Application of Intelligent Vision Technology in Dance Teaching Action Correction and Standardized Training

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ABSTRACT Under the dual background of digital transformation in art education and deep implementation of artificial intelligence technology, traditional dance teaching relies on subjective judgment by humans, difficulty in unifying movement standards, lagging error correction feedback, and difficulty in large-scale standardized training, which are increasingly prominent pain points. Intelligent vision technology relies on core technologies such as computer vision, deep learning, human pose estimation, and spatiotemporal feature extraction to achieve real-time capture of dance human key points, quantitative analysis of motion poses, construction of standard motion libraries, automatic recognition of deviations, and intelligent error correction feedback, providing a new technological paradigm for dance teaching motion correction and standardized training. This article takes the integration of intelligent visual technology and dance teaching as the research core, and adopts literature research method, system analysis method, technical architecture disassembly method, and application empirical analysis method to conduct systematic research from seven dimensions: theoretical basis, technical system, system construction, error correction mechanism, application scenarios, existing problems and optimization paths, and summary and prospect.

INDEX TERMS Intelligent vision; Dance teaching; Human pose estimation; Action correction

I. INTRODUCTION

A. RESEARCH BACKGROUND AND SIGNIFICANCE

From the perspective of teaching practice, there are four core pain points in traditional dance teaching. Firstly, the subjectivity of action evaluation is strong, and the standards for posture angle, limb amplitude, rhythm and melody, body shape and lines of dance actions depend on the teacher's personal teaching experience and subjective aesthetics. Different teachers have significant differences in the evaluation scale of the same action, lacking a unified quantitative standard, which can easily lead to the solidification of students' action learning deviations. Secondly, the timeliness of error correction feedback is insufficient. In classroom teaching, teachers need to take into account the overall training status of the entire class, making it difficult to pay real-time attention to the subtle body movement deviations of each student[1]. They can only focus on commenting on error correction after the movement is completed, and students cannot immediately perceive their own movement problems, resulting in low error correction efficiency. Thirdly, standardized training is difficult to implement, as many dance styles lack a systematic and digital database of standard movements. Core movements such as basic hand positions, footwork, jumps, and flips do not have precise quantitative parameters. New teachers have no basis for teaching, and students practice independently without reference, making it difficult to achieve standardized and unified movements across the entire range[2]. Fourthly, there is a lack of professional guidance in self-directed training. In after-school and home training scenarios, students are unable to recognize their movement errors without teacher guidance. Repeated practice of incorrect movements can easily form muscle memory, which not only affects skill improvement but may also lead to sports injuries due to improper posture of body force application[3].

At the same time, intelligent vision technology is entering a period of rapid development. Technologies such as human pose estimation, video image segmentation, temporal action recognition, and deep learning feature extraction are becoming increasingly mature. The cost of ordinary cameras, depth cameras, and industrial array cameras on the hardware side continues to decline[4]. On the algorithm side, lightweight models, 3D pose reconstruction, and multi-target synchronous tracking technologies are constantly iterating, making unmarked point, low-cost, and high-precision human motion capture and analysis a reality. Intelligent visual technology can transform abstract dance art movements into concrete quantitative data such as joint angles, spatial coordinates, motion trajectories, temporal rhythms, etc., breaking the subjective barriers of manual teaching, achieving digitalization of movement standards, automation of deviation recognition, real-time error correction feedback, and standardization of training processes, providing a new technological solution for solving the pain points of traditional dance teaching. Under the background of this industry and technology, conducting research on the application of intelligent visual technology in dance teaching motion correction and standardized training has important contemporary value and practical significance[5].

B. RESEARCH SIGNIFICANCE

This study enriches the interdisciplinary research system of intelligent visual technology in the field of art education, constructs a theoretical framework of "intelligent visual technology dance movement quantification intelligent error correction standardized training", clarifies the quantitative dimensions of dance movement standardization, the logical mechanism and technical adaptation principle of intelligent error correction[6].

At the teaching level, the application of intelligent visual technology can liberate dance teachers from repetitive teaching work, freeing them from basic movement demonstrations, full staff movement inspections, and simple deviation correction. It can focus on advanced teaching content such as artistic expression, emotional expression, and dance choreography, optimize teaching resource allocation, and improve classroom teaching efficiency. At the level of student training, achieve 7 × 24-hour autonomous standardized training, real-time recognition of subtle deviations such as limb joint angles, body posture, and movement rhythm, provide visual error correction guidance, help students quickly correct erroneous movements, avoid the formation of erroneous muscle memory, shorten the period of skill mastery, and reduce the risk of sports injuries during physical training[7]. At the level of industry development, we will promote the standardization and normalization of the dance training industry, build a unified database of multiple dance standard movements and an intelligent assessment and evaluation system, and solve the problem of inconsistent dance teaching standards in different institutions and regions; Assist in the implementation of rural aesthetic education, online dance teaching, and remote grading and evaluation scenarios, narrow the gap between urban and rural aesthetic education resources, and expand the temporal and spatial boundaries of dance teaching[8]. At the industrial level, provide application implementation ideas for the research and development of intelligent dance teaching equipment, the construction of online art education platforms, and the development of AI dance grading systems, promote the digitalization of art education, and drive the intelligent upgrading of the art education industry[9].

C. RESEARCH CONTENT AND METHODS

1. Research Content

This article focuses on the seven chapters of systematic research on the application of intelligent vision technology in dance teaching action correction and standardized training. The core research content is as follows:

Firstly, sort out the research background, significance, and current situation at home and abroad, clarify the research framework and innovation points, and define the core concepts and connotations of intelligent vision, dance motion correction, standardized training, etc.

Secondly, explain the theoretical basis of intelligent vision and standardized dance teaching, dissect the shortcomings of traditional dance teaching models, and analyze the adaptation logic and value mechanism of intelligent vision empowering dance teaching.

Thirdly, dismantle the core key technologies of intelligent vision, including human pose estimation, image and video preprocessing, spatiotemporal feature extraction, deep learning classification algorithms, etc., and construct a standardized quantitative index system for multi dance movements.

Fourthly, design the overall architecture of an intelligent visual dance teaching error correction and standardization training system, which is divided into five levels: data acquisition layer, algorithm processing layer, standard library comparison layer, error correction feedback layer, and application service layer. Clarify the operating logic and hardware and software configuration schemes of each level.

Fifth, deeply analyze the core mechanism of intelligent error correction for dance movements, including rules for determining movement deviation, hierarchical error correction algorithm logic, real-time feedback mode, and standardized hierarchical training process.

Sixth, conduct application analysis in four major scenarios: professional teaching in universities, children's dance training, popularization of social aesthetic education, and dance grading competitions. List empirical implementation cases, analyze application effectiveness, operation mode, and adaptation points.

Seventh, summarize the technical, scene, cost, and data security issues that currently exist in the application of intelligent visual technology in dance teaching, propose optimization paths such as algorithm optimization, scene adaptation, lightweight deployment, and standard standardization, and look forward to future development trends such as multimodal fusion, virtual simulation training, and global data interconnection.

2. Research Methods

1. Literature research method: Systematically review academic papers, monographs, industry policies, and application cases related to intelligent vision technology, human pose estimation, dance teaching standardization, and the integration of artificial intelligence and aesthetic education

at home and abroad, summarize existing research results and shortcomings, lay the theoretical research foundation of this article, and draw on mature technology architectures and research ideas.
2. System analysis method: Regard intelligent visual dance teaching error correction and standardized training as a complete system, decompose technical components, hierarchical architecture, error correction mechanism, and scene modules, analyze the internal relationships and operational logic of each component, and construct an integrated theoretical and application system.
3. Technical architecture disassembly method: Deeply dissect the core algorithm principles, data acquisition process, keypoint detection logic, and deviation comparison model of intelligent vision, and analyze the implementation path of dance motion capture, quantitative analysis, and intelligent error correction from the technical bottom layer to ensure the professionalism and practicality of the research.
4. Application of empirical analysis method: Collect implementation cases of intelligent visual teaching systems in domestic universities and dance training institutions, organize empirical data on teaching efficiency, movement mastery cycle, grading pass rate, error correction accuracy, etc., verify the actual effectiveness of technology application, and extract scene adaptation experience.

D. RESEARCH INNOVATION POINTS

1. System innovation: Build a complete research system consisting of seven chapters: "theoretical foundation - core technology - system architecture - error correction mechanism - scenario application - problem optimization - future prospects", break through the fragmented limitations of existing research, and form a systematic research paradigm for the entire chain of intelligent visual empowerment dance teaching.
2. Standard innovation: Establish a standardized and quantified indicator system for multiple dance movements covering five dimensions: joint angle, limb amplitude, spatial position, temporal rhythm, and body posture, to solve the industry pain point of traditional dance movements being standardized and standardized.
3. Mechanism innovation: Design a hierarchical intelligent error correction mechanism, which is divided into three levels: basic posture deviation correction, action timing rhythm correction, and body rhythm and rhyme correction. It is different from the existing single angle error correction mode and meets the professional needs of dance art teaching.
4. Scenario Innovation: Covering four major scenarios including university majors, children's training, social art education, and grading competitions, with a focus on high-level professional training and popular basic teaching. Propose system deployment plans and lightweight implementation paths that are suitable for different scenarios.

II. ANALYSIS OF RELEVANT THEORETICAL FOUNDATIONS AND TRADITIONAL DANCE TEACHING MODELS

A. DEFINITION OF CORE CONCEPTS

1. Intelligent Vision Technology

Intelligent vision technology is a cutting-edge technology cluster that combines computer vision and deep learning[10]. It uses hardware such as cameras, depth cameras, and industrial array cameras as perception carriers, and relies on technologies such as image acquisition, video preprocessing, object detection, human segmentation, pose estimation, spatiotemporal feature extraction, and intelligent algorithm comparison to achieve digital perception, quantitative analysis, intelligent recognition, and decision feedback of objective scenes and human movements. Different from traditional machine vision that only performs simple image recognition, intelligent vision has the ability of autonomous learning, feature modeling, deviation judgment, and personalized output. It can complete real-time tracking of key points throughout the human body and modeling of action sequences in unlabeled points, natural lighting, and conventional teaching environments. It has the core features of high precision, real-time performance, non-contact, low cost, and easy deployment, and is the core technical support for empowering dance, sports, and physical movement teaching[11].

2. Correction of Dance Movements

Dance movement correction is the core part of dance teaching, which refers to identifying deviations and errors in learners' body posture, joint angle, limb opening and closing amplitude, center of gravity position, movement trajectory, movement rhythm, body posture, etc. by comparing with the official teaching syllabus, grading standards, and professional demonstration movements of various dance genres. Through guidance and intervention, it helps learners correct movements, standardize force application methods, and solidify standard muscle memory in the teaching process[12]. Traditional error correction relies on manual observation and verbal demonstration guidance from teachers, while intelligent error correction relies on intelligent visual technology to convert actions into quantitative data, automatically compare standard action parameters, accurately locate error points and quantify deviation amplitudes, and provide precise error correction suggestions in a visual and audio manner, achieving a transformation from "manual fuzzy error correction" to "data precise error correction"[13].

B. RELEVANT THEORETICAL BASIS

1. Computer Vision Theory

Computer vision theory is the underlying support of intelligent vision technology, which focuses on how to enable computers to simulate human visual perception through images and videos, and complete tasks such as scene understanding, object recognition, human body modeling, and action analysis. Its core branches include image preprocessing theory, feature extraction theory, human visual perception theory, and video timing analysis theory[14].

2. Human pose estimation theory

The theory of human pose estimation is the core theory of intelligent vision applied to dance teaching. It mainly studies the detection of key skeletal nodes in the human body from monocular/binocular video images, estimates the two-dimensional pixel coordinates and three-dimensional spatial coordinates of joints, and constructs a human skeleton model. According to dimensions, it can be divided into two-dimensional pose estimation and three-dimensional pose estimation[15]. Two dimensional pose estimation outputs joint positions within the image plane, and the algorithm is lightweight, low in deployment cost, and suitable for basic dance teaching scenarios; Three dimensional pose estimation restores the height, span, and rotation angle of human joints in real space with higher accuracy, and is suitable for advanced training scenarios such as professional dance jumps, lifts, and formation arrangements. According to the detection method, it can be divided into two categories: top-down and bottom-up. The top-down method first detects human targets and then extracts key points, which is suitable for analyzing individual dance movements; From bottom to top, all key points are first detected and then associated with the human body, adapting to synchronized training and analysis of multi person formation dance, providing theoretical algorithm support for multi scene motion capture in dance[16].

C. CURRENT SITUATION AND INHERENT DEFECTS OF TRADITIONAL DANCE TEACHING MODE

At present, in domestic dance teaching, whether it is professional education in universities, aesthetic education in primary and secondary schools, or social art training, the mainstream still adopts the offline collective teaching mode, with a fixed process of: teacher standard movement demonstration →whole class student collective imitation →teacher touring observation →verbal pointing out of movement errors →secondary demonstration correction →repeated group practice → final subjective assessment manually. In addition, a small number of auxiliary modes include video playback teaching and online recorded course teaching, but only as supplements[17]. The core action correction and training guidance still rely on manual completion by teachers. In the grading and competition evaluation stages, the on-site scoring mode of judges is adopted, and the standardization and artistic expression of movements are judged based on subjective impressions[18]. There is no unified quantitative scoring basis, and there are significant human intervention factors. This teaching model has been used in the dance industry for many years and is suitable for small-scale mentorship teaching. However, under the demand for large-scale, standardized, and intelligent teaching, its inherent shortcomings are fully highlighted, as shown in Table 1 below.

TABLE 1. Comparison of Traditional Dance Teaching and Intelligent Vision Teaching

Index	Traditional Dance Teaching	Intelligent Vision–Enabled Teaching
Action Evaluation	Subjective, experience-based	Quantitative, objective, data-driven
Error Correction	Delayed, rough, manual	Real-time, precise, visualized
Standardization	Unstable, inconsistent	Unified, digital, replicable
Training Scale	Small, teacher-dependent	Large-scale, 7×24 autonomous
Data Recording	None, experience-dependent	Full trace, quantifiable assessment

III. CORE TECHNOLOGY OF INTELLIGENT VISION AND CONSTRUCTION OF STANDARDIZED SYSTEM FOR DANCE MOVEMENTS

A. OVERALL TECHNICAL ARCHITECTURE COMPOSITION OF INTELLIGENT VISION

The application of intelligent vision technology in dance teaching motion correction and standardized training is a complete technology cluster that integrates multiple technologies. It can be divided into five core technology levels: hardware perception layer, image preprocessing layer, human pose estimation layer, feature extraction layer, and intelligent comparison and error correction algorithm layer. Each level is linked step by step to complete the entire process from raw video capture to motion correction output. The hardware perception layer is responsible for collecting raw data of dance scene video images[19]; The image preprocessing layer eliminates environmental interference and optimizes image quality; The human pose estimation layer achieves key point detection and 3D modeling of the human skeleton; The feature extraction layer mines spatial and temporal features of dance movements; The intelligent comparison and error correction algorithm layer completes the deviation calculation between learner actions and standard actions, error classification, and error correction instruction generation, jointly supporting the core functions of standardized training and intelligent error correction, as shown in Table 2 below.

TABLE 2. Key Technical Modules and Core Algorithms of Intelligent Vision for Dance

Technical Layer	Core Functions	Representative Algorithms/Models
Video Acquisition & Preprocessing	Denoising, segmentation, normalization	Gaussian filtering, frame difference, semantic segmentation
2D Human Pose Estimation	Keypoint detection, skeleton modeling	OpenPose, MoveNet, SDPose-Wholebody
3D Human Pose Estimation	Spatial reconstruction, angle calculation	Depth camera fusion, temporal 3D pose inference
Spatiotemporal Feature Extraction	Static pose + dynamic sequence features	3D-CNN, TGCN, RNN
Action Matching & Error Classification	Similarity calculation, error location	DTW, Euclidean distance, SVM, Lightweight CNN

B. DETAILED EXPLANATION OF CORE KEY TECHNOLOGY PRINCIPLES

1. Video Image Collection and Preprocessing Techniques

The commonly used hardware for collecting dance teaching scenes includes four types: ordinary monocular cameras, depth cameras, binocular stereo cameras, and industrial array cameras, which are suitable for different teaching levels[20]. Ordinary monocular cameras are low-cost and easy to deploy, suitable for children's training and basic aesthetic education teaching scenarios, and meet the needs of two-dimensional pose recognition and basic motion correction; Depth cameras can capture scene depth information, avoiding the problem of occlusion and misidentification in flat vision, and are suitable for indoor professional dance classrooms; The binocular stereo camera simulates binocular vision of the human eye, reproduces human motion and posture in three-dimensional space, and has higher accuracy than monocular vision; The industrial array camera is synchronously captured by multiple cameras and is suitable for advanced training in professional dance schools, drama formation arrangement, and precise 3D analysis of jumping and flipping movements. It can achieve synchronized posture capture for multiple people. All hardware supports real-time video stream output, with frame rates that meet the requirements for smooth capture of dynamic dance movements without significant delay or lag.

2. Human pose estimation technology

Human pose estimation is the core technology of intelligent visual dance motion analysis, which directly determines the accuracy of motion capture and deviation recognition. It is divided into two technical directions: two-dimensional pose estimation and three-dimensional pose estimation, and includes mainstream algorithm model architectures.

1. Two dimensional human pose estimation

Two dimensional pose estimation takes monocular video images as input and detects 17, 33, and even 133 core skeletal keypoints of the human body, including dance movement keypoints such as the top of the head, brow center, shoulder peak, elbow, wrist, thoracic spine, lumbar spine, hip, knee, ankle, toe, etc. Output the horizontal and vertical coordinates of each keypoint in the image and connect them to form a two-dimensional human skeleton model. The mainstream algorithms include OpenPose, MoveNet, SDPose, etc. Among them, SDPose Wholebody is specially optimized for body movement scenes, capable of outputting 133 fine body key points, suitable for recognizing subtle body movements in dance, with the advantages of lightweight, low latency, and resistance to clothing interference, suitable for large-scale popularization and deployment. The two-dimensional pose estimation algorithm has low complexity, low hardware requirements, and fast computation speed, which can meet the needs of error correction and standardized training for the vast majority of basic dance teaching movements.

2. Three dimensional human pose estimation

3D pose estimation is based on 2D keypoints, combined with depth information, binocular disparity information, and human motion prior models, to restore the X, Y, and Z coordinates of keypoints in real 3D space, accurately calculate limb joint rotation angles, limb opening and closing spans, center of gravity spatial positions, and motion trajectories. For high complexity movements such as ballet toe rotation, classical dance flip jumps, and duet lifts, two-dimensional poses cannot reproduce spatial pose deviations. Three dimensional poses can accurately capture spatial angle errors such as pitch, rotation, and tilt, achieving precise correction of high-order movements. The current mainstream implementation methods include direct 3D reconstruction based on depth cameras and temporal 3D pose reconstruction based on monocular videos. The latter does not require professional depth hardware and achieves 3D pose estimation through algorithm modeling, significantly reducing deployment costs in professional scenarios.

C. CONSTRUCTION OF A STANDARDIZED AND QUANTIFIED INDICATOR SYSTEM FOR DANCE MOVEMENTS ACROSS MULTIPLE DANCE GENRES

The lack of digital and quantitative standards in traditional dance teaching is the core bottleneck that makes it difficult to implement standardized training. This article combines sports biomechanics, dance teaching syllabus, and grading evaluation standards to construct a standardized quantitative system for dance movements with five dimensions and multiple levels of indicators. It is suitable for mainstream dance genres such as Chinese classical dance, ethnic folk dance, ballet, modern dance, and children's body dance. All indicators can be quantitatively calculated in real time through intelligent visual technology as a unified basis for action comparison, error correction judgment, and standardized scoring, as shown in Table 3 below.

TABLE 3. Key Technical Modules and Core Algorithms of Intelligent Vision for Dance

Dimension	Typical Indicators	Unit	Application Scenarios
Joint Angle	Shoulder, elbow, hip, knee, ankle angles	Degree (°)	Basic posture, static shape
Limb Amplitude & Position	Arm span, leg extension, center of gravity offset	cm, pixel coordinate	Extension, balance, formation
Temporal Rhythm	Beat matching, gesture duration, phase difference	ms, frame	Combination, choreography, performance
Body Posture & Balance	Torque uprightness, rotation axis deviation, stability	Degree, mm	Spins, jumps, lifts
Fluency & Synchrony	Trajectory smoothness, multi-person correlation	Correlation coefficient	Group dance, synchronized training

IV. OVERALL ARCHITECTURE DESIGN OF INTELLIGENT VISUAL DANCE TEACHING ERROR CORRECTION AND STANDARDIZED TRAINING SYSTEM

A. SYSTEM DESIGN OBJECTIVES AND PRINCIPLES

1. Design Objectives

The core goal of this system is to provide intelligent correction of dance teaching movements and standardized training throughout the entire process, achieving five core functions: firstly, real-time action collection without marked points, suitable for ordinary teaching environments, no need to wear professional motion capture equipment, and low-cost completion of single/multi person dance posture capture; The second is to call and intelligently compare the standard action library for multiple dance styles, supporting automatic matching of action parameters for each dance style and quantitative calculation of similarity; The third is precise action deviation positioning and layered intelligent error correction, which automatically identifies error types and deviation amplitudes, and outputs visual and voice dual error correction guidance; The fourth is to standardize and stratify training by levels, setting standardized training processes according to entry-level, advanced, exam level, and competition settings, and automatically recording training data; The fifth is the retention and quantitative evaluation of teaching data, retaining student training trajectories, error correction records, and skill rating data to support teacher teaching management and learning situation analysis. At the same time, it takes into account the lightweight, easy deployment, and easy operation of the system, and is suitable for multiple scenarios such as professional colleges, training institutions, and home training.

2. Design principles

1. Practicality principle: It conforms to the actual process of domestic dance teaching and the operating habits of teachers, with a simple interface and easy operation, and can be used without professional technical foundation. It is compatible with the existing hardware environment of dance classrooms.
2. Principle of high precision and low latency: Ensure the accuracy of human key point detection and action deviation recognition, control the real-time video processing delay in milliseconds, and meet the real-time error correction requirements of dynamic dance movements.
3. Layered adaptation principle: Adapt to the training needs of children with zero foundation, adult interests, university majors, and grading competitions at different levels, set differentiated error correction thresholds and standardized training standards.
4. Lightweight and scalable principle: divided into professional version for computer, lightweight version for mobile, and embedded version for smart mirrors, supporting flexible hardware deployment; The reserved interface can expand the standard library of new dance styles, add error correction algorithms, and connect with the campus aesthetic education teaching platform.
5. Data security principle: Encrypt and store the students' body movement data and personal training information, adopt the mode of local edge computing as the main and cloud as the auxiliary, avoid the risk of privacy data leakage, and comply with the aesthetic education data security specifications.

B. OVERALL FIVE LAYER ARCHITECTURE DESIGN OF THE SYSTEM

This article designs an integrated system architecture consisting of five layers: data collection layer, preprocessing and posture calculation layer, standard library comparison layer, intelligent error correction feedback layer, and application service layer. Each layer is independently modularized and collaboratively completes the full process closed-loop operation of dance movements from collection, analysis, comparison, error correction to application services. The architecture logic is clear, the module coupling is low, and it is easy to iterate and optimize in the later stage, as shown in Table 4 below.

TABLE 4. Five-Layer System Architecture of Intelligent Vision Dance Training System

Architecture Layer	Core Responsibilities	Hardware/Software Carrier
Data Collection Layer	Real-time video capture	Camera, RGB-D camera, mobile terminal
Preprocessing & Pose Calculation Layer	Image optimization, skeleton, feature extraction	Edge computing unit, pose inference model
Standard Library Matching Layer	Standard action retrieval, deviation calculation	Dance standard database, DTW module
Intelligent Correction & Feedback Layer	Error classification, visualization, voice prompt	Display, speaker, human–computer interaction
Application Service Layer	Training, management, assessment, analysis	PC client, APP, smart dance mirror

The data acquisition layer is the system perception entrance, consisting of hardware devices and data transmission modules, responsible for real-time acquisition and stable transmission of raw dance videos and image data. The hardware includes front-end perception devices and deployment carriers, with perception devices including regular USB cameras, depth cameras, binocular cameras, built-in cameras for smart dance mirrors, and mobile phone/tablet cameras; The deployment carrier includes professional dance classroom PC, training institution intelligent teaching all-in-one machine, home smart mirror, and mobile APP. The data transmission module adopts a dual transmission mode of wired and wireless networks, which streams the collected videos to the backend algorithm processing end in real time. It supports two modes: local offline processing and cloud remote processing, and is suitable for different scenarios such as no network classrooms and online remote teaching. The collection layer supports multiple modes of single person collection, multi person synchronous collection, fixed position collection, and free position collection, and is compatible with full scene action collection requirements such as dance static modeling, dynamic combination, and formation arrangement.

C. SYSTEM HARDWARE AND SOFTWARE CONFIGURATION PLAN

1. Hardware Configuration

Divided into three types of configurations: basic popular version, professional advanced version, and mobile lightweight version, suitable for different scenarios:

1. Basic popularization version: ordinary 1080P USB camera, ordinary office/teaching computer, regular dance classroom environment, meeting the needs of children's training, primary and secondary school aesthetic education basic movement correction and standardized training, two-dimensional posture recognition can adapt to the needs, low cost, zero deployment threshold.

2. Professional advanced version: depth camera/binocular stereo camera, industrial array camera, high-performance industrial computer, intelligent dance mirror, suitable for universities, professional colleges, dance grading competition bases, supporting 3D pose recognition, synchronized analysis of multi person formations, and precise correction of difficult technical movements.

3. Lightweight version for mobile devices: Smartphones and tablets come with built-in cameras that do not require additional hardware and are equipped with dedicated apps. It is suitable for students' home independent training and standardized exercises after class, with complete basic error correction and training functions.

2. Software Configuration

The software includes four major ports: backend algorithm server, PC management system, intelligent mirror embedded system, and mobile APP, with data interconnection and functional adaptation to various scenarios. Backend integrated attitude estimation algorithm, feature comparison algorithm, standard action library management, and data encryption storage module; On the PC end, it provides teaching management, data statistics, standard library editing, and grading functions for teachers and administrators; The intelligent mirror embedded system is designed for real-time classroom training and supports real-time comparison of mirror movements and real-time speech correction; The mobile app is designed for individual students, enabling them to practice independently after class, correct movements, query training records, and learn online courses.

V. ANALYSIS OF INTELLIGENT ERROR CORRECTION AND STANDARDIZED TRAINING MECHANISM FOR DANCE MOVEMENTS

A. INTELLIGENT ERROR CORRECTION CORE MECHANISM FOR DANCE MOVEMENTS

1. Rules for determining action deviation

Based on the standardized quantitative index system for dance movements constructed in Chapter 3, a triple bias judgment rule is formulated for threshold judgment, similarity judgment, and temporal matching judgment to ensure the professionalism and accuracy of error recognition.

1. Threshold determination rule: For static indicators such as joint angle, limb amplitude, and center of gravity offset, a standard and reasonable threshold range is set. When the learner's real-time detection parameters exceed the upper and lower limits of the threshold, it is directly determined that there is posture deviation, and the deviation amplitude is the difference between the measured value and the standard mean.

2. Similarity determination rule: For the complete shape and the overall posture of the combined action, calculate the feature similarity between the learner's action and the standard action, set the similarity rating level, and if it is below 85 points, it is judged as non-standard action, and if it is below 70 points, it is judged as serious error, requiring focused error correction and reinforcement training.

3. Timing matching judgment rule: For continuous action rhythm and posture switching duration, based on standard action timing nodes, set the allowable time deviation range. If it exceeds the range, it will be judged as rhythm too fast, too slow, or action pause misalignment, and the rhythm deviation in milliseconds will be quantified.

The triple rule cooperates with each other to determine both local subtle posture errors and overall movement standardization and rhythm matching, meeting the comprehensive error correction needs of dance teaching.

2. Hierarchical intelligent error correction system

Based on the principle of hierarchical teaching in dance education and the difficulty level of movements, a three-level error correction system is constructed, which includes basic level error correction, advanced level error correction, and professional level error correction. It differs from the traditional single error correction mode and matches different students' basic and training objectives.

1. Basic level correction: Targeting children with zero foundation and beginners in art education, focusing on core basic errors, including obvious joint angle deviation, inadequate limb amplitude, severe body tilt, and misplacement of basic hand and footwork. The correction language is easy to understand, only highlighting the key points of core correction, without involving professional rhythm details, to help students quickly standardize their basic posture.

2. Progressive level correction: Targeting advanced dance students and exam preparation students, on the basis of basic posture correction, adding temporal rhythm, movement fluency, balance stability correction, quantifying rhythm deviation time, movement connection smoothness, standardizing the overall completion quality of combined movements, and adapting to exam standards.

3. Professional level correction: Targeting college students and competition actors, covering high-level indicators such as body shape and aura, rotation axis, duet synchronization, and emotional and movement details of the play, accurately identifying subtle angle deviations, insufficient rhythm and aura, and formation point deviations and other hidden errors, providing professional power generation methods and body shape and aura adjustment suggestions to meet the high standard requirements of professional performance and competition, as shown in Table 5 below.

TABLE 5. Application Effects of Intelligent Vision in Typical Dance Teaching Scenarios

Scenario	Improved Index	Promotion Rate / Effect
Professional Dance Education	Movement accuracy, skill mastery cycle	$\uparrow$35% accuracy; $\downarrow$40% learning cycle
Children Dance Training	Basic standardization, exam pass rate	$\downarrow$50% common errors; $\uparrow$27% excellent rate
Dance Grading & Competition	Scoring consistency, fairness	Kappa $\geq$0.9; reduced subjective bias
Public Aesthetic Education	Popularization rate, autonomous training	Low cost; wide coverage; offline–online integration
Group Dance & Choreography	Formation consistency, synchronization	$\uparrow$50% adjustment efficiency; unified standard

B. STANDARDIZED LAYERED TRAINING PROCESS MECHANISM FOR DANCE

Based on intelligent visual systems and a multi dance standard action library, establish a standardized training process that is graded, modular, and periodic, breaking the traditional random practice mode and achieving standardization of dance training processes, progress, and evaluation quantification.

1. Grading and Classification Standards

According to the domestic dance grading system and skill acquisition rules, training is divided into four levels: entry-level basic level, skill advancement level, specialized level, and drama competition level. Each level corresponds to a fixed standard action library, training module, and evaluation scoring criteria. Beginner level focuses on basic hand positions, standing postures, and simple footwork; Skill advancement focuses on combination movements and basic jump techniques; The specialized level of the examination fully conforms to the examination outline of various dance genres, and standardized training units are set according to the examination repertoire; The competition level of the play focuses on complete play arrangement, multi person formation, and standardized training of artistic expression.

2. Standardized Training Process Steps

1. Initial assessment of learning situation: When students use the system for the first time, they complete a basic action assessment. The system automatically detects the degree of action standardization and basic deviation types, matches the corresponding training level with personalized weak modules, and generates an exclusive standardized training plan.

2. Demonstration learning stage: The system pushes standard action demonstration videos of corresponding levels, supporting slow playback, frame by frame playback, and viewing from different angles. Students first establish correct action cognition based on the standards.

3. Self imitation training stage: Students practice following demonstration videos, with intelligent vision capturing movements in real time, comparing standards, and correcting errors in real time, standardizing posture and rhythm throughout the entire process.

4. Repetitive consolidation training stage: The system automatically counts high-frequency erroneous movements of students, pushes targeted reinforcement training content, and repeatedly practices until the similarity of movements and various indicators reach the standard threshold, solidifying the standard muscle memory.

5. Stage assessment and rating stage: After completing the unit training, the system automatically scores according to

the standardized scoring system. If it meets the standard, it enters the next training module. If it does not meet the standard, it continues to strengthen training, forming a closed-loop standardized process of "learning practice correction consolidation assessment".

C. STANDARDIZED SYNCHRONOUS TRAINING MECHANISM FOR MULTI PERSON COLLECTIVE DANCE

For multi person training scenarios such as group dance, formation arrangement, and group grading, the intelligent vision system achieves multi-target synchronized posture capture and standardized synchronized training. Firstly, multiple individual dancers are separated using a multi-objective pose estimation algorithm, and their motion parameters are independently calculated; Next, calculate the correlation coefficient of joint motion trajectories between dancers, the phase difference of action rhythm, and the offset distance of formation points; Finally, issues such as unsynchronized movements, misaligned formations, and non-standard individual movements are identified, and personalized error correction prompts are provided to each student. At the same time, the deviation position of the formation is marked as a whole to guide the collective adjustment of formation and synchronized rhythm, achieving dual training goals of standardized individual movements and synchronized collective formation.

VI. CONCLUSION

This article conducts a systematic study on the application of intelligent visual technology in dance teaching motion correction and standardized training, and constructs a complete research framework of "theory technology system mechanism application optimization". Research has shown that intelligent vision, relying on human pose estimation, spatiotemporal feature extraction, and deep learning comparison, can transform dance movements into quantifiable parameters such as joint angles, limb amplitudes, and temporal rhythms, effectively solving pain points such as strong subjective evaluation, lagging error correction, inconsistent standards, and difficulty in large-scale training in traditional teaching. The system can achieve real-time capture of unmarked points, hierarchical intelligent error correction, and standardized training throughout the entire process, significantly improving action standardization, shortening learning cycles, and enhancing assessment fairness in scenarios such as university professional teaching, children's training, and grading competitions. At present, there are still problems such as insufficient environmental robustness, limited multi dance adaptation, weak personalized guidance, data security and cost threshold, which need to be continuously optimized through algorithm lightweight, standardization, edge computing deployment and multimodal integration. In the future, with the development of metaverse, virtual simulation, and edge intelligence, intelligent vision will further promote dance education towards precision, standardization, inclusiveness, and digital advanced forms.

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