SKILL TESTING SYSTEM DESIGN FOR SALTER BASED ON VIRTUAL REALITY

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Abstract: A new skill system based on the virtual reality technology was designed and applied. According to the skill testing for salter, the design project and main implementation method of the system were explained in detail.

Key words: Testing system, Vocational skill, Virtual reality

INTRODUCTION

As an integrated technology of computer graphiics, multimedia technology, artificial intelligence, human-machine interface technology, sensor technology, high-parallel real-time computing technology, human behavior research, etc. Virtual Reality (VR) has been developed since the 1990's. The characteristics of VR technology is about a three dimensional space virtual environment structured by computer, or a vivid virtual scene designed by computer according to realistic environment, so it can bring about multisensory feeling to users. In recent years, VR technology has been widely used in the fields of real estate, military affairs, medical treatment, design, education, and so on, and it has brought in great benefit.

There are many technology types of work in salt industry, and every type of work has its own special requirements and specific vocational skills. In the traditional skills appraisement system, the methods of examination in room and skilful operation in the actual locale to appraise salters' theoretical knowledge and operation skills were adopted respectively. However, there are many drawbacks in this system. For example, it not only wastes time and work, but also is limited by site, climate and other conditions, and it is disadvantageous to unify vocational skills appraise and gain authoritative identification conclusion for all workers in the whole industry.

In this work, a new system of vocational skill appraisement based on VR was designed and applied to the field of salters. Virtual reality modeling language (VRML) was used to build up a three dimensional virtual environment of salt works, and the salter can complete the same operation on the computer as on the actual locale of the product line of salt works, the scores can be given by the

computer automatically in accordance with the operation. In this way, the appraisement of theory and operation can be integrated better, and it is no longer limited by the site and climate of the salt works, but also the network characteristics of VRML can be applied, and the system can be pulished on the Internet, which is convenient for all salters throughout the country to carry out the unified authority appraisement.

SYSTERM DESIGN

Function design

The system functions were shown in Figure 1.

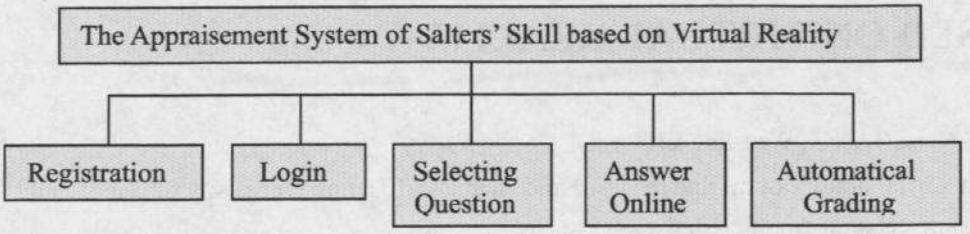

Fig.1 The system functions structure

(1) Registration Function. To carry out the skill appraisement, examinees of the salters must register at first. Personal information, type of work and skill level were required to provide during the registering so as to the system would be able to select appropriate test questions at random for the examinees.

(2) Login Function. The appraisement system provides a safe mechanism to confirm the identity of examinees, and only the registered examinees can enter the system to participate in appraisement by right of the registered identity.

(3) Functions of selecting questions. In light of the information registered by examinees, the system can select different questions at random for different examinees who take different types examination at different level. The examination questions include theory part and operation part, and this paper mainly focused on the operation part.

(4) Answer Online Function. This is the core of the system. A virtual three-dimensional operation scene built by VRML was used as an examination platform. According to the requirements of various questions, examinees use the mouse to operate virtual devices in the scene directly. The embedded Java Applet program will make different response according to the different operations of examinee in the virtual scene, and give a operation score.

(5) Automatically Grading Function. The examination result of every question will be recorded in the information database of examinees, and a total operation score will be calculated.

Database design

The system database manages the examination information of examinees and questions. When an examinee enters the system, the system can select questions randomly according to the type of work and skill level after the recognition of the information registered by the examinee. The main entity-relation (E-R) chart of the database is shown in Figure 2.

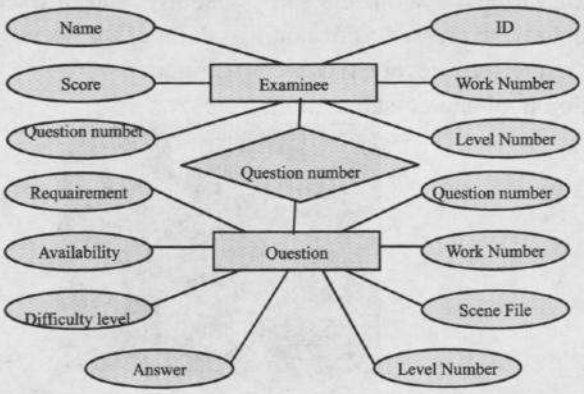

Fig.2 E-R chart

IMPLEMENTATION OF VIRTUAL SCENE

The scene of salt works is huge and complex. In order to simulate factually the proportion relation of the various parts of salt works, and shield off the difference of the actual terrain and hypsography, the system used an ideal salt works which is over ten thousands units of area as a template, and different scale model of virtual scene for salt works according to the whole classification and detail choice principles was built up.

Scene classification principles

The virtual salt works is outdoor and open, and its component parts are similar. In view of these characteristics, the scenes are divided into four levels according to the overlooking distance. The first level is the whole scene from the seaside tide station to the salt aheap. It mainly shows the whole structure of the salt works. The second level is the scene of the central evaporation area or the crystallization area. It shows the structure of each area and the process of evaporation or crystallization. The third level is the scene of a evaporation area, a crystallization unit or a adjustment unit. It mainly gives the operation process and method in a unit, the relationship among the pools and the collaborative work of the sluice gates. The fourth level is the elaborate three-dimensional scene which shows the detail information of a single evaporation pool or crystallization pool. At the same time, it also provides scenes for the realization of complex interactive control operations. The organizational structure of the scenes is shown in Figure 3.

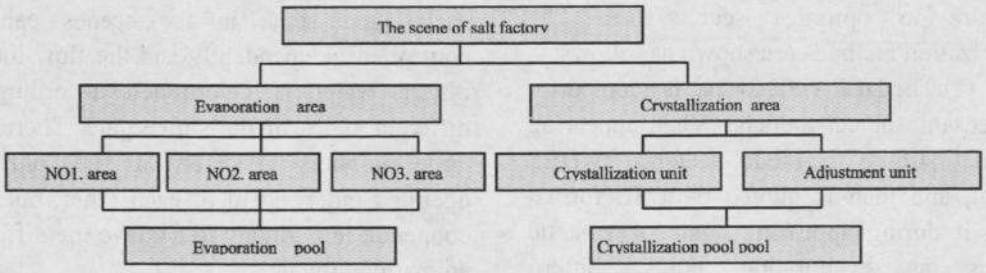

Fig.3 organizational structure of the scenes

Detail choice principle

The virtual scenes includes distant scene which shows mainly contours and boundaries and is build with rough three-dimensional graphics and close scene which shows mainly visual and living details and can be

constructed by the specialized modeling tool. The scenes at front three levels show the location relations of various areas in the salt works. So they should be expressed as distant scene. The scenes at the forth level show the details of evaporation pool and crystallization pool. In order to achieve real effects, they are expressed as close scene and must be built subtly and affixed corresponding material. Parts of the scenes are shown in Figure 4 and Figure 5.

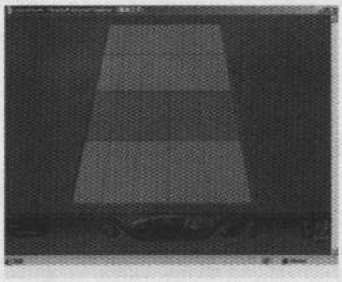

Fig. 4 Evaporation area scene

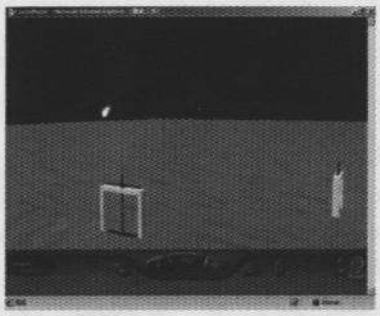

Fig.5 Evaporation pool scene

Scene building

VRML is the same ASCII description language as HTML, so it is hard to use VRML to build three-dimensional virtual scene.The powerful 3DMaxs software can be adopted to build three-dimensional model which is educed to VRML scene files (*. wrl). The scene files built by 3DMaxs have a large numbers of redundancies, and it is disadvantageous to transmit large file by networks, so that the paper introduces VRMLPad which is professional editor software to optimize scene files. The optimization methods are shown as follows:

(1) The DEF-USE format is adopted for the reusable object models. When appearing for the first time, the model is named by DEF format, and then is quoted by USE format when it during appearing again. The static objects as evaporation pools, bittern transportation ditchs do not engage interactive control and action, and are often used repeatedly, so they should be built with the DEF-USE format. Finally, the numbers of polygon drawn in the scene are reduced greatly, and the building of scenes are sped up.

(2) Proto statement was used to define a prototype. A certain object is firstly defined as a prototype and then instantiated by specifying its attributes, which is a concrete realization form of the subject modeling. For example, various gates in the system is the key to interactive control, and each has its own switch logic, so the sluice gate is firstly defined a prototype that includs its events and dynamic effects of opening and closeing, then is instantiated to different objects. In this way, each sluice gate in the scenes can be controlled independently and the flow line of bittern water is determined according to different states of the sluice gate. Therefor , large numbers of gates can not only be operated independent of each other, but also cooperate in harmony to achieve the different animation effects.

(3)Simple nodes are used to build scene model. Some simple nodes used could save time of the datas transmitted. And they were also optimized and dealed with in a certain degree by many browsers. In addition, there are some trouble when complex models

obtained through Boolean operation are amended and affixed the texture picture to. Therefor, the complex model should be composed of simple nodes.

(4)Compress file for the faster transmission. The texture data may be stored with the format of JPEG or PNG. The VRML files such as ASCII can be compressed by winzip or winrar tool, then be renamed the file extension name to *. WRL, and finally be uploaded to the homepage to browse direct. In this way, the network transmission speed will be speeded up greatly.

IMPLEMENTATION OF CONTROL

Implementation of dynamic interactive control function

The interactive control of the system was very complicated. For example, a certain operation usually related to many sluice gates, and different animation process were carried out in accordance with different states of these sluice gates, In this way, the opration process and and animation process couldn't be confirmed by the predefined model. For the advanced external program can respond user's different operations, the External Authoring Interface (EAI) model can be used to control scene. EAI is a advanced class package of Java which is put forward by SGI company to strengthen communicate and inosculation of VRML scene and external environment.It allows Java Applet program to access and control nodes in VRML scenes .Through the external process, users may participate in the building of virtual scenes to change the performance form of objects, to design animation and define the way of behavior of every role for scenes. Sequentially, the more senior and more complicated interactive control can be realized.

In order to control every sluice gate, the sequential naming method was adopted to name them and the two-dimensional array was used to store these names during writing Applet program. Thereinto, the first dimension expressed the number of pools or ditchs, and the second dimension expressed the number of sluice gates. At the same time, every sluice gate must has a trigger which was registered an event listener. When any trigger was touched off, the method callback () was called automatically to dealing with the corresponding event. The data parameter of the method denoted a triggered object. Judging from the data parameter, the touched sluice gates was confirmed. And in the basis of the state that is open or close, the system judged what users have done and gave the corresponding animation process. When controlling scenes, the EAI method can't institute the action path of the scene, so the Java thread was used to achieve the dynamic effects of the animation.

Embedment of virtual scene and control program

After selected operation questions, the corresponding scene files, control files and question description were taken out from the system database in accordance with the selected question number. Then the three parts were added dynamically to show page of the questions. The question requirements were stored as the text and shown direct. The scene files and control files were stored by their file names, so they were embedded in the page by using <embed>. The embedded mode is as follows:

(1) Embedding VRML file

<embed src= <%=testBean. getVRML () %> height="300" width="300"

Pluginspage= http://www.parallelgraphics.com/cortona vrml_dashboard = "false">

(2)Embedding Applet file

<applet> code=<% = testBean. getApplet() %> width= "300" height= "200" </applet>

TestBean was a JavaBean which is used to select questions. By called its methods getVRML () and getApplet (), the operation scene files and interaction control files in questions were obtained respectively. The pluginspage parameter provides the URL of a web site where the VRML plug-in can be downloaded automatically for the browsers without the plug-in. The display page of the test question is shown in Figure 6.

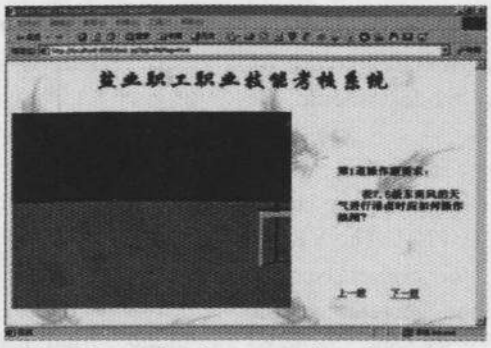

Fig.6 Examination questions interface

CONCLUSION

The vocational skill appraisement system based on VR alters completely the traditional appraisement model. The vocational skills level of the salters can be appraised more accurately and scientifically in virtual operation environment. Combining with the training system based on VR, the vocational skill of any salter who is any tpye of work at any level can be trained and appraised anytime and anywhere. In this way, the training costs will be reduced , the training effects will be improved , the appraisement will be intensified, and more professional and technical personnel who is high-level and high-quality will be brought up for the salt industry.

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