Chapter 61
Practice of Virtual Reality Case Teaching Using in the Military Training Based on Virtools

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Abstract In order to promoting case teaching effect of military theory, enhancing consciousness of resisting training, the military academy teaching should expand to method of virtual reality case teaching. Virtual reality case teaching not only makes use of various 3D model and alternant engines but also evolving various military tactics conditions for virtual scene. By assembling virtual scene and material model, the military academy students can carry on diverse and nonlinear step-by-step drill and analysis for military theory and equipment operation, and the military academy students can promote study effect of theory knowledge and equipment operating skill.

Keywords Virtual reality · Virtual reality case teaching · Military theory · Military teaching

With fast development of advanced simulation technologies like virtual reality, the application of new-type teaching and training mode of "enhancing hardware with software, replacing real scene with virtual environment and combining virtual environment in reality" in resisting training in military virtual environment, provides a new approach for satisfying demands in many respects like school teaching, military fighting and commanding training and equipment security training. Virtual reality case teaching is based on virtual reality technology and fighting simulation. Different from traditional teaching, by stimulating various sensatory organs, it makes student addicted into the course and thus accomplish the goal of fast learning, real experience, and enhanced skills.

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61.1 Introduction

The form of modern IT-based war changes extremely fast and the gap between different war forms is becoming narrow. To enhance capacity of army to modern war, it is necessary to enhance consciousness of resisting combat training and create a teaching training environment with tactic scene. Currently, academy is changing the mode of teaching and training in order to realize a new-type teaching method "learning modern war in lab and researching war mode in future development." Change of demand of modern war causes fast development of military technology. New types of weaponries appear one after another with enhanced complexity, better speed, high price, and limited output. Aiming at the status, to convert new technologies and new theories into battle effectiveness as early as possible and provide services for army, during teaching process, we must insist in "combination of theory and practice, integration of virtual technology and practice" and organize diversified nonlinear military specialty resisting training method.

In the traditional military theory and equipment operation teaching, some factors like nonobjective of theory and limitation equipment cause that separate of theory and practice, isolated of equipment operation, unrealizable joint operations training and adaptability tactical training. During weaponry learning and operation, students can enhance their basic weaponry operation ability by listening theoretic interpretation. However, due to impossible creation of tactic training environment, students have weak adaptability to weaponry operation. Therefore, a vivid weaponry operation training environment with virtual reality case teaching method has been built to enable students to accept weaponry adaptability operation training in corresponding tactic background during theoretic learning. Meanwhile, the distributive multi-unit integration grouped training and nonlinear deduction of teaching case have been developed with computer network technology so as to provide a brand-new technical mode for integrated united combat training based on information system in academy. Virtual reality case teaching adopts human-machine interactive functions of simulation and virtual reality technology. In comparison with traditional teaching training, this method can better adapt to requirements of development of weaponry teaching and training in the new situations.

61.2 Virtual Reality Case Teaching Method

During virtual teaching process, virtualization of the real weaponry and creation of a virtual tactic scene can break the limitation of traditional theoretic teaching and enable students to conduct theoretic learning and operation training based on their own characters. With virtual teaching system, teacher can present some event courses and phenomena which are complicated, abstract, and inappropriate to be

observed directly so as to show teaching contents in an all-round way, in multi-dimensions. Aiming at real environment which may exist in teaching, corresponding virtual scene is developed to realize visualized virtualized 3D reappearance of tactic scene in order to solve out the problems involved in learning and research, satisfy demand of class teaching, enhance effect of combat training, and shorten period of real weaponry teaching. Therefore, virtual reality case teaching method created by combination between combat simulation technology and virtual reality technology can help academy thoroughly change traditional military theory research method and provide conditions and opportunity for reform and development of modern military theory teaching.

Virtual reality case teaching [1] is a new-type military theory teaching method brought and gradually enriched by scholars including Prof. Hu Xiaofeng from National Defense University. This is a case teaching form which is aiming to realize theory and weaponry on the basis of computer war simulation system; through providing more vivid case environment and space–time, the system virtualizes whole process of various actual or possible cases and events in the past, present, and future and supports multi-variable, multi-nodes virtual play in the cases to achieve the goal of learning and research of military theory. Virtual reality case teaching is a special military case teaching form, similar with other military case teaching methods. It is characterized by subjectivity, practicability, and interactivity. But it also has remarkable differences from common case teaching.

First of all, support of computer war simulation basic environment. War simulation basic environment is the foundation for realization of virtual case. The teaching is to create virtual reoccurrence of researched case with 3D virtual reality technology and adopt multivariate nonlinear deduction and evaluation method instead of traditional linear presentation form. By war simulation system providing vivid war environmental and space–time scene [2], the teaching method presents the realistic condition of the case event to the largest extent while conducting multi-dimensional deduction and evaluation on the case in virtual scene to make case evolvement course dynamic changing.

Secondly, case virtualization of military theory and weaponry operation. Most of the cases used in traditional teaching had actually happened in the past. Through discussion and analysis on these cases, student can achieve the objective of theoretic learning. But the cases are more diverse in virtual reality case teaching. They may be the real cases in the past which are represented by virtual simulation environment to present war in history; they may also be the stimulation of future. Through proactive simulation, integrate all impossible situation in the future like new combat theories, action patterns and weaponries in the virtual battlefield environment; observe development course of war by simulation; and analyze and evaluate the matters involved in the research in order to learn about war in the future. Besides, some events which never exist or happen in reality may be virtualized to learn and research diversified military actions. For instance, by assumptive analysis and research on a specific case of battle, change the course and result of the battle in order to make research on decision making. Therefore, it

is valuable for use to conclude experience, realize nature of things and further deepen understanding and realization on uncertainty of the war.

Thirdly, diverse human machine interactive methods. The interaction in traditional case teaching is mainly reflected on the discussion and mutual inspiration, while the interaction in virtual reality case teaching may be in many ways: in terms of form of practice, virtual reality case teaching may involve independent research of individual, homework completed by group discussion, confrontation, and deduction among multiple groups, etc. to adapt to demands of different case teachings. With regard to analysis method, make static analysis on actual conditions of case or make dynamic deduction by changing some conditions to know about different results of case in different situations. As to realization method, make faster-than-real-time simulation by computer based acceleration in order to speed up simulation and shorten simulation duration, or conduct quasi-real-time simulation to research details of some events at a lower speed ,and organize human-machine counteraction to deem computer as rival in research, or multi-person counteraction in order to complete the deduction of the whole case by multiple students playing different roles.

Traditional case teaching is divided into six segments: exercise, assignment, individual learning, group discussion, conclusion, and achievement evaluation. Virtual case teaching is the adjustment and sublimation based on these steps according to its inherent characteristics. With virtual environment as a basic teaching platform, the whole teaching course is in a war simulation environment so as to form seamless joint of whole practice environment, simulation system, and teaching activity. Virtual reality case teaching may be divided into four phases: teaching preparation, learning organization, research on playing, and conclusion. Therefore, no matter virtual case or case virtualization, no matter future virtualization or reality virtualization, all help achieve the goal of innovation of military teaching, enable case teaching of military theory and weaponry to extend to deduction and innovation from simple conclusion and complete experiment and test in actual course of simulation.

61.3 Design and Development of Virtual Case Teaching System

Virtual reality case teaching system is classified in two major parts in general. One part is virtual war simulation basic environment and another part is military specialty training deduction system. In the part of virtual war simulation basic environment, conduct parameterization design for strategic factors like geography, weather, human culture and society and build up corresponding virtual basic environment in order to support teaching and training of military specialty cases, complete multivariate nonlinear deduction and evaluation analysis, etc. [3]. Military specialty training deduction system is a system customized according to

demand of teaching of military specialties basically with high pertinence. It helps learn and analyze certain specialty or problems in certain field such as certain air target identification training system. The principle of the system is conducting special theoretic knowledge in combination with specific case in a virtual tactic background and thus obtaining corresponding feedback about operation so as to keep accumulating experiment and achieve the objective of grasping corresponding knowledge and skills.

Now we will introduce design and development method of military specialty training deduction system in detail with certain air target identification training system. The teaching system involves contents like basic knowledge, weaponry operation, target identification, and training assessment. Student can know well and grasp theoretic knowledge about air target identification through all these contents and enhance skill of air target identification by training and operation in corresponding tactic background.

Virtual reality simulation engine Virtools used in this system is a set of non-immersive virtual reality development tools developed by France's DASSAULT. With complete functions, visual development interface and human-machine interactive interface and programming environment of flow chart type, the tools are extensively used in the development of military virtual training system. In the graphic interfaces, developer drags behavior building blocks (BB) to the target and finally builds up multi-functional interactive application. Virtools contains 682 BBs so far and user can also edit and combine in their own ways. By Virtools' script language or Visual C++ and other tools, user can conduct self-defined development and form a BB system with certain function step by step.

Virtual reality case teaching based on Virtools platform and resisting training system include not only basic action and behavior of components (functional simulation), but also work logics among components (performance simulation). However, Virtools has no ability of building up 3D model, so generally other 3D modeling tools (like 3DS Max) are used in realizing 3D models like weaponry and landform models [4, 5].

This system erects tactic scene and production of equipment model on this basis and then convert these models with assisting file plug in of Virtools and finally import in Virtools platform. In the next step, according to relevant requirements of case teaching, after parameter-based editing of tactic conditions, natural conditions, and other conditions, position model and apply embedded BBs mechanically, for instance, it realizes flight path actions of single or multiple planes with plane models and functions like rotation, moving and zoom in/out of camera. Figure 61.1 shows BB's message transmission flow.

Now, we make a simple introduction by taking the example of MouseRotate. First of all, define speed of Entity3D variable and vector variable to save displacement data for saving model and mouse and create management object MB and rendering object RC.

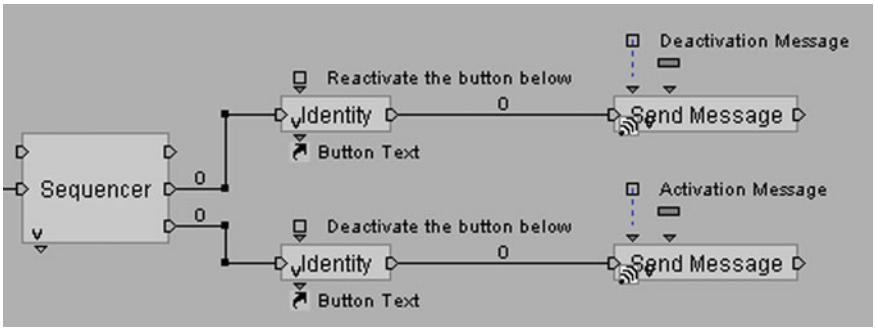

Fig. 61.1 The message function block structures

```
InputManager MB = InputManager.Cast (
    bc.GetManagerByGuid (GetInputManagerGuid ()));
    RenderContext RC = bc.GetPlayerRenderContext ();
    //Initiating variable when click with a mouse
    IntersectionDesc desc;
    rcx.Pick (x, y, desc); //mouse placement coordinates
    obj = desc.Object; //rotate model with mouse displacement
    MB.GetMouseRelativePosition (speed);
    speed.x* = RSpeed; //unit rotation angle
    Float delta = bc.GetDeltaTime ()/1000.0;
    if (axis ==1) {//when rotating around Y axis
    obj.Rotate (1.0, 0.0, 0.0, 0.0, obj));
    obj.Rotate (0.0, 1.0, 0.0, speed.x*delta, obj);
    obj.Rotate (0.0, 0.0, 1.0, 0.0, obj);}
```

When implementing air target identification virtual reality case teaching, in order to achieve the goal of virtual environment simulation, add a part of military task conditions, landform and weather blocks to virtual scene to create tactic scene of corresponding case in combination with 3D model of air target. Then, add operation functions of 3D models of devices like optical detection devices to provide student with sense of scene operation during theoretic knowledge learning, as shown in Fig. 61.2.

The interfaces of the system mainly include initial interfaces and main interfaces. Development of initial interfaces includes operation buttons, operation instruction menu; the development of main interface puts priority on interactive button, mainly realized by push button, wait message, wave play, show, and hide. Mouse is able to change image of button when it is within button scope and can realize functions like show, hiding, trigger, and inhibit by click.

The interactive menu is developed mainly with corresponding BBs, like mouse wait, 2D picking, sequencer, hide, show, active script, deactivate script, set as active camera, switch on parameter. If many menu item parameters are saved in switch on parameter, a part of menu may be hidden or shown by click and

Fig. 61.2 An air target identification virtual case system

corresponding events (roaming, free track and identification operation) and others may be triggered.

After system development, make a function model to enter virtual case system. The system saved as CMO format is unrecognized, therefore release it as an EXE file, and then transfer and operate in the form of module.

61.4 Conclusion

Virtools-based virtual reality case teaching system helps students to visually three-dimensionally understand military theoretic knowledge before virtual tactic scene, grasp basic operation steps and flows of equipment, intensify resisting training consciousness by different case background set in the scene and deepen realization on specialty knowledge. Therefore, it contributes to the enhancement of teaching training effect based on tactic background. Creation of corresponding military case scenes corresponding to different specialties with a virtual reality software system allows students to conduct virtualized diversified nonlinear learning and grouped training prior to actual weaponry operation and tactic training to reduce the operation accident and weaponry loss during military training. It also can provide

students with a repeatable, low-cost, high-efficient, short-duration virtual learning and training environment, enhance teaching efficiency, learning effect, and operation skills.

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