Research on the VR Technology in Basketball Training

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Abstract: *With the rapid development of virtual reality technology in the field of life, sports simulation teaching has received unprecedented attention. VR technology provides teaching workers with advanced and scientific training methods, and basketball training simulation also promotes the development of computer technology. This paper mainly studies the feasibility analysis of VR technology in basketball training. Firstly, a human basketball training model is established, and then the images are preprocessed. Taking the denoised background grayscale image and the target frame grayscale image as the experimental objects, the difference operation is performed on the two images using the background difference principle introduced above. Finally, the bwlabel function is used to mark the coherent region in the differential binary image, and the area of the region can be calculated. The results show that VR technology makes the basketball training process more efficient, and players can interact with the virtual environment in a virtual environment to a natural way.*

Keywords: *VR technology, basketball training, simulation model*

1. Introduction

With the gradual enhancement of scientific research capabilities around the world, new technologies continue to emerge. At present, the development momentum of VR technology is very strong. Basketball is a popular sport, and more and more young people like to play basketball in their free time to keep fit. However, basketball training is often affected by weather and venues, causing training to be interrupted. VR technology can build a virtual environment. The mesh subdivision algorithm solves the contradiction that the higher the accuracy of the model, the more memory it consumes during the rendering process, and finally achieves the goal of using lower memory to achieve a high-precision visual effect virtual model.

VR technology continues to be widely used in various industries, and it also brings huge economic and social benefits. The field of sports also needs more new vitality in VR technology. Applying virtual reality technology to college physical education courses, such as aerobics, volleyball, and basketball training, can avoid physical injuries during the learning process, and can also demonstrate some actions that cannot be accurately described in language and reduce sports learning Cost of venue and equipment in the process. At the same time, make information technology play a greater role in basketball tactical training, and promote the process of combining information technology with basketball training.

2. VR technology and basketball training

2.1. VR technology

Virtual Reality (VR) technology is an advanced computer interface technology and computer user interface. It provides users with various intuitive and natural real-time perceptions such as vision, hearing, and touch. Interactive means maximize the convenience of user operations, thereby reducing the burden on users and improving the efficiency of the entire system. Virtual reality is a computer system that can create and experience a virtual world. The virtual world is the entire virtual environment or the entire given simulation object. The virtual environment is generated by a computer, which acts on the user through vision, hearing, touch, etc., to produce an immersive interactive visual simulation. People's experience in the virtual world is characterized by Immersion, Interaction and Imagination. This is also called the virtual technology triangle [1].

Using computer graphics and other technologies to simulate scenes in reality is the virtual reality technology (VR). People can have the same feeling in the created scene as in the real scene. VR system includes environment simulation, perception, information interaction, sensor equipment interaction, etc. It is a simulation interaction system that combines physical object motion simulation and virtual information transmission. The simulation environment is to generate three-dimensional simulation graphics with feedback capabilities through computer modeling and simulation software. Perception refers to the changes in vision, hearing, smell, taste, touch, force, and behavior trajectory that can occur in the real world in the virtual system. Information interaction means that people's various status information in the system, such as body movement positioning, body signal acquisition, etc., can be grasped by system users in real time. The interaction of the device is that the user manipulates or commands the characters in the virtual scene through the three-dimensional interactive device. The user can react in time according to the activity, and finally feedback the various perceptual information caused by the behavior to the user to achieve the interactive Function [2].

In virtual reality modeling, the calculation relationship between the partial derivative of the objective function and the parameters in the network (that is, the network weight and the bias parameter) and the nodes are as follows:

$$\begin{cases} \dfrac{\partial L(W,b;x,y)}{\partial W_{ij}^{(k)}} = a_j^{(k)} \delta_i^{(k+1)} \\[3mm] \dfrac{\partial L(W,b;x,y)}{\partial b_i^{(k)}} = \delta_i^{(k+1)} \end{cases} \quad (1)$$

The calculation formula of Pearson correlation is as follows:

$$sim(i,j) = \frac{\sum_{u \in U}(r_{ui} - \bar{r}_i)(r_{u,j} - \bar{r}_j)}{\sqrt{\sum_{u \in U}(r_{u,i} - \bar{r}_i)^2}\sqrt{\sum_{u \in U}(r_{u,j} - \bar{r}_j)^2}} \quad (2)$$

Among them, U represents the set of users who have commented on item i and item j at the same time. First input the neural network for forward propagation operation, obtain the output activation value of each neuron node on each hidden layer in the network, and calculate the output value of the output layer of the network. The calculation formula is as follows:

$$\delta_i^{(k)} = \frac{\partial L(W,b;x,y)}{\partial z_i^{(k)}} = \frac{\partial(1/2 \| y - o_{out}(x) \|^2)}{\partial z_i^{(k)}} = -(y_i - a_i^{(k)}) \cdot f'(z_i^{(k)}) \quad (3)$$

Among them, $z_i^{(k)}$ represents the weighted sum of the input of the i-th neuron node in the k-th layer. The residual calculation formula of the i-th node of the k-th network is:

$$\delta_i^{(k-1)} = \frac{\partial L(W,b;x,y)}{\partial z_i^{(k-1)}} = \frac{\partial(1/2 \| y - o_{out}(x) \|^2)}{\partial z_i^{(k-1)}} = (\sum_{j=1}^{m} W_{ji}^{(k-1)} \delta_i^{(k)}) \cdot f'(z_i^{(k-1)}) \quad (4)$$

The main key technologies in VR technology include: graphic image recognition technology, augmented reality (AR) stereo display technology, stereo sound transmission technology, computer terminal interactive equipment access technology, auditory induction technology, gesture recognition technology, eye movement and head movement tracking technology, as well as tactile, force perception and other acquisition and feedback technology. The virtual reality roaming system is mainly composed of two aspects: one is the model rendering technology based on three-dimensional model, which needs to carry out three-dimensional solid modeling, build the actual geometry in the scene, and at the same time carry out texture mapping on the model and add lighting effect to the scene; the second is based on the drawing technology, which requires the use of high-definition camera to take panoramic images.After the image is processed, the omni-directional real graphics are reconstructed. The process of model rendering is relatively complex, but the cost is low and the data is complete. Image rendering does not need to establish a three-dimensional model, which has high rendering efficiency and strong sense of reality. However, relying on high-definition image acquisition equipment, the data lacks integrity and the scene accuracy is insufficient [3].

2.2. Basketball training

In college basketball, the application of players' skills and tactics is in pushing, pulling, squeezing, resisting, and even in violent collision, which puts forward higher requirements for basketball players' physical fitness. In short, the general trend of modern basketball will continue to develop in the direction of "fast, high, complete and accurate". Among them, "fast" is mainly reflected in the high score. The speed and rhythm of the current game are getting faster and faster. The number of fast attacks and scores are increasing. Many excellent teams score more than 100 points per game. "Height" is mainly reflected in the height of athletes and the control of the field of high altitude competition. "All" requires the comprehensiveness of the individual and that of the whole team. Individuals should not only have superb skills, but also have "unique skills" and versatility, as well as good physical quality and tenacious style of work. The whole team should be flexible in tactics, balanced in attack and defense, and the strength of the players should be relatively average, so that they can play. "Accurate" mainly refers to the accuracy of shooting. In modern basketball games, the shooting percentage is constantly improved to ensure the victory of the game. "Accuracy" is also reflected in the athletes' mastery of technical action norms, skillful tactical coordination, and proper use of technology. In today's fierce competition, to win the competition, we must be in a high-intensity confrontation, which requires a very good physical strength as a guarantee. Without good physical fitness as a guarantee, the technology can' t be fully played out in the fierce competition, and the tactics will also be limited [4-5].

Through the observation of basketball teaching and training activities and personal participation, basketball can be divided into two categories: ball-holding and running without the ball. In the ball-holding movement, the most obvious and effective one must be the sudden stop and sudden dribbling action. Take this action as an example, it is through the change of foot movement during high-speed dribbling to achieve suddenness the deceleration of the ball may become a static state; or the dribble at a low speed or a constant speed, suddenly kicking the ground and accelerating the state. In the process of such changes, the foot needs to quickly change the body's movement state by exerting force during braking deceleration and force acceleration, and the foot must also have a good cushioning ability to absorb and relieve the rapid change of the body's center of gravity brings the impact to the foot and reduces the damage. Through the force and buffering of the foot, it finally provides a basic guarantee for the completion of the emergency stop and start action. In the off-ball running, the role and use of the foot movement are more prominent. In the off-ball defense, in order to well contain the offensive players, the foot movements such as side sliding step, cross step, and retreat step are very important. Good guarantees an excellent defensive position. The continuous change of foot movements is based on the fact that the feet are using different force and buffering as the basis, which is of great significance to completing the defensive task. When offensive off the ball, it is most obvious from the scramble for rebounds, whether it is rushing to grab the rebound or the point grabbing technique of the jump on the spot, in the short-term continuous high-quality take-off, the foot Power plays an important role, and the cushion protection given by the foot every time you take off and land is even more important. The foot action not only adds help to the completion of the rebounding action, but also escorts the completion of the rebounding action to avoid injury[6-7].

2.3. Basketball training path planning

According to the virtual person's familiarity with environmental information and obstacles, it can be divided into path planning for static obstacles and path planning for moving obstacles. The tracking method based on feature matching only uses the individual characteristics of the target to track, regardless of what the target is, and does not need to consider the integrity of the target. The reason why this method can achieve target tracking is that the sampling time interval of the sampled images is very short. In this case, we can consider these selected features to be smooth in time. We need feature extraction and feature matching to perform target tracking based on feature matching, regardless of whether the target is a rigid moving target or a non-rigid moving target. Since it is a tracking method based on feature matching, of course, it is necessary to select a suitable reference feature, then extract the features in the subsequent adjacent frames, and finally judge whether it is the same target by matching these features, so as to complete the tracking of the target. The reconstruction of traditional human posture is based on robot kinematics. The human body is regarded as a complex structure with rigid body properties. Before data calculation, the coordinate value of a joint point in the reference coordinate system of the reference part needs to be obtained as a priori after the data, according to the principle of robot kinematics, the coordinate points of each joint are calculated step by step by detecting the three-dimensional change angle of each part [8].

Background extraction is the first step of moving object detection. The data input of moving object detection is a series of continuous video frames. The task of moving object detection is to track the target in this series of video frames. Therefore, we must decompose consecutive video frames into static images. In these static video frames, some frames do not contain the target, some frames contain the target. A simple method of background separation is to use the frame without object as background frame. In this method, we need to record the video of the background when the target does not enter the video recording field, and then we can use the first frame of the video as the background frame, and the subsequent target frame only needs to carry out differential operation with the background frame. We can also average the first n image frames without target in the video, and use the mean image as the background frame. Therefore, in all video frame sequences, the probability of background pixels appearing at each pixel position is much greater than that of target pixels. In this way, we can sample a pixel in the image by time, and the pixel with the highest probability of occurrence is the background pixel. By doing this for all pixels in the image, we can get the background image [9-10].

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The process of geometric modeling is to build the basic geometric framework of the model according to the obtained dimensions. The addition of model attributes, especially texture, is to use the photo processing to attach to the model surface to achieve the rendering of the model effect, so as to increase the realism. The final optimization process is to optimize the database level in the model, so that the model has good real-time performance. The comparison of sampling data is shown in Table 1 and Figure 1. Because of the three-dimensional coordinate information provided by the optical marker point, the spatial coordinate information is transformed into the angle information for comparison. Only the displacement transformation of the superior node is inherited, and then the initial attitude of the model is (0,0,0). At the start of the program, the movement calibration of human body and virtual character is completed. According to the IMU data, the relative posture angle of each joint point of the upper limb relative to each node of the upper limb at the current moment is calculated. Finally, it is input into the corresponding node of the virtual character, and the human upper limb action can be followed by quaternion rotation.

Table 1: S ampling data comparison.

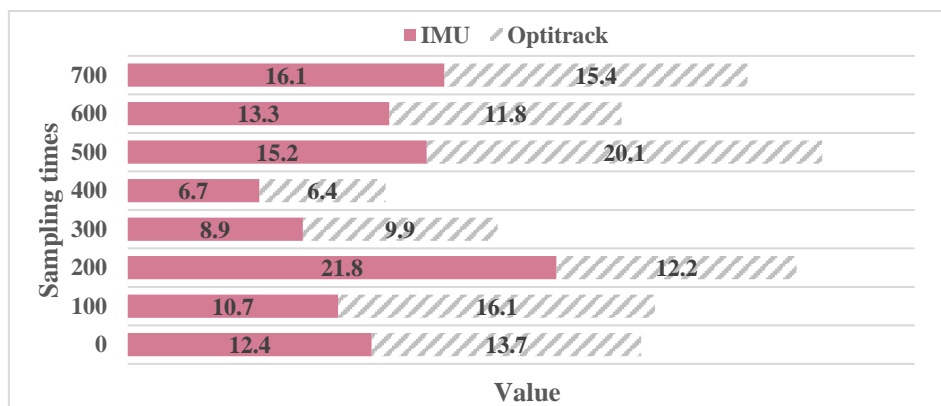| Sampling times	0	100	200	300	400	500	600	700
IMU	12.4	10.7	21.8	8.9	6.7	15.2	13.3	16.1
Optitrack	13.7	16.1	12.2	9.9	6.4	20.1	11.8	15.4

Figure 1: Sampled data comparison.

4. Conclusion

This paper mainly studies the feasibility analysis of VR technology in basketball training. The article mainly elaborates the related theories and key technologies of target detection and tracking in video images. Focus on the three modules of moving target detection, image segmentation and target tracking. On the basis of summarizing and analyzing the existing moving target detection and tracking technology, the preprocessing, target detection, image segmentation and target tracking of video sequence images are explored and researched. In the extraction of the core algorithm target, combined

with the scene of multi-target interaction, denoising filtering and mathematical morphology processing are performed on the video image sequence and the differential binary image.

In the basketball teaching and training, we should put more energy into the physical strength training, especially the strength training of some small muscle groups in the lower limbs and feet. We should formulate the teaching and training plan purposefully, and design and arrange the technical movements in the teaching and training with emphasis. This can not only effectively improve the physical strength of the participants; it can also provide basic guarantee for the improvement of the overall technical level; it can also reduce the risk of related injuries in teaching and training, which not only ensures the health status of participants, but also ensures the sustainability of teaching and training. More importantly, through the increase of attention and input in this link, especially after the improvement of lower limb and foot strength, it is conducive to better grasp the use of technical movements, and plays a positive role in improving the overall effect of teaching and training.

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