Application of Visual Simulation Technology Based on the Virtools Method in Equipment Virtual Maintenance

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Abstract: In this paper, 3dsmax is used to build three-dimensional model of scene and virtual equipment. Virtools is used to edit various maintenance scenes and build a virtual maintenance system consistent with the actual environment. According to the operator's action instructions, the system shows the real-time human-computer interaction process, the state change of the model, the scene response process after the operation, which makes the virtual environment and the real installation operation consistent, and realizes the virtual maintenance training of the equipment. The virtual maintenance training system can be applied to the maintenance training in Colleges and universities, so as to reduce the loss of real equipment and improve the efficiency of equipment use.

1. Introduction

With the coming of information war, all kinds of high-tech weapons and equipment have been put into use, but at the same time, it also brings a series of new problems, such as high-tech weapons and equipment are expensive, maintenance is not easy to carry out, maintenance training will cause damage to weapons and equipment at ordinary times. In view of this kind of problem, the importance of virtual maintenance is increasingly prominent. In order to achieve the purpose of virtual maintenance, visual simulation is an important part.

In this paper, a new type of equipment is taken as the research object, and the 3D scene modeling and visual simulation driving are systematically studied. The system mainly realizes the virtual representation of the real maintenance environment and the visual description of each maintenance process. According to the characteristics of the system, this paper analyzes the system, studies the technical route that should be adopted in the system development, and constructs the overall framework of the system. In the process of program debugging and application, the system runs smoothly, the simulation effect is real, smooth and high fidelity, which can replace the real equipment for training.
2. A New Equipment Virtual Maintenance Training System

2.1. System Hardware Composition
There are many models of a new equipment system. It needs a lot of system resources to be able to display and generate scenes in real time and respond to human-computer interaction instructions in real time. At the same time of real-time display, many key technologies need to be solved, which need a lot of calculation. At the same time, in order to obtain good real-time and fidelity, there are also higher requirements for the graphics card. Considering the generality of the software system and the trend of the rapid growth of the performance of the microcomputer, the high-grade microcomputer with the high-efficiency graphics acceleration card is selected.

2.2. System Software Composition
The function of the system software mainly includes five parts: "training equipment", "training content", "system setting", "online communication" and "exit", which are used to realize the theoretical learning and real-time communication of the operator and improve the actual operation ability.

2.3. Research Ideas
According to the dimension of real equipment and the environment of inspection and maintenance, the 3D structure model of high-resolution equipment components is established by 3dsmax software. Based on the illumination, material mapping, animation processing and camera adding of the model, the Virtools graphics engine is used to drive the digital model. At the same time, factors such as strength attribute, prompt function and other auxiliary maintenance are added, which makes the whole scene delicate and lifelike, with strong operability, and can meet the maintenance training of various maintenance level personnel.

3. Analysis and Establishment of Visual Simulation Model

3.1. Visual simulation model
The visual simulation model mainly includes three-dimensional model of virtual scene and three-dimensional model of virtual equipment.

Most of the training scenes are static entities, whose behaviors are deterministic and their states do not change. But there are also some passive entities whose state changes with time, such as the movement of vehicles, the flutter of clouds, the rotation of clock pointer, etc.

In order to create an environment for users to feel immersive and immersed in, virtual reality system must be able to display all objects in the objective world realistically according to needs. It is not only required that the object model displayed be similar to the real object in appearance, but also required that they be very lifelike in shape, light, texture and other aspects.

3.2. Characteristics of the model
The modeling includes geometric feature modeling, interactive feature modeling and behavior feature modeling.

The establishment of 3D geometric model requires accurate mapping of the shape of each component to make its geometric dimensions consistent with the real equipment.

3.3. Establishment of realistic model
The visual model should not only reflect the three-dimensional geometric characteristics, interactive characteristics and behavior characteristics of the virtual entity, but also show some of its physical attributes, such as material, texture, six degree of freedom, so as to build a realistic three-dimensional entity model.
3.3.1. Setting material properties. All objects in the real world are made of materials with specific texture. Similarly, in 3dsmax, these phenomena in the real world can be simulated by assigning corresponding materials to model objects. For example, in the laboratory table, the selected material has the characteristics of wood.

3.3.2. Use of texture. A large number of textures are used in the virtual model to increase the realism. Texture refers to the two-dimensional images mapped to the surface of the three-dimensional model. Using texture mapping technology can more accurately reflect the actual structure of the scene, and can increase the level of detail and the reality of the scene. At the same time, the use of texture can greatly reduce the number of polygons in the environment model and improve the refresh rate of graphics display. Is the model display effect after texture mapping.

3.3.3. Application of light effect. The model with material and map can show good luster and effect only under proper illumination. Therefore, several lights can be placed in the three-dimensional scene to make the scene have a real lighting effect. In the future calls to Virtools, the parts that need to be called have been given the lighting effect.

3.3.4. Camera setting and animation production. The application of camera effect can show the three-dimensional effect of each part well. 3D animation is an important part of the whole system. Through 3D animation, the usability and operability of the system can be greatly improved. The system reflects the dynamic characteristics in real time through three-dimensional animation.

3dsmax has strong animation function. In the scene implementation of the system, after the animation is made, the switch is set in the scene. When the switch is touched, the AVI file generated by 3D animation will be called.

4. The Scene Generation

4.1. System workflow

There are two main steps to generate the scene Firstly, 3D models and maintenance scenes built by 3dsmax are saved to a format recognized by Virtools through plug-ins. Then, Virtools software and VC software platform are used to render and drive the system to achieve maintenance scenes. The workflow is shown in Figure 1.
4.2. Build virtual environment with Virtools
Virtools is a powerful technology software for 3D interactive display. It realizes 3D virtual scene with deep immersion sense through perfect organization modules, such as: creating application program, action engine, personalized rendering engine, web player, software development kit, etc., so that participants can get the feeling of immersive experience. Figure 4 shows the setup of some scripts in the system. Through the setting of these scripts, the functions of the whole system can be realized.

In function, the system mainly realizes theoretical learning, structural learning, common troubleshooting and maintenance process of a new type of equipment. The menu bar contains five buttons: "training equipment", "training content", "system settings", "online communication" and "exit". There is a one-to-one correspondence between the names of training equipment and training content. The names of training equipment and training content are stored in the system database, and a constraint relationship is established. When a training subject is selected, only the names of training content belonging to the target component will be displayed, which is also conducive to the modification and update of training equipment and training content. "System settings" mainly realizes password modification. "Online communication" is used for students' random questions. It is a way of communication and is realized by using TCP/IP network protocol.

3D display window is the core part of the system, which is used for human-computer interaction.

4.3. Improvement and use of tool library
In order to repair the target parts and connect with other systems in the future, a relatively complete tool library is set up for use. Figure 6 shows some tools in the system tool library because there are many tools, it is impossible to display them all, so some tools are intercepted for explanation.

4.4. Setting of other functions
In the interactive simulation design of virtual maintenance training system of a new equipment system, mouse and keyboard are used to operate the model. For example, use the mouse to select components and menus. The user uses the assembly sequence determined previously, which is the sequence
expressed by the menu, to carry out accurate assembly. At this time, if the user does not determine the assembly sequence and assembly path according to the order of the menu, the system will generate an error warning and prompt the correct assembly content.

In this system, the strength attribute is added to make the user have an intuitive understanding of the force needed to dismantle each component. In this system, the right mouse button is used to select the target part and add the strength attribute.

5. Conclusion
Through simulating the maintenance process of the system, the virtual maintenance visual simulation of a new type of equipment realizes the maintenance reproduction of the system under the virtual condition. The whole visual simulation process has a high fidelity, which can display the whole system in a three-dimensional manner in an all-round way, respond to the operation process in real time, reproduce the whole maintenance process in a very real way, solve the problem that it is difficult to carry out maintenance training by using real equipment, effectively shorten the training time, save training funds, and improve the maintenance level of students.

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