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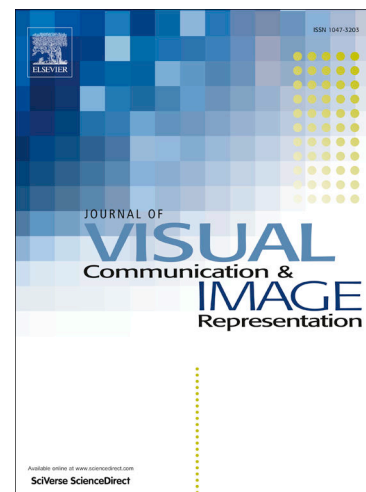
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# Application of Multimedia Technology in Water Conservancy and Hydropower Engineering

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**Abstract:** Multimedia covers a wide range. In general, digital audio production, animation video production, website production, and even game development can all be attributed to multimedia. The definition of multimedia narrowly defined, that is, the project with interactive program development as the main object of this paper, such as interactive CD production, touch screen presentation production, etc. Of course, there will still be a lot of content related to graphic design, animation, video processing, audio production and so on. The application of multimedia technology in water conservancy and hydro-power engineering is characterized by a variety of media means to represent the design, construction process and post-construction scene of water conservancy and hydro-power projects and to simulate the phenomenon in the project, such as the performance of water conservancy and hydro-power projects. Hub layout, structure of main buildings, dam flood discharge, rubber dam dam overflow, sluice dispatching process, ship lock crossing process, etc. In the water conservancy and hydro-power project, computer multimedia technology has been widely used from the general design proposal to the entire pivot project demonstration system. This paper mainly introduces the design and development of the multimedia demonstration system for water conservancy and hydro-power projects.

**Keywords:** Multimedia; Water Conservancy and Cydro-power; Demonstration system; Information Technology

## 1. Introduction

The human society in the 21st century is an information-based society. Human beings transmit information and accept information through various channels [1]. Multimedia technology uses computer technology to process a variety of information such as text, graphics, images, sound, video and animation, and integrates the system and is interactive. The coverage of multimedia is very broad. If in a broad sense, digital audio production, animation video production, website production, and even game development can all be attributed to multimedia [2-4]. The definition of multimedia narrowly defined, that is, the project with interactive program development as the main object of this paper, such as interactive CD production, touch screen presentation production, etc. Of course, there will still be a lot of content related to graphic design, animation, video processing, audio production, etc. [5-7]. The application of multimedia technology in water

conservancy and hydro-power engineering is characterized by a variety of media means to represent the design, construction process and post-construction scene of water conservancy and hydro-power projects and to simulate the phenomenon in the project, such as the performance of water conservancy and hydro-power projects. Hub layout, structure of main buildings, dam flood discharge, rubber dam dam overflow, sluice dispatching process, ship lock crossing process, etc. [8]. With the development of computer technology, 3D design technology is widely used in other industries, and the aircraft and automobile industry are pioneers. Later, 3D design technology has also become a field in electronics, molds, construction of civil and industrial construction, plumbing and pipelines. Indispensable means, these have a strong impact on the existing design process of the water conservancy and hydro-power industry, and 3D design technology is increasingly valued by designers and researchers in the field of hydro-power engineering [9-11].

System simulation technology is a new technology gradually formed with the development of computer science and technology. It has become an indispensable means of analysis, research, design, evaluation, management and decision-making for complex engineering, for complex engineering design and Management provides an effective analytical method [12]. In the traditional field of water conservancy and hydro-power engineering, system simulation technology has been applied to many aspects and achieved remarkable results. However, water conservancy and hydro-power engineering is a complex system engineering, including temporary water retaining building construction, dam construction, dam foundation excavation, tunnel and spillway excavation, etc., and the various components within the system are interconnected and mutually constrained. The relationship is complicated and the simulation results of the construction of water conservancy and hydro-power projects include a large amount of data and graphic information. Simple text, diagrams, or mathematical models do not accurately express the accuracy and credibility of the simulation [13-14]. Therefore, it is inevitable to seek new technologies to combine with system simulation technology to realize visualization of simulation technology. With the development of computer software and hardware and the enhancement of graphics processing capabilities, computer simulation technology has gradually evolved from numerical simulation to visual simulation. People are increasingly demanding visual display of simulation results [15]. Visual simulation technology is a new technology generated under this demand, and is receiving more and more attention. The visual simulation system not only provides the user with a human-computer interaction environment of a multi-view, multi-angle, multi-level observation simulation process visualization platform, but also allows the user to intuitively modify each simulation parameter and visually display the simulation results accordingly. Scientifically and intuitively describe the complex logical relationship between time and space in all aspects of engineering construction, and express simulation results simply and clearly, which can effectively serve design and decision-makers and have important significance for improving the efficiency of construction organization design and management modernization level. [16-17].

As early as 1961, G.W. Morgenthler first proposed the concept of "simulation" and explained it technically - the reproduction of the nature of the system or activity in the absence of the actual system [18]. At present, simulation, also known as simulation, is considered to study the existing or designed system by experimenting with the system model to reproduce the essence of the actual system. With the development of computers, simulation technology has been applied in many fields and brought great social benefits, such as aviation, aerospace, electric power, chemical and other fields, which not only reduces the consumption of test materials and funds, but also avoids

the tradition. The danger of testing [19-22]. In 1986, the National Science Foundation (NSF) seminar on scientific computing and graphics and image processing proposed the application of graphics and imaging technology to scientific computing, thus creating a new field - simulation computing visualization [ twenty two]. The development of visual simulation technology has generally gone through three stages: the first stage is the early graphical simulation, that is, the use of flow charts and network diagrams to build simulation models, such as the circular network visualization model; the second stage appeared in the early 1990s Graphical visualization and two-dimensional animation, such as the simulation study of the earth-rock dam transportation system by Sun Guoqiang of Tianjin University [23]; the third stage is the combination of three-dimensional animation technology and system simulation technology researched in the late 1990s to the present, development The 3D visualization simulation system for system operation, the system software development platform is generally 3Dmax software, virtual reality software and Arc GIS software. For example, the dynamic construction visualization system developed by Kamat and Martinez, the visual simulation system of the Jinanqiao hydro-power Station network schedule developed by Wang Renchao of Tianjin University [24-26].

The application of multimedia technology in water conservancy and hydro-power engineering is characterized by a variety of media means to represent the design, construction process and post-construction scene of water conservancy and hydro-power projects and to simulate the phenomenon in the project, such as the performance of water conservancy and hydro-power projects. Hub layout, structure of main buildings, dam flood discharge, rubber dam dam overflow, sluice dispatching process, ship lock crossing process, etc. In the water conservancy and hydro-power project, computer multimedia technology has been widely used from the general design proposal to the entire pivot project demonstration system. This paper mainly introduces the design and development of the multimedia demonstration system for water conservancy and hydro-power projects.

## **2、multimedia technology**

### **2.1 The application of multimedia technology and its editing tools**

Multimedia technology is a comprehensive technology including computer technology, audio-visual technology, communication technology, etc. It allows users to communicate information through text, graphics, sound, animation and other media interactively, and processed by computer to separate or The techniques and methods of synthetic morphology. Today, with the rapid spread of 3D animation technology, the application of multimedia virtual technology has reached a new level, because it can not only construct a virtual reality environment to simulate all existing and non-existent things space and entities in the real world, but also Simulating what has happened in the past or what might happen in the future, so it has a wide range of applications and a wide variety of applications. The technology has been used as a means of bidding by the construction industry. When the house is still in the planning stage, the computer can demonstrate the architectural animations that have been designed according to the design in advance. The customer can “immersively” view the entire building along the designated route. External environment, internal structure and decoration; with touch screen and interactive presentation software, customers can choose what they want to see as they like. The creation of multimedia works not only involves the creative factors of art, communication, education, psychology, etc., but also needs to be able to conveniently combine multimedia information such as pictures, texts, sounds and images into specific requirements. The method of performance. In order to save the

creation time of multimedia works, a relatively simple, integrated and efficient editing tool is needed to assist the creation and presentation of multimedia works. The editing tools are divided into the following categories:

(1) Descriptive language: The idea is to treat each title development process as a combination of "books" according to the structure of the book. Each screen is designated as one page, and there are multiple levels of objects on each page. Set the pages and the content of each page and the actions between them, and then design the work using the specified code-sharing language. Among these tools, the representative of the US Symetrix Multimedia Tool-Book tool.

(2) Interactive icon: Let the user arrange the required components directly on the screen, define the action of the component itself and the relationship between the components and the components, and use a visual method to make multimedia works on the microcomputer. This method is suitable for users without programming experience to develop an interactive multimedia system in a short time. Among these tools, Authware Professional, Icon Author, and Founder Oss are more representative.

(3) Time flow type: It is more suitable for developing the briefing system. It has a strong time sequence in the media display. It is mainly composed of graphic and text information. The more famous ones are: ACTION, PowerPoint, Harvard Graphic tool.

## 2.2 Collection of multimedia data resources

The production of multimedia presentation systems, first of all, the collection of various data resources. Multimedia data mainly includes text data, image data, audio data, etc. This is one of the key factors for the success of the demonstration system:

(1) Collection of text data: Numbers and texts can be collectively referred to as text (TEXT), which is a traditional form of media. Various text editors now support the collection and preparation of text. There are several methods for text data collection:

a. Scan the printed matter with a scanner, convert the text into a bitmap image, and then analyze and identify it by a specific software OCR (Optical Character Recognition);

b. Enter with the keyboard.

(2) Acquisition of image data: The image includes two types: one is a still image (Still Images), and the other is a full motion video (Full motion video). There are several methods for image data collection:

a. Using a video card to connect some video input devices such as a camera and a frame capture device, these image materials are mainly obtained by digitizing the video image. Common software for editing videos are: Quick Time, video Blaster, Screen Machine, Video Machine;

b. Scan with color, black and white, and grayscale scanner (Scanner), digitize photos and pictures, and then use image processing software such as Photo-style, Photo-shop, Gallery Effect to smooth, sharpen, blur, etc. ;

c. Purchase digital images or pictures, use a digital camera, flexibly capture photos, and send them directly to a computer for processing.

(3) Acquisition of audio data: The production of multimedia audio data includes factors such as making sounds, editing sounds, and integrating sounds into programs. Common types of audio include waveform audio, MIDI Audio, and digital audio.(CD Audio). There are two sources of sound from the Sound Blaster:

a. Analog (such as a pen) audio signal input, such as ordinary recorders, radios, and other audio output (Lineout) and microphone;

b. Digital (Digital) audio signal input, such as (CD, MIDI controller, CD-ROM drive, etc.).

### 2.3 Processing of multimedia data resources

(1) Processing of text data: Editing and integrating the data in PowerPoint, forming different displays by different combinations of four types: style, positioning, font, and size. In this way, the effect of entering and exiting each media object (such as flicker, control rotation, fade in and out, etc.) is made, so that the content of the text shows a lively scene.

(2) Processing of image data: Photo-shop can be transformed to produce special effects such as Rotate, Resize, Mirror, Resolution, Resampling (Resampling) Re-sample, etc.; the image can be cut, copied, pasted (Paste) to the standard MS-WINDOWS clipboard or Photo-style clipboard; the entire image or part of it can be applied Special image filters for special effects such as smoothing filters to remove spots (Despeckle), special effect filters for adding Emboss, Mosaics, etc.

(3) Processing of sound data: Multimedia audio can be produced in software specially used for sound processing, such as Sound Design, etc., and can also be produced on some multimedia editing software. Windows Sound Recorder is a powerful tool for audio data production. It allows us to "see" music as much as listening to music. The Sound Recorder program has the following functions:

- a. Recording function: set the sampling frequency and the location where the recorded data is stored, transfer the recorded data into the system memory, and store the recorded data in the disk;
- b. Play function: play voice files from the system memory and play voice files from the disk;
- c. Compression function: compress the voice file in the memory;
- d. Edit function: delete, modify, copy, etc.

## 3. Design and development of multimedia demonstration system for water conservancy and hydro-power projects

### 3.1 General development process of the demo program

1) According to the preliminary idea put forward by the user, communicate with the user to analyze the user's needs, make a project planning book and propose the overall design of the system;

2) Submit a multimedia design plan to the user according to the content of the plan book, and describe the design plan and sample of the title, interface, script, and music;

3) Submit a material requirement list to the user, describe all the materials to be released, and provide the user with reports, design drawings, pictures or photos and video materials related to water conservancy and hydro-power projects;

4) Data collection, data processing, multimedia design, and programming according to the determined multimedia design scheme;

5) Complete the test version of the product and start testing and correction;

6) Write a manual and a development report to submit the official CD-ROM product to the user.

Although multimedia development projects involve a large number of technical names, however, according to different characteristics, a multimedia development project can be divided into three parts: material part; interactive part; design part.

#### (1) Material section

Part of the material is produced in the multimedia project. There are three kinds of situations. One is that the user can provide complete materials, such as text images, dubbing materials, animation materials, video materials, etc. (the animation here refers to computer production). The



processed digital animation, the video data refers to the digitally recorded content of the camera, and in this case, the production of the material part will be very simple. Simply process and process the material. For text and image data, just follow the design style of the multimedia program, and edit and modify it with software such as Photo Shop or Fire Works. For user-supplied Auto CAD drawing source files (dwg format files), you can edit them with Auto CAD software, delete content that is not related to multimedia performance, and make appropriate modifications, and then export them to Windows metafiles in wmf format, or use Hyper. Snaper DX software for screen capture, which is available for multimedia software calls. Dubbing, animation, and video material are processed and clipped and composited using Premiere or After Effects software. The second case is based on the information provided by the user, and the corresponding content material needs to be created. Usually in this case, you must first determine the type of material to be produced and the difficulty level and quantity of each type according to the project requirements. The materials that need to be produced are as follows: 1) Digitalization of data: refers to Transform traditional material into computer files. There are usually text input, image scanning, and video capture digitization. 2) Image processing: refers to the effect of creating a digital image, adding text, and the like. 3) Computer animation: In the title of multimedia project, or the need to visualize the design scheme, principle, overall layout of the project, the structure of the main building and the completion scene of the water conservancy and hydro-power project, the computer animation is usually used. Usually divided into two-dimensional animation, three-dimensional animation, video post-processing.

#### (2) Interactive part

The interactive part refers to the use of multimedia production software, such as Director, Authorware, and even VB, VC, Dehphi, etc., to organically organize the design interface and various multimedia materials into a whole. The interactive part is the final work of the whole multimedia project. Its quality directly affects the quality of multimedia products. A multimedia product with smooth running speed, few bugs and clear navigation can completely forget the existence of multimedia programs. Just enjoy the content. The production of water conservancy and hydro-power project demonstration program generally adopts Authorware software, and its flow-line design method is convenient for organizing multimedia materials for water conservancy and hydro-power project demonstration better and faster. The framework structure and the chapters of water conservancy and hydro-power project introduction can be A correspondence. The content of the page that needs to be called repeatedly can be made into a media library by using the framework structure, can be called in any page content, and returns to the called page after the call is completed.

#### (3) Design part

The design part here refers to the design of the interactive interface and navigation. The interactive interface and navigation design part of the multimedia product is very important, because after the final multimedia product is delivered to the user, the user uses the multimedia presentation system to deal with the interface and the navigation system. A good multimedia product should generally have a friendly interface. The style that matches the performance of the water conservancy project can be quickly used by the general user without professional training or only a small amount of guidance. Even if the structure of the water conservancy and hydro-power project demonstration is complicated, it will not cause the user to be lost. The direction is not found in the jump button. This requires the programmer to better organize the various multimedia

materials and clearly give navigation tips. The water conservancy and hydro-power project demonstration system generally requires a switching function that can manually and automatically play multimedia programs. The dubbing commentary or background music has a switching function to facilitate use in different occasions. For example, sometimes manual explanation is required. At this time, there may be no need for voice interpretation and background music. The jump of the program should be controlled manually by the explainer, and the content that you want to explain can be freely selected. Sometimes the multimedia program needs to be placed. It is automatically looped in the showroom to allow viewers who come to visit at different times to watch what they are interested in.

The application of multimedia technology in water conservancy and hydro-power engineering is characterized by a variety of media means to represent the design, construction process and post-construction scene of water conservancy and hydro-power projects and to simulate the phenomenon in the project, such as the performance of water conservancy and hydro-power projects. Hub layout, structure of main buildings, dam flood discharge, rubber dam dam overflow, sluice dispatching process, ship lock crossing process, etc. In the water conservancy and hydro-power project, computer multimedia technology has been widely used from the general design proposal to the entire pivot project demonstration system. This paper mainly introduces the design and development of the multimedia demonstration system for water conservancy and hydro-power projects.

### 3.2 3D modeling design

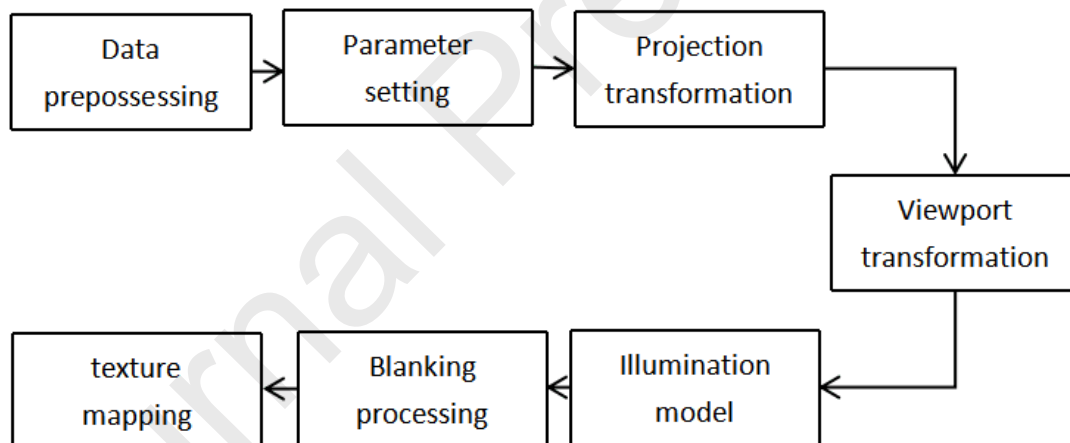


Figure 1 3D modeling process

The three-digit modeling step is shown in Figure 1:

(1) Data preprocessing: A. Convert the geometric model data of the object obtained after modeling into a form of basic graphics that can be directly received, such as: point, line, (triangle) surface, etc.; B, for image data, such as : Texture image preprocessing, including image format conversion, image quality improvement, and image pyramid generation.

(2) Parameter setting: Before rendering the 3D scene, you need to set the parameters of the scene parameters of the line, including the nature of the light source (mirror, diffuse and ambient light), the orientation of the light source (distance and direction), sensitive processing (smooth or Plane processing) and texture mapping methods. In addition, you need to set parameters such as the viewpoint position and the direction of realization (by specifying the viewpoint).

(3) Projection transformation: After determining the relative position between the observer



and the object, it is also determined how the object is projected onto the screen. Projection transformation - generally divided into two types: perspective projection transformation and ortho projection transformation. Orthogonal projection directly projects the object onto the screen without changing its relative size. The true size of the reaction object is mainly used for engineering drawings. The perspective projection obeys the projection rules of the object near and far, similar to the visual effect of photography or human. There is a strong stereoscopic effect, so the perspective projection transformation is usually used when creating a 3D scene.

(4) Viewport transformation: The light and dark values of the visible bina 2D image can be obtained by the illumination model calculation, thereby displaying the shaded rendering of the model. The illumination model should consider the effects of floodlights caused by the integration of environmentally distributed light sources, diffuse reflections that are attracted and re-emitted through the surface of the object, and specular reflections (highlights) produced by the surface finish of the object, ultimately in different colors (256 And its different brightness (16 levels) represent the surface illumination characteristics of different elements.

(5) Blanking processing: In order to improve the realism of the graphics and eliminate ambiguity, the hidden parts of the entities should be eliminated in the real process. This processing is called blanking. The algorithms represented are painter algorithm, depth buffer algorithm and ray tracing algorithm.

(6) Texture mapping: In order to increase the fidelity and reality of the model, textures can be added to the grayscale image of the 3D model to make it a 3D model with texture mapping. At present, there are mainly two methods of extracting texture from image map and calculating texture according to a certain formula to add texture mapping to the model.

## **4、 Discussion**

### **4.1 Terrain, geological construction of 3D CAD/CAE integrated analysis technology**

The terrain and geological model of 3D CAD/CAE integrated analysis meets the basic features of the actual terrain, geomorphology and geological structure of the express hub area, and some idealized treatments for post-CAE analysis. At this stage, although the professional 3D geological system in the hydro-power industry can fully meet the needs of geological engineer design, it also has certain weaknesses in the service of structural engineers. This paper proposes a convenient 3D geological structure theory based on the Civil 3D platform. The established 3D geological model can not only ensure the basic consideration of the relevant geological constraints of the hub layout, but also can be directly input into the large CAE analysis for CAD/CAE integrated analysis. . Figure 2 and Figure 3 show the three-dimensional topographic and geological model diagrams of the hydro-power station pivot project for CAD/CAE integration analysis.

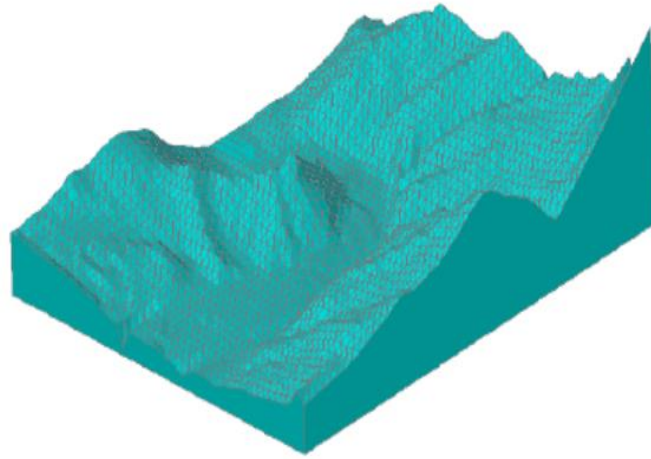


Figure 2: Three-dimensional topographic map of hydro-power station pivot project

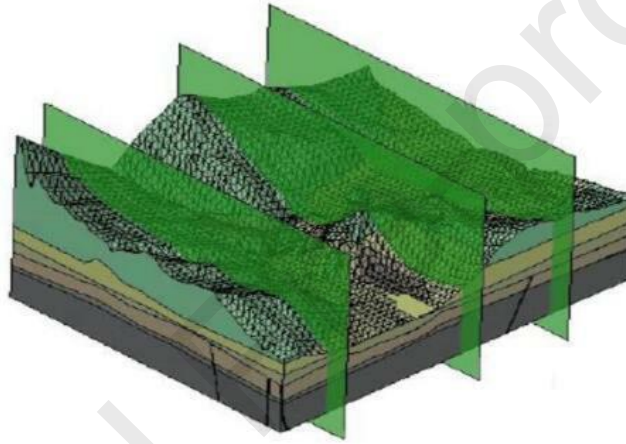


Figure 3 Hydrogeological power station pivot engineering geological model

#### 4.2 three-dimensional excavation plan

In the three-dimensional excavation design, a positive wedge shape (cut square body) and an inverted wedge shape (filled square body) are often used as excavation entities. There are two main ways to generate excavation entities: (1) using a three-dimensional design platform to close the excavation slope, slope or horse track, and assign spatial attributes, use the lofting function to generate three-dimensional wedge-shaped entities; 2 draw the designed excavation center line And set different elevations in turn, which is converted into a three-dimensional polyline, and the excavation entity is generated by stretching along the path. By using the above two excavation entities and three-dimensional solid terrain and geological models for Boolean operations, three-dimensional excavation and filling design can be completed, and three-dimensional excavation boundaries can be established. However, for the core wall dam, since the part of the core wall is bounded by the relatively impervious layer during excavation, after the above excavation is completed, the boundary of the relatively impervious layer in the three-dimensional geological model must be used to face the wall under the core. The excess body in the range is re-excavated to complete the three-dimensional excavation and filling design of the dam. Figure 4 shows a three-dimensional excavation diagram of the hub project. Since the road excavation body is small compared with the excavation body of other parts, the excavation body is not shown in the

figure.

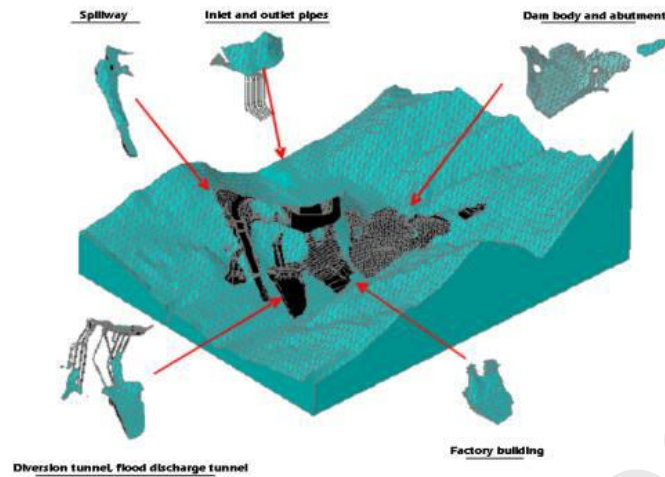


Figure 4 Schematic diagram of three-dimensional excavation of hydro-power project  
4.3 3D rendering output and roaming production

After completing the layout of the hub, combined with the theory of visual simulation technology under the three-dimensional design, based on the layout of the three-dimensional model of the hub, the corresponding lighting, material, baking and other processing, and set buttons, cameras and add information and corresponding roaming path to the corresponding model, that is, Output 3D renderings and roaming animations. The use of three-dimensional design techniques in the layout of hub projects is not just a three-dimensional representation and three-dimensional visualization of a simple design. The 3D effect is displayed only to better express the 3D design results. Figure 5 shows the three-dimensional effect of the hub layout and the roaming animation.



Figure 5: Hub 3D effect and roaming animation

#### 4.4 Model error analysis

In this paper, one node is selected for analysis, which is numbered from No. 1 to No. 4. The error of the model at 4 nodes is shown in the table below. The error at node 1 is 1.91%, the error at node 2 is 1.22%, the error at node 3 is 1.56%, and the error at node 1 is 1.11%.

Table 1 model error table

Analysis node	No.1	No.2	No.3	No.4

error	1.91%	1.22%	1.56%	1.11%
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## 5、 Conclusions

(1) The overall process of the three-dimensional design of the hub project is proposed, and the key technical problems of the three-dimensional design technology in the deterministic hub layout scheme are analyzed, and the corresponding solutions are proposed: the information hub project design is proposed. And management concept; created a 3D geological model construction method suitable for hub layout and CAD/CAE integrated analysis; studied the excavation Boolean operation, collision detection, engineering drawing rapid customization, CAD/CAM integration, visualization, etc. The core theory of the three-dimensional layout of the hub. Based on the above work, a set of methods for the three-dimensional design of the power plant hub layout was created.

(2) Based on its power station pivot project, the three-dimensional design method of the newly established hub layout scheme was verified, and the three-dimensional geological model creation, three-dimensional excavation design and engineering quantity statistics of the hub project applied to CAD/CAE integration were completed. The three-dimensional configuration of the typical building of the hub, the layout of the hub, the rapid customization of the three-dimensional engineering drawings, the three-dimensional steel bar layout, the renderings based on the three-dimensional design and the roaming animation production, etc., initially realized the three-dimensional design of the pivot project, and proved that the method of creation was feasible.

(3) The technical problems of CAD/CAE integrated analysis technology in the layout of the hub are put forward, and the solution is given. The development of CAD/CAE integrated composite data interface is completed. On this basis, CAD/CAE integration is expounded. The design under the analysis analyzes the fast feedback mechanism.

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Journal Pre-proofs

contribution

- 1) In the water conservancy and hydro-power project, computer multimedia technology has been widely used from the general design proposal to the entire pivot project demonstration system.
- 2) This paper introduces the design and development of the multimedia demonstration system for water conservancy and hydro-power projects.

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