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Research on the Logistics Equipment Training Simulation System Based on Virtual Reality Technology

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***Abstract*—Logistics equipment training is an important means to improve the logistics business level. The traditional training method has high training cost, high equipment loss and is vulnerable to the external environment. Using virtual reality technology to establish a realistic training simulation environment to simulate the simulation training, not only can reduce the training cost, but also improve the training efficiency. The article clarifies the system design requirements, designs the system framework, introduces the key technologies used, and provides a feasible method for logistics simulation training.**

Keywords—virtual reality; logistics equipment; training simulation; modeling

I. INTRODUCTION

Logistics equipment training is an important part of improving logistics business training, and it is the basic guarantee for improving the effectiveness of security. The user's ability to operate logistics equipment correctly and skillfully is a necessary condition for ensuring the wartime support capability of the troops and improving the combat effectiveness of the troops. Improving the operational skills of logistics equipment requires a lot of training and improving operational skills. However, most of the logistics equipment contains many kinds of technical equipment, high application technology level, strong technical use and maintenance, and mostly large-scale vehicle equipment. There are many problems in using traditional installation training: logistics equipment is complex in structure and high in training and maintenance. The number of colleges and universities is insufficient, and it is difficult to guarantee sufficient training time; due to environmental constraints, some trainings cannot be exercised [1]. Therefore, it is necessary to use virtual reality technology to simulate the logistics equipment, and through the simulation training, the trainees can master the operation process and maintenance method of the logistics equipment.

II. SYSTEM DESIGN REQUIREMENTS

Any training simulation system is a simplification of the training of the installation. In order to ensure the training effect, certain requirements must be met in the simplification process, so that the simulation training can preserve the fidelity required by the training. The following requirements should be met in the design of the logistics equipment training simulation system [3]:

The first is to ensure that the physical model of the logistics equipment in the training simulation system is highly similar to the real geometric features of the real equipment. The fidelity of the geometric model of the equipment is the basis of the good simulation training effect. Only by ensuring the high similarity between the geometric model and the real equipment, can create a highly immersive virtual environment and make the trainees “immersive”.

The second is that the physical model of the logistics equipment can be decomposed. Since there are multiple operational steps in completing a specific training course of the logistics equipment, in the actual operation process, the equipment involved is refined and decomposed. For example, when modeling an accident trailer, it is necessary to separately establish a solid model of the inner pot, the outer pot, the lid, the safety valve, etc., instead of establishing these as a whole as a solid model.

Third, the logistics equipment entity model can show behaviors consistent with real equipment. In the simulation training process, the physical model of the equipment is not static, but should show the corresponding state changes as the training progresses, otherwise the training effect will be greatly reduced. Therefore, the real behavior of the solid model needs to be described in detail in the training simulation system to enhance the fidelity of the system.

Fourth, after the training is completed, the results can be evaluated. Simulated training is different from real training. It has no real results to check. Therefore, it is necessary to set a scorer for each step in each training course, and score each operation step according to the specific operation of each step in the virtual operation process. Achieve an assessment of virtual training.

III. SYSTEM FRAME DESIGN

According to the system requirements, this paper designs the framework of the logistics equipment training simulation system, which can be divided into three parts: one is the foundation layer, which is mainly responsible for the management and maintenance of the system basic data; the other is the model layer, responsible for the construction of logistics equipment. The third is the display layer, which is an overall display of the virtual training scene after integrating the simulated training data and the environment-determined information. The system design is shown in Figure I.

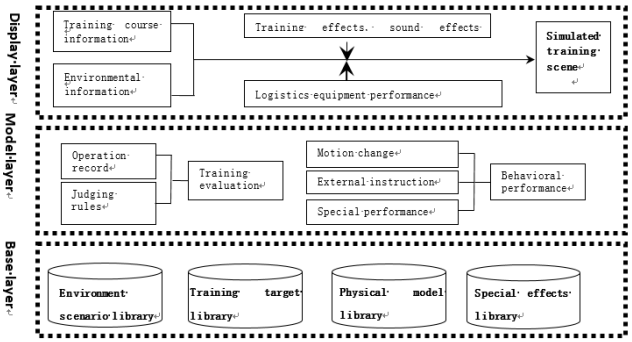

FIGURE I. SYSTEM ARCHITECTURE

The base layer is composed of the environment base library, training target library, entity model library and special effect library, and the corresponding maintenance tools. It is the data foundation of the experimental prototype system. The environmental scenario library is the basis for realistic simulation of wartime logistics support. The training target library mainly manages various training objectives of the logistics equipment, and edits and manages the targets in the library according to different environment settings. The physical model library mainly manages various weapon equipment models in the virtual battlefield environment. For the logistics equipment, special node ID information needs to be set to facilitate the acquisition of each component information in the simulation training. The effects library is responsible for providing realistic effects for the logistics equipment entities during the training simulation, including blower sound, water vapor in the pressure cooker, etc.

The model layer is the core of the prototype system and is the basis of the simulation operation. Generate realistic virtual space based on real training subjects and training objectives, and provide a computing environment for entity model behavior and training evaluation.

The display layer is mainly responsible for the visual display of the base layer and the model layer. It combines the environment, the geometric features of the solid model and the behavior of the entity to generate realistic battlefield scenes. It is necessary to display the specific training courses such as the unfolding of the logistics equipment and the production of the staple food. At the same time, it is necessary to display the special effects and battlefield sound effects in the training scene to create a realistic training environment.

IV. KEY TECHNOLOGY

It can be seen from the foregoing that the simulation training effect is good or bad, which is largely determined by the similarity of the logistics equipment geometric model, the authenticity of the logistics equipment behavior model and the fidelity of the special effects. The above three problems mainly involve three techniques of geometric modeling, behavior modeling and special effects simulation [4].

A. Geometric Modeling

Geometric modeling is a description of the appearance of logistics equipment, including external properties such as size, color, and texture. The current theories and techniques for geometric modeling are relatively mature, and commercial software such as MultiGen Creator, 3D Max and AutoCAD has been widely used in geometric modeling. By collecting textures, decomposing three views, etc., not only can the external features of the equipment be detailed and realistic, but also the internal detail structure and the constraint relationship between the components can be realistically described, solving the geometric model and The problem of real equipment similarity [5].

B. Behavioral Modeling

Geometric modeling solves the problem of the model “looking like”, but it cannot describe the various states and behavioral responses during the operation of the equipment. Therefore, it is necessary to make the model “moving like” through behavioral modeling. Due to the autonomous behavior and intelligent behavior in the operation of logistics equipment, it is mainly necessary to express various physical motion characteristics that real equipment should have according to external input. Therefore, the physical engine is used to model the equipment based on physical behavior. It has realistic motion characteristics.

Through the encapsulation of physical algorithms, the physics engine can realistically simulate the motion of various rigid bodies, and has been widely used in foreign countries. In motion simulation, the physics engine regards the object as a rigid body, and simulates the motion state of the object by calculating the physical property such as the velocity and angular velocity of the object. In the aspect of collision detection, many physical engines adopt the method of hard contact, which avoids The occurrence of penetration during rigid body collision greatly improves the fidelity of the simulation effect.

After establishing the physical model of the equipment entity, the behavior model is associated with the geometric model, and the linkage between the two can make the logistics equipment entity not only look like but also can show the real motion behavior. Figure II is a schematic diagram of the combination of the behavioral model of the equipment entity and the geometric model using the physics engine.

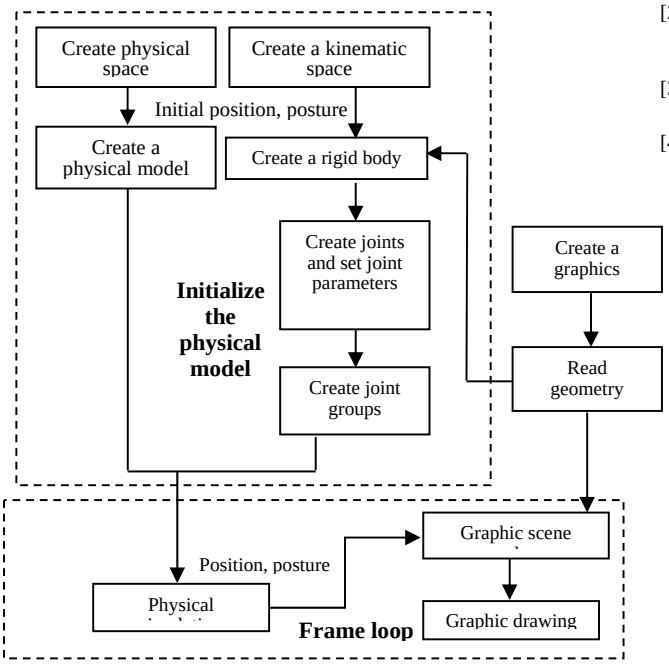

Figure II Physical model and geometric model combined schematic

FIGURE II. PHYSICAL MODEL AND GEOMETRIC MODEL COMBINED SCHEMATIC

C. Special Effects Simulation

Special effects simulation mainly includes simulation of a series of phenomena such as flame, smoke and water vapor generated during the operation of logistics equipment. These effects are not static scenes, but a process of dynamic change that eventually disappears from formation to development. These effects are often described using particle systems.

The basic principle of using particle system pairs to simulate is to describe the characteristics of flames and smoke through the irregular motion of tiny particles (such as cubes, spheres, points) with certain properties. This method has a high physical fidelity. This paper can simulate the above effects by combining the bulletin board and texture map.

V. CONCLUSION

Using virtual reality technology [6] to express various characteristics of logistics equipment, construct a realistic training environment for simulation training, so that trainees can improve the operational level and proficiency of logistics equipment in the virtual training environment. For the logistics training, the training mode is diversified, so that the training is not limited by the number of weather and equipment, and the equipment loss can be reduced. Under the premise of ensuring the training effect, the training cost is greatly reduced, and the training efficiency is greatly improved [7].

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