Test of Dance Training System Based on Motion Capture and Virtual Reality Technology

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Abstract

In order to meet students' learning needs and improve their learning efficiency, it is necessary to develop a dance training system combining motion capture and virtual reality technology. Through this system, students can learn the dance movements of the virtual teacher through OpenGL, and the system will use the sensors worn by the students to capture the students' dance dynamics, analyze and feedback the results. The final system test also proved that the system has certain advantages and certain interest in dance learning. Of course, it is necessary to carry out the next step of the system performance research.

Keywords: *3D graphics engine; OpenGL; optical motion capture system*

1 INTRODUCTION

People mainly learn dance movements by participating in dance training and watching videos, but both the first and the second way are certain shortcomings. The first way requires students to have enough time to learn, and the second way, when students move to imitate mistakes, they can not be corrected in time. Visualizing dance movements in a 3D virtual environment can help students improve their learning efficiency, but the lack of feedback can also lead to a series of problems. Therefore, it is necessary to build a new dance training system by combining motion capture and virtual reality. By installing action sensors on the students, the system will automatically collect the action information of the students and feed the information back to the students. In addition to accurately and objectively reflect the students' learning level, these information data can also evaluate the level gap between students and teachers.

2 DANCE TRAINING SYSTEM DESIGN

2.1 System architecture

The dance training system combining motion capture and virtual reality technology includes motion matching module, motion capture module, 3D graphics engine module and motion database module, as shown in Figure 1, there is also an inevitable connection between module and module. After the system captures the user action data, it will compare it with the database action data and visualize the action through the 3D graphics engine.

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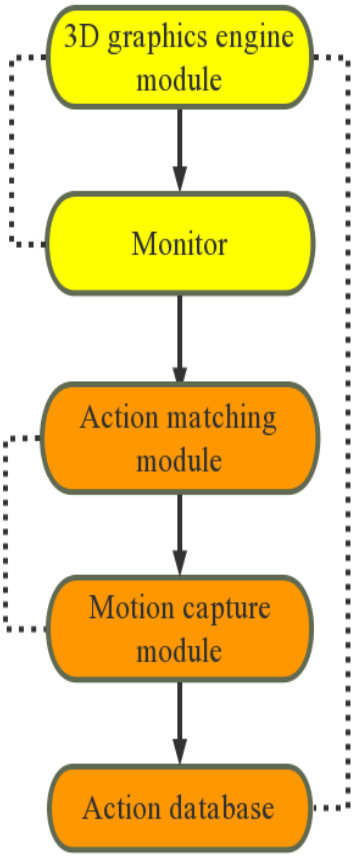

Figure 1: Composition components of the dance training system

2.2 Action tracking

The virtual teachers presented in the system are mainly made by rendering 3D animation through OpenGL. Students can learn the dance by imitating the movements of the virtual teacher, and the perspective of the virtual teacher will be independently adjusted to the Angle that the students need. Therefore, students can adjust their mistakes in time by comparing with the virtual teacher's movements. In addition, in order to timely feedback movement data for students, the system will also use the sensors worn by students to track and capture students' dance movements. For example, the system uses an optical motion capture system, which can provide feedback information to users at the fastest speed.

2.3 Feedback type

System through real-time feedback can effectively improve students' learning efficiency, through the students practice, using real-time capture and reflect the virtual portrait, let the students see himself and the teacher standing side by side, when the students are wrong, wrong parts will be marked as red, the right part will be marked as yellow, thus, students can not only effectively observe their own movements, but also can quickly correct their work. In addition to real-time feedback, the system can also improve the quality of students' learning through scoring feedback. For example, [1] when the students complete the dance training, the system will issue the students' dance training report, in which the data are listed to score the movement completion level of each part of the students. So that students have an understanding of their dance movements, clearly see their advantages and disadvantages, and analyze which parts need to be improved. In addition, the system also provides the slow-motion playback function, which is the third system feedback mode. Students can check whether their various body parts are in place by playing back their slow motion. In the playback, the different color mark of the virtual portrait will help students to understand their comprehensive level, the more incorrect the action, the darker the color mark. Of course, subsequent students can also correct their dance movements by referring to the teacher's movements. The system feedback method is shown in Figure 2.

Figure 2. System feedback method

In fact, these three kinds of feedback involve the comparison between movements, which is the comparison between students and teachers. Through comparison, [2] students' dance movements can be standardized. Actions can be decomposed into a series of poses, in order to normalize the poses and ensure that the position has the same root and orientation. Because the student and the teacher are not consistent, so the need to divide the teacher and students joint position by the total length of the body segment, [3] by 15 joints to indicate a certain position. Examples include left / right elbow, left / right thigh, left / right ankle, left / right head, [6] etc. In the feedback, the color of each joint depends on the accuracy of the posture, which is calculated mainly by the Eucoan distance between the teacher and the student posture. [8] In the final scoring feedback, the average joint position of the teacher and student posture over all frames is also calculated based on the Eucanoid distance, [9] thus obtaining the joint score. In slow-motion playback, the Euclidean distance is zero, or the color is white, which means that the movement is normal, but the larger the Euclidean distance, the color deepens, and the greater the movement error. [10]

3 SYSTEM TESTING

3.1 Feature selection

Joint position and angle and rate represent the measure of difference between action and movement, [11] and comparing these three characteristics separately can find the characteristics most suitable for dance evaluation. The following table evaluates three features using two sets of data, [12] the first representing movements of similar movements and the second representing movements of dissimilar movements. Using the right T test, these actions quantify the following results. [13]

Table 1: Right T test results of one and three characteristics

Movement and joint characteristics	First group	Group 2
Position	Average:16.87	Average:40.3
	Standard deviation:6.77	Standard deviation:6.85
Rate	Average:1.17	Average:2.05
	Standard deviation:0.60	Standard deviation:0.07
Angle	Average:17.42	Average:38.07

	Standard deviation:7.75	Standard deviation:7.12

3.2 Comparison experiment

The results of systematic dance learning and self-study can test the effectiveness of the dance training system combining motion capture and virtual reality. Therefore, [15] it is necessary to set up special experiments, which are divided into four men and four women, [16] respectively from the experimental group and the control group. Students in the experimental group mainly conduct dance training and learning through the system, [17] while students in the control group learn dance through self-study. To ensure the fairness and scientific objectivity of the experiment, both groups had no previous dance learning experience and had never participated in dance training. [18]

Table 2: Basic information of the students

Number	Gender	Group
1	Female	Experience group
2	Female	Experience group
3	Male	Experience group
4	Male	Experience group
5	Female	Control group
6	Female	Control group
7	Male	Control group
8	Male	Control group

Evaluation of the experimental and control groups by the T-test yields an experimental baseline, [19] which resulted in a P-value of 0.2116 and P> 0.01, so that the baseline difference between the two groups was not obvious. Table III was obtained by analyzing the baseline and post-training changes by the T test. [21]

Table 3: Comparison of the differences before and after the training session

	Pre training (baseline)	After training
Average value	37.08	37.92
Standard deviation	7.15	5.02
P value	0.337	
t value	0.421	
Freedom	11	

As can be seen from the above table, there is no significant difference in the pre-and post training results, [5] mainly because the students do not fully grasp the movements, [20] while the following table is the data of the students in the experimental group and the control group after the improvement of the movements, which are analyzed by the T test. [14]

Table 4: Improvement of dance movements in the experimental group and the control groups

	Experience group	Control group
Average value	10.83	0.83
Standard deviation	5.37	6.70
P value	0.001	
t value	3.918	
Freedom	11	

From the above table, there are significant differences between the improved experimental group and the control group, and the improvement in the experimental group is better, [1] which also shows that the effectiveness of this system is greater than that of self-study. According to the results, the students participating in the test were surveyed, and the following figure was obtained.[7]

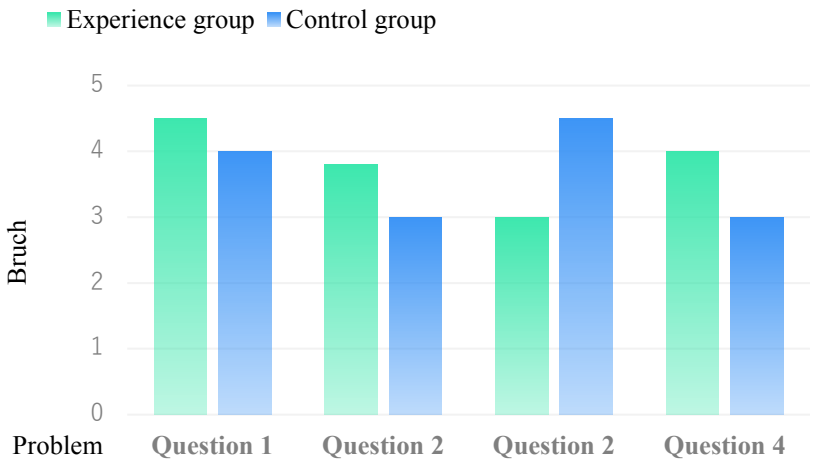

Figure 2: The questionnaire survey results

Among them, question 1 is "whether the system will be recommended", [4] question 2 is "whether the interest in dance is improved after learning dance through the system", question 3 "is the dance movement difficult", [2] and question 4 "do you find the course interesting". The answer is divided into yes, no, general, recorded as five points, one point, three points respectively. The results show that the system can stimulate students' interest in learning and improve their learning efficiency. [13]

4 CONCLUSION

The dance training system combining motion capture and virtual reality can provide students with a more real and effective dance course, and stimulate students 'interest in learning to the greatest extent, so that students' image can be virtualized. In addition, the system will also capture the students' learning dynamics, summarize them into the data, analyze the data, and help the students to find the key and difficult points in the dance training. The experimental results also show that the dance training system combining motion capture and virtual reality can not only evaluate different movements, but also help students to a greater learning level than self-study.

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