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Applications of Computer Virtual Reality Technology in Modern Sports

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Abstract—**The technology of virtual reality has been widely used in various fields and it's been playing an important role in recent years. It possesses characteristics such as high immersion, dynamic interactivity and digitization of multidimensional information, etc, which are exactly the needs for the combination of modern sports development and technology advancement. Along with the recognition and investment of countries all over the world for sports development, Virtual reality technology has been frequently applied in sports event broadcasting, theoretically digital physical training and physical education. The introduction of virtual reality technology into sports will be conducive to the scientific training of competitive sports and the study on digitization of technology theory, and in the meantime benefit the rapid development of modern sports.**

Keywords- virtual reality; modern sports; physical education

I. INTRODUCTION

The computer technology of virtual reality has come into sight since the 1980s. It is an artificial Virtual Environment of three dimensional information, which consists of computer software, hardware and various sensing devices [1]. Virtual reality technology is based on a series of high technologies, including interactive interface technology, multifunction sensing technology, high definition display technology and three dimensional computer graphics technology, etc. The core of it is composed of computer equipment, location tracking equipment, image acquisition equipment, display equipment and other hardware such as interactive devices as well as related software. This technology can veritably simulate those realizable objects and environment in the real world functionally and physically. In this virtual environment, users will experience the feeling of "immersion" as well as put into practice this virtual interaction of environment. By means of virtual reality technology, one will totally be in the virtual environment created by computer, which makes him or her observe more intuitively the external law of objects and understand more systematically the internal changes of them. Through the contact with objects in this virtual environment, participants will have exactly the same feelings as they have in the real world, which means they are being in the virtual environment and becoming part of this virtual system [2].

II. FEATURE ANALYSIS ON VIRTUAL REALITY TECHNOLOGY

The core of virtual reality system consists of computer equipment, location tracking equipment, image acquisition equipment, display equipment and other hardware such as interactive devices as well as related software. It includes visual system which is based on helmet-mounted displays, auditory system which is based on speech recognition, sound synthesis and sound localization [3].

Virtual reality computer technology has many features, among which there are four basic and outstanding ones as follows: multi-sensation, immersion, interactivity and imagination. Composed of these distinctive features, virtual reality technology is being utilized widely.

A. Multi-Sensation

In addition to visual perception of ordinary computer technology, virtual reality technology also includes distinctive features such as motion perception, auditory perception, tactile perception, force perception, even olfactory and taste perception, etc. Powerful as it is, virtual reality technology is limited by related conditions, especially by electronic sensing technology, which makes it is only provided with the perceptive functions in sense of hearing, force, vision, touch and motion.

B. Immersion

Immersion can be understood as tele-presence, which means the participants could veritably exist in the virtual world created through computer. They will feel immersive and fully participate in the three dimensional virtual world, for it is the same as in the real world in the respects of vision, hearing, touch and even smell [4].

C. Interactivity

Interactivity of virtual reality technology has changed the situation in which users can only accept the information given by computer. Now with professional technology equipment, users can communicate and contact with the objects in virtual environment according to their own needs, they can even change them, which adds naturalness and sense of reality to it [5].

D. Imagination

The imagination of virtual reality technology is based on its expanding function, which can expand human imaginary space and change human cognitive range. Whether they can be carried out in the real world or not, they can be achieved through virtual reality technology. To a great extend this feature inspire human imagination.

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III. FUNCTIONS OF VIRTUAL REALITY TECHNOLOGY

A. The Acquisition of Athletes' Three Dimensional Information

The three dimensional information of human motion is the foundation and key point of the analysis and research on human three dimensional motion. It consists of postures of human bones and joints from different angles and their corresponding three dimensional coordinate information. In order to get three dimensional information of human motion, motion capture of athletes' technical movements should be needed in the first place, then there will be mechanical analysis and technical processing.

Non-contact human motion tracking method has been put forward by researcher Wang Zhaoqi from computer institute of national academy of sciences in order to obtain all necessary parameter data of each node for the subsequent human motion three dimensional simulation. This is a method in which many sets of video capture devices will be located at training grounds or game sites so that the process of athletes' motion will be captured from all directions as well as from different angles before the videos being processed through sorting, video clipping and sound purification by professional software.

B. The Establishment of Digitized Human Motion Simulation Model

The main research of virtual reality technology is based on digitized virtual human model which is shown in virtual reality system through three node methods: joint, bone segment and hu-manoin. The method of hierarchically establishing three dimensional digital human model is put forward by researchers Sun Yongchao et al from computer institute of national academy of sciences, in which virtual human body is divided into muscle, skeleton and skin and based on these structural layers virtual human body is established. Meanwhile, human skeleton is divided into three parts: joint, bone and hu-manoin. In general, virtual human skeleton model and virtual human surface model together constitute a complete virtual human model, which means the virtual human model we usually see is just a virtual human surface model, virtual human skeleton model is not included. Therefore, a virtual human model consists of two parts, one is surface (including garment. Skin and muscle), the other is skeleton. The whole surface model is constituted by 53 interconnecting parts, between every two of them there is certain space which will increase the flexibility of digitized virtual human model. Therefore, the model will be able to freely simulate the postures of human motion in the real world.[6].

Broadcasting director technology of TV relaying is the key of connecting real-time information and TV consumers. The task of director is to process real-time information concerned by the consumers in order to keep them informed and involved in a vivid and direct way. This procedure of information processing is known as information packaging. (as shown in the following figure1)

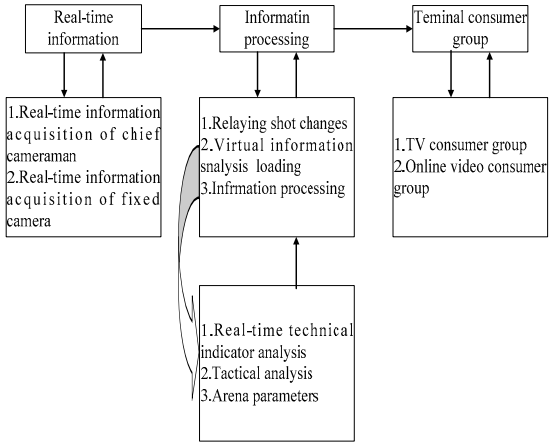

Figure 1. Information Packaging

C. Virtual Comparison of Technical Movements

Simulation technology plays an important role in the analysis and research on technical movements. Along with the participation of computer technology into physical education and physical training, sports research institutes all around the world have been making unremitting efforts to develop all kinds of simulation systems for technical movements and take it as a priority. Since virtual athletes can accurately simulate the standard actions of each sports event, it is conducive for athletes to perfect and enhance their skills through observing the details of ideal actions from different angles and positions. Due to this system, we could compare the technical movements of real athletes with standard simulation actions, which will not only benefit physical training very much, but it will also be in favor of the analysis and evaluation on the results of movement accomplishment.

IV. APPLICATIONS OF VIRTUAL REALITY TECHNOLOGY IN MODERN SPORTS

A. Applications of Virtual Reality Technology in Sports Event Broadcasting

1) Digital Virtual Advertisement System

Virtual advertisement refers to billboards placed on the field through virtual reality technology during sports events, or virtual billboards which replace the original advertisements without being noticed. The synchronous utilization of virtual advertisements makes the broadcasting more splendid and colorful. This technology greatly improves the flexibility of advertisements, enhances the effect as well as increases profits. There are plenty of specific applications of virtual advertisements in various sports event broadcasting through VR technology, such as the ones on both sides of the goal in Italy Serie A and Germany Bundesliga; the ones on the tracks of F1 World Grand Prix, etc.

Virtual advertisement system can be applied to any sports event broadcasting. It doesn't matter if the quantity

and parameters of the camera are changing, the audiences are switching seats or how the weather is, the system will perform perfectly. It is of great practical applicability.

2) Virtual Sports Event Analysis System

Virtual sports event analysis system combines virtual reality technology with sports events and generates relevant graph, images, text and data as well as achieve close integration of them . It can be applied to any sports events, and insert real-time comment graphs, animations and video overlay at anywhere and any surface in order to make the sports events easy to understand. For instance, the display of world record greatly improves the accuracy and authority of comments. This is a reform in sports live broadcasting, analysis and comments.

3) Virtual Reproducing System

Virtual reproducing system is mainly applied to live broadcasting and comments. It can provide dynamic three dimensional graphs of stadiums, players and balls as well as continually change shooting spots. First of all, a single frame has to be chosen and frozen. Then the frozen two dimensional video images gradually become a animated three dimensional scene, i.e. the stadium, players and ball will be changed into corresponding three dimensional graphs. The virtual camera can do circle shooting around the stadium, thus the audience will know exactly what is happening in the game from any angle. This system needs the three dimensional model of the stadium in advance. In addition, it will take a few minutes to prepare the material. Virtual reproducing system will gradually change the mode of sports event broadcasting, which means it will partly replace slow replay and simulate real-time situation of the game from every angle. Therefore ,what is presented to the audience in the game will not be controversial or difficult to tell any more.

B. Applications of Virtual Reality Technology in Physical Training

1) Virtual Reality Technology and Physical Training

Through quantitative analysis of sports technical movements, virtual reality technology presents skills elements such as strength, shifts and speed in graphs, which plays an important role in modern competitive sports, and based on this technology, we can make a deep analysis on the differences of technical movements between athletes in the real world and the ones in three dimensional virtual environments. Putting on the same screen the technical movements of real athletes with virtual standard movements will be more conducive for the coaches to do the analysis intuitively and systematically, and it will also help the athletes find out their skill weaknesses. It plays an important role of improving training quality and results. Through virtual reality technology, we can vividly simulate various environments of training and competition, which will to a certain extend make up a series of problems about college physical training caused by the faultinesses of sports field and equipment or the lack of funding. To some newly designed technical movements, we could let the virtual athletes try them first through virtual reality technology, which will make it possible for coaches to demonstrate and test the scientific rationality as well as make improvement and perfection of the technical movements before the real athletes carry them out. Therefore, the safety factor will to a great extend be enhanced, and the risk will be lowered [7].

2) Functional Requirements

a) The construction of virtual training scene: . There are specific requirements for specific sports event.

b) Motion data acquisition:. Through sensor tracking devices, motion data will be directly record and used for generating computer animation. The greatest advantage of this method is that it can obtain real data of human motion(including training facilities), which will achieve vivid results and ensure the scientificity of training[8].

c) Physiological, biochemical and psychological data acquisition: Physiological and biochemical indexes as well as psychological indexes are the important reflection on athletic completion state. According to different sports events, it is possible to achieve physiological and biochemical data acquisition and psychological data acquisition by means of sensors and intelligent equipment.

d) Motion replay: Motion replay is the essential requirement of sports simulation system, which cannot be well achieved by traditional camera under certain conditions. For instance, sometimes training video of sail-boating and sail-boarding may not be ideal.

e) Graphical training effect analysis: The method of graphical training effect analysis refers to a error evaluation method which is used to show error analysis results by means of computer graphics, and it is divided into online evaluation method and offline evaluation method [9].

3) System Composition

Sports simulation system which is based on virtual reality technology can be divided into immersive and non-immersive sports simulation system. The former requires equipments such as three dimensional helmet-mounted displays, stereo glasses, data gloves, stereo headphones, graphic workstation and high-performance computer ,etc, which enables the users to feel authentic stereo vision and hearing as well as achieve interactive operation with virtual environment, thus they will be totally immersed in this virtual environment (as shown in the following figure2), and its features can be seen from the expensive equipment and the strong sense of immersion; while the latter establishes a virtual world with abundant auditory and visual information by means of software technology, its features can be concluded as economical and convenient.

4) Application Examples

American image company and University of California Davis jointly developed a sled device for competition, which would bring the players into a simulated world. Stereo images created by computer technology has made a dark training room into the competition scene, in which players who use this device could truly experienced the feeling of the sled moving down at full speed along the track. The laboratory equipment would detect players' status at any time and forecast possible problems during competition through technical analysis and functional diagnosis in order

to work out the best strategy and design the best route. Therefore the aim of improving athletic performance could be achieved. By means of this set of device, U.S. team which attended the 16th Winter Olympics in France saved half of the training costs than practical training in France, and the time of training was greatly increased. This is exactly the charm of sports simulation training based on virtual reality technology.

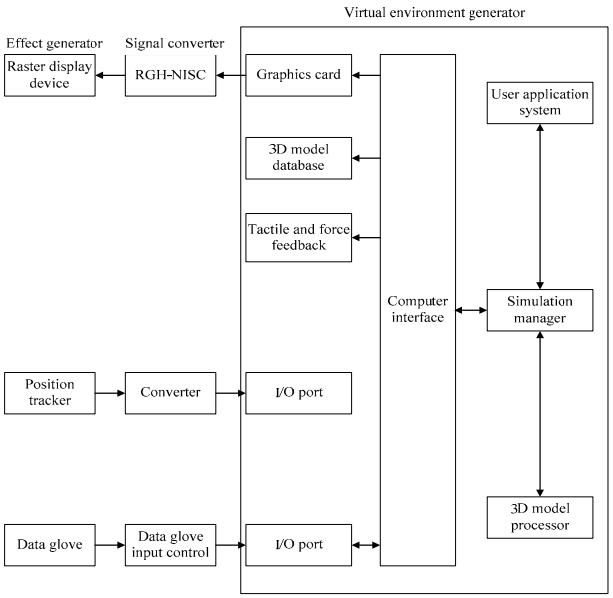

Figure 2. Competitive sports Simulation System Struvture Chart Based on VR

C. *Applications of Virtual Reality Technology in Physical Eeducation*

Not only can virtual reality technology achieve traditional knowledge impartation, but it can also the impartation of moves and skills. As long as there is proper model base, students will feel immersive while watching the process of move performance. Since the process is controlled by computer, students can watch it repeatedly with slow display from different angle or even participate in person.

Based on this mature technology of virtual reality, teaching courseware will be made, through which students could overcome the disadvantages when they have to watch the teaching video shot from only one angle or they are unable to see clearly the teacher's demonstration for it is too fast during the learning of a certain move. Since students will be able to adjust teaching process freely and selectively learn the key points according to their own situation, it will not only achieve teaching students in accordance to their aptitude, but it also is a burden reduction of the teachers, which will to a great extend solve the problem of faculty shortage.

Physical education courseware is a new type of teaching method which is based on virtual reality technology, it is also a trend of physical education development. In the process of developing and applying virtual reality physical education, it is necessary to pay attention to the respective features between virtual reality courseware teaching and traditional teaching method in order to make them complement each other instead of being in opposition to each other. The former is good at image teaching, by means of vivid and dynamic effect, man-machine interaction, it establishes a brand-new learning environment; while the latter does well in teaching by precepts and examples and is teacher-dominated, through giving full play to instructors' teaching level and ability, it creates good teaching atmosphere. Therefore, while employing virtual reality technology during physical education, we should know that the key significance of computer-assisted instruction lies in "assist", and the teachers will still be the "mentors".

V. CONCLUSION

It can be predicted that along with the holdings of various sports events in China and the outstanding performance of our athletes, sports development will receive more and more attention, which will promote the intensive study on sports techniques. Virtual reality technology will play an increasingly important role in various aspects such as competitive sports broadcasting, training, competition, physical education, etc. Therefore, it is necessary for us to follow the development and to further study on virtual reality technology, for it is of great practical significance in the development of competitive sports.

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