Implementation of Marine Fire Fighting VR Platform Based on Probuilder Modular

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Abstract. In this paper, the multi person cooperative ship fire training system based on VR technology provides an effective training method for ship fire safety training. Through the existing ship fire protection process, the simulation scheme is proposed, and the corresponding process is developed on the basis of the simulation scheme. According to the functional requirements of ship fire simulation module, using VR technology, the 3D model is established with the help of the rapid modeling kit of Probuilder, the typical training scene is built after importing unity3d, the script is written with C# language, and the online VR fire training system is realized with the help of network communication framework, so that the trainees can carry out cooperative fire drill in VR interactive way, and realize the actual ship firefighting simulation training of anti-jamming process. The development of multi person cooperative ship fire training system will be of great significance to improve the efficiency of ship fire training, reduce the cost of ship fire drill and ensure the personal safety of trainees.

Keywords: Ship Fire-fighting, Virtual Reality, Unity 3D, Probuilder

1. Introduction
The major of navigation technology is to train high-level navigation technical talents with good comprehensive quality, strong awareness of safety and environmental protection and international competitiveness in line with the national education policy and relevant international and domestic laws and regulations. The teaching content is closely linked with the actual work, and the teaching process is not only academic education but also skill training.

1.1. Research Background
Due to the lack of practical experience, there are many dangers such as accidental scald, asphyxia caused by accidental release of carbon dioxide and so on. And the use of real equipment training also has many disadvantages, such as high teaching cost, environmental pollution, more affected by the weather and so on [1].

1.2. Research Status
The research on ship fire protection at home and abroad is mainly based on actual operation. Some scholars at home and abroad have carried out the research on the use of virtual equipment to carry out practical training, but the relevant construction content is highly targeted, the hardware equipment required for the operation of virtual environment is high, and there are also some problems such as the limitation of training site.

1.3. Construction Scheme of Ship Fire Fighting Platform
In order to provide students with a teaching environment close to the real ship, it is planned to use virtual simulation technology to build a ship fire training system, and the virtual graphics card technology will be used to build a network training platform, so as to reduce the difficulty of teaching, improve the quality of teaching, save teaching costs and improve the safety factor of dangerous operation.

The core content of the ship fire training system is the ship structure model. In order to reduce the hardware requirements, we try to simplify the model as much as possible on the premise of ensuring the teaching requirements. Therefore, we choose Probuilder to create a real-time 3D model of visual simulation. The created model can be driven by unity3d engine and presented by VR helmet to improve the immersion of virtual environment.

The construction of virtual ship training platform not only enables students to understand, participate in and understand all the contents of working on the ship, and effectively cultivate the basic skills necessary for modern navigation, but also integrates the learning contents into the whole process of safe navigation, intuitively constructs a realistic ship simulation environment for students, and solves the problems of students' disconnection between theory and practice and unclear learning objectives.

2. Design of Ship Fire Fighting Model

2.1. Introduction of Virtual Reality Technology
Virtual reality technology is considered to be one of the most important and novel research directions in the computer field in the 21st century. The most characteristic is that the three-dimensional modeling function of virtual reality can build a vivid virtual environment in the computer. People can easily and intuitively "enter" the virtual space and immerse themselves in interactive reasoning. The virtual reality technology is applied to the actual fire fighting work, using computer, network, application software and database technology and resources, taking the ship fire accident as the background, the virtual fire scene and rescue environment are constructed, and the functions of on-site information query, disaster scenario construction, auxiliary decision analysis and so on are realized.

2.2. Characteristics of Ship Fire Fighting
Different from ordinary buildings, ships are mobile buildings on the sea. In case of fire and other accidents, the disaster risk and rescue difficulty will be very large. Strengthening the professional training of advanced fire fighting skills is an important way to reduce disaster hazards and enhance the effect of fire fighting and rescue. At present, the advanced ship fire fighting training is still based on practical operation, which has many problems, such as large consumption, high risk, long preparation period, low authenticity, poor repeatability and so on [2]. Especially for the navigation professional schools, the training site and conditions are limited, which makes it more difficult to realize.

With the rapid development of VR software and hardware technology, the fire simulation training mode based on VR technology arises at the historic moment. By imitating the real scene of ship fire in the virtual scene and adopting the human-computer interaction mode, the trainees' ability of handling and decision-making in case of ship fire is trained [3, 4]. Compared with the traditional combat training, this training mode is more participatory, more repeatable, and more safe and controllable, which provides a new idea for advanced ship fire fighting training.
2.3. Development of Marine VR Fire Fighting Platform

With the advantages and accumulation of VR technology research and development over the years, combined with the current demand of ship fire training, the ship fire training platform is developed by using VR technology. The platform can achieve a variety of training purposes, such as ship fire knowledge training, ship structure cognition, multi scene fire fighting, cooperative comprehensive exercise and other distributed scene training, and can be used for operation assessment and evaluation.

The fire training system based on virtual reality platform provides a new means for fire safety education [5-7]. Virtual reality technology can build realistic virtual training scene for trainers, and make them strengthen their fire escape ability in the virtual fire scene. Based on unity3d virtual reality platform, this paper develops a virtual reality system for the requirements and process of fire training and safety education. The system uses Probuilder to build a three-dimensional model, imports unity3d to build a fire training scene, uses C # language for script programming, realizes the interaction between users and the scene, and finally releases in PC and HTC-VIVE synchronously. After verification, the system has good interaction and immersion, which can make up for the lack of traditional fire training to a certain extent [8].

3. Technical Principles

3.1. Virtual Scene Making Based on Probuilder

Virtual technology can give full play to its own advantages in scene production. Scene production is to make full use of various models that have been processed to build different scenes. After investigating the real environment, scientific and practical virtual reality software is adopted to reorganize and improve the existing models, layout planning and edit the interactive operation interface of the created scenes, and finally the overall release [9].

Unity officially launched the rapid modeling suite of Probuilder in 2018.1. The previous life of Probuilder is a popular plug-in in unity resource store, which helps developers build models directly in unity engine to quickly generate levels for game playing test. Probuilder suite mainly includes three parts: Probuilder: for modeling directly in the scene window of unity; Progrid: for accurate grid adsorption operation in the process of modeling, to ensure that the model has the correct size; Polybrush (beta): for modeling directly in the scene window of unity It can be used to carve model meshes. The working principle is similar to Z-Brush and Mudbox, and even many shortcut keys are the same.

3.2. System Driven Engine

Unity 3D supports importing models in FBX, obj and other formats. Just import the 3D model created and rendered by 3dsmax, and add some scene elements to build a realistic virtual reality fire training scene. Unity 3D supports C #, java script and other programming languages, and can realize the customization of a variety of typical fire scenes [10]. This system mainly uses C # language to write the content. Unity 3D has the ability of cross platform, and can be well compatible with Android, windows, HTC-VIVE and other platforms. Unity 3D mainly relies on the C # language of Visual Studio Suite for content writing, which can customize the required fire training content.

3.3. Probuilder Interaction

Probuilder is a unique mixture of 3D modeling and level design tools, and it is optimized for building simple geometry, but it can also edit and expand the mesh in detail according to the needs. Probuilder can help you quickly create prototypes of buildings, complex terrain, vehicles and weapons, or create custom collision geometry, trigger areas or navigation grids.

Build, edit and texture custom geometry in unity. Using Probuilder for scene level design, prototype design, collision grid, all of which can be tested in real time. Advanced features include UV editing, vertex color, parametric shape and texture blending. With the help of ProBuilder's model export function, you can easily adjust the interaction effect in any external 3D modeling suite.
3.4. Fire Modeling and UI Interaction Process

The fire scene construction will be based on particle system to realize the visualization of ship fire and water column of fire gun. The main work includes: 1. The most difficult point of ship fire simulation is to choose an appropriate fire spread model, which should be accurate and meet the real-time processing ability of computer. 2. Visualization of ship fire and water column of fire gun is realized by using particle system. Particle system is an effective method to simulate variable and irregular objects. 3. Using bounding box for collision detection to simulate the process of fire fighting.

UI interaction process must be in line with the practice of ship fire protection, simulating the whole process from fire discovery to successful rescue. Specific to the application of fire fighting equipment, it includes at least four fire fighting experience scenes, one maintenance experience scene and one CO2 roaming scene. It can operate the basic fire-fighting equipment in the living area and other places, and complete the operation and related processes of the water fire-fighting system on the main deck. Through modeling, it can realize the roaming between carbon dioxide, as well as the remote start, manual electric start, manual pneumatic start, emergency pure manual start of the carbon dioxide fire-fighting system.

3.5. Helmet Roaming

In order to provide a more immersive visual experience, the laboratory plans to equip 10 pairs of HTC-VIVE commercial 3D helmet virtual reality glasses, and build a virtual reality ship training room based on unity3d and HTC-VIVE. In the training room, HTC-VIVE commercial version is equipped with a handle device combined with a helmet. The experimenter can interact with the ship in the virtual scene through his own body movements and instant movement, which not only enhances the sense of immersion, but also increases the interest of the learning process [11].

4. System Release

After the relevant scene content is built in unity3d, the real virtual reality training scene can be realized by using Vrtk suite to interact with HTC-VIVE device.

This system uses the classic version of HTC-VIVE PC virtual reality glasses. Two mobile handles and a virtual reality head display are configured. This device can realize most of the functions of virtual reality fire scene. Unity3d provides virtual reality API interface for developers, which can publish the content of the software to the corresponding virtual reality glasses. Through the existing integrated Vrtk suite and Steam VR plugin software, the basic virtual reality operation can be realized. The virtual reality operations involved in this system include grasping objects by handle, radiating rays by handle and moving.

5. Conclusion

In view of the current situation and shortcomings of ship fire fighting training, combined with VR technology and network communication technology, using unity3d as the development platform and based on the typical ship fire disposal process, a multi person collaborative ship fire fighting system is built. Through VR technology, the trainees can experience the fire environment visually and audibly, and be familiar with the environmental characteristics of the fire area. With the help of three-dimensional modeling technology, the virtual fire environment of fire training is built, and the virtual fire equipment is operated by the way of somatosensory interaction. Through the network communication technology to build the network background and develop the client interface, realize the interactive data synchronization between multiple clients, so as to realize the cooperative fire drill of multiple fire stations. The system can provide a safe dynamic fire training environment, so as to improve the trainees' cooperative combat ability, reduce the training cost of ship fire drill, and improve the trainees' training efficiency. Through the training, the trainees can quickly organize decision-making, correctly and decisively command, actively cooperate and coordinate, and constantly improve the overall fire fighting ability.
Through the construction of ship virtual environment, the virtualization of ship fire drill can be realized, and all kinds of fire scenes can be truly restored, so that the trainees can have a more unforgettable understanding of safety knowledge through immersion training. At the same time, VR simulation of the use of high-risk water fire extinguishing system and carbon dioxide fire extinguishing system can reduce the risk of training.

In the post-epidemic period, with the help of virtual training platform, it can realize non-aggregation, anytime and anywhere learning.

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