Virtual Reality Simulation of Equipment Training Based on Unity3D

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Abstract. All along, the combination of virtual and real equipment training is an effective means, which can improve training efficiency and solve training contradictions. In this paper, the equipment training virtual reality system is designed by using Unity3D virtual reality design software. This provides an effective solution for equipment training. This paper mainly studies and discusses the structure, key technologies and implementation methods of virtual system.

1. Introduction

With the changing demands of modern warfare and the rapid development of military technology, our army's new weapons and equipment emerge in an endless stream. Its complexity and scientific and technological content are getting higher and higher, the renewal speed is getting faster and faster, the price is expensive, and the number of actual equipment is less. If the actual equipment is used for training, it will be limited by the site, the number of equipment, complex structure, operating frequency, and safety of use. The traditional video learning can only be simulated but not displayed. It can not complete the interaction between students and equipment, and can not meet the needs of the new situation. There are still some problems in traditional equipment skill training, such as difficult to achieve individualized teaching, lack of attractiveness of training methods, high cost of training funds and poor quality of training.

The emergence of virtual reality (VR) technology provides a new way for equipment skills training, which enables trainees to learn and simulate vocational skills in virtual assembly scene. The purpose of this paper is to design and develop a virtual platform for training personnel to improve equipment training based on virtual reality technology.

Firstly, the teaching design of equipment training system is completed based on the analysis of relevant theoretical basis. Secondly, according to the design principle of virtual training system, the elements of equipment training system are designed. Thirdly, according to the analysis of theory and design of teaching system, the design of system function and frame mode is completed.

The application of virtual reality technology to our army equipment and the development of virtual training system are of great significance to the maintenance and support of our army equipment. It is an important guarantee for training qualified maintenance personnel. It effectively solves the problems of complex equipment structure, high price, limitation of site, quantity, model and low training efficiency in equipment training. Therefore, this paper designs a simulation maintenance system for a certain type of equipment, which provides an effective solution for equipment maintenance training[1-5].
2. Overall Structure Design of Virtual Reality System

According to the analysis of system functional requirements and the selected implementation mode, the simulation maintenance training system consists of five parts: virtual assembly, virtual service, virtual demonstration, virtual maintenance and equipment display. The software design of the system is as follows:

This system uses Solidworks 2016 as the platform of system three-dimensional modeling development, 3dsmax 2016 as the tool of model rendering and animation generation, Access 2012 as the system database to store parts library, parts library, special tool library, testing tool library and some service flow samples.

Virtual maintenance simulation is an omni-directional simulation in virtual environment, which is closely around the theme of equipment training and runs through the whole life cycle of products. Virtual simulation technology of equipment training includes virtual display, virtual assembly, virtual control and so on. Virtual training simulation completes a series of action simulation according to the predetermined training process, including the simulation of virtual prototype behavior, interaction between virtual tools and virtual prototypes, etc. According to the configuration of virtual training simulation environment, it can be divided into immersion virtual training simulation technology and non-immersion training simulation technology. In this paper, the non-immersive simulation technology is studied by using Unity3D software combined with the built three-dimensional maintenance model.

There are many parts in the equipment model itself. Generally, it belongs to large assemblies. The three-dimensional modeling technology provided by Solidworks software has a good effect in dealing with large assemblies. The authenticity of the virtual training scene directly determines the high fidelity of the virtual training space environment and the immersion of the trainees. However, the construction of relevant three-dimensional models in system scenes is one of the key factors affecting the authenticity of virtual training scenes. When creating the virtual training environment space for equipment, 3ds Max is used to render the three-dimensional model established by Solidworks, and Photoshop image software is used to construct and optimize the relevant interface and button control, in order to achieve the accuracy of the equipment mechanism model. Finally, the produced three-dimensional model is exported to a format file compatible with Unity 3D. FBX, which is used to implement the follow-up interactive functions of equipment virtual training system[6-13].

![Figure 1. Equipment Model Construction](image1)

![Figure 2. Three-dimensional graphics rendering of equipment](image2)
3. Virtual Training Simulation Technology Based on Unity 5.0

The system simulates the real operating environment as much as possible. And can carry out virtual service training for equipment. The service training of equipment is divided into maintenance and maintenance, which are implemented based on the structure principle and disassembly steps of equipment. In order to achieve the combination of virtual and real, while constructing the training system, in order to deepen the impression of operators during training, the actual equipment operation video shooting was made for the difficult operation steps, and the video stream was inserted into the training system. After analyzing the fault, the demonstration video is played to deepen the operator's impression and improve the training quality. Video stream acquisition, source and scoring criteria.

The system adopts the gradual start mode, and its C# code is shown in Figure 3.

```
using System.Collections;
using System.Collections.Generic;
using UnityEngine;

public class MovieCamera : MonoBehaviour
{
    public float speed = 30;
    private float endZ = 100;

    void Start()
    {
    }

    void Update()
    {
        if (transform.position.z < endZ)
        {
            transform.Translate(Vector3.forward *
            speed * Time.deltaTime);
        }
    }
}
```

**Figure 3. System Entry Code**

4. Virtual Exhibition

The structural principle of equipment is the basis of equipment support. Before the maintenance of complex equipment, maintenance personnel must master the structure principle of equipment skillfully, and equipment is often closed three-dimensional, its internal structure is often difficult to understand in actual equipment, virtual display can solve this contradiction well. It provides a very ideal observation platform for maintenance personnel by changing the observation position, transparency of shell, or component observation. It can effectively help maintenance personnel understand the connection relationship of complex equipment structure. In the process of virtual display, firstly, the model is imported into Unity3D, and the basic parameters of lighting and camera are set. Then, through the VC function programming, the virtual simulation of the actual maintenance process is carried out according to the maintenance process, which achieves a better design effect. The virtual display module of the system is shown in Figure 2.

After the model is imported into the maintenance scene, in order to form a realistic maintenance environment, it is necessary to set the elements of Light (light), Character (virtual role) and Frame (frame); adjust the type, illumination range and illumination intensity of Light to create a real maintenance environment; set the 3D Frame to mark the specific orientation as the reference point and coordinate point for maintenance; and set the Haracte as the reference point for maintenance. The position, size and direction of R are adjusted to create a more realistic maintenance form.

In the design of interactive maintenance, on the one hand, it is necessary to simulate the real maintenance steps and maintenance methods, on the other hand, it is necessary to simplify the process of real maintenance and realize the purpose of familiarizing users with maintenance operations. The
realization of interactive maintenance process is mainly realized by calling scripts: firstly, the scripts of specified objects are created; secondly, the scripts are programmed according to specified actions. For some complex and special operations, they can be programmed by calling the VC function scripting language of Unity3D, as shown in Fig 4.

![Figure 4. Equipment Virtual Display](image)

5. Virtual Assembly

Virtual assembly is to simulate the three-dimensional assembly process of products according to the shape and accuracy characteristics of product design, and allow users to control the three-dimensional real assembly process of products in an interactive way to verify the assemblability of products. This definition focuses on the simulation process of physical assembly process of products, and embodies the idea of an analysis process.

The three-dimensional model is the basis of the whole virtual assembly, and its quality directly affects the authenticity of the virtual environment. Because Unity3D has no modeling function, it is necessary to use modeling software to build three-dimensional entity first. However, because this paper is a mechanical product model, we first use the professional mechanical three-dimensional drawing software Solidworks to model, then import the built model into 3dsmax, and then export it from 3dsmax to Unity3D. Preliminary analysis should be carried out before the model is established. Complex mechanical products should be decomposed into several simple parts, and then the three-dimensional modeling of each component should be carried out. After the model is built and successfully imported into 3dsmax, the work is to give the model material and mapping, so as to increase the reality of the model, reduce unnecessary polygons, and improve the refresh rate of the display.

The key technology of virtual assembly is the discrimination of part collision and assembly distance. They can be realized by using BOX and VC script provided by Unity3D for special collision. As shown in Fig 5.
6. Conclusion

Compared with traditional training, virtual training has considerable advantages in improving training flexibility, breaking through training conditions and reducing equipment maintenance costs. Unity3D software is powerful and easy to operate. It is very suitable for the development of similar systems. Especially in view of the current situation of more new equipment, relatively expensive price and complex operation procedures in our army, virtual simulation training can be used to improve training quality and training environment. In training, more realistic and practical virtual training can be developed according to different contents. System.

At present, there are some problems in equipment skill training in our country, such as time-consuming, laborious, inadequate training and unsatisfactory training results. In recent years, with the development of virtual reality technology and education technology, the application of virtual reality technology to equipment skills training is a positive practice to adapt to the development of the times. By analyzing and summarizing the theoretical basis of the equipment virtual training system, this paper completes the teaching design of the equipment virtual training system, and designs the system elements, system functions and framework mode according to the design principles of the virtual training system. Finally, taking the assembly of equipment automata as an example, the case design, development, application and evaluation of vehicle assembly virtual training system are carried out based on 3DS Max and Unity 3D development tools.

In view of the extensive application of virtual training in practical training, this system mainly considers that the value of simulation equipment can not be too high, and the cost of simulation equipment can be reduced as much as possible when meeting the requirements of training effect. At the same time, the system requirements are analyzed from functional completeness, system availability and system reliability. The system composition and structure framework are given. This method provides a new way to realize virtual maintenance training system, and has important reference value for popularization of large equipment virtual training system and modernization of equipment maintenance training in China.
7. References

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