Research on Sports Simulation Under the Background of Sports Power

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ABSTRACT: *With the rapid development of computer technology, computer simulation technology as the mainstream of the computer industry has been applied in various industries in the world, and virtual reality technology as the mainstream technology of computer simulation technology has been widely used. The computer simulation technology is not only applicable to the transformation planning of the old city to new town in construction industry, city evaluation, arts and other fields, especially under the background of sports power it has also been applied in human motion in sports. In this paper the effective data and the original data are stored in the database, so that sports research staff could compare and decide the relevant parameters conveniently; 3D models of athletes and movement are constructed by MAYA; the motion paths of athletes are planed through algorithm A*; use programming way of JAVA to complete the arrangement of background service data; use Unity-3D technology to show the background data figuratively in a simulation system with 3D model; At the same time, the application of computer simulation technology in the sports of human body has enriched people's cultural life, so that people can simulate sports at home and realize the sharing of data. This research promotes the development of computer simulation technology, provides a powerful guarantee for the development of modern sports under the background sports power, accelerating the development of sports of our country and the world, which is of great significance on the study of human motion sports.*

Keywords: Computer Technology, Virtual Reality, Human Sports, Simulation, 3D Modeling

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1. Introduction

With the rapid development of information technology and digital technology, computer technology has been widely used in all aspects of people's lives. At the same time, in the context of sports power, as the leisure and entertainment environment in people living space, to a large extent sports is changed by the impact and influence of computer simulation technology; the development of economic globalization has driven the rapid development of human sports, so digitalization and informatization of sports has been the trend of economic globalization; From the development achievements at home and abroad, research on

simulation technology at home and abroad has been quite mature, and computer simulation technology has been applied in the construction, life and so on. Through the use of computer simulation technology, realistic 3D model of human sports is created. Use VR virtual reality technology to simulate each movement action, environment and motion scene human. In short, the application of computer simulation technology can promote the development of human sports. This paper focuses on the design of human sports simulation under the background of sports power. The study is divided into several parts including 3D modeling, VR virtual reality and Unity-3D front-end display, and each part is linked together to realize the simulation of human motion scenes with virtual simulation system, satisfying the simulation design of human motion under the background of sports power. Therefore, the design and research of this subject has great significance and influence [1]-[3].

2. Research on the Simulation of Human Motion Sports

2.1 Concept and Characteristics of Virtual Reality Technology

As a new high technology, although the research time is not long, virtual reality has been applied to many aspects, and its development has great influence on the development of the world. There is not a perfect definition, and it is usually interpreted as: a kind of computer simulation system to create and experience the virtual world; through the use of computer technology, a lot of information are fused into a dynamic interactive 3D scene simulation system with entity behavior, and experience can be immersed in the environment, so as to achieve the simulation of the real world with the virtual environment [4]-[5].

VR technology has three characteristics: autonomy refers to that in the simulation environment, the action is done automatically by the computer; interactivity mainly refers to human-computer interaction, and experiencer interacts action with virtual environment; the sense of presence refers to that in virtual simulation environment, the experiencer can feel their existence, and there are a feeling on the scene personally, not the simple simulation system [6].

As shown in Figure 1, it is the VR system diagram.

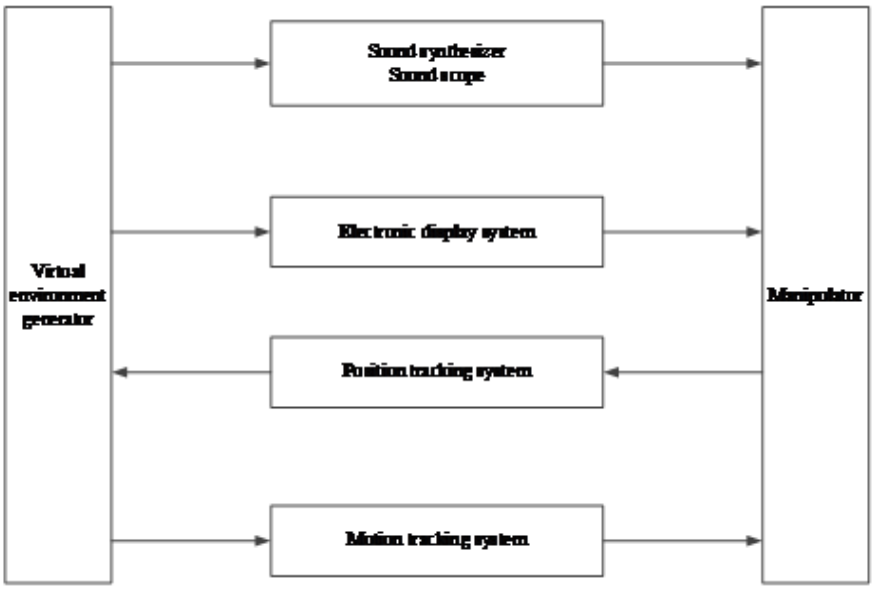

Figure 1.1VR System

2.2 Sports Simulation Technology

With the improvement of people's living standard and the rapid development of digital, "*office obesity*" has become a common symptom. Therefore, people's demand and cognition for sports are more and more high; especially in China, a sports power, the sport requirements will be gradually increased, and with the impact of the computer technology, the design of a set of perfect human physical simulation system is an important mission [7]-[8].

The simulation technology of human sports is an important branch of computer simulation system (Figure 2 is the schematic diagram of computer simulation system). It is through the computer technology to finish the simulation of environment, scenes,

action of athletes of human sports and it can reproduce and simulate the athletes' movements, skills, as well as the command and emergency response capabilities. At present, the human body sport simulation technology is an emerging technology, and has not a perfect physical simulation system, but simulation technology plays an important role in the development of sports skill and the modern sports industry.

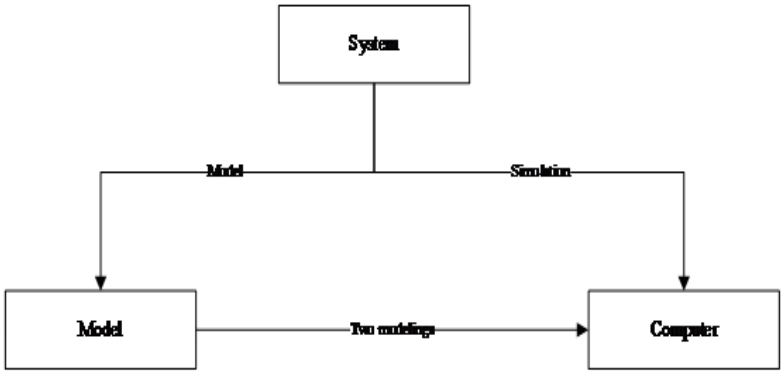

Figure 2. Computer Simulation System

3. Algorithm Design Based on Virtual Reality

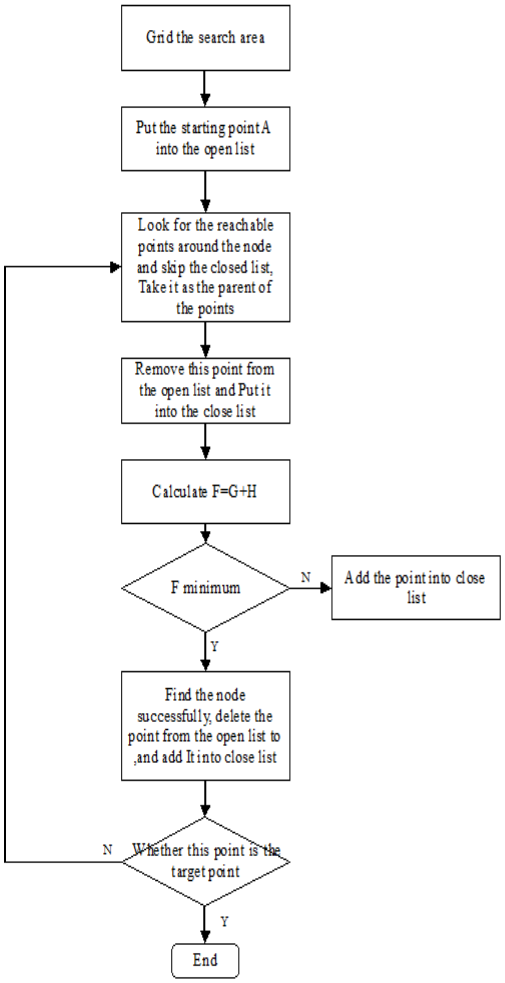

Figure 3. A* Algorithm Schematic Diagram

In this paper, the design of the algorithm mainly refers to the process of human sports. The algorithm uses the A* algorithm to plan and optimize the athlete's motion path, so that the simulation system use the best path to simulate the movement of the scene.

3.1 Path planning based on A* algorithm

In the course of sports, any sport will consider the path of choice. The purpose of this part of the design is through the implantation of the algorithm to make sure that athletes in the simulation process could reach the target point using the optimal path. In this paper, the soccer game is taken as an example to study the algorithm.

*A** algorithm is a classical algorithm in the path planning, and the algorithm has a great advantage in the priority choice. The principle diagram of the *A** algorithm is shown in figure 3.

Calculation steps are as follows:

The map is simplified as a raster map, which is convenient for analysis and subsequent programming. As shown in Figure 4 it is a raster map, and the green square *A* represents the starting point, the red square *B* represents the target point, the blue rectangle represents obstacles (Sports obstacles are generally the other players).

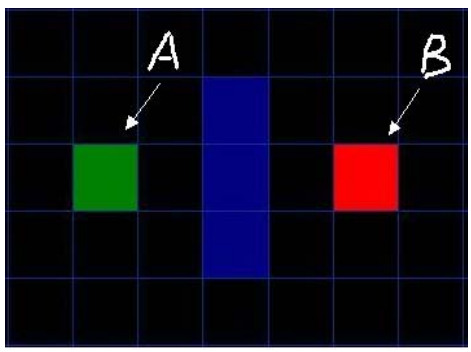

Figure 4. Grid Map Diagram

(1) Starting with A, take it as the pending unit and put into the open list.

(2) Seek all possible reaching squares around the starting point of A and put them in the open list. At the same time, set parent grid of the squares to the starting point A;

(3) Remove the A from the open list and move it to the "close list" (squares that are not checked). In Figure 5, light green stroke square said joining the "open list," said light blue stroke said putting A in the "closed list".

Find a reasonable square according to the formula:

$$F = G + H \tag{1}$$

G indicates the consumption of A moving to other squares and H indicates the consumption of other squares moving to B, so minimum F indicates that the square is most reasonable.

(4) Select the square with smallest F from the open list and record as C, and remove C from the open list and move it to the close list.

(5) Add all adjacent and accessible squares of the C to the open list and set C as the parent node.

(6) If the G value of the D square is small, the parent node is changed to C, and then the value of the F is calculated. If the G is larger, it is shown that from C to D is not the optimal path, and there is no need for any operation, as shown in figure 6.

(7) Repeat step 6, and find minimum F from the open list, remove from the open list, and move to the closed list. Find the adjacent and accessible square around it until the target point appears from the open list, indicating the optimal path from the starting point to the target point, as shown in Figure 7.

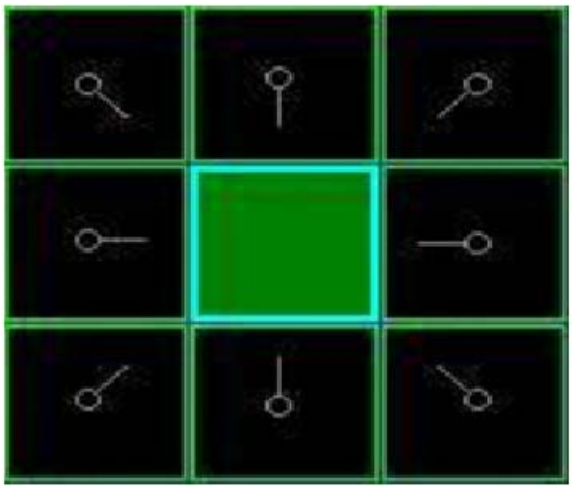

Figure 5. Detailed Map

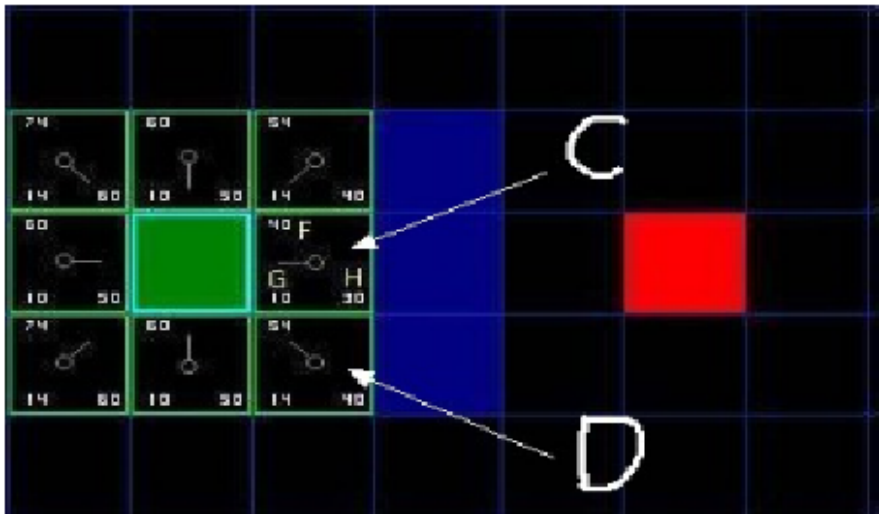

Figure 6. Path Selection Map

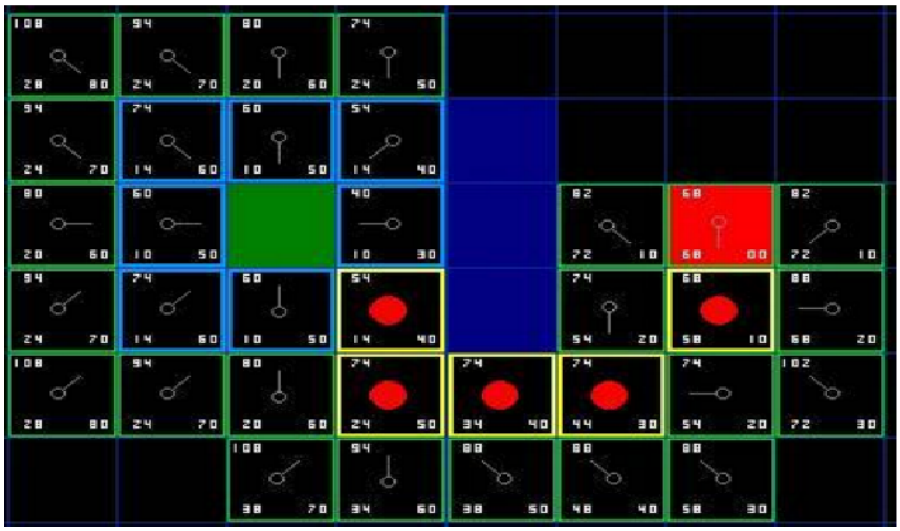

Figure 7. Optimal Path Map

Experimental Results of the Algorithm:
In the process of sports, athletes not only find the shortest path, but also ensure the shortest movement time. Figure 8 is the road map of the athlete from the starting point to the target point. There are many paths in the graph, and through the A* algorithm to finish the final selection of a path.

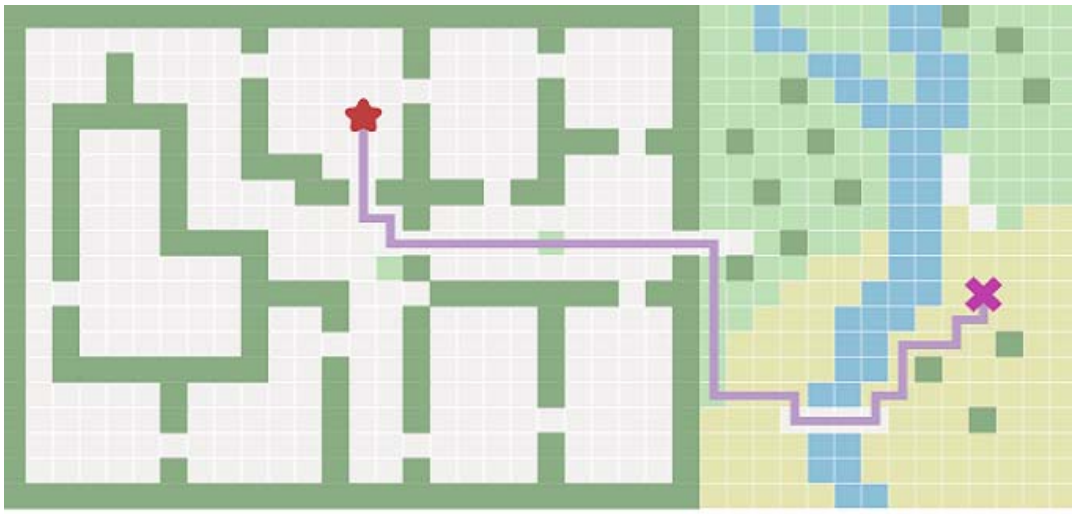

Figure 8. Route Diagram

4. Simulation of Human Sports

This paper includes the design of database for data storage, MAYA modeling, background service and front-end display to realize the final completion of the simulation system of human motion sports under the background of sports power, and the system structure is shown in figure 9.

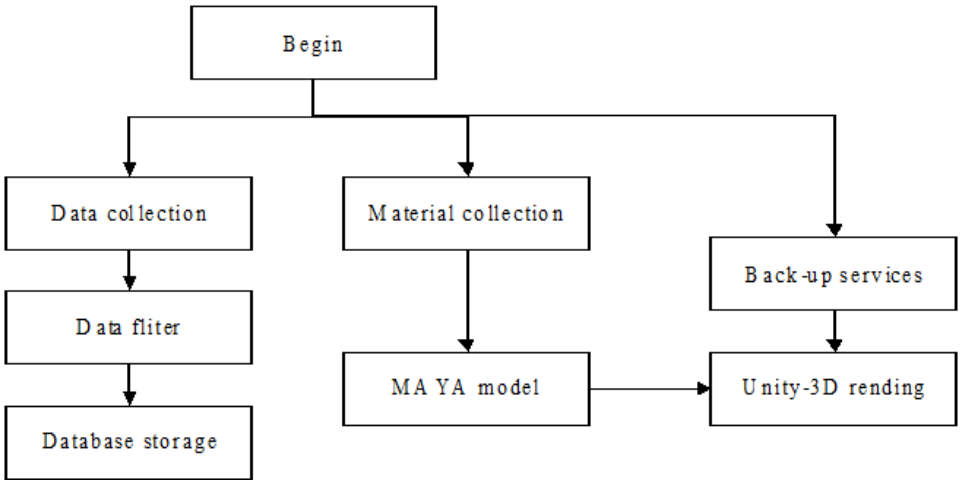

Figure 9. System structure

4.1 Data Storage based on MySql Database
With the help of the Mysql database, the data of the movement of the human body are saved in real time. Compared to other databases, Mysql database operation is relatively simple, easy to use, and can use Nevicat for Mysql tools to operate directly on the Mysql database. The data are presented intuitively in the form of tables, so as to ensure the data persistence, but in the process of data being saved to the database, because the Mysql database also has capacity constraints, a large amount of data will cause the database to collapse, thus setting the data retention period is essential [9]-[10].

The primary task of the realization of human sports and sports simulation technology is to collect and store the data of all sports. All the data in this thesis are from the data record of sports events. The acquired data is stored in the MySQL database, then the data will be processed, and the processed data (valid data) is stored in the database. Update the original data and the valid data in the database every other week. Conduct the data backup every 24 hours to realize convenient, real-time, accurate tracking of the changes in the physical parameters and make decisions, data flow chart are shown in figure 10.

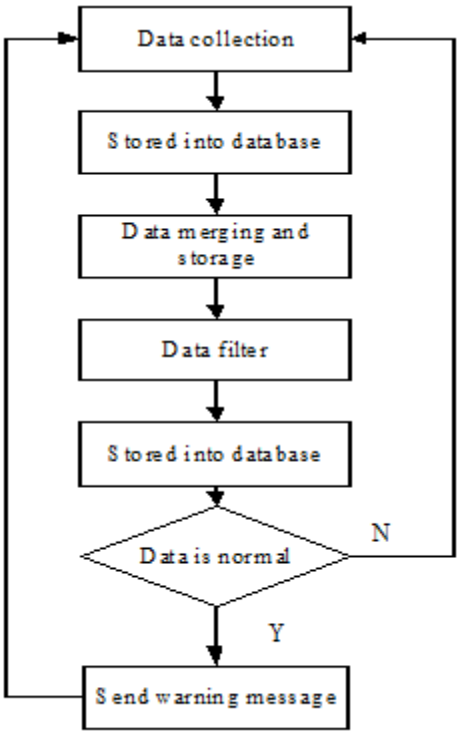

Figure 10. Data flow chart

4.2 Human Motion Modeling based on MAYA

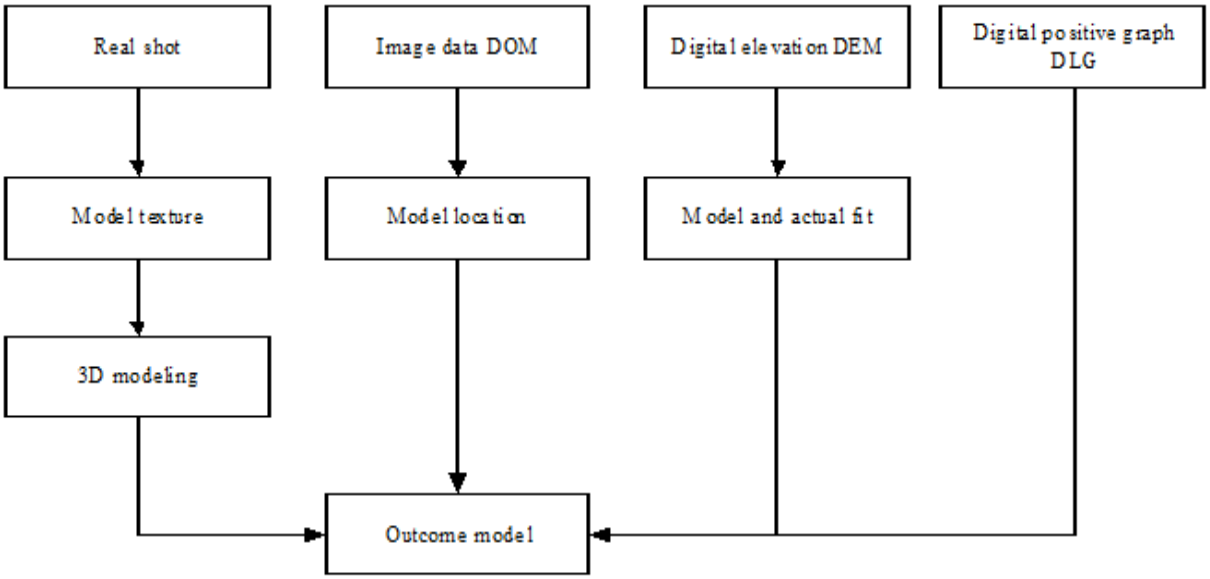

Figure 11. Flow chart of the model

MAYA is the most commonly used software in the modeling of human body, it is better than the 3D-MAX software in the dynamics and morphology of the model, so this paper uses MAYA to model the human sports.

The use of MAYA in sports figures and related actions to model, enhance three-dimensional effect. This part is to pave the way for Unity-3D technology. MAYA model will be displayed in the front of the Unity-3D, so as to achieve the digitization and informatization of human sports and to show the 3D model of the image figuratively in the physical process. The flow chart of the model is shown in figure 11.

Take soccer as an example to establish the 3D model. Figure 12 is a three-dimensional model of the human body figure, and figure 13 - figure 14 are three-dimensional models of the important actions in football.

Figure 12. 3D Model of athletes

Figure 13. 3D Model of dribbling

Figure 14. Pop and tip model

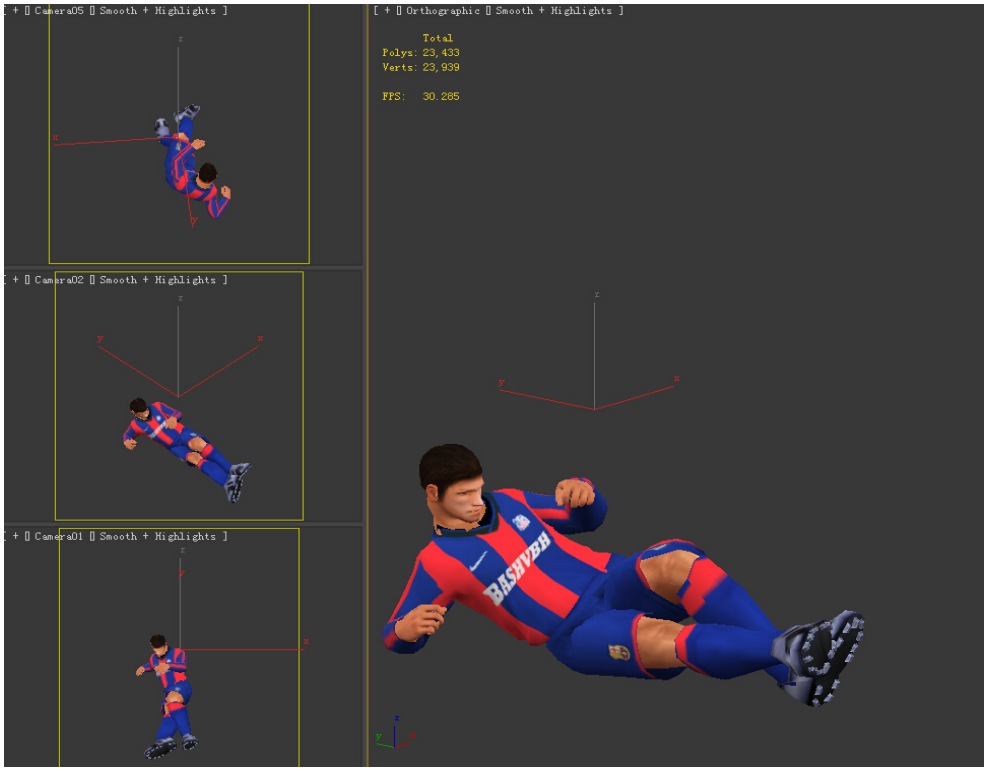

Figure 15. 3D Model of attacking

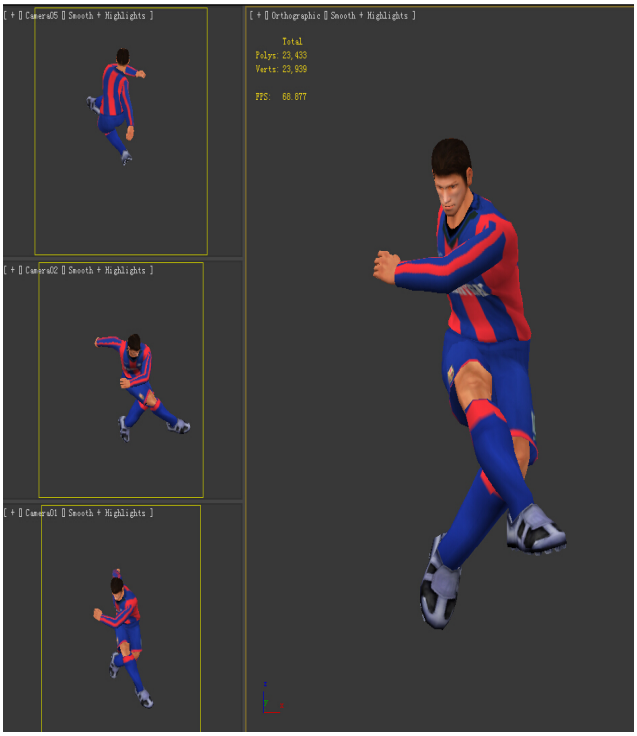

Figure 16. 3D Model of shooting

Figure 17. 3D Model of defending

4.3 Implementation of Back-end Service Based on JAVA

This part uses the Java language and with the help of eclipse software to complete the program. The athlete's motion response, path selection are in the form of data sent to Rabbit-MQ. Unity-3D receives Rabbit-MQ data and makes a series of actions. The program flow chart is shown in figure 18.

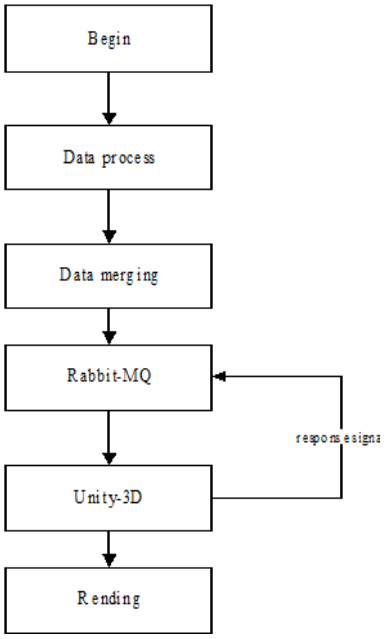

Figure 18. Program flow chart

In this paper, Rabbit-MQ is used to realize the communication between applications. The communication mode is a typical producer - consumer approach. Rabbit-MQ supports persistence of messages and we could write data to disk. In order to ensure the safety of the data, most programmers will use this communication, some of the code as shown in figure 19.

```
VALUE* updata_data_for_queue(VALUE* data, int length, int* newLen)
{
        int index;
        int count;
        int max;
        VALUE* pData;

        if(NULL == data || 0 == length || NULL == newLen)
                return NULL;

        max = length << 2;
        pData = (VALUE*)malloc(max * sizeof(VALUE));
        memset(pData, 0, max * sizeof(VALUE));

        count = 0;
        for(index = 0; index < length; index ++){
                if(check_pos_valid(data[index].x, data[index].y - 1)){
                        pData[count].x = data[index].x;
                        pData[count].y = data[index].y -1;
                        count ++;
                }

                if(check_pos_valid(data[index].x -1, data[index].y)){
                        pData[count].x = data[index].x -1;
                        pData[count].y = data[index].y;
                        count ++;
                }

                if(check_pos_valid(data[index].x, data[index].y + 1)){
                        pData[count].x = data[index].x;
                        pData[count].y = data[index].y +1;
                        count ++;
                }

                if(check_pos_valid(data[index].x + 1, data[index].y)){
                        pData[count].x = data[index].x + 1;
                        pData[count].y = data[index].y;
                        count ++;
                }
        }
```

Figure 19. Part of code

4.4 Front End Display based on Unity-3D

As a rendering engine, Unity-3D is used by many simulation systems. Compared with other engines, Unity-3D has a simple and convenient development environment, easy to operate, at the same time, it has a good rendering effect. In the design of sports simulation system, the use of this rendering engine can give users a good experience. In this design, through the MAYA to establish the human sports model, through the A* algorithm to select the best path for the athletes, through the action response to respond to the action, and finally to show the simulation scene in Unity-3D. Rendering interface of football field are shown in figure 20.

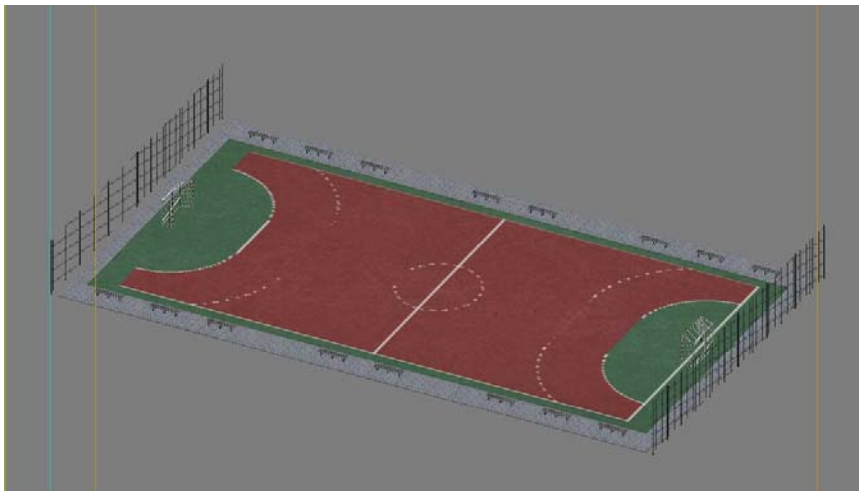

Figure 20. Rendering interface of football field

All of the work done in the paper is to prepare for the rendering of the Unity-3D front end. By receiving the back-end service and transplanting the MAYA 3D model into the scene, and adding to the response of the action, we could achieve a complete simulation of the human body sports system.

5. Conclusion

With the improvement of living standards, people's demands for cultural life are also increasing. At the same time, the simulation of information technology will undoubtedly bring great convenience to people. In this paper, the computer simulation technology is applied to the design process of human sports, breaking the traditional mode that people have to play sports or watch sports in the stadium. Through the application of computer virtual reality technology, people can fully understand the human body sports at home. At the same time, the way to store the sample data with the database has brought great convenience to the sports workers for comparing various sports parameters; the Unity-3D technology will be used to show 3D model and 3D motion in sports. Therefore, this study has an important role to promote the development of computer technology in human motion in sports, and is good to promote the development of world human sports industry and technology, but also to speed up the development process of simulation technology in Internet Era. Although some achievements have been made in the field of virtual reality, but there are still some shortcomings. In future research, we can consider the use of augmented reality technology and through the glasses to achieve the interaction of the experience. In a word, under the background of sports power, this paper lays the foundation for the research of computer simulation technology in human sports.

6. References

[1] Yi, X., Lin, Z., Zhang, F. (2010). Research on the Simulation System of Background Advertisement Setting of Sport Events, *IEEE*.

[2] Wang, Y. X., Jiang, Y. P. (2014). Research on the Simulation System of the Sports Training[J]. *Applied Mechanics & Materials*, 484-485, 1067-1070.

[3] Le, Z. Q. (2014). Research on Sports Simulation Technology Based on Virtual Reality Technology, *Applied Mechanics & Materials*, 687 - 691. 3058-3061.

[4] Hu, R. M., He, Z. D., Bai, F. (2014). The Research of 3D Human Motion Simulation and Video Analysis System Implemented, *In:* Sports Training, *Advanced Materials Research*, 926-930. 2743-2746.
[5] Zhu, L. J. (2011). The Study of the Sports System Simulation Theory and Application, *Advanced Materials Research*, 179-180 (1) 1235-1241.
[6] Satou, F. (1992). Simulation on the research & development of sports goods (Special Features on Sports Engineering, *Journal of the Japan Society for Simulation Technology*, 11 *p* 174-179.
[7] Lindeman A, R. (2012). Sports simulation device creating the illusion that sports objects interact with real world features, US Patent No. 20120322568.
[8] Zhang, L., Hu, J. (2017). Exploring the Most Important Factor of Chinese Sports Charity by Using System Dynamics Simulation, *In:* Proceedings of the Tenth International Conference on Management Science and Engineering Management. Springer. Singapore.
[9] Yang, J. Y. (2015). Harmonic Motion-based Simulator Design for Multipurpose Sports Simulation, *International Journal of Advanced Smart Convergence*, 4 (2), 163-169.
[10] Lin, S., Yuan, Y., Zheng, W. (2013). Evaluation Model Construction and Simulation Research on Tourist Diversion Strategy, Ecotourism Scenery Sport, *Applied Mathematics & Information Sciences*, 7 (6), 2249-2257.

Author Bibliography
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