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Research Article

The Simulation of Aerobics Performance Based on Virtual Reality

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The competition aerobics training project is based on the continuous summarization of experience, and on the basis of maintaining the characteristics of its own project, it also actively draws on the structure of other types of skills, and it is developed on the basis of further enriching the new "health, strength, and beauty" characteristics of competition aerobics training. This paper studies and analyzes the simulation of aerobics performance based on virtual reality. This paper firstly gives the definition of virtual reality and then studies and analyzes the action simulation recognition algorithm. The calculation methods of human action recognition usually include two types, the behavior recognition algorithm corresponding to the template and the behavior recognition algorithm based on the state space. And this paper studies the number of formation changes and the speed of the fitness aerobics complete set of movements. This paper analyzes the number and space usage of the aerobics complete sets of formation changing venues and also studies the positioning and moving paths of the aerobics complete sets of movement players. The experimental results show that the use of a complete set of three-dimensional space basically meets the requirements. The use of three-dimensional space in group B is more abundant than that in group A, and the total number of five types of space transformations is more than 10. The three groups and the two types of space have more conversions to reflect the sense of hierarchy, making the complete set of movements more active, but the number of conversions should be increased.

1. Introduction

Bodybuilding is an emerging sport that has developed rapidly since it was introduced in China. It skillfully combines basic gymnastics, modern dance, and rhythm music, with distinctive features and a strong sense of the times. Competitive aerobics is a kind of sports that can perform continuous, repetitive, and difficult complete sets of dynamic sports with the cooperation of music. The emergence of the competitive aerobics training service project is evolved from the traditional aerobic sports, with "racing" as an important purpose. The complete set of movements in competitive aerobics training adopts coherent dynamic coordination to demonstrate the athletes' competitive ability of "health, strength, and beauty" and seven basic steps, various dynamic coordination, and full execution of difficult movements.

The development of aerobics has now entered a relatively mature stage. Innovation can reach a new era, grasp the development law of aerobics in the world, conduct innovative research, find problems in time, find solutions, organically combine theoretical research results with practical applications, and promote the vigorous development of aerobics. Aiming at the insufficiency of the relevant research on the change of aerobics formation, this paper further considers the existing problems and development trend of the formation change of aerobics on the basis of previous research, in order to provide some references for the arrangement, competition, and training of aerobics through the research of this paper.

The innovation is reflected in the following: (1) The definition of virtual reality is given, virtual reality technology, also known as VR, also known as fantasy or spiritual technology. (2) The research and analysis of the motion simulation recognition algorithm is carried out. The calculation methods of human motion recognition usually include two types, the behavior recognition algorithm corresponding to the template and the behavior recognition algorithm based on the state space. (3) This paper conducts an experimental analysis and discussion on the formation change law of aerobics complete sets of movements in fitness.

2. Related Work

According to the research progress at home and abroad, different scholars also have a certain degree of cooperative research in virtual reality and aerobics performance simulation. Bastug et al. highlighted the importance of VR technology as a disruptive use case for 5G (and beyond) leveraging the latest developments in storage/memory, fog/edge computing, computer vision, artificial intelligence, and more. They also revealed the limitations of the current network and proposed more theoretical and innovative reasons to lead VR to the masses [1]. Kihonge presents a comprehensive process for designing 4C spatial mechanisms in a virtual environment. Virtual reality allows users to view and interact with digital models in a more intuitive way than using a traditional human-machine interface (HCI). The software developed as part of this research also allows multiple users to network and share designed mechanisms [2]. Elbamby et al. discuss the challenges and drivers of ultrareliable and low-latency VR. Furthermore, in an interactive VR gaming arcade case study, Elbamby et al. demonstrate a future vision of wireless VR that can be realized by intelligent network design utilizing millimeter wave communication, edge computing, and active caching [3]. Jia and Li designed a core training system for aerobics special strength quality based on artificial intelligence to realize intelligent training of aerobics special strength quality. By analyzing the working process of the module, the intensity of aerobics special movements is analyzed. The experimental results show that the designed system can realize the real-time and stable strength training of aerobics special movements and improve the training efficiency [4]. Shao and Cheng analyzed the factors affecting the quality of aerobics education in coastal areas and put forward corresponding countermeasures and suggestions to improve the quality of aerobics education. Different from the previous sports aerobics courses, in order to make aerobics continue to develop in a diversified way, it is necessary to continuously promote the reform and optimization of gymnastics guidance, the update of course content, and the update of guidance methods [5]. Vankipuram A et al. present the details of the framework and development methodology related to VR-based training simulators. In addition, Vankipuram A et al. also reported the main findings of a usability study. This usability study was conducted to evaluate the various efficacies of this VR simulator by using questionnaires with different care providers [6]. However, these scholars did not research and analyze the simulation of aerobics performance based on virtual reality but only discussed its significance unilaterally.

3. Method of Aerobics Performance Simulation Based on Virtual Reality

3.1. Definition of Virtual Reality. Virtual reality technology, also known as VR, also known as fantasy or spiritual technology, is the use of computer hardware system technology innovation and image processing science and technology, so that users can realize a virtual environment through visual, auditory, tactile, olfactory, and other perception means. With the help of unique output and input devices, the user travels in the virtual environment, and the virtual environment gives feedback to the user, so that people feel as if they are in the real environment. Figure 1 shows the virtual reality transmission system.

The virtual world generated by virtual reality technology can be called "a three-dimensional virtual world supported by computer technology, generated by a computer and carried inside the computer." The virtual reality world refers to the three-dimensional color graphics generated by high-performance computers. This virtual world can be divided into two situations: one is to simulate the reproduction of the real world in the virtual reality world, such as the restoration of cultural relics, the virtual reconstruction of protected ancient buildings, or in the field of architecture, and the simulation of unfinished buildings. Another situation is a completely virtual perceptual world established according to people's imagination. Virtual reality essentially provides people with visual, auditory, and tactile sensations through a computer, and at the same time, they can feel the virtual world in a real and natural way. This greatly facilitates people's use, thereby reducing people's work burden and improving work efficiency [7]. Figure 2 shows the virtual reality software service platform.

3.2. Action Simulation Recognition Algorithm. The calculation methods of human action recognition usually include two types, the behavior recognition algorithm corresponding to the template and the behavior recognition algorithm based on the state space. Two classic algorithms in template matching method and state space method, DTW algorithm and BP neural network algorithm, can be selected to realize human action recognition.

In the DTW algorithm, the amount of distortion needs to be calculated, and the calculation of the amount of distortion is generally obtained by the distance algorithm. The amount of distortion obtained under different distance algorithms is different, and the matching degree of the final experiment is also different. Therefore, three classical distance algorithms are compared and studied to analyze their advantages and disadvantages. In the BP neural network algorithm, in order to improve the efficiency of the algorithm and the generalization ability of the network, the traditional BP neural network algorithm has been improved, and two methods can be used to optimize the network training samples [8].

3.2.1. DTW Algorithm. The dynamic time warping algorithm is a nonlinear dynamic warping method that combines distance measurement calculation and time warping high-tech. It was first used in speech recognition.

The DTW algorithm used to be a mainstream algorithm in the field of speech recognition. During speech recognition, different people or even the same person may have different time lengths and time intervals when they say the

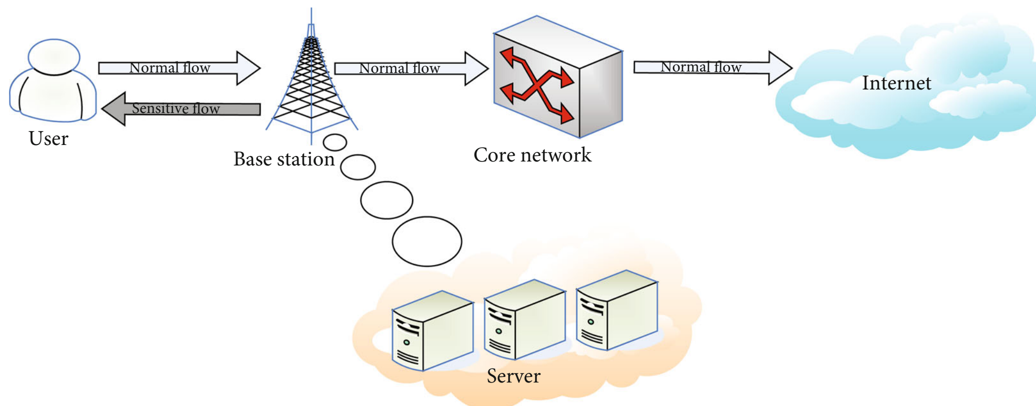


Figure 1: Virtual reality delivery system.

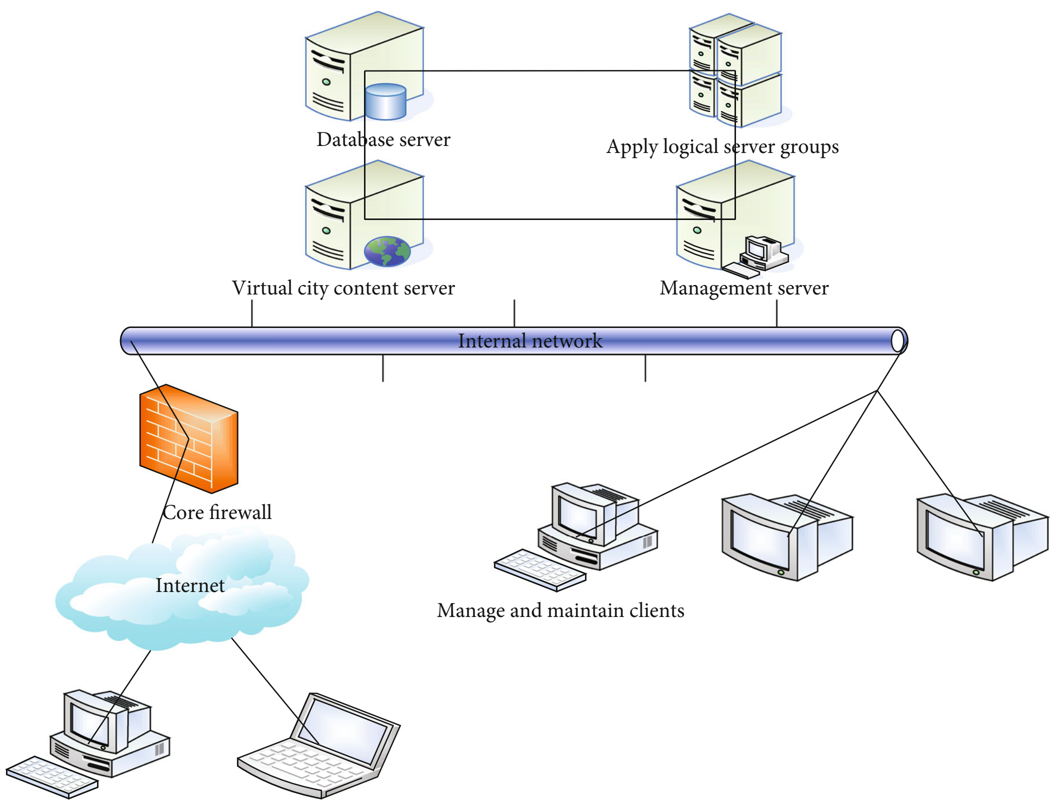


Figure 2: Virtual reality software service platform.

same word or sentence [9]. For this difficult-to-ignore time interval problem, when the template to be tested matches the reference template, the time axis of the new word needs to be processed so that the time of the template to be tested corresponds to the time of the reference template [10], as shown in Figure 3.

Assuming two action templates of different lengths, the test sample template $D = (D_1, D_2, \cdots, D_m)$ and the standard sample template $L = L_1, L_2, \cdots, L_m$, construct an $m * n$ matrix K for the two templates, which maps the two templates. Matrix element k_{st} represents the distance between vector D_s and vector L_t, which can generally be obtained by Euclidean distance, Mahalanobis distance, chi-square test, etc. [11].

A continuous set of matrix elements from k_{11} to k_{mn} in matrix K is defined as a regular path U as shown below.

$$U = \{u_1, u_2, u_3 \cdots u_h\} \ \max(m, n) \le h \le m + n - 1. \quad (1)$$

The DTW minimum distortion distance is obtained by U, as follows:

$$\mathrm{DWT}(D, L) = \min \left\{ \frac{\left(\sum_{h=1}^{h} u_h\right)}{h} \right\}. \quad (2)$$

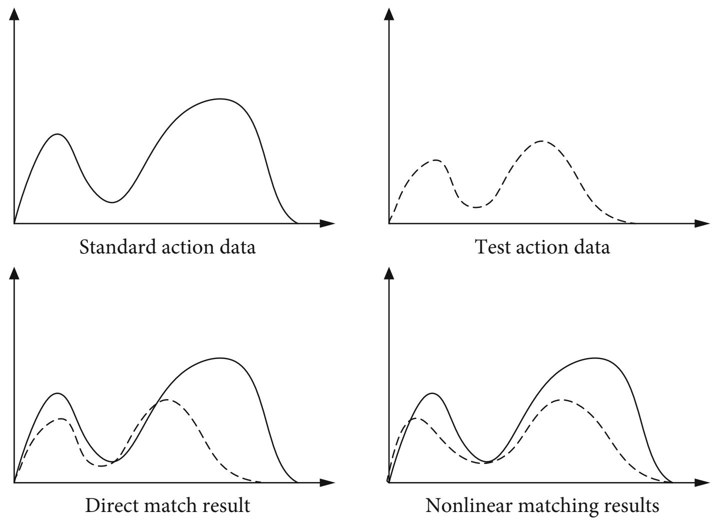


Figure 3: Comparison of algorithm matching results.

Searching for the optimal path is the process of finding the adjacent elements with the smallest cumulative distortion between the point on the current path and the surrounding matrix elements. Through the dynamic programming idea, the cumulative distance $\varphi(s, t)$ can be calculated as follows:

$$\varphi(s, t) = k(D_s, L_t) + \min \{\varphi(s-1, t-1), \varphi(s-1, t), \varphi(s, t-1)\}. \quad (3)$$

3.2.2. Distance Algorithm in DTW Algorithm

(1) Euclidean Distance. Euclidean spacing, also called Euclidean metric, is a typical spacing formula that is widely used in various fields. The Euclidean distance of two i-dimensional vectors a and b is defined as follows:

$$l_{a,b} = \sqrt{\sum_{h=1}^{i} (a_h - b_h)^2}, \quad (4)$$

where a_h and b_h are the h-th dimension components of vector a and vector b. The higher the value of the Euclidean distance l, the greater the distance between the two vectors and the greater the difference; the smaller the value of l, the smaller the distance between the two vectors and the smaller the difference [12]. If in a two-dimensional plane space, the formula for the Euclidean distance between two points $m(a_1, a_2)$ and $n(b_1, b_2)$ on the plane can be directly simplified:

$$l_{m,n} = \sqrt{(a_1 - a_2)^2 + (b_1 - b_2)^2}. \quad (5)$$

The advantage of Euclidean distance is that it is simple and widely used. The disadvantage is that the dimension inconsistency among the fractions cannot be considered. Before the actual use, the fractions must be normalized so that they have nothing to do with the unit; the correlation between the fractions cannot be considered. Because sometimes several scores that reflect cell properties at the same time also affect the results [13].

(2) Mahalanobis Distance. The calculation of Mahalanobis distance is based on the overall sample, because the covariance matrix of the sample population is used in the calculation formula, and different sample populations will produce different calculation results [14].

The formula for the Mahalanobis distance between vector A_m and vector B_n is as follows:

$$l_{a,b} = \sqrt{(A_m - B_n)^P Q^{-1} (A_m - B_n)}. \quad (6)$$

The advantage of the Mahalanobis distance is that it is not dimensionally limited, because the Mahalanobis distance between two points has nothing to do with the unit of measurement in the original data. The Mahalanobis distance between the two points measured by the normalized data results and the centralized data results (that is, the difference between the origin data results and the average) is equal. The Mahalanobis distance method can also eliminate negative effects on linear inertia between variables. But the disadvantage is that it exaggerates the negative effect of changing more subtle variables, and the Mahalanobis distance is not stable due to the influence of the covariance matrix [15].

3.2.3. BP Neural Network Algorithm. The BP algorithm uses the Delta machine learning rule and uses methods such as gradient search to minimize the mean square error coefficient between the network input and output and the expected input and output. The BP neural network structure usually includes an entry layer, a central layer, and an input and output layer. Since the central layer may also have a single layer or multiple layers, it is also called a hidden layer [16]. The calculation of the weight U_{mn} of the network is the core of the algorithm. When there are s neurons in each layer, there are $n = 1, 2, \cdots, s$; $m = 1, 2, \cdots, s$.

The algorithm execution steps of BP neural network are as follows.

Step 1. Initializing the weight coefficients.

The weight coefficient of each layer is initialized to a small random number, and the commonly used methods are the random value method within [-1,+1] and the NW (Nguyen-Widrow) method, especially, $U_{n,s+1} = -\varphi$.

Step 2. Inputing sample $A = (A_1, A_2, \cdots, A_S, 1)$ and expected output $B = (B_1, B_2, \cdots, B_S, 1)$ into the network.

Step 3. Calculating the output of each layer.

For the output A_{nr} of the nth neuron in the rth layer, there are

$$L_n^r = \sum_{m=1}^{s+1} U_{nm} A_m^{r-1}, A_{n+1}^{r-1} = 1, U_{n,s+1} = -\varphi, \tag{7}$$

$$A_n^r = g(L_n^r). \tag{8}$$

Step 4. Calculating the learning error k_n^r of each layer.

For the output layer, the error is

$$k_n^t = A_n^t \left(1 - A_n^t\right)\left(A_n^t - B_n\right). \tag{9}$$

For other layers, the error is

$$k_n^h = A_n^h \left(1 - A_n^h\right) \Sigma_i U_{\text{in}} k_n^{r+1}. \tag{10}$$

Step 5. Modify weight U_{in} and the threshold φ.

$$U_{nm}(d+1) = U_{nm}(d) - \beta k_n^r \bullet A_m^{r-1} + \tau \Delta U_{nm}(d). \tag{11}$$

Among:

$$\Delta U_{nm}(d+1) = -\beta\beta k_n^r \bullet A_m^{r-1} + \tau \Delta U_{nm}(d). \tag{12}$$

Step 6. After calculating the weights of each layer, it can be judged whether the current network achieves the expected effect through the given index. If the expected effect has been achieved, the algorithm ends; if the expected effect is not achieved, continue to jump back to Step 3 and continue to execute until the network reaches convergence [17].

The flowchart of the BP neural network is shown in Figure 4. When training the network, pay attention to the fact that the calculated average error may not reach the accuracy set at the beginning. Therefore, before training the network, it is necessary to set an upper limit on the number of iterations so that the program cannot end running [18].

3.2.4. BP Neural Network Algorithm Optimization. In order to enhance the generalization ability of the network, the following two ways can be provided to achieve sample optimization. For the classified three-layer BP neural network, the effect of the training set on the generalization ability is very obvious, even better than the effect of the hidden layer node data on the generalization ability of the network. Therefore, the training data can be optimized to improve the generalization ability of the network [19].

In the body dynamic recognition using Kinect, because the Kinect sensor is under test, the detection of related nodes or the displacement of the joints often occurs. Figure 5(a) is the skeleton image of the standing posture of the body under normal circumstances, and Figure 5(b) is the skeleton image after the displacement of the joint points of the human body. Therefore, it can be seen that the collected practice data is likely to be incorrect. This conclusion also makes the trained dynamic network very likely to be untrustworthy, and the generalization ability is quite poor. In order to deal with these problems, we must first improve the accuracy of the joint points collected by the Kinect and clear the wrong data information on the joint points. Second, it is necessary to optimize the samples by using the correlation between the data information, so as to improve the accuracy of the training data and improve the generalization ability of the training network [20].

3.2.5. Removal of Garbage Data. In terms of improving the accuracy of the joint points collected by the Kinect, the ratio between the bones of the ordinary human body is generally constant, so the calculated upper body value is shown as follows:

$$K_{\text{torso}} = 4K_{\text{head}}, L_{\text{torso}} = 1.4L_{\text{head}}, \tag{13}$$

$$K_{\text{arm}} = 2.2K_{\text{head}}, L_{\text{arm}} = 0.5L_{\text{head}}, \tag{14}$$

$$K_{\text{forearm}} = 1.9K_{\text{head}}, L_{\text{forearm}} = 0.46L_{\text{head}}, \tag{15}$$

where K_{torso} and L_{torso} refer to the height and width of the torso, K_{arm} and L_{arm} refer to the height and width of the upper arm, K_{forearm} and L_{forearm} refer to the height and width of the forearm, and K_{head} and L_{head} refer to the height and width of the head. Based on the structural analysis of the human body, it is concluded that the human body has eight joints with the same length, which are the left and right thighs, the left and right calves, the left and right upper arms, and the left and right lower arms.

Therefore, by comparing the relative proportional coefficients of the existing human body components, it can be judged whether the obtained training statistics are error statistics after joint points are lost. Through these judgments, if wrong data is generated, then this set of training data results may be regarded as garbage data results, or directly eliminated from the training data results, which improves the accuracy of training samples to a certain extent.

3.2.6. Reducing the Sample Dimension

(1) Factor Analysis. In the case of ensuring that the number of joint points is basically not lost, due to the relatively

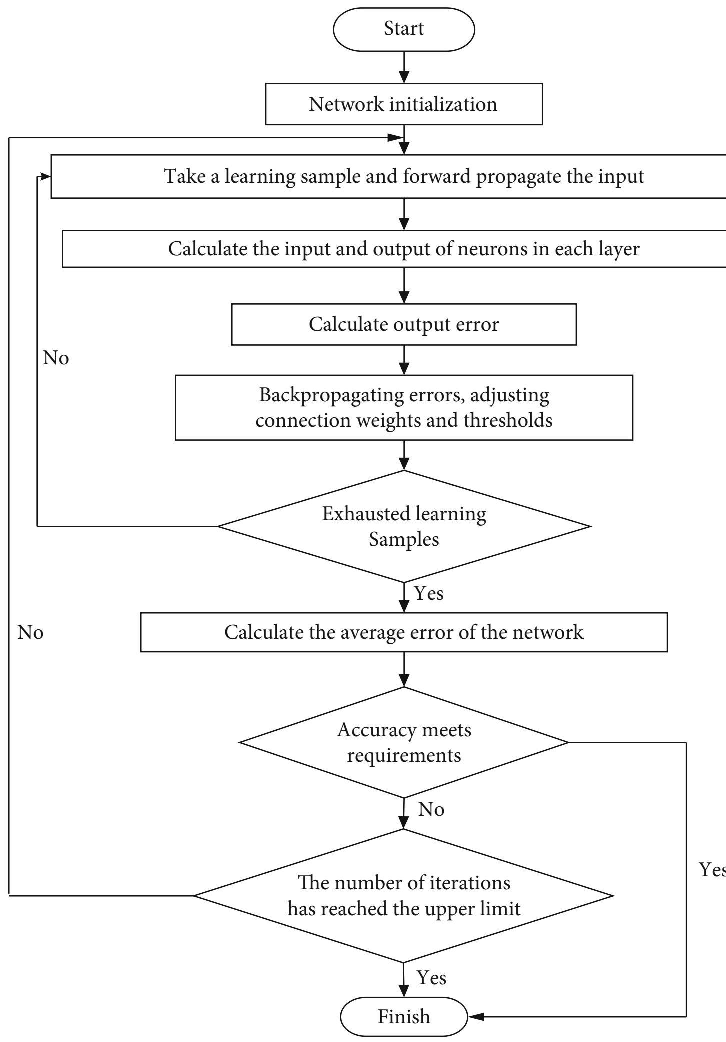
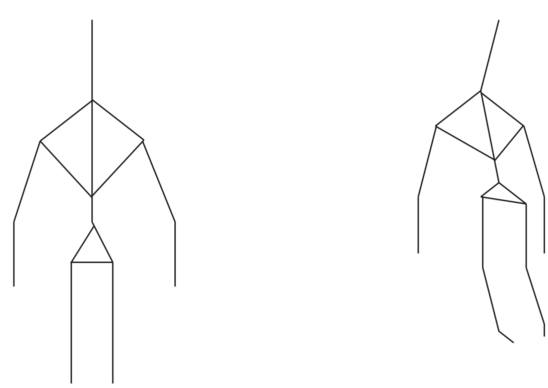


Figure 4: Traditional BP neural network algorithm flow.



(a) Normal skeleton in an upright state (b) Skeleton with joint offset in upright state

Figure 5: Kinect captures joint point skeleton diagram.

large number of dimensions of the training samples and the different accuracy, the samples were subjected to secondary optimization and factor analysis was carried out on the samples. It is a widely used multivariate data analysis method and is often used to reduce the dimension of sample data.

The mathematical representation of factor analysis is a matrix: $A = CG + D$, that is,

$$\begin{cases} a_1 = c_{11}g_1 + c_{12}g_2 + c_{13}g_3 + \cdots c_{1h}g_h + \varphi_1, \\ a_2 = c_{21}g_1 + c_{22}g_2 + c_{23}g_3 + \cdots c_{2h}g_h + \varphi_2 \\ \cdots\cdots, \\ a_r = c_{r1}g_1 + c_{r2}g_2 + c_{r3}g_3 + \cdots c_{rh}g_h + \varphi_r, \end{cases} \tag{16}$$

where vector $A(a_1, a_2, a_3, \cdots a_r)$ is the original observation variable and $G(g_1, g_2, g_3, \cdots g_r)$ is the common factor of $A(a_1, a_2, a_3, \cdots a_r)$.

(2) Factor Analysis in BP Neural Network. Let the overall sample of BP neural network be $A = (a_{nm})_{s*r}$, where a_{nm} is the mth index of a_n.

The raw data is normalized before factor optimization. In real life, due to the difference in order of magnitude and dimension, the data we collect cannot generally be used directly. In order to reduce the negative impact of the above-mentioned factors, it is necessary to standardize the original data analysis. The general normalization method adopts the normalization method of zero mean and standard deviation, and the normalized sample is A_{sr}.

Then, compute the correlation coefficient matrix $T = (t_{nm})_{r*r}$ of the total sample and solve for the eigenvalues of T and their corresponding unit eigenvectors, where

$$t_{nm} = \frac{\sum_{c-1}^{s} (a_{cn} - \overline{c_k})(a_{cn} - \overline{c_M})}{\sqrt{\sum_{c-1}^{s} (a_{cn} - \overline{c_k})^2} \sqrt{\sum_{c-1}^{s} (a_{cn} - \overline{c_M})^2}} = \frac{1}{s} \sum_{c-1}^{s} a_{cn} \bullet a_{cm}. \tag{17}$$

According to the requirements of the contribution rate, take the factor loading matrix C of the first h eigenroots and their corresponding eigenvectors:

$$C = \begin{bmatrix} p_{11}\sqrt{\varphi_1} & p_{12}\sqrt{\varphi_2} & \cdots p_{1h}\sqrt{\varphi_h} & \\ p_{21}\sqrt{\varphi_1} & p_{22}\sqrt{\varphi_2} & \cdots & p_{2h}\sqrt{\varphi_h} \\ \cdots & \cdots & \cdots & \cdots \\ p_{r1}\sqrt{\varphi_1} & p_{r2}\sqrt{\varphi_2} & \cdots & p_{rh}\sqrt{\varphi_h} \end{bmatrix}. \tag{18}$$

Finally, perform factor conversion on the obtained factor loading matrix to calculate the factor integral. The main ways of factor rotation are oblique rotation and orthogonal rotation, and the variance is the largest orthogonal rotation, denoted by the rotated factor loading matrix as

$$D_{rh} = C_{rh} T_{rr}^{-1}. \tag{19}$$

The formula for calculating the factor score is as follows.

$$G_{sr} = A_{sr} D_{hr}. \tag{20}$$

The above-mentioned factor analysis method can be used to reduce the dimensionality of the sample to further improve the accuracy of the sample.

4. The Experimental Results of the Simulation of Aerobics Performance Based on Virtual Reality

4.1. Objects. The main research object of this paper is the evolution of the movement formations of complete sets of competitions such as fitness and aerobics. The subjects of the survey were 17 sets of complete sets of movements in the top 5 finals of the two groups of fitness and aerobics A (higher vocational colleges) and B (sports colleges) in the games.

4.2. Quantity and Speed of Formation Changes of Complete Sets of Fitness Aerobics. The number and speed of formations are a factor in formation and a demonstration of the ability of the players.

In Figure 6, the competition items of group B are self-selected routines, which far exceed the time of the representative team of group A, so it puts forward higher requirements on the physical strength of the players. The total number of complete sets of action formations for group B teams is about 20, of which more than 14 are valid formations, and an average of 12-16 shots appears in an effective formation.

Based on the above analysis, coaches need to reasonably control the number and speed of formations when arranging the number and speed of formations. Limit the number of sets to 13-16, and keep the speed at 12-16 beats to complete the speed change of a formation. At the same time, it is necessary to make targeted arrangements and exercises according to the physical ability of the athletes. While improving the artistry of formation arrangement, it is necessary to increase the practice of running movements in the formation to ensure clear structure and orderly completion of movements.

4.3. Utilization of Venue and Space for Aerobics Complete Sets of Movements

4.3.1. Analysis of Site Utilization. Aerobics competitions are held on a 12-square-meter field. The full utilization of the playing field is a combination of the entire arts action protocol. For the convenience of statistics, the venue is divided into 1 (front left), 2 (front right), 3 (rear right), 4 (rear left), and the central area in a counterclockwise direction, which is often referred to as "four corners and one center."

From the competition situation, as shown in Figure 7, the overall utilization of the two groups at the four points and the central area is 2.58 times, 3.24 times, 2.29 times, 3 times, and 9.41 times. The use of four points is well balanced.

4.3.2. Analysis of Spatial Transformation. In the choreography of complete sets of movements, subtly transforming the three-dimensional space into ground, standing and air is an effective means to improve the artistic effect of

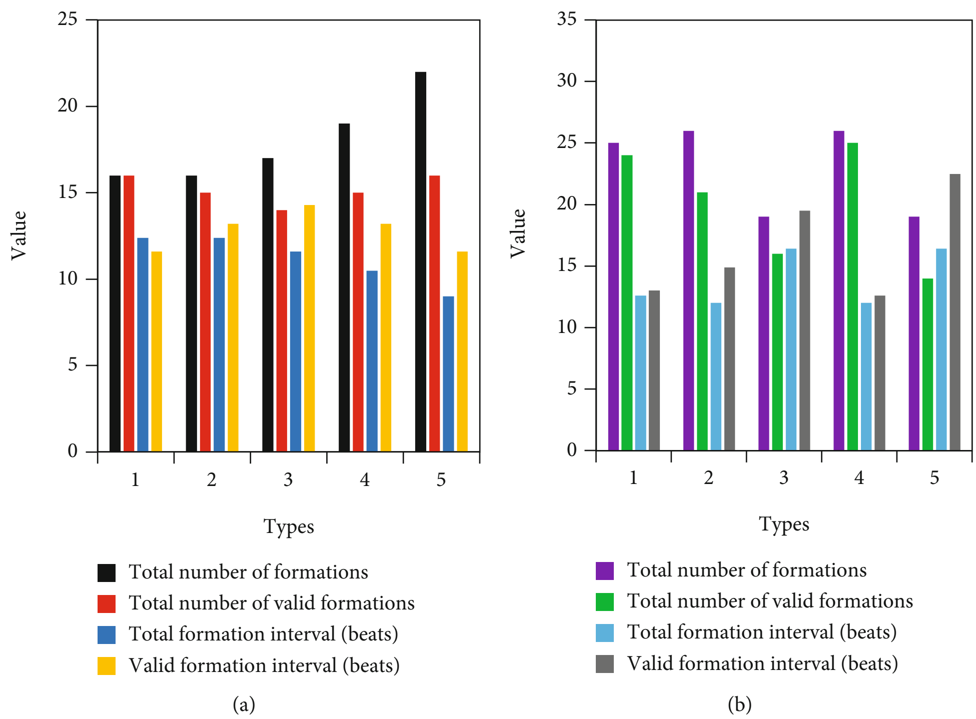


Figure 6: The formation changes of group A (a) and group B (b).

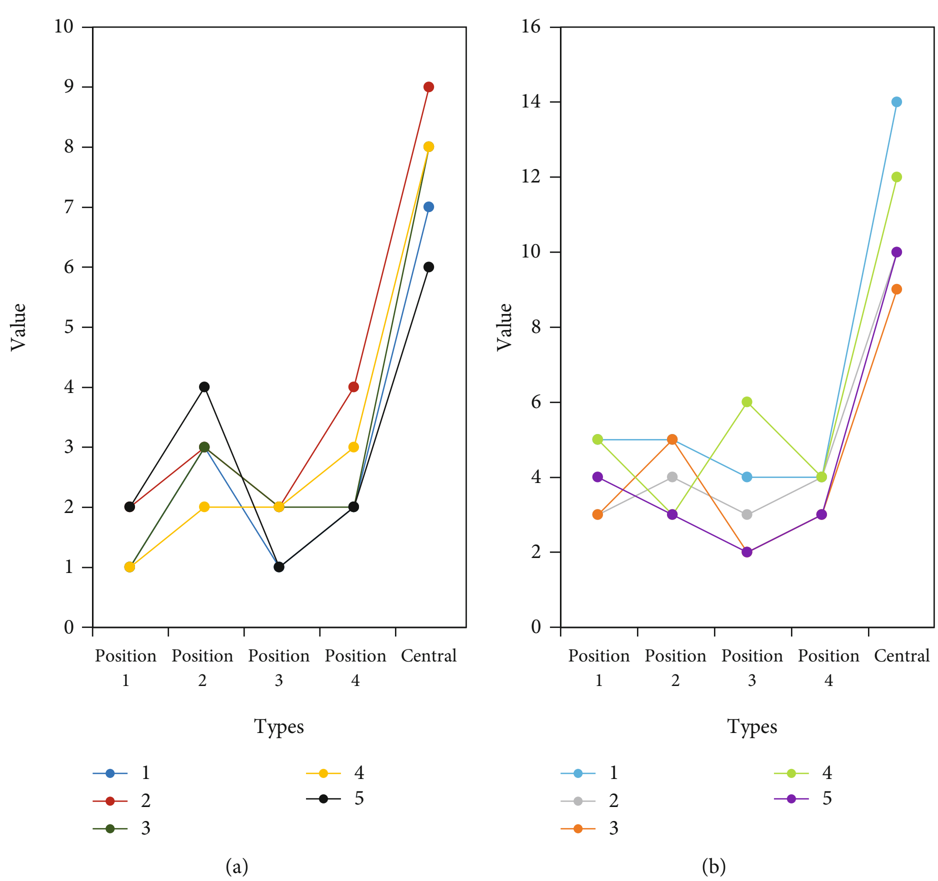


Figure 7: Site utilization in group A (a) and group B (b).

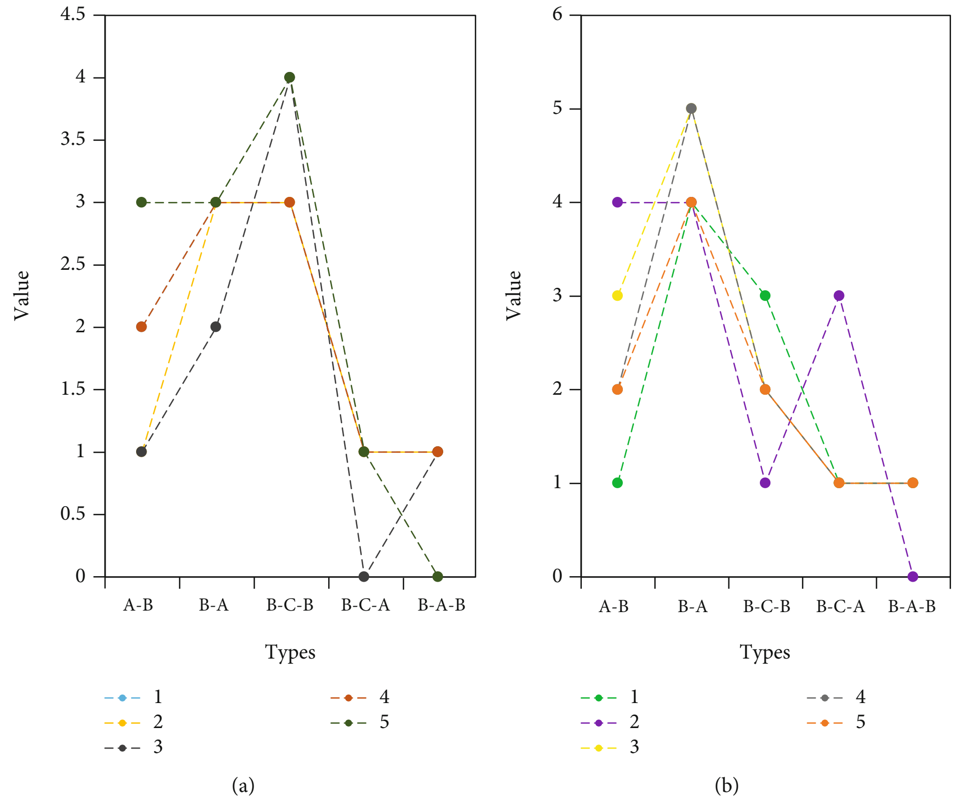


FIGURE 8: Spatial transformation of group A (a) and group B (b).

complete sets of movements. The types of space conversion mainly include ground-standing, standing-ground, standing-air-standing, standing-air-ground, and standing-ground-standing. As can be seen from Figure 8, there are five types of spaces in the two groups, namely, 21, 36, 27, 11, and 8. Standing is the most suitable for the human body structure, so the space conversion from standing accounts for the vast majority. B-A and B-C-B have more space conversions, and B-C-B reflects the space conversion between players taking off and landing and landing into standing. The number of B-C-A and B-A-B transformations is small, and the average is less than 1 time. In the application of these two spatial transformations, there is a lack of groups in both groups, which shows that the use of space is not balanced.

From the above analysis, it can be concluded that when training changes, attention must be paid to the balanced utilization of various forms of spatial transformation, and the research on types and type arrangements must be strengthened, in order to improve the spatial layering of training changes, make up for deficiencies, and shorten the gap with the national strong team.

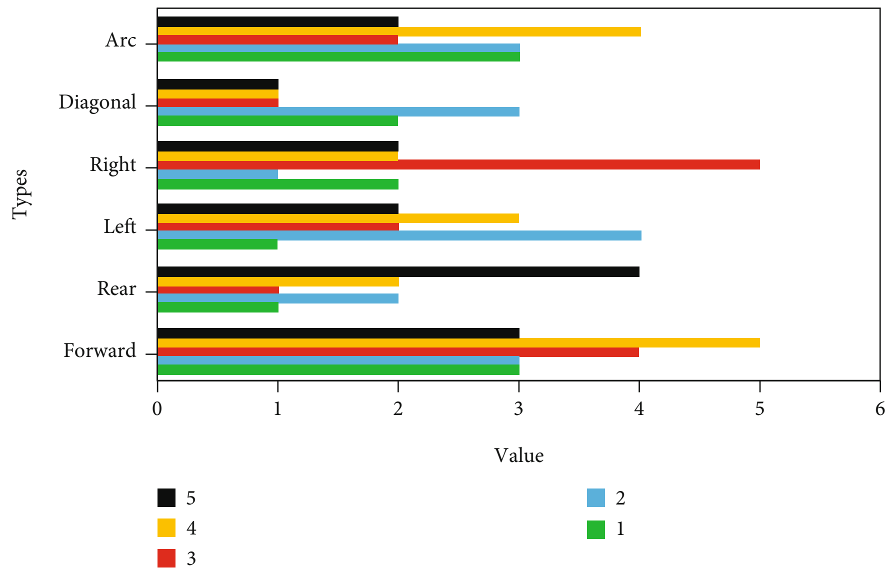
4.4. The Position and Movement Route of the Aerobics Complete Set of Players. According to the needs of the research, randomly select a player to analyze the movement changes of the players' front, rear, left, right, diagonal, and arc lines for the research object.

It can be seen from Figure 9 that the two groups are relatively balanced in the selection of moving paths, which are 37 times, 31 times, 25 times, and 24 times, respectively; the diagonals and arcs are 34 times and 26 times, respectively. Overall, it works well for the variety of moving routes. The application of the four directions is more balanced, and there is no excessive bias in one direction and imbalance in the other.

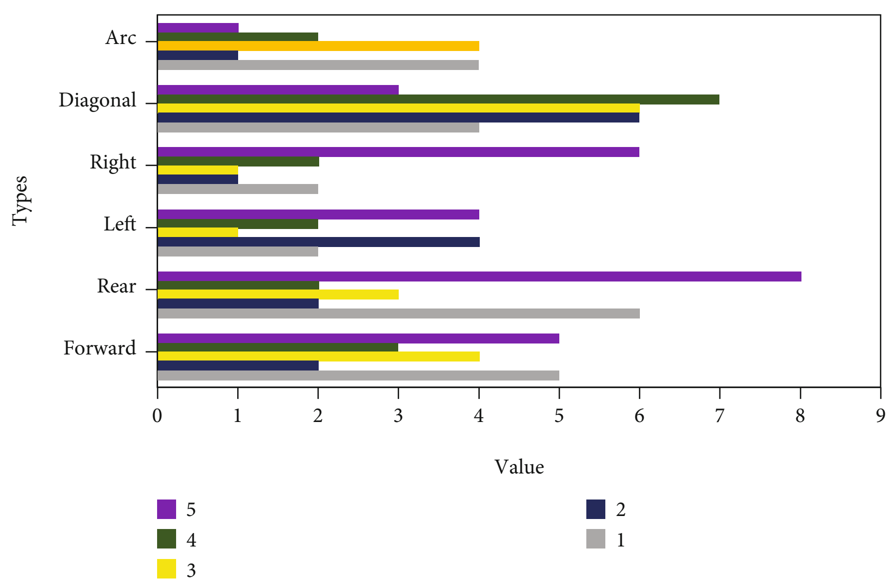
4.5. Selection of Types of Aerobics Complete Sets of Movements. The change of aerobics form is a continuous process. The previous training is the foundation of the next training, and the next training is the sublimation of the previous training. It is the mutual transformation of these forms that makes all aerobics colorful and more ornamental.

From the data in Tables 1 and 2, it can be seen that there are certain differences in the selection of training types among different groups of participating teams, especially the use of excessive and repetitive training. Two groups of training accounted for 76.5%, and excessive training accounted for 23.5%. Making the most of excessive training can add energy to the entire set, giving it a tight flow.

Compared with irregular training, regular training is used more for sets of movements, as shown in Tables 3 and 4. Group B was superior to group A in the use of irregular training. The number of irregular trainings of the representative teams in group A is lower than the average of 3.2 times, and the participating teams even have irregular training vacancies. Only when team members are able to complete routine training do coaches start thinking about organizing rich irregular formations in the field.



(a)



(b)

Figure 9: Group A (a) and group B (b) moving route statistics.

Table 1: A compositional and transitional formations, statistics on the number of valid formations, and repeated formations.

Ranking	Forming formation (number)	Excessive formation (number)	Valid formation (number)	Repeat formation (number)
1	11	3	15	1
2	10	4	14	2
3	12	3	13	2
4	15	2	14	3
5	17	3	15	5

The rules of the competition make it clear that we must take full advantage of the three-dimensional changes in space. As can be seen from the above, the tiered training for each team was used more than twice, indicating that tiered training plays an indispensable role as a factor that enriches the content of the entire training arrangement.

5. Discussion

To sum up, the following conclusions are drawn through theoretical and empirical analysis of the survey results and the influencing factors on the formation of fitness and aerobics complete sets of movements: the rules have a wider range of art arrangement scoring for art referees, refine the scoring factors, enrich the scoring content, and have more comprehensive requirements for the evaluation of formation factors. The formation changes of aerobics complete sets of movements need to follow the principle of clear pattern,

Table 2: Formation and transitional formation, effective formation, and number of repeated formations.

Ranking	Forming formation (number)	Excessive formation (number)	Valid formation (number)	Repeat formation (number)
1	17	5	23	2
2	15	4	20	4
3	8	4	15	2
4	20	3	24	2
5	9	3	13	4

Table 3: Statistics of regular and irregular formations in group A and the number of hierarchical formations.

Ranking	Number of regular formations	Number of irregular formations	Hierarchical formation
1	15	1	5
2	15	1	4
3	13	2	3
4	15	2	4
5	19	1	4

Table 4: Statistics on the number of regular and irregular formations and hierarchical formations in group B.

Ranking	Number of regular formations	Number of irregular formations	Hierarchical formation
1	16	6	3
2	15	4	2
3	10	2	5
4	15	8	3
5	9	3	1

principle of display movement, principle of diversity and novelty, and principle of fluency of route change. Within the scope allowed by the rules, selecting as many participants as possible can make more full use of the venue space and enrich the patterns of formation changes. In the creation of the formation, by changing the direction, the route, the combination of the number of people, etc., each area of the venue must be used in a complete and balanced manner, so that the formation change is more novel, beautiful, reasonable, and smooth.

6. Conclusions

The design of the formation changes of the complete sets of movements in the aerobics competition should be based on the requirements of the competition rules, through directions, routes, various pace types, and different combinations of numbers, and the formation changes are more novel, beautiful, reasonable, and smooth, so as to improve artistry and attract referees and spectators. The basic regulations for the formation transformation of complete sets of movements in fitness and aerobics competitions are as follows: in the complete set of movements, at least one formation change occurs; in the complete set of movements, there must be more than one high, medium, and low spatial level transformation. The movement and transformation of the formation should pay attention to the smoothness of the movements and the strong contrast, pay attention to the reasonable collocation of points, lines, and planes, and use a variety of methods to fully, evenly, and effectively use the three-dimensional space of the entire venue. The rules have more specific requirements for the artistic arrangement of complete sets of action formations. Therefore, coaches should carefully study the scoring elements in the rules when arranging the formations, so as to improve the ability to create and innovate.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The author declares no conflicts of interest.

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