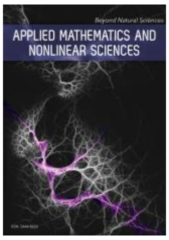
sciendo Applied Mathematics and Nonlinear Sciences, 9(1) (2024) 1-14



Applied Mathematics and Nonlinear Sciences

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Application of Interactive Multimedia System in Early Childhood Dance and Artistic Creativity Cultivation

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Submission Info

Communicated by Z. Sabir
Received February 20, 2024
Accepted May 18, 2024
Available online July 5, 2024

Abstract

This paper utilizes MPEG4 technology to design an interactive multimedia system and applies the system to instruct young children's dance movements and techniques in their dance learning. The implementation process of the system is to use a multi-layer neural network to establish a coarse estimation method of dance posture, and then through the root node deep regression network to deeply estimate and analyze the 2D posture of young children in the process of dance. Finally, the multi-feature fusion module is used to fuse the skeletal points and key point features of the body to analyze the 3D posture of young children during the dance. After testing the recognition effect of the system and analyzing the application effect of the interactive multimedia system, the overall movement completion time of the spiral dance in the experimental group was significantly reduced, and the time required for the rotational movement in the dance was also reduced from the initial 1.22 s to 0.899 s. There were significant differences in the levels of artistic creativity in all dimensions of artistic creativity before and after the application of the interactive multimedia system ($P<0.05$). This paper provides a reference method for improving the ability of young children to dance and cultivate artistic creativity. Also, it lays the foundation for the educational application of interactive multimedia systems.

Keywords: MPEG4 technology; Gesture estimation; Neural network; Multi-feature fusion; Early childhood dance.
AMS 2010 codes: 68P30

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ISSN 2444-8656
https://doi.org/10.2478/amns-2024-1629

1 Introduction

With the continuous progress of society, the accelerating pace of people's work, and the popularization of computers in more and more families, the application of multimedia in kindergarten teaching has become more and more widespread [1-2]. Interactive multimedia teaching in kindergarten is based on network technology, using advanced informatization means and tools to realize all digitalization from environment resources to activities [3-6]. A digital kindergarten is constructed on the basis of the traditional kindergarten to expand the time and space dimension of the kindergarten in reality, which enhances the teaching efficiency of the conventional kindergarten, expands the functions of the traditional kindergarten, and ultimately realizes the comprehensive informatization of the educational process [7-9].

The introduction of modern multimedia technology into the field of early childhood quality education makes a new trend in the reform and development of early childhood education. Young children are curious, active, competitive, imitative, able to learn in their way, and try to innovate in their learning. The multimedia network environment can fully mobilize young children's interest in independent education, active experimentation, active exploration, and active experience [10-11]. So that young children's intelligence and all kinds of potential to be developed, the spirit of innovation to be cultivated, practical ability to be trained.

Literature [12] describes the problems encountered along the way in a career in dance studies, from early dance training to university dance courses and research centers to becoming a dance artist or researcher. Literature [13] summarizes the relationship between reflective connections and dance teaching through a project at the Lambert School of Dance, where dance teachers are expected to engage in creative and reflective practice from time to time in their teaching of the curriculum. Literature [14] argues that dance teachers can start from the perspective of aesthetic value when evaluating students' competence so that the dance has both power and beauty, and the beat of music and dance is strictly controlled so that the dance and music are perfectly integrated. Literature [15] analyzed the optimization of the combination of multimedia-based music education and early childhood dance teaching, combined with regional characteristics. The integration of music concepts into early childhood dance education is an effective measure to stimulate the interest of young children in dance, improve the level of young children's learning, and improve the quality of teaching. Literature [16] used neural networks to build a prediction model and analyzed the reliability and error of the prediction model for dance students' special performances. The test results show that the model constructed by the neural network predicts the level of dance performance and physical quality development more accurately than the regression model. Literature [17] analyzed the evaluation process of multimedia teaching and the current situation of multimedia teaching and visualized it with data. The results showed that the system is important for improving the effectiveness of classroom teaching. Literature [18] used virtual reality simulation technology to conduct a preliminary study of sports dance rehearsal and realized a virtual simulation system for sports dance rehearsal practice, focusing on the virtual human body animation technology, dance movement editing and choreography, and sound music harmony.

The purpose of this paper is to design an interactive multimedia system that utilizes MPEG4 technology and JAVA language technology. The interactive multimedia system is then applied to the instruction and learning process of young children's dance, and the virtual teacher in the system is utilized to instruct and improve the young children's dance movements so as to improve their dance ability and artistic creativity. First, a multilayer neural network is combined with the ReLU activation function to obtain a coarse estimate of young children's dance posture. The root node deep regression network is used to analyze the 2D posture of young children in dance and obtain the distribution information of each node of the body in space. Finally, the multi-feature fusion module is designed to fuse the key points of the young children in the dance process with the skeletal point features to get the absolute depth of each node and then estimate and analyze the 3D posture of the young children in the dance process through the inverse projection method. After the accuracy of the dance posture estimation method is verified on this basis, the danceability and artistic creativity of young children are analyzed after the application of the interactive multimedia system to explore the application effect of the interactive multimedia system.

2 Pathways to the use of interactive multimedia systems in early childhood dance

2.1 MPEG4-based interactive multimedia system

A typical interactive multimedia system is generally composed of four subsystems, namely, image segmentation, camera tracking, background generation, and image synthesis. Due to the characteristics of MPEG4 technology itself, this paper basically puts background generation and image synthesis in the image processing subsystem to complete. In this paper, the use of MPEG4 real-time transmission of graphics streaming media in the design of the system structure combined with the JAVA language technology to design the interactive multimedia system framework is shown in Figure 1. JAVA Media Framework (JMF) can be audio, video, and other time-based media combined into the JAVA program, which makes the JAVA program the ability to capture video and audio signals, storage, playback, JMF can be divided into JMF API and JMF RTPAPI, the former is used to capture, process, store and play media streams. The latter is mainly used for transmitting media streams, including sending and receiving media. It is important to provide access to scene files in the system.

The operation of access to other SQL databases is realized through the use of the database interface JDBC provided by the JAVA language because the Java SDK is specially set up in the package java.sq1 to implement the SQL function of the class. This database access operation is important as a module in an interactive multimedia system. MPEG-J provides the process of using JIAVA technology to program and control the operation of the MPEG4 terminal and the specific presentation of the scene content. If the terminal doesn't have an MPEG4 player program, it's necessary to download the MPEG4 player program and the particular scene content to play MPEG4 content.

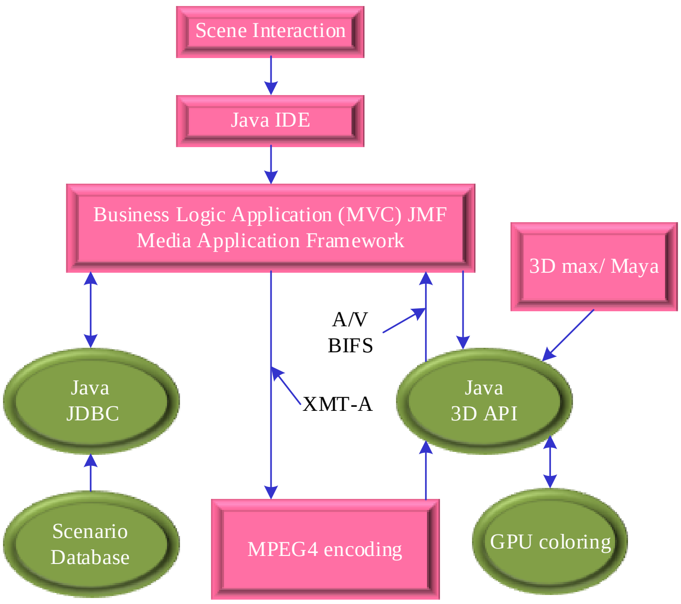


Figure 1. Interactive multimedia system diagram

2.2 Application of Interactive Multimedia Systems

In this section, we design the application path of an interactive multimedia system for early childhood dance, and we show the specific flow of the path in Fig. 2. The application path is analyzed in terms of the process of early childhood dance before, during, and after the class. The virtual teacher assists in the effective improvement of early childhood dance learning as a part of the early childhood dance learning environment. The virtual teacher based on the virtual environment possesses four aspects of work, i.e., the function of troubleshooting, the function of providing basic instruction and guidance to young children in dance, the function of measuring the results of young children's dance, and the function of supervising the process of learning dance. With the help of the virtual teacher based on the interactive multimedia system, the children can complete the independent learning of technical and theoretical knowledge of dance assigned by the teacher, which gives full play to the children's subjectivity and creativity in learning dance. The teacher in the dance class assesses the difficulties faced by the children in learning dance techniques and theories by analyzing the teaching records and assessment results transmitted by the virtual teacher and provides guidance.

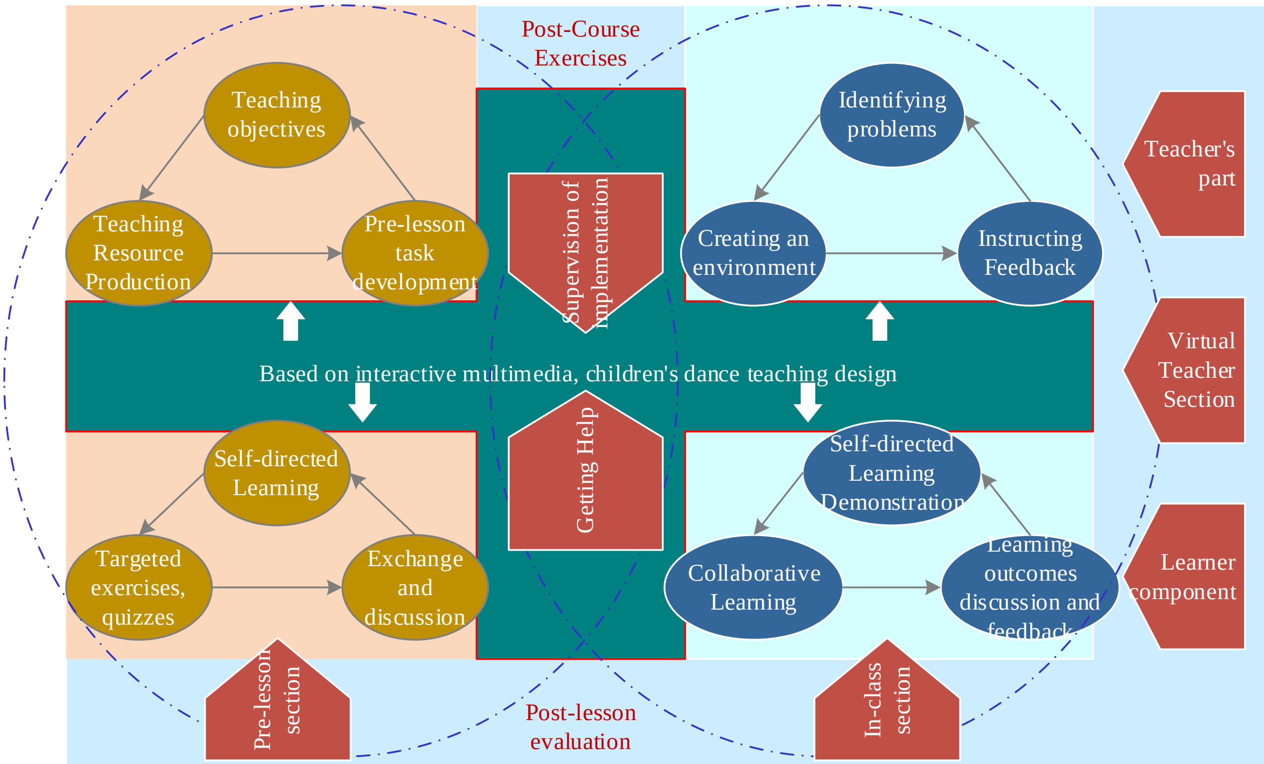


Figure 2. The interactive multimedia system is applied in the child's dance

3 Methods for analyzing the estimation of three-dimensional postures in the dance process of young children

3.1 Three-dimensional rough estimation module for young children's dance postures

In this paper, the 2D pose of each person is first obtained by a 2D pose estimation algorithm in toddler dance, and then the corresponding 3D pose is calculated by solving the depth of each key point. To reduce quantization errors in the depth-solving process, this section first designs a 3D human pose coarse estimation module during toddler dance to preliminarily predict the depth value of each key point.

The posture coarse estimation module is responsible for processing the 2D toddler posture estimation results directly. Batch normalization (BN), ReLU activation function, and residual connectivity are all features of a simple multilayer neural network used in the module. The pose coarse estimation module's specific structure is depicted in Fig. 3. Firstly, the 2D poses of young children during dancing are normalized according to the image size by dividing the horizontal and vertical coordinates of the 2D coordinates by the width and height of the image, respectively, with the specific formulas shown below:

$$x_{norm} = \frac{x}{w}, y_{norm} = \frac{y}{h} \tag{1}$$

The normalized 2D pose is expanded into a one-dimensional vector of size $(B, 2\times J)$, where B is the number of samples and J is the number of keypoints, which is usually 17. Next, the 2D pose is inputted into a fully connected layer, and the dimensionality is increased to 128 by a linear mapping, and then features are extracted by two convolution modules containing residual joins, and finally the dimensionality is reduced from 128 to J by a fully connected layer to obtain the depth of each keypoint relative to the root depth of the node $\hat{d}_{rel\text{-}coarse}$. Its size is (B, J) and the size of each sample is $(1, J)$. The coarse estimation module is able to obtain a preliminary depth of the keypoints in the toddler's dance, but the result is not the final gesture estimation result, which is mainly to provide preliminary depth information for the two depth estimation modules in the later section, to optimize the feature matching degree in each view, and, at the same time, to give a preliminary range space thus reducing the quantization error.

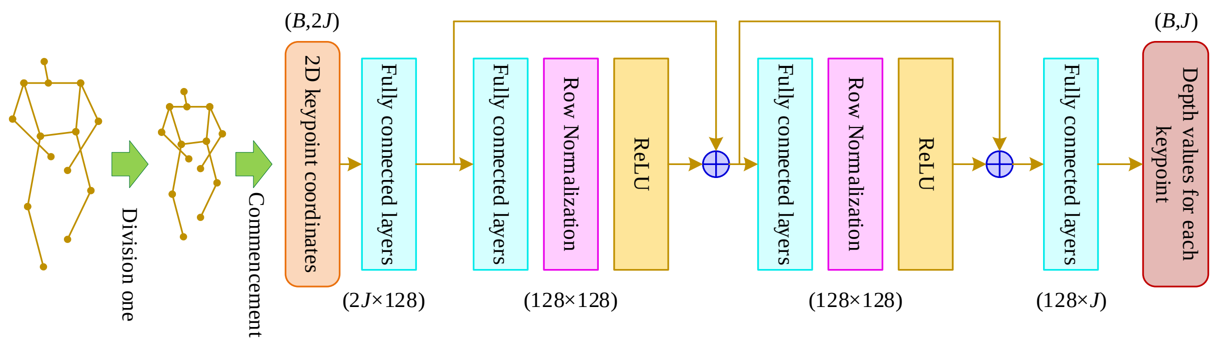


Figure 3. Three-dimensional human attitude measurement module

3.2 Root node-based depth estimation method for 2D dance poses

In this paper, the posture of the toddler during the dance is firstly back-projected to different depths to get the 3D posture at various depths and then projected to different auxiliary viewpoints, respectively. The spatial consistency is utilized to evaluate the scores of the 3D posture at each depth on the auxiliary views. Then, the neural network is used to regress the scores of each depth. Finally, the confidence level of the root node at each depth is obtained so as to preliminarily determine the position of the target toddler in 3D space.

3.2.1 Multi-perspective Spatial Consistency Assessment Methodology

A continuous interval $[d_{\min}, d_{\max}]$ on the Z axis of the camera coordinate system is quantized into N discrete values, where each value represents a depth relative to the origin of the camera coordinate system. Since the range of the interval is sufficient to cover the common 3D space shared by multiple cameras, one of the N virtual depths can always be found to be close to the true depth of the target child in 3D space.

Assuming that a 2D pose in the target perspective image is p, its root node is first given a virtual depth d, and since the relative depth of each key point is obtained, the virtual absolute depth of each key point is $d+\hat{d}^{j}_{rel\text{-}coarse}$, where j represents the j th key point. After obtaining the absolute depth of the entire 2D pose in the toddler dance, the corresponding 3D pose of the toddler dance can be obtained by inverse projection computation p^{d}_{3d}. Unlike the baseline method, the depths of p^{d}_{3d} the individual keypoints are not exactly the same because of the preliminary depth information obtained by the coarse estimation module. After obtaining the 3D pose p^{d}_{3d} with depth d, it is projected to the auxiliary viewpoint to obtain p^{d}_{3d} the 2D projection under this viewpoint q^{d}. Traversing the 2D poses $\{p'\}$ predicted by HRNet for each toddler's dance process under this auxiliary viewpoint, the 2D pose r_d closest to q^{d} is obtained by calculation. The specific calculation formula is as follows:

$$r_d = \arg\min_{p'} \sum_{j=1}^{J} \tau\left(p_j', q^{d}_{j}\right) \tag{2}$$

Where function $\tau(\cdot)$ computes the Euclidean distance between two keypoints.

Subsequently, for the 2D pose p of the target toddler, the score matrix S^{J} can be solved, where $S^{J} \in \mathbb{R}^{N\times J}$, $S^{J}_{d,j}$ denote the distances between the j th keypoints of the pose q^{d} projected to the auxiliary view and its matching 2D pose r^{d} when the depth is d.

The specific formula is as follows:

$$S^{J}_{d,j} = \exp\left\{-\frac{\left[\tau\left(r^{d}_{j}, q^{d}_{j}\right)\right]^{2}}{2\cdot\sigma}\right\} \tag{3}$$

Where σ is a hyperparameter. The closer the distance between two key points is the higher the score. The higher the score of $S^{J}_{d,j}$, the higher the probability that the j th key point of the 2D posture p of the target child is near depth d during the dance.

Score matrix S^{J} records the geometric consistency of the 2D posture p at each depth with the posture at other viewpoints. When more than one auxiliary viewpoint exists, the scoring matrices of the gesture p at multiple auxiliary viewpoints are usually weighted and summed. In this case, the keypoint confidence of each matching stance r_d obtained by the 2D toddler dance stance estimation algorithm is used as a weight.

3.2.2 Root node deep regression network

The structure of the root node depth regression network is similar to the pose coarse estimation network. Its input is a score matrix S^{J} with length N and number of channels J. Its output is a depth vector $D \in \mathbb{R}^{N\times 1}$, and each element in D represents the confidence of the root node at that depth. In this paper, adaptive local soft-argmax is used, firstly, a sliding window of size δ is used to slide on D to find the sliding window with the largest response on D, and then the standard soft-argmax is computed within that window to obtain $\hat{d}$. The specific formula is as follows:

$$\hat{d} = \frac{\sum_{i=i}^{i'+\delta-1} d_{i'} D_i}{\sum_{i=i'}^{i'+\delta} D_i}, where\ i' = \arg\max_{i''} \sum_{i=i''}^{i''+\delta-1} D_i \tag{4}$$

In this paper, the network is trained by minimizing the L_1 loss between $\hat{d}$ and the true value d_*. The loss function is shown in Eq. where p denotes each 2D pose in the target view:

$$L_{pose} = \sum_p \left\| \hat{d}(p) - d_*(p) \right\|_1 \tag{5}$$

3.3 Keypoint-based 3D Dance Posture Analysis Approach

In this section, we will fine-tune the projections of depths $\hat{d}_{rel\text{-}fine}$ relative to $\hat{d}_{rel\text{-}coarse}$ in a smaller range from $\hat{d}_{rel\text{-}coarse}$. The auxiliary viewpoints are evaluated for spatial consistency, from which the depth value closest to the true value is identified.

Similar to the root node estimation module, the 3D projection of the 2D pose p of the toddler during the dance at each depth is first calculated, and then the score matrix $S^{J,rel}$ at each viewpoint is calculated with the following equation:

$$S_{d^{rel},j}^{J,\,rel} = \exp\left\{ -\frac{\left[\tau\left(r_j^{\left(\hat{d}_{coarse}+d^{rel}\right)}, q_j^{\left(\hat{d}_{coarse}+d^{rel}\right)} \right) \right]^2}{2\cdot\sigma^2} \right\} \tag{6}$$

$S_{d^{rel},j}^{J,rel}$ represents the distance score between the projection $q_j^{\left(d_{coarse}+d^{rel}\right)}$ of the j rd keypoint under other viewpoints and the matched keypoint $r_j^{\left(\hat{d}_{coarse}+d^{rel}\right)}$ when the relative depth is d^{rel}. The closer the two keypoints are, the higher the score. In addition, in order to improve the accuracy of fine-tuning, this paper adds another new spatial consistency assessment metric: the skeletal score matrix $S^{B,rel}$. $S_{d^{rel},b}^{B,rel}$ evaluates the pose $q^{\left(a_{coarse}+d^{rel}\right)}$ projected to the auxiliary viewpoint when the relative depth is d^{rel} with its calculation as shown in Equation (7):

$$S_{d^{rel},b}^{B,\,rel} = \exp\left\{ -\frac{\left| r_b^{\left(\hat{d}_{coarse}+d^{rel}\right)} - q_b^{\left(\hat{d}_{coarse}+d^{rel}\right)} \right|}{2\cdot\sigma^2} \right\} \tag{7}$$

Where $q_b^{\left(\hat{d}_{coarse}+d^{rel}\right)}$ denotes the length of the b rd bone of $q^{\left(\hat{d}_{coarse}+d^{rel}\right)}$ and $q_b^{\left(\hat{d}_{coarse}+d^{rel}\right)}$ denotes the length of the b th bone of $r^{\left(\hat{d}_{coarse}+d^{rel}\right)}$.

In this paper, a multi-feature fusion module is designed to improve the reliability of the input features by compensating between different features, so as to improve the prediction accuracy of each key point. The specific structure of the multi-feature fusion module is shown in Fig. 4, which uses two kinds of features as inputs, which are key point features and bone features. The length of the two input features is N, and the number of channels is the number of keypoints J, and the number of bones B, respectively.

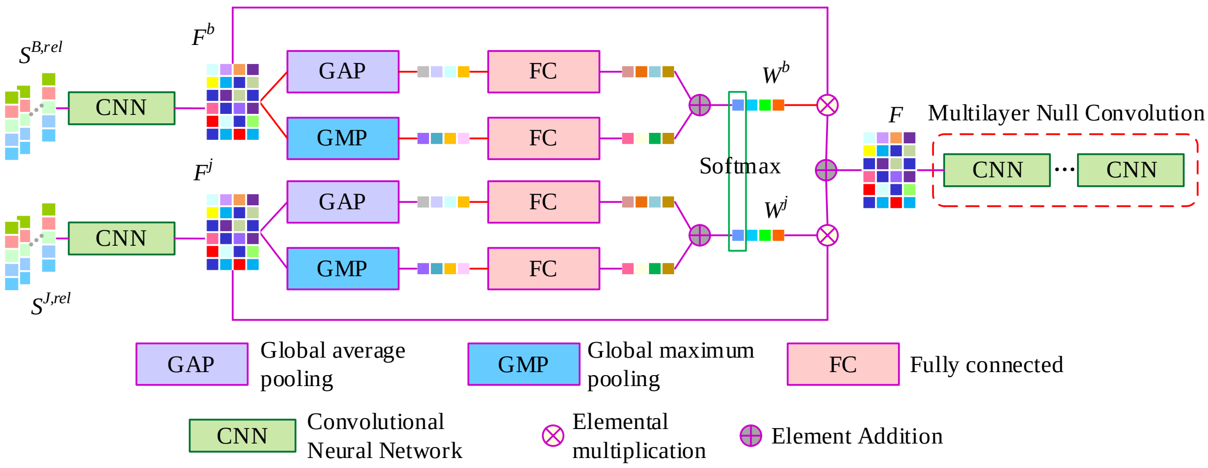


Figure 4. Multi-feature fusion module

Firstly, the two score matrices are respectively convolved in one dimension to obtain two features F^b and F^j with the same number of channels, after which two one-dimensional vectors of length N are obtained by global tie pooling, global maximum pooling, full connection and other operations, respectively, and the two vectors are executed element-by-element Softmax to generate the weight vectors W^b and W^j, and finally the two weight vectors are multiplied by the elements of the two feature matrices and summed up to get the fusion feature F. The weight summation process is shown in Equation (8):

$$F = W^b \cdot F^b + W^j \cdot F^j \tag{8}$$

The relative depth of each key point is calculated by standard soft-argmax:

$$\hat{d}_{j_{rel\text{-}fine}} = \sum_{i=1}^{N}\left(d_i^{rel}\cdot D_{i,j_{rel\text{-}fine}}\right) \tag{9}$$

Where d_i^{rel} denotes the value of the i nd depth after quantization.

Similarly, the L_1 loss function is used to compute the distance between the relative depth $\hat{d}_{rel}$ and the true relative depth d_{*rel} and this is used as the loss function for the keypoint regression network. The calculation is done as follows:

$$L_{joint} = \sum_p \sum_j \left\| \hat{d}(p)_{j_{rel\text{-}fine}} + \hat{d}(p)_{j_{coarse}} - d_*(p)_{j_{rel}} \right\|_1 \tag{10}$$

Where $d_*(p)_{j_{rel}}$ denotes the true depth of the j rd keypoint of the p nd target toddler dance pose in the target toddler dance image relative to the root node. The absolute depth of each key point is calculated as follows:

$$\hat{d}_{j_{abs}} = \hat{d}_{j_{rel\text{-}fine}} + \hat{d}_{j_{rel\text{-}coarse}} + \hat{d} \tag{11}$$

Finally, this paper utilizes the absolute depth of each key point to back-project the 2D posture of the toddler during the dance into the 3D space and obtains the 3D posture of the final toddler dance.

4 Effectiveness of interactive multimedia systems in early childhood dance applications

4.1 Accuracy Analysis of Dance Gesture Recognition Methods

Before the experiments, it is first necessary to verify that the method constructed in this paper for analyzing young children's dance posture estimation has a certain degree of usability so as to make the final experimental results more convincing. Thus, in this section, COCO and ICDPED datasets are selected as the datasets for the method validity test to conduct the experiments. COCO dataset is a widely used computer vision dataset, which is divided into training, validation and testing sets. The dataset has a large number of samples, a complete range of categories, complex and varied human poses, and a variety of picture environments with rich occlusion, blurring, and height distortion. When doing experiments related to human gesture estimation, we can extract the pictures of character categories for practice.

In this paper, 5 indicators, namely, AP, AP^{50}, AP^{75}, AP^L and AP^M, are selected as indicators of method validity. AP^{50} represents the accuracy of the test result when the threshold is 0.50, AP^{75} is a relatively higher standard, requiring the accuracy of the test result when the threshold is equal to 0.75, and AP is the average accuracy of the detection result when the thresholds are 0.05, 0.55, 0.60, ..., 0.90, and 0.95, respectively. AP^M denotes the accuracy of the detection target for medium type scale (32^2 < total number of pixels occupied by the figure in the image < 96^2) and AP^L denotes the accuracy of the detection target for large scale (96^2 < total number of pixels occupied by the figure in the image). The experimental results of the accuracy analysis of the posture estimation analysis method for young children's dance are shown in Table 1. The average accuracy of the gesture estimation method on the ICDPED dataset is 83.49%, and the four accuracy metrics of AP^{50}, AP^{75}, AP^L, and AP^M are also in the range of 80.02%-84.96%. In the validation set of COCO dataset, the average accuracy of this paper's dance posture estimation method reaches 89.95%, which is at a high level. The average accuracy of posture estimation in the test set is also able to reach 88.47%. This can prove that the posture estimation method constructed in this paper for young children's dance process is more successful and has a certain degree of usability.

Table 1. Dance gesture data set recognition results (%)

Data set	AP	AP^{50}	AP^{75}	AP^{L}	AP^{M}
Val (COCO)	89.95	82.39	80.77	86.68	86.28
Test (COCO)	88.47	84.18	81.29	83.75	83.34
ICDPED	83.49	84.96	82.17	82.95	80.02

4.2 Analysis of the impact of the capacity of young children to dance

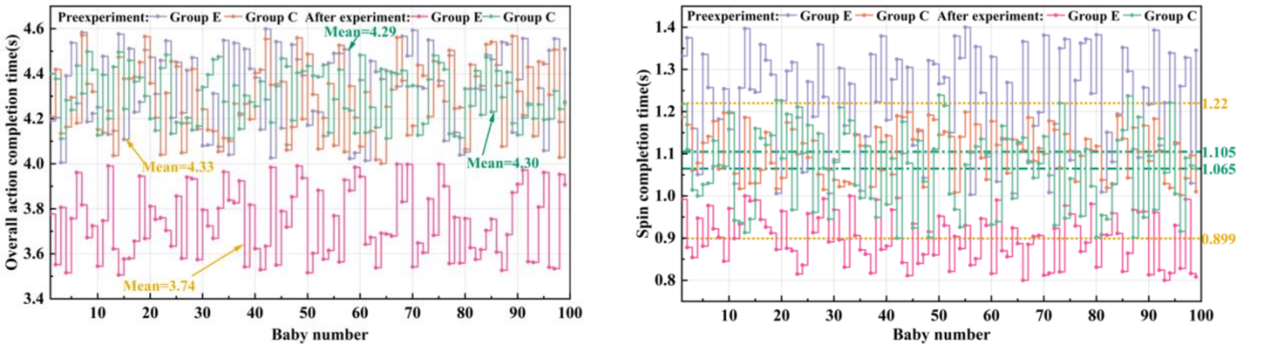
This paper is based on the interactive multimedia system to guide the teaching of young children's dance process. The 99 young children's dance ability who have been guided to learn are compared and analyzed with the 99 children who have not been guided to understand by the interactive multimedia system in order to explore the effect of the application of the interactive multimedia system in young children's dance.

4.2.1 Analysis of changes in the completion time of young children's dance movements

In the process of young children's dance, the shorter the time taken for the spiral turn dance movement, the better the young children's control of their overall ability as well as their ability to rotate the dance movement. Therefore, in this section, the dance posture estimation method was utilized to identify the spiral rotation movements during the young children's dance process, and the time taken by each young child to complete the overall spiral rotation dance movements and the rotational movements therein was counted as a reflection of the young children's dance ability. After three-dimensional image analysis of the two spiral movements of the experimental group (from now on referred to as Group E) and the control group (from now on referred to as Group C) captured before and after the experiment, the results of the data analysis of the overall spiral movement and the time required to complete the rotation are shown in Figure 5, with (a) and (b) representing the time needed for the completion of the overall spiral movement and the rotation movement of the children, respectively. In the spiral dance movement, before the experiment, the completion time of the overall dance movement of the children in group E was 4.33s. The completion time of the overall dance movement of the children in group C was 4.29s, which indicated that there was no significant difference in the danceability of the children in the experimental group and the control group before the experiment. After learning under the guidance of the interactive multimedia system, the completion time of the whole spiral dance movement of children in group E was reduced to 3.74s.

In contrast, children in group C needed 4.30s to complete the entire set of spiral dance movements on average, which showed that there was a very obvious difference between the two groups. The difference between the two is obvious. It shows that after learning the dance through the interactive multimedia system, the overall completion time of the spiral dance is shortened, the rotation speed is increased, and the level of the spiral dance movement is improved. From the analysis of the time required for the rotational movements in the spiral dance, the average time taken by the children in group E to rotate before the experiment was 1.22s, and the time taken by the children in group C to rotate was 1.105s, which was even slightly lower than that taken by the children in the experimental group. After learning the dance movements through the interactive multimedia system, the children's rotation time was reduced to 0.899s.

In contrast, the average rotation time of the children who did not use the interactive multimedia system was 1.065s, which means that the children's rotation time was reduced through the guidance of the interactive multimedia system. Their rotation skills were improved, while those in the control group were relatively poorer than those in the experimental group. The children's rotational ability during spiral turns is relatively slow. It is concluded that the application of the interactive multimedia system in the learning of dance by young children will help them to strengthen the control of their bodies in dance, which will lead to a complete dance movement and improve their dance ability.



(a) Screw the whole motion to complete the time

(b) Spin the time of the rotation

Figure 5. The analysis of the time of the spiral dance movement

4.2.2 Analysis of Body Center Displacement in Early Childhood Dance

This section analyzes the displacement of the center of gravity in the process of young children's spiral turn dance in order to further explore the effect of the application of an interactive multimedia system on young children's dancing ability. The undulation change of the toddler's body center of gravity is the Z-axis direction in three-dimensional space, i.e., the Z-axis direction represents the displacement of the toddler's body up and down during the dance process. When young children complete the spiral turn dance movement, with the knee and ankle joints stirring and twisting force as well as the feet center of gravity shift, the body will show up and down, which is also the fluctuation of the center of gravity of the body. The results of the comparative analysis of the center of gravity displacement in the Z-axis direction in the process of young children's dance are shown in Table 2. The maximum value of the Z-axis movement of the children in group E before the experiment was 0.528±0.045m, and the maximum value of the Z-axis movement of the children in group C was 0.534±0.036m. The P-value of the maximum value of the T-test was 0.589>0.05, which indicated that the experimental group and the control group did not have significant differences. After learning through the dance movement instruction under the application of an interactive multimedia system, the maximum value of the children's movement in the Z-axis reached 0.559±0.089m. The minimum value also increased, compared with the pre-experimental increase of 0.019m. After the T-test, it was found that the maximum value of the center of gravity displacement in the dance of the children in Groups E and C did not have any significant difference between the maximum value of the center of gravity displacement in the dance of the children in the Group E and Group C (P=0.597>0.05). The higher the degree of stretching of the body, the faster the rotation speed of the young children during the dance, and if the center of gravity of the body is lowered or squatting, the rotation speed will be slowed down, i.e., the higher the center of gravity of the human body is, the faster the rotation speed will be. The experimental results show that although the experimental group did not produce a significant difference in Z-axis center of gravity movement with the control group, there was some progress, which indicates that danceability has improved.

Table 2. Analysis of displacement and displacement of z-spindle

Group	Pre-experiment survey		Post-experiment survey	
	Maximum value (m)	Minimum value (m)	Maximum value (m)	Minimum value (m)
Group E	0.528±0.045	0.495±0.072	0.559±0.089	0.514±0.062
Group C	0.534±0.036	0.488±0.071	0.541±0.026	0.489±0.059
T	2.206	8.524	2.634	5.268
P	0.589	0.854	0.597	0.665

4.3 Analysis of the level of artistic creativity development in young children

Kaufman proposes the Kaufman Domain-Oriented Creativity Scale (K-DOCS) to measure the level of individual creativity in five domains: daily creativity, academic creativity, expressive creativity, mechanical creativity, and daily creativity. In order to assess the effect of the interactive multimedia system on the development of artistic creativity of young children in early childhood dance, this paper uses the questions about artistic creativity in the K-KOCS scale as the scale for measuring the artistic creativity of young children from the individual dimension in this study. It analyzes the changes in artistic creativity of young children's dance before and after the application of the interactive multimedia system. The results of analyzing the level of toddlers' artistic creativity development in dance are shown in Figure 6, where A are the results of analyzing the levels of appropriateness, novelty, technicality, aesthetics, imagination, and thoughtfulness shown in toddlers' dance, respectively. The p-value of the pre-and post-test measurements of the six dimensions is less than 0.05, so there is a significant difference between the artistic creativity reflected in the process of young children's dance before and after the experiment. It can also be seen from the mean values that after the interactive multimedia system is applied to the dance learning of young children, the mean scores of the artistic creativity shown in the six dimensions of young children's dance are higher than the scores of 1.11-1.927 before the experiment, which indicates that the level of artistic creativity cultivation of the young children has been significantly improved after the dance learning with the participation of the interactive multimedia system.

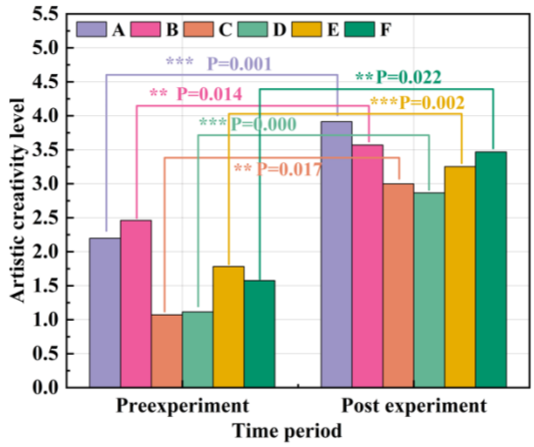


Figure 6. Analysis of the cultivation level of young children's artistic creativity

5 Conclusion

This paper applies the interactive multimedia system designed based on MPEG4 and JAVA language technology to the process of guided learning of young children's dance. It constructs a posture estimation method to recognize the posture and movement of young children's dance. The application effect of the interactive multimedia system has been analyzed, and the results show that:

1) The average accuracy of the posture estimation method on the ICDPED dataset is 83.49%, and the four accuracy indicators of AP^{50}, AP^{75}, AP^{L} and AP^{M} are also in the range of 80.02%-84.96%. It can be proved that the posture estimation method for young children's dance constructed in this paper is more successful and has certain usability.

2) In the spiral dance movement, the overall completion time of the dance movement of the experimental group was 4.33s before the experiment. The completion time of the spiral dance movement of the experimental group was reduced to 3.74s through the guidance of the interactive multimedia system, which was a very obvious difference between the experimental group and the children in the control group. Similarly, after learning the dance movement with the guidance of the interactive multimedia system, the time taken by the children to rotate was reduced to 0.899 seconds. In terms of Z-axis center of gravity movement, although the experimental group of children did not have a significant difference in Z-axis center of gravity movement with the children of the control group, there was a slight improvement, which indicated that the danceability had been improved.

3) The p-values of the six dimensions of artistic creativity of the children before and after the experiment are less than 0.05, so there is a significant difference between the artistic creativity of the children reflected in the dance process before and after the experiment.

In conclusion, the interactive multimedia system designed in this paper has achieved remarkable results in the teaching of young children's dance, which is of great help to the improvement of young children's dance ability and the cultivation of artistic creativity.

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