

Research Article

Application of Fine Motion Capture Method for Tai Chi Chuan Assistant Training

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Tai Chi Chuan is an important part of Chinese wushu and is the product of the Chinese civilization; it contains abundant philosophy sense. Tai Chi Chuan has experienced a long historical process of development; in the process of development and change numerous for brief, to the rough, now widely process of Tai Chi Chuan for its style is easy to learn and has a strong role of strengthening the body while widely popular among the people of all ages. The existing Tai Chi Chuan training methods have not satisfied people's pursuit of spiritual life that has more and more high request, therefore urgently needs to study new and efficient Tai Chi Chuan training method. In this paper, the characteristics and development history of the Tai Chi Chuan development were analyzed. In order to overcome difficulties in training, at present, the research on application of AI technology with fine motion capture method auxiliary taijiquan training is aimed at, which can further improve the social mass to understand Tai Chi Chuan, and guide people to exercise more scientifically, improve the body quality, training effect, and enrich the spiritual and cultural life.

1. Introduction

With the continuous development of our social economy, the quality of people's living standard continues to improve; the pursuit of health also is rising, so more and more social masses choose through sports to improve their physical quality and health level. Tai Chi Chuan is a training sport chosen by a lot of people. It is a fist of the traditional martial arts in China, through the scientific exercise, it can improve human body functions, and has a positive effect to improve people's health level.

The schemes of Tai Chi Chuan training are shown in Figure 1. It shows that Tai Chi Chuan is a traditional sport, which with the function of curing not ill, adjusting body and mind, and the rich national cultural charm. Therefore, it is widely popular with the masses.

Tai Chi Chuan is one of China traditional martial arts and has been listed as world nonmaterial cultural heritage. It is a blend of traditional Chinese Confucianism, Taoist philosophy of Tai Chi, and dialectical thought of Yin and Yang; sets the temperament; strengthens physical health care; and

combats against a variety of functions and combined with the five element changes of Yin and Yang of medicine and Chinese medicine meridian. There were many different taijiquan factions in the history; there are reference and inheritance relationship among the various factions; each Tai Chi Chuan factions made outstanding contribution for the development of China's traditional culture. Tai Chi Chuan not only contains martial arts and philosophy but it also absorbs the traditional medicine meridian, qi, and blood, such as guiding theory. It conforms to the ancient Chinese medicine of traditional Chinese medicine and physical knowledge, to Tai Chi Chuan physical activity for a long time, can have very good training effect, and makes the person body quality enhances unceasingly. Many scholars around the world have done lots of research works on the development status and training methods of Tai Chi Chuan course, which will promote the Tai Chi Chuan movement conducted in-depth, and achieved fruitful research results. Li et al. [1–3] studied the Tai Chi Chuan training effect on the well-being of the elderly, and the study results shown that Tai Chi Chuan training can promote the exchanges



FIGURE 1: Diagram of Tai Chi Chuan training.

and promote the physical training and literacy of old people in a certain extent, to let them in a larger extent and improve the well-being. Jiménez-Martín et al. [4] studied the influence of three different modalities Tai Chi Chuan to people body of clinical cases and found that most common forms used in the research design associated with TCC correspond to those linked to the sports modality of this activity, while the forms associated with the therapeutic modality are scarcely present. Domestic and foreign relevant scholars [5–10] carried out much research work about assistant training method for Tai Chi Chuan movement; the research work on the dissemination and promotion of Tai Chi Chuan has played a positive role. With the development of competitive sports, many scholars studied the difference training methods between the traditional Tai Chi Chuan and competitive Tai Chi Chuan, and some reasonable training suggestions were made out for competitive Tai Chi Chuan and traditional Tai Chi Chuan training, respectively, for Tai Chi to adapt to different people playing a promoting role.

The cultural connotation, characteristics, and the development of Tai Chi Chuan and the shortage of its common training methods are studied in this paper, in order to a better support training and improve training efficiency and effectiveness; a method about fine motion capture Tai Chi Chuan assistant training is researched by combining with AI technology. It can improve the training efficiency and effectiveness for Tai Chi Chuan training, and for Tai Chi Chuan, better promotion also plays a positive role.

2. Related Works

2.1. Development History of Tai Chi Chuan. Tai Chi Chuan is one of Chinese martial arts, and in the form of a genre [1, 11–13], it draws on many other martial arts genre theory and technology of the essence. Before the warring states period, the taijiquan theory has formed the basis of the theoretical system; many technical elements about Tai Chi Chuan have been derived. In the late Ming dynasty, the complete concept of Tai Chi Chuan, its theory, and technology architecture began to appear. Several important genres of Tai Chi Chuan are widely popular both at home and abroad from Qing dynasty derivation and are developed gradually. The theory system of Tai Chi Chuan was the complete form in Ming dynasty and to early Qing period. In Qing dynasty, the first development peak time of Tai Chi Chuan appeared, and the major genres of Tai Chi Chuan

began to appear in this period. In 1950s, Tai Chi Chuan started from family local area, widely to the society. Such as the soft boxing club, Wu-dang Tai Chi Chuan. In advance Tai Chi Chuan, Spring Tai Chi Chuan club was established in Shanghai, YongNian Tai Chi Chuan club was established in Beijing. These clubs supported the public to learn Tai Chi Chuan [14–18] and the famous Tai Chi Chuan agencies. During this period, much research works about Tai Chi Chuan have been carried out, and some of the academic scientific insights are actively advocating Tai Chi Chuan. Among them, the more representative includes Tang Hao, Xu Zhedong, etc.; they devote a great deal of energy to study the history of Tai Chi Chuan.

After the founding of new China, Tai Chi Chuan gets unprecedented development; it becomes the real service for mass sports fitness method and mass towards the world and makes the Chinese nation excellent culture shared by all over the world. In the 1950s, China's national sports commission sports department of the martial arts division organized a number of Tai Chi Chuan experts to choreographing the 24 types of simplified Tai Chi Chuan.

Today, Tai Chi Chuan has become a kind of fitness exercise, which has a wide influence and attracts people to participate in worldwide. As its participation and influence is big, international cultural experts call it "the world's fitness brand."

2.2. Characteristics of Tai Chi Chuan. Tai Chi Chuan [19–22] is a blend of Chinese traditional philosophy, ethics, art, and aesthetics, keeping in good health, literature, painting, calligraphy, music, dance, drama, and many other cultural factors.

The movement characteristic of Tai Chi Chuan is a unique sport of waist axis of limb flexion and rotation speed of uniform circular motion, which is different from other sports. The waist as the axis of limb flexion and rotation speed of uniform circle movement is the main part of the taijiquan movement; it plays a major role in the Tai Chi Chuan movement. By seizing the individuality movement characteristic of Tai Chi Chuan, its characteristic is easy soft, round living nature, hips, and continuous, clear, flexibility, spiral wound. These dynamic image is driving from the waist to the limb extremely slow to fast, and "virtual and real" two kinds of motion process cycle of uniform circle movement of speed. It is the symbol of Tai Chi Chuan.

2.3. Main Training Method and Content of Tai Chi Chuan. The systematic training for Tai Chi Chuan can be divided into five stages [22–25]; they are learning shelf, fixing shelf, kneading shelf, along shelf, and opening shelf. Through the five stages of training, you will be able to systematically master authentic Tai Chi Chuan.

The first stage is learning the shelf (understand rules, skilled routine). Learn shelf stage is the early stages of practice of Tai Chi Chuan. At this stage, you need to master the basic action of simple. The basic action includes fixed step hand silk action and skilled cooperate gait coordination practice. After these preliminary exercises, you will understand the basic movements, footwork, hand type, and step

type of Tai Chi Chuan and get the basic characteristics and style of Tai Chi Chuan. This stage must be conscientious and a recruit type to practice and do not rush. After a period of practice, repeated practice makes the routine more skilled and strengthens memory. Then, to do it in a relaxation, soft, natural, and easy state, and get rid of its frozen, which you can finally achieve more skilled, drill down naturally.

The second stage is fixing shelf (master requirement, embody characteristics). After completing the first stage Tai Chi Chuan training and a period of practice to action after skilled, you can get into the second stage. This stage is about fixing shelf training for Tai Chi Chuan; in this stage, you need according to the requirements of Tai Chi Chuan for each part and complete set of shelves to correct generally; the relatively obvious common faults should be corrected and demonstrate the basic movement characteristics of Tai Chi Chuan.

The third stage is kneading shelf (adjust the posture to accurate). In the third stage, when training each set of Tai Chi Chuan boxing, you should put each part of your body in right place in accordance with Tai Chi Chuan standard action, make sure each part of your body meets the requirements. At this stage, you should make sure each set of Tai Chi Chuan boxing stretch generous gestures, and make sure your posture is unbiased, center of gravity is accurate.

The fourth stage is alonging the shelf (along with nature, highlight style). In the fourth stage, along the shelf is based on the stage of kneading shelf to make sure that each set frame of Tai Chi Chuan boxing is according to the requirements of the flowing, continuous runs throughout. Exercise style of this period requires to do “fast and not random, slow and do not come loose, light and not superficial, sink and not frozen.” Conform to the boxing theory of up and down parts in the whole, waist as the axis, successively permeate, and achieve hand-eye step posture of coordination and pneumatic power full reunion realm.

The fifth stage is opening shelf (usage is clear, change freely). Based on the four stages of Tai Chi Chuan basic training, your set of Tai Chi Chuan can reach a certain level. And then, you can get into the fifth stage (opening shelf stage); at this stage, you need to analyze each posture movement apart based on posture standard specification and basic skills of solid, which is not only to learning but also to knowing why to do like this. It is to understand the intention of each movement, know that every boxing potential of meaning and its change in different situations, know each usage of flexibility, make sure what you can really grasp, and improve your practical combat level.

2.4. Main Problems in Tai Chi Chuan Training. Through consulting relevant data and investigation questionnaire, we found that the current social masses give supportive to practice Tai Chi Chuan generally; due to it helps in improving the quality of the human body and reducing body problems caused by long bow sitting such as lumbar disc of office workers and students. But learning and training Tai Chi Chuan are restricted by time, place, and training cost and can not to the public scope of better promotion. Now, the following problems exist in Tai Chi Chuan training learners.

2.4.1. Lack of Teaching Resources. At present, although the Tai Chi Chuan is welcomed by the masses, but there are a relatively small number of professional Tai Chi Chuan coaches, and their teaching levels of the good and bad are intermingled. It is very bad to the popularization of Tai Chi Chuan promotion.

Network video teaching for Tai Chi Chuan is also in a process of development, but this way is lack of the interaction communication between teaching staff and students; students are easy to form withdrawn action. In addition, the Tai Chi Chuan training venues are one of the main problems of restricting its propulsion; the professional Tai Chi Chuan teaching and training are seldom on the market.

2.4.2. Trainees Learn Quickly but Lack of Capability. In the fierce competition in the Tai Chi Chuan athletic field, performance is the only measure. Coaches and athletes all hope get a good result as early as possible, which will lead lack of enough attention and patience to athletes' skill training process usually. The spoil things type of enthusiasm training by excessive is formed, which has violated the law of development of sports training and physical, and causing athlete has a lot of injuries. Basic skills are the foundation of all the sports, if the basic skills are not practiced well enough, and it is impossible to improve technology level. Without basic skill for protection, the technical main point is difficult to accurately, and exercise levels cannot reflect in action.

3. Assistant Training Research

3.1. Introduction about Assistant Training Method. With the rapid development of computer technology [26–29], the motion capture technology and other fields of science and technology are gradually applied to physical education teaching. The Tai Chi Chuan teaching activities have very strong practicality and motion capture technology applied to Tai Chi Chuan training, can be used as a proper complement to traditional teaching, are used to overcome the shortage of the traditional training methods, and promote efficiency of Tai Chi Chuan teaching.

Rapid popularization and development of computer network technology have made it possible to apply technology to Tai Chi Chuan teaching. Through the combination of motion capture technology and traditional teaching can make up inherent defects of traditional teaching methods and forms. Fine motion capture technology is a technology to collect changes of human body movement and space displacement by sensor devices and transformed them into digital model.

In recent years, this technology has been widely applied to many fields and got very good development in the assistant training teaching. An assistant training system can observe student training position from multiple visual based on motion capture technology and with analyzing the movement parameters that got by sensor devices, which can provide more scientific, more intuitive, and reliable training advice for students. It can improve the learning efficiency and achieve the goal of assistant training.

3.2. Tai Chi Chuan Assistant Training Method. In this paper, we study the application of AI technology, and using fine motion capture assistant method for Tai Chi Chuan training, the technical process diagram is shown in Figure 2.

As shown in Figure 2, we can see that teaching video library and AI study and analysis algorithm are the difficult points, in the process of the fine motion capture method for Tai Chi Chun assistant training. Thus, determining what is the Tai Chi Chun standard action and how to evaluate students training are the focus in the study of this paper.

3.3. Assistant Training System Design. According to Section 3.2 of the Tai Chi Chuan assistant training analysis, through access to sports training assistant system design of related data, questionnaire survey, and market research to the social populace, Tai Chi Chuan assistant training system should have as follows: (1) AI autonomous learning ability of Tai Chi Chuan for standard action learning and phonetic explanation, (2) fine motion capture for students training action and expression, and (3) according to the accumulation of autonomous learning, trainees' training movements should be evaluated by assistant training system; if it needs to improve, some corresponding opinions and action demonstration should be put forward, otherwise will this action as examples of autonomous learning, etc.

The main functions and the main components of the Tai Chi Chuan fine motion capture assistant training system are shown in Figure 3.

Figure 3 shows the main functions and main components of the fine motion capture assistant training system for Tai Chi Chuan. We can see that the main functions of fine motion capture assistant training system are self-learning Tai Chi Chun teaching method, capturing trainers' training movements, reading and evaluation training movement, giving suggestions for improvement, human-machine interaction, etc., while its main components of fine motion capture assistant training system are equitable wearing equipment, motion capture camera, CPU for computing processing, screen for human-machine interaction, etc. By the way, the assistant training system should also small, easy to carry and convenient erection of use, etc.

The main function modules and functions of Tai chi assistant training system are shown as Figure 4.

Figure 4 shows that the Tai Chi Chuan assistant training system based on fine motion capture mainly contains four function modules; they are self-learning module, motion acquisition module, and test scoring module. Self-learning module can learn teaching video of Tai chi Chuan standard movements in the database autonomously. Motion acquisition module can collect the movements of trainee training Tai Chi Chuan, then filtering, noise reduction, and storage the physical parameters. Test scoring module can match physical parameters of students to the physical parameters in the database automatically and compared with the teaching video database standard action to get student training function of action points. Improvement proposal module can put forward concrete suggestions on promotion of student training actions according to the first three modules of data accumulation condition.

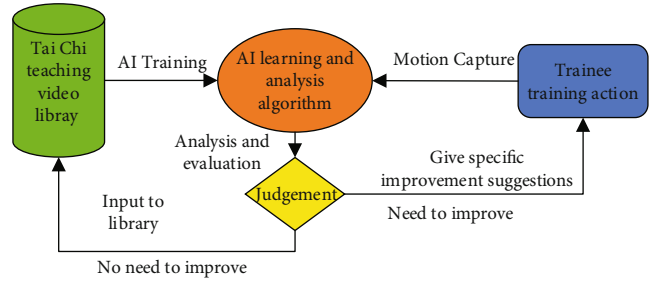


FIGURE 2: Schematic diagram of Tai Chi Chun assistant training.

Among them, to ensure the objective evaluation system of assistant training system is correct, the Tai Chi Chuan teaching video material should cover each age stage from 28 to 65 years old, cover height from 155 to 195 mm, and male and female faculty ratio of 1:1. Teaching video data requirements are shown as follows:

$$\begin{cases} \text{age} = [18, 65], \\ H = [150, 195], \\ \text{male} : \text{female} = 1 : 1. \end{cases} \quad (1)$$

For more detailed, better capture the trainees' Tai Chi Chuan training action and action evaluation work, structure diagram of human body is established according to the characters of the human body structure as shown in Figure 5(a).

Figure 5(b) is the human body structure simplified model. The black nodes in the figure represent each key moving part of the human body, respectively; the specific relations of them are shown in Table 1.

In order to describe trainees' movements of Tai Chi Chuan training more scientifically and precisely, the human body structure is simplified into the 13 nodes. The degrees of freedom at each node have a different direction, mainly including before and after, left, right, and rotation. And the testing body geometry center is set as the origin of coordinates, and a three-dimensional space rectangular coordinate system is established. The X axis is pointing to the human body in front, the Y axis is pointing to the opposite direction of gravity, and Z axis is pointing to the left side of the body. Each point location can be expressed by vector \mathbf{a} , \mathbf{b} , ..., \mathbf{n} , respectively.

$$\mathbf{a} = [A_x A_y A_z A_\theta], \quad (2)$$

$$\mathbf{b} = [B_x B_y B_z B_\theta], \quad (3)$$

$$\mathbf{c} = [C_x C_y C_z C_\theta]. \quad (4)$$

The vector formulas (2), (3), and (4) represent the positions of the 3 key nodes shown in 0(b) in the space coordinate system, and the remaining 10 key node positions can be obtained using the same method. Each element in a vector represents the key node in the three-dimensional space coordinate X, Y, and Z coordinate values and the rotation angle value of the node. A matrix of $13 \times 4\mathbf{R}_t$ can be

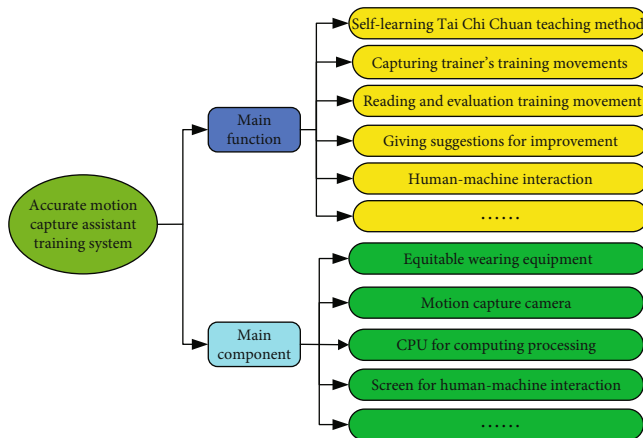


FIGURE 3: The main function and composition of fine motion capture assistant training system.

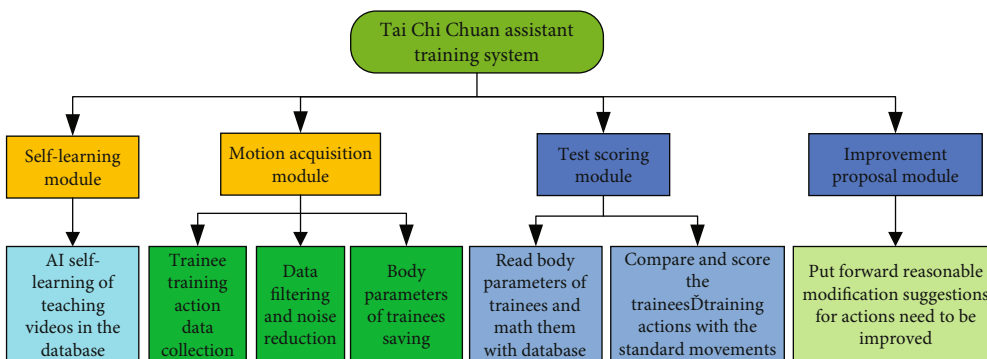


FIGURE 4: Tai Chi Chuan assistant training system.

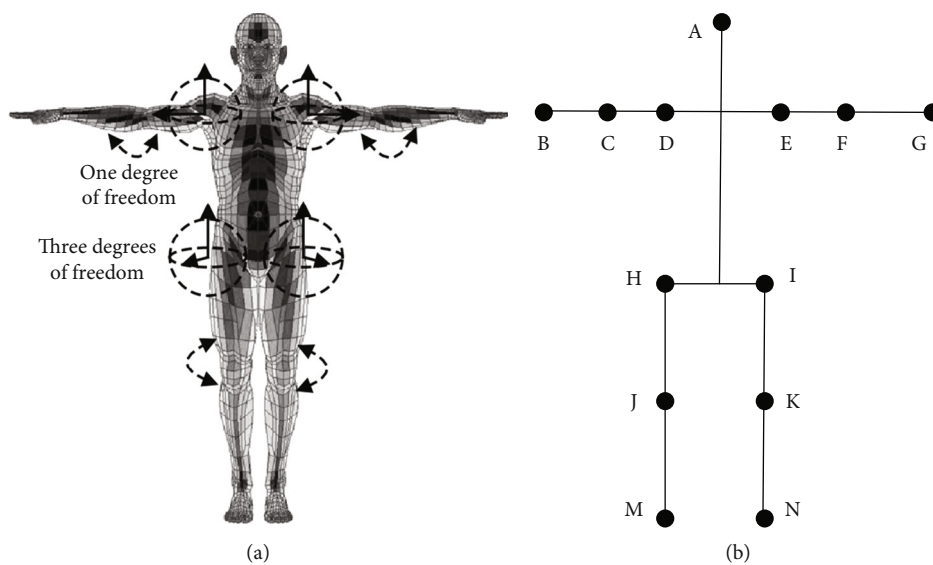


FIGURE 5: Model for the human body.

TABLE 1: The specific relations of each node and the key points.

Node number	Body part	Node number	Body part	Node number	Body part
A	Head	E	Left shoulder	I	Left hip joint
B	Right hand end	F	Left elbow	J	Right knee
C	Right elbow	G	Left hand end	K	Left knee
D	Right shoulder	H	Right hip joint	M	Right foot
N	Left foot				

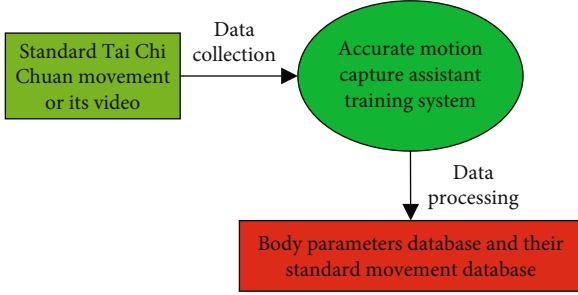


FIGURE 6: Diagram of standard action read process.

established according to the position of each node vector of the human body, which can describe the state of position in the process of training Tai Chi Chuan.

$$\mathbf{R}_t = \begin{bmatrix} A_x & A_y & A_z & A_\theta \\ B_x & B_y & B_z & B_\theta \\ C_x & C_y & C_z & C_\theta \\ \vdots & \vdots & \vdots & \vdots \\ N_x & N_y & N_z & N_\theta \end{bmatrix}. \quad (5)$$

Tai Chi Chuan fine motion capture assistant training system can get and store the parameters of body position for real-time and storing trainees' physical parameters (such as height, weight, arm, and leg length), which will be used in action of training students after the assessment and put forward relevant suggestions for improvement.

Tai Chi Chuan fine motion capture assistant training system for the basic process of autonomous learning Tai Chi standard action is shown in Figure 6.

Tai Chi Chuan precision motion capture auxiliary training system based on a lot of different ages, different genders, and different height personnel demo video standard Tai Chi Chuan movement, by reading the related parameter data are collected for autonomous learning, and the corresponding data processing of faculty body parameter database of library and corresponding Tai Chi Chuan as a standard action.

The flow diagram of trainees' training movement evaluation based on Tai Chi Chuan fine motion capture assistant training system is shown in Figure 7.

Figure 7 shows the Tai Chi Chuan assistant training system for training evaluation process. As shown in Figure 7, we know that Tai Chi Chuan fine motion capture assistant training system can be get the data that parameters matching

of Tai Chi Chuan standard action database and establish the training of personnel human motion state matrix \mathbf{R}_{t0} , based on the physical parameters and standard each act and faculty body as shown as follows:

$$\mathbf{R}_{t0} = \begin{bmatrix} A_{x0} & A_{y0} & A_{z0} & A_{\theta0} \\ B_{x0} & B_{y0} & B_{z0} & B_{\theta0} \\ C_{x0} & C_{y0} & C_{z0} & C_{\theta0} \\ \vdots & \vdots & \vdots & \vdots \\ N_{x0} & N_{y0} & N_{z0} & N_{\theta0} \end{bmatrix}. \quad (6)$$

Reading the body parameters of trainee, match the faculty body parameters in the database, and get the state of human body in the process of Tai Chi Chuan training as shown in formula (5).

State of the human body parameters in the process of training Tai Chi Chuan of trainees is similar compared to standard action and get the state parameter error, and some corresponding suggestions for improvement are put forward. The process formula of similarity comparison is shown as follows:

$$\begin{aligned} \Delta \mathbf{R}_t &= \mathbf{R}_t - \mathbf{R}_{t0} \\ &= \begin{bmatrix} A_x & A_y & A_z & A_\theta \\ B_x & B_y & B_z & B_\theta \\ C_x & C_y & C_z & C_\theta \\ \vdots & \vdots & \vdots & \vdots \\ N_x & N_y & N_z & N_\theta \end{bmatrix} - \begin{bmatrix} A_{x0} & A_{y0} & A_{z0} & A_{\theta0} \\ B_{x0} & B_{y0} & B_{z0} & B_{\theta0} \\ C_{x0} & C_{y0} & C_{z0} & C_{\theta0} \\ \vdots & \vdots & \vdots & \vdots \\ N_{x0} & N_{y0} & N_{z0} & N_{\theta0} \end{bmatrix} \\ &= \begin{bmatrix} \Delta A_x & \Delta A_y & \Delta A_z & \Delta A_\theta \\ \Delta B_x & \Delta B_y & \Delta B_z & \Delta B_\theta \\ \Delta C_x & \Delta C_y & \Delta C_z & \Delta C_\theta \\ \vdots & \vdots & \vdots & \vdots \\ \Delta N_x & \Delta N_y & \Delta N_z & \Delta N_\theta \end{bmatrix}. \end{aligned} \quad (7)$$

$\Delta \mathbf{R}_t$ is the parameter error value matrix of the human body movement state parameters and standard action state,

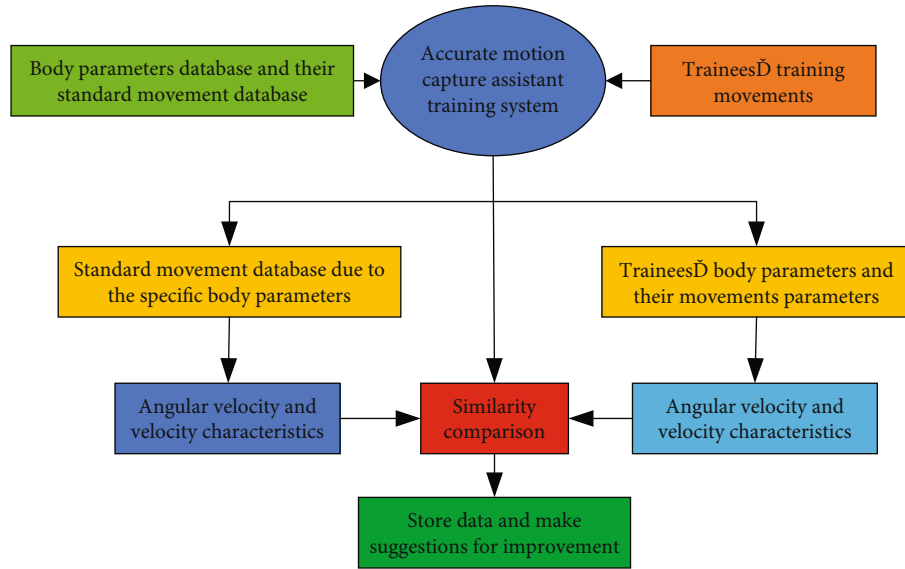


FIGURE 7: Flow diagram of Tai Chi Chuan training evaluation.

in the process of the Tai Chi Chuan training. The smaller error of the absolute value of matrix element indicates the movements more standard; suggestions for improvement are also based on the error value matrix.

In the process of practicing Tai Chi Chuan, the rating action is based on movement deviation to determine the amplitude and the need to action according to the deviation dimensionless as follows:

$$\Delta \mathbf{R} = \frac{\Delta \mathbf{R}_t}{\mathbf{R}_{t_0}} = \frac{\begin{bmatrix} \Delta A_x & \Delta A_y & \Delta A_z & \Delta A_\theta \\ \Delta B_x & \Delta B_y & \Delta B_z & \Delta B_\theta \\ \Delta C_x & \Delta C_y & \Delta C_z & \Delta C_\theta \\ \vdots & \vdots & \vdots & \vdots \\ \Delta N_x & \Delta N_y & \Delta N_z & \Delta N_\theta \end{bmatrix}}{\begin{bmatrix} A_{x0} & A_{y0} & A_{z0} & A_{\theta0} \\ B_{x0} & B_{y0} & B_{z0} & B_{\theta0} \\ C_{x0} & C_{y0} & C_{z0} & C_{\theta0} \\ \vdots & \vdots & \vdots & \vdots \\ N_{x0} & N_{y0} & N_{z0} & N_{\theta0} \end{bmatrix}} \cdot \begin{bmatrix} \frac{\Delta A_x}{A_{x0}} & \frac{\Delta A_y}{A_{y0}} & \frac{\Delta A_z}{A_{z0}} & \frac{\Delta A_\theta}{A_{\theta0}} \\ \frac{\Delta B_x}{B_{x0}} & \frac{\Delta B_y}{B_{y0}} & \frac{\Delta B_z}{B_{z0}} & \frac{\Delta B_\theta}{B_{\theta0}} \\ \frac{\Delta C_x}{C_{x0}} & \frac{\Delta C_y}{C_{y0}} & \frac{\Delta C_z}{C_{z0}} & \frac{\Delta C_\theta}{C_{\theta0}} \\ \vdots & \vdots & \vdots & \vdots \\ \frac{\Delta N_x}{N_{x0}} & \frac{\Delta N_y}{N_{y0}} & \frac{\Delta N_z}{N_{z0}} & \frac{\Delta N_\theta}{N_{\theta0}} \end{bmatrix}. \quad (8)$$

Based on the action of different dimensionless shown in equation (8), $\mathbf{f}(\mathbf{R})$ is the movement differences during a complete set of Tai Chi Chuan training, which can be obtained on the basis of the $\Delta \mathbf{R}$ get students Tai Chi Chuan exercise of and time integral; calculation process is shown as follows:

$$\mathbf{f}(\mathbf{R}) = \int \Delta \mathbf{R}(t) dt. \quad (9)$$

$\Delta \mathbf{R}(t)$ is the action deviation in the process of students to practice Tai Chi Chuan in real time.

The whole process of Tai Chi Chuan training can be digital output by fine Tai Chi Chuan motion capture assistant training system, which is shown as follows:

$$F_{\text{out}} = \sum_{t=0}^T f(\mathbf{R}). \quad (10)$$

T is the whole time of trainee to complete a whole set of action.

For application of AI intelligent algorithm to rate the motion of the students to practice Tai Chi Chuan, the specific process is shown as follows:

$$S = \mathbf{W} \times \mathbf{f}(\mathbf{R}) + \mathbf{b}. \quad (11)$$

S is the output scores value, \mathbf{W} is the weight matrix, and \mathbf{b} is for bias. Application of equation (11) is for trainees to practice Tai Chi Chuan movement difference filtering and score.

3.4. Results and Analysis. Tai Chi Chuan trainees according to age are divided into 20~30 years old, 30~40 years old, 40~50, 50~60 years old, aged 60~70, and 70~80, six groups in this paper. According to the Tai Chi Chuan fine motion

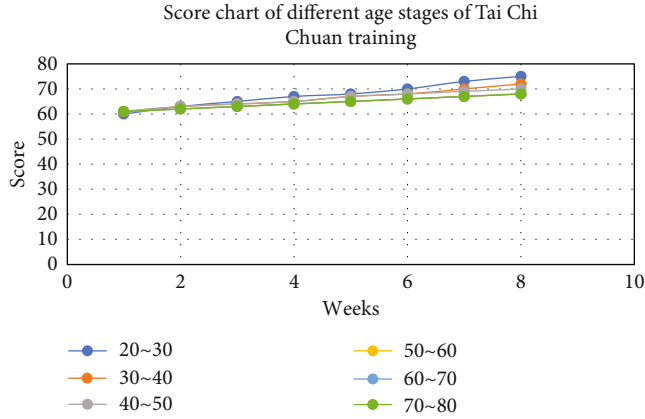


FIGURE 8: Score chart of different age stages of Tai Chi Chuan training.

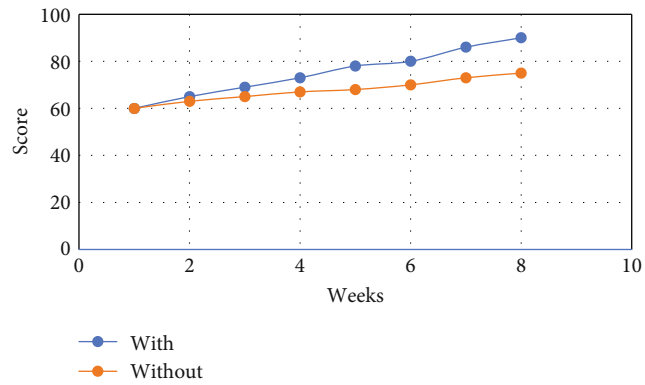


FIGURE 9: Score comparison with and without assistant training system.

capture assistant training system studied in Section 3.3, its grading evaluation module is adopted to study and statistic the various age groups under the condition of without assistant training system in 8 weeks.

Tai Chi practitioners of different age groups of Tai Chi Chuan movement score are to adopt large sample statistical average calculated.

$$E(S) = \frac{1}{n} \sum_{i=1}^n S_i. \quad (12)$$

S_i is a certain age group within the sample in the i th Tai Chi Chuan action score value of the trainer.

And six Tai Chi Chuan trainees' groups' Tai Chi Chuan training scores are in Figure 8, respectively.

Figure 8 shows that the training scores that improve speed of Tai Chi Chuan training of different age groups in the eight-week training process with the Tai Chi Chuan fine motion capture assistant training system score are different. And the smaller the age of the trainee and the stronger ability to learn, the faster speed to improve the score.

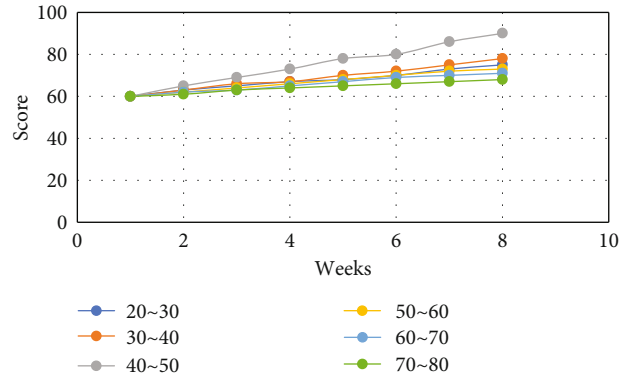


FIGURE 10: Score chart of different age stages of Tai Chi Chuan training.

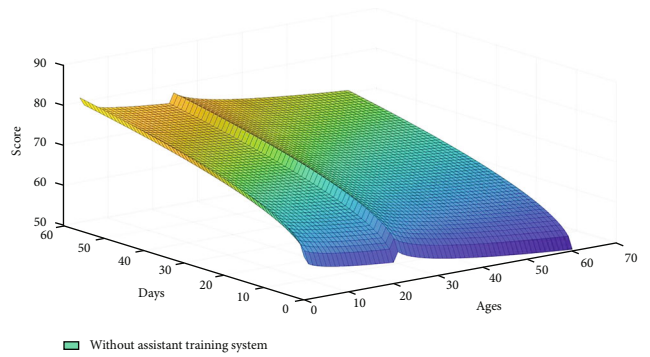


FIGURE 11: Score prediction for all age groups without assistant training system during different training time.

Figure 9 shows the score comparison of the 20~30 years old Tai Chi Chuan trainees with and without the Tai Chi Chuan fine motion capture assistant training system in eight weeks.

Figure 9 shows that the Tai Chi Chuan fine motion capture assistant training system studied in this paper to improve the Tai Chi Chuan training scores of 20~30 years old groups have significant effect; it can help improve the Tai Chi students withdrawn actions and improve the training efficiency.

Figure 10 shows the training scores of 20~30 years old, 30~40 years old, 40~50, 50~60 years old, aged 60~70, and 70~80, six groups of Tai Chi Chuan trainees with the Tai Chi Chuan fine motion capture assistant training system in eight weeks.

Contrast Figures 8 and 10, it shows that the Tai Chi Chuan fine motion capture assistant training system for different ages of learners to improve the efficiency of Tai Chi Chuan training has a great help, and 40~50 learners improve the most significant effect.

According to a large number of different age levels of Tai Chi Chuan training score values, AI intelligent algorithm is applied to deal with data and fitting and to predict the presence of fine Tai Chi Chuan motion capture assistant training system for different age groups of Tai Chi Chuan training

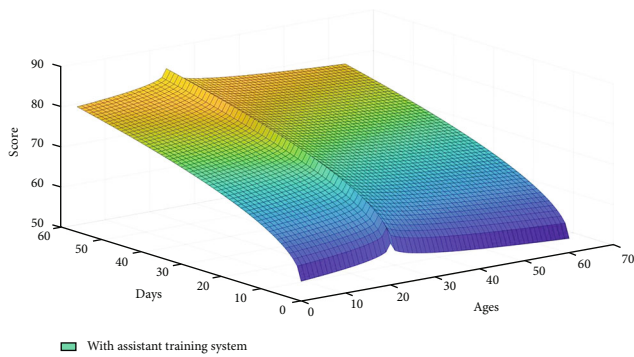


FIGURE 12: Score prediction for all age groups with assistant training system during different training time.

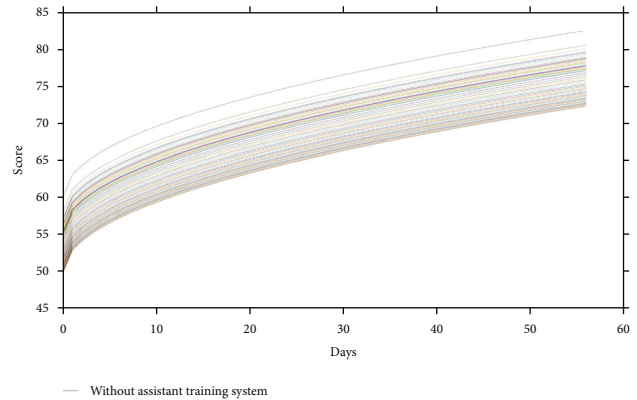


FIGURE 15: The score prediction without assistant training system in 8 weeks.

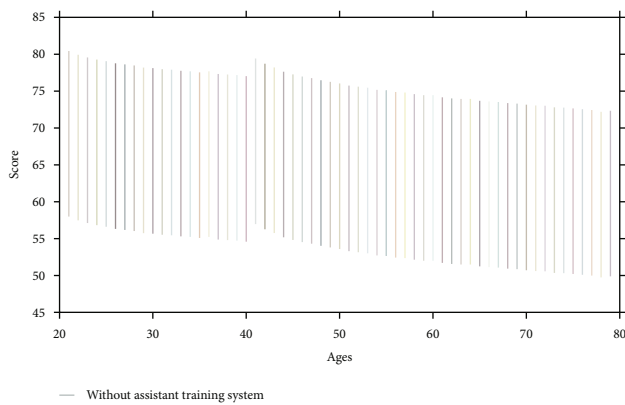


FIGURE 13: Score prediction for all age groups without assistant training system.

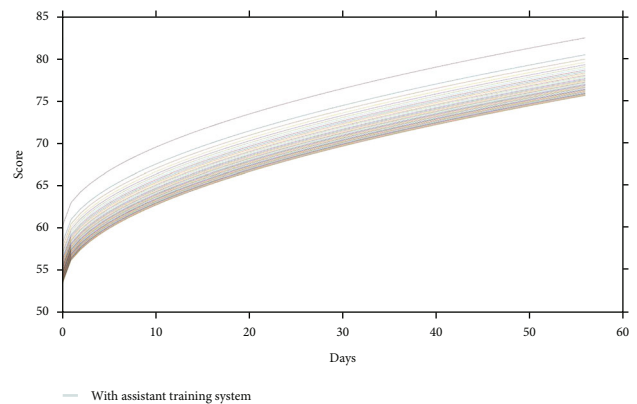


FIGURE 16: The score prediction with assistant training system in 8 weeks.

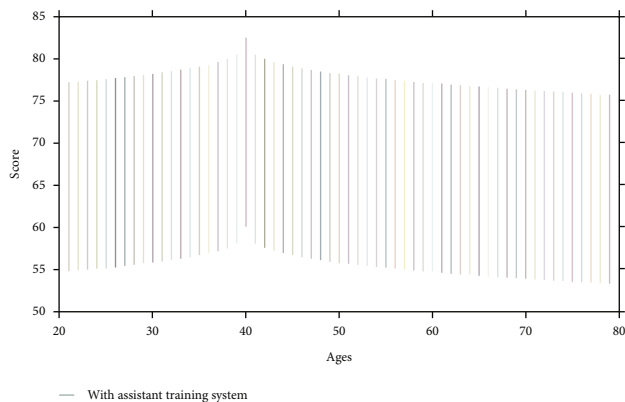


FIGURE 14: Score prediction for all age groups with assistant training system.

effect, which is shown in Figures 11–16. The data of Figures 11–16 are obtained from different age levels of taijiquan training in different training period for tracking.

Figures 11 and 12 show the training score improvement of different age stages of Tai Chi Chuan trainees in 8 weeks. The main difference is that the Tai Chi Chuan fine motion assistant training system is used to guide the training or not.

By comparing Figures 11 and 12, we can know that the Tai Chi Chuan auxiliary training system have a positive effect to the training of all age groups. While it has different improve effect to different age stages of training, and its effect to years groups around 30 is the most obvious.

4. Conclusions

Aiming at solving the problems existing in the Tai Chi Chuan training, a Tai Chi Chuan fine motion capture assistant training system is studied and designed. And it is used to help Tai Chi Chuan trainees improving their training quality and efficiency in this paper. Firstly, the development situation at home and abroad and the research status of Tai Chi Chuan are introduced in this paper. Secondly, the main training methods and contents of Tai Chi Chuan are learned shelf, fixed shelf, knead shelf, along shelf, and open shelf, which is conducted by analyzing and summarizing the research states of Tai Chi Chuan. Thirdly, the main contradictions existing in current training for Tai Chi Chuan are analyzed in detail. Fourthly, aiming at the existing problem of Tai Chi Chuan training, the assistant taijiquan training

system based on fine motion capture is studied this paper, and the system has the ability of autonomous learning, trainees' training assessment and modification suggestions, and other functions, which can improve the efficiency of people training effectively. It also plays a positive role in overcoming the current main problems of Tai Chi Chuan training and has the promotion of Tai Chi Chuan. Fifthly, the Tai Chi Chuan fine motion capture assistant training system for different age groups of Tai Chi Chuan trainees to improve their training quality and effect has a positive effect. Besides, the assistant training system studied in this paper can be applied to assist other sports training, according to the specific content of the training to modify built-in algorithm.

Data Availability

The labeled datasets used to support the findings of this study are available from the corresponding author upon request.

Conflicts of Interest

The authors declare no competing interests.

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