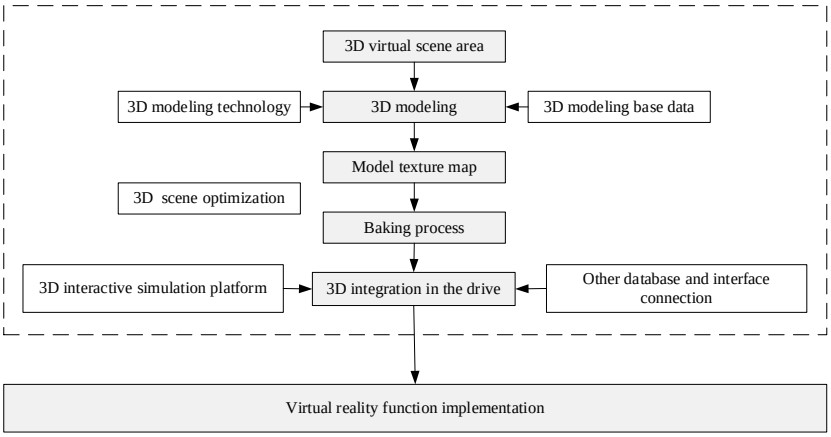

Figure 1.Structure of 3D modeling process for VR

Hydraulic engineering visual simulation system components

For project design, the designer is concerned with changes of the typical time period of the system state, and therefore should be adopted discrete system simulation project design. Discrete simulation systems, does not need to describe the changing state of the system between two discrete time, just you need to know the time and in the order of occurrence of each event occurring events describe the system status for each point in time, to grasp the dynamic of change process [5]. Hydraulic engineering visualization simulation generally built by touch, three-stage model experiments and results analysis, and the like. Hydraulic engineering model test method can be used to promote the simulation clock, clock propulsion method next event time advance method and a fixed increment of time to promote the two methods. Next event time advance method: every event in the simulation process of determining when the next event occurs while simulation clock to advance to the nearest future event (the first event) occurred at a time, the system state changes. In this case, the time point of the system state changes, the first event become a reality, based on this event and calculate the time for the next event, the simulation clock continues to advance, the system continues to change state. WATER visual simulation system consists of data collection, consisting of data management, simulation and virtual reality four parts, the system structure and data flow shown in Figure 2.

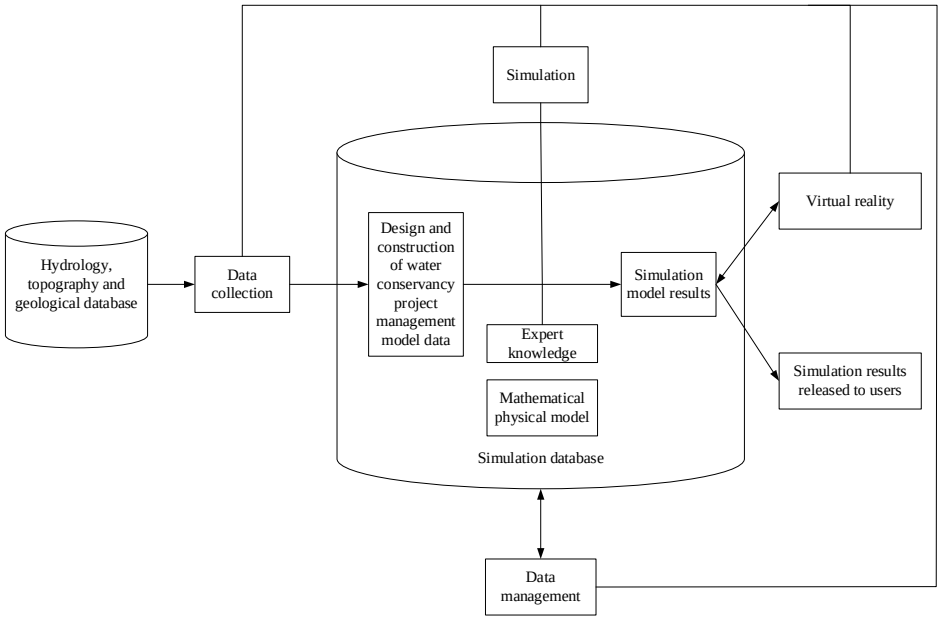

Figure 2.The structure of hydraulic engineering visual simulation system

Data collection for collecting relevant data. It mainly relies on the use of digital photography technology to satellite images, aerial photos and other objects of the process, such as workstations and appropriate use of photography vector generation 4D software product, which is mainly used to collect topography, hydrology, space and other information; or using three-dimensional modeling technology for hydraulic structures, metal structure, mechanical and electrical equipment.

Data management is a central part of the whole system, which on the one hand the need to collect to the massive, diverse data sources unified management (ISO), publishing useful information, but also for the subsequent simulation and virtual reality to provide the source data. Systems based on relational database systems, GIS provides a connection to the database through ArcGIS product components. It supports multi-user spatial database design, create, edit and sharing; data information unit project as a unit, instead of the management to file for the unit, convenient for users.

Engineering Simulation is the core of the simulation system. It is based on the design of hydraulic engineering professional requirements to mathematical theory, mechanics, systems engineering, information technology and professional and technical specifications, based on experience by means of expert knowledge, statistical data, using the digital model to simulate actual or envisaged The system, to experiment and make decisions. Virtual reality and real-time graphical workstation driver software for interactive real-time visual simulation, using a large-screen projection and sound equipment, giving the feeling of being there. It visualization technology as a tool, which greatly improved the work environment engineer.

Hydraulic engineering visualization simulation system case study

Water conservancy construction and management is a very complex huge project, with a long period of project implementation, invest more financial and human resources, the ecological environment impact, wide areas of expertise and other characteristics. Early experiments carried out for a variety of water projects, the traditional method is to use narrow than physical mock-feet to simulate various design parameters of the test water projects by applying a variety of water conditions, although this method is straightforward, but there are After forming a solid model difficult to modify, it covers an area of large, waste of resources and other shortcomings. WATER VR technology based applications shown in Figure 3.

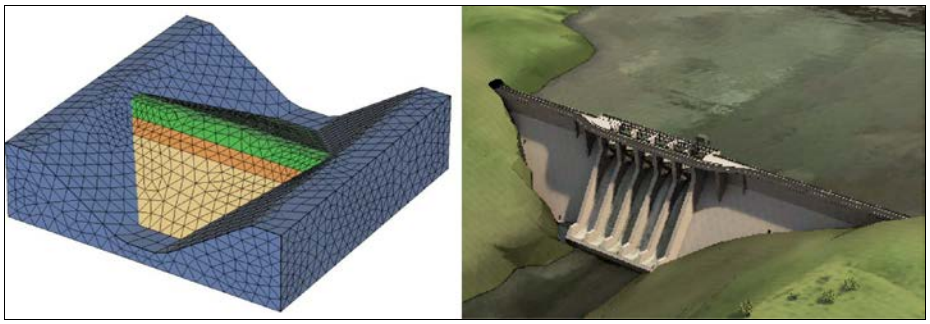

Figure 3. Hydraulic engineering visualization simulation system case

Hydraulic engineering visualization simulation traditional two-dimensional design is not clearly and directly display the designer's ideas, including various professional hub, construction, electrical and mechanical design professionals cannot very smooth cooperation and exchange in the two-dimensional plane. In the actual construction schedule management, data statistics, compilation, transmission and storage is still estimated statistics, manual preparation, labor reporting, and document delivery based, difficult to adapt to the requirements of modern construction. The emergence and development of virtual reality and simulation technology just adapt to this objective need, with broad applications in water conservancy projects, to solve the problems it has opened up new avenues.

Conclusion

This paper studies the three-dimensional visual simulation based on VR major water conservancy projects, the establishment and consolidation method describes the terrain and surface features a digital model of the proposed structure of hydraulic engineering simulation system consists of data acquisition, data management, simulation and virtual reality that provide the basis for the construction management decisions. I believe that with the popularity of virtual reality technology in water resources among scientists, the virtual water conservancy system will become an important platform to promote the project design study.

References

[1] Gao Z, Liu S, Ji M, et al: Computer Applications in Engineering Education, Vol.19(2011) No.2, p.315.

[2] Seth A, Vance J M, Oliver J H: Virtual reality, Vol.15 (2011) No.1, p.5.

[3] Balamuralithara B, Woods P C: Computer Applications in Engineering Education, Vol.17 (2009) No.1, p.108.

[4] T. Hartmann, J. Gao, and M. Fische: Journal of Construction Engineering and management, Vol.134 (2008) No.10, p.776.

[5] D.W.F. Van Krevelen, and R. Poelman R: International Journal of Virtual Reality, Vol. 9(2009) No.2, p.1.