Online Intelligent Teaching Method of Track and Field Error Avoidance Based on Multimedia Video

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Abstract. The traditional teaching method adopts the unified teaching method, which can not fully pay attention to the students' differences in learning track and field movements, which leads to students' errors in learning track and field movements and affects the teaching effect. Therefore, this paper studies the online intelligent teaching method of track and field error avoidance based on multimedia video. After the multimedia video image is collected and processed, the 3D contour feature of track and field action is used to reconstruct and decompose. The gray-scale contour model is used to detect the track and field wrong actions in the image. By analyzing the causes of the wrong actions, the teaching of avoiding the wrong movements in track and field is completed. A case study in a university proves that the teaching method can improve the standard of students' movements and the teaching effect is better.

Keywords: Multimedia video · Track and field wrong action · Wrong action evasion · Online intelligent teaching

1 Introduction

Track and field, as a major subject of physical education in primary and secondary schools, is the key content of physical education curriculum. Good study of track and field can effectively improve students' physique, cultivate their strength and resilience, and promote their physical and mental health. The new national curriculum requires students to care about their physical and mental health, cherish life, improve their psychological quality, build up a strong and healthy body through physical training, cultivate team spirit, and learn how to learn and do things. Now in the technical teaching of track and field sports, the teaching method is mainly fixed class as a unit, in this model, teaching is the teacher's explanation demonstration [1]. However, in the technical items of track and field, the professional requirements of each track and field movement are very high. It is difficult for the students to observe the composition of the movement completely under the teacher's demonstration action, understand the key and heavy difficulty of the track and field movement, and the problems in the technical study can not be fed back to the students in time, so that the students can form the correct movement concept,

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and the students are easy to make mistakes, so that it is difficult to achieve satisfactory teaching effect [2]. The traditional teaching method is easy to cause the difference between the students with higher physical ability level and the students with lower physical ability level under the same teaching schedule. So some students are easy to lose their enthusiasm for learning and can't keep up with the teaching schedule of other students. The traditional teaching method is difficult to meet the needs of training talents in the new era. Therefore, it is necessary to reform the teaching of track and field courses for physical education majors in colleges and universities. When teaching track and field, it is very important to correct and adjust students' wrong actions in time. Wrong track and field movements will not only affect the results of track and field sports, long time to maintain the wrong posture will affect the health of students [3].

Based on the above analysis, this paper will study the multi-media video based on the track and field error movement to avoid online intelligent teaching methods. After the multimedia video images are collected and processed, the 3D contour features of track and field movements are used to reconstruct and decompose the images. The gray scale contour model is used to detect the wrong motion in the track and field images. By analyzing the causes of the wrong motion, the teaching of avoiding the wrong motion in track and field is completed. The designed online intelligent teaching method based on multimedia video can improve the standard of students' track and field movements, and the teaching effect is more ideal. The innovation of this paper is the use of multimedia video technology, the maturity of the technology to promote the modern curriculum reform provides great convenience, the use of multimedia technology can improve the efficiency of modern teaching, improve students' learning enthusiasm.

2 Research on Intelligent Teaching Method of Wrong Track and Field Motion Evasion Based on Multimedia Video

2.1 Multimedia Video Image Acquisition and Processing

In sports training, visual recognition technology is used, mainly through the decomposition of three-dimensional contour features to complete the wrong action recognition. For example, in the hurdle movement, the site is fixed, assuming that the starting point angle of the site is the origin, and the length, width and height directions are respectively x-axis, Y-axis and z-axis [4]. The field length x_0, width y_0, and the highest z_0 of the athlete's flight are 14 m, 8 m and 5 m respectively, and the three-dimensional coordinate system is established. The three-dimensional coordinate system is shown in Fig. 1.

By confirming the coordinates of the shoulder, hand, toe and other important parts of the athletes, the outline of the athletes can be drawn. For example, when an athlete makes a leap in the air, he can determine whether there is any error in the movement such as swinging his legs or feet according to the difference between the toes and shoulders on the z axis. But it is easy to be affected by the environment disturbance when the contour feature is extracted according to this method, which leads to high error rate of error detection. Using 3D modeling and detection technology to realize motion image processing, it can complete image feature decomposition and detection through image processing, and check the integrity of the wrong action.

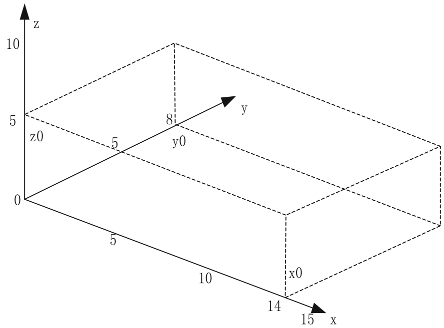

Fig. 1. Three-dimensional coordinate system of track and field

In accordance with the above ideas, in the use of three-dimensional visual scanning and tracking recognition technology to complete sports training in the wrong action image acquisition. For image preprocessing, we need to take into account the random distribution of images with irregular attributes [5]. If any point is regarded as the initial value of data acquisition, the attenuation coefficient must be set and the image row replacement must be performed. Combined with the wrong motion image sequence, corner marker and 3D template can be matched to reconstruct the image and calibrate the contour. On the basis of image localization, the differential feature of the image can be obtained by compensating the difference of moving frames. Using the parallax function, the image pixel features can be weighted, the shape model can be solved, and the error motion distribution domain can be obtained. By decomposing the related pixel features, the tracking parallax can be obtained and the contour features can be determined [6]. Using the weight of intersection points to cover each interval information, the feature can be determined to extract data items and complete pixel estimation. In practice, when the feature sampling points and the model match, the gray stage quantization decomposition is needed to obtain the image fuzzy vector set:

$$E^{CV}(c_1, c_2) = \mu L(C) + v \cdot A(in(C)) + \lambda_1 \int_{in(C)} |I - c_1|^2 dxdy + \lambda_2 \int_{in(C)} |I - c_2|^2 dxdy \quad (1)$$

In formula (1), c_1 is the reconstruction target of error action image; c_2 is the feature distribution primitive of error action image reconstruction, μ, v, λ_1 and λ_2 refer to the sampling weight coefficients of multimedia video images, which are all constants greater than 0, and $L(C)$ is the length of image reconstruction contour; $A(in(C))$ is the brightness of the reconstructed pixel. Through gradient decomposition, the image is scanned from the spatial dimension, and the 3D image reconstruction can be realized.

2.2 Image Decomposition and Reconstruction

According to the above idea, motion feature extraction is needed in the process of image pixel decomposition to estimate the edge feature of wrong motion contour. According to the motion attitude space vector, motion elements can be introduced into the closed curve. The active region can be represented by time-delay function, and the wavelet multidimensional scaling coefficients can be obtained by referring to the set of background graph rules [7]. For the modeled image module, block matching can be implemented, and the differential matching of moving frames can be realized by multi-dimensional decomposition. In practice, in 3D modeling testing, the contour of the reconstructed image is obtained:

$$E = \theta E^{LBF} + (1 - \theta)E^{LGF} + vL(\phi) + \mu P(\phi) \tag{2}$$

In formula (2), θ refers to the gray weight coefficient of the neighborhood of each error action pixel. In the three-dimensional data field, there are two regions, as the sampling point matching field, E^{LBF} is the local gray information of track and field action in the image, E^{LGF} is the local gradient energy item of track and field action in the image, $L(\phi)$ is the constraint term of the edge contour length of the track and field action in the image, and $P(\phi)$ is the regular term of the edge contour length of the track and field action in the image. Through smoothing filtering, the model definition can be completed, and the local gradient feature decomposition can be realized by using quantitative information, and the correct and wrong actions in the image can be distinguished. In the case of centralized distribution of moving image pixels, the gray value of neighborhood error action image reconstruction has correlation, which can be used for image segmentation, extract the information of image 3D data field, and complete the reconstruction of action 3D coordinate system [8]. According to the detection results, it can match the contour model of the wrong action, complete the corner marking of the image sequence, and determine the Gaussian distribution of the error action in the image:

$$P(\phi) = \int \frac{1}{2}(|\nabla \phi| - 1)^2 dx \tag{3}$$

According to the Gaussian distribution of the error motion in the image, the error track and field motion in the multimedia video image is detected.

2.3 Wrong Track and Field Motion Detection

According to the gray-scale contour model, the 3D motion modeling and detection can be completed by combining the wrong motion rules. Concretely speaking, it is to match the motion correlation in the wavelet kernel space and complete the construction of motion mapping function. In the region boundary position, the acquired image template value can be analyzed and the moving frame coordinate of the image feature can be obtained according to the ray direction. In error motion modeling and detection, the intersection coordinates of feature moving frames need to be solved, and the corresponding 3D data field can be obtained by minimizing the reconstruction gray value [9, 10]. When the external disturbance is not fixed, it is necessary to decompose the contour features of the athlete's body to enhance the visual recognition component estimation. Region-pixel information can be obtained by traversing addressing, information collection and reconstruction of feature database using local binary fitting:

$$L = J(w, e) - \sum_{i=1}^{N} a_i \left\{ w^T \phi(x_i) + b + e_i + y_i \right\} \tag{4}$$

In formula (4), $J(w, e)$ refers to the repeated pixels in the moving position; x_i and y_i are the correct and wrong action eigenvectors of the i Gaussian unit, a_i is the standard action configuration sequence, and $\phi(x_i)$ is the contour feature distribution function. Through the analysis, we can extract the three-dimensional feature of the wrong action, and complete the action detection through decomposition.

Through 3D modeling and detection, the feature quantity of wrong movement can be extracted, but there is a great difference in position between different sports. In order to meet the requirements of sports training guidance, it is necessary to extract all position information, and then realize vector normalization by summing. For any motion, it is necessary to extract spatiotemporal features, do a good job in direction gradient and boundary selection, so as to accurately depict the motion. When the action features are combined, it can be seen that the images collected by machine vision contain 30–960-dimensional information, which makes the feature dimension far exceed the training samples. In order to ensure the efficiency of the method, dimensionality reduction is needed to reduce the computational complexity while preserving the important features.

Based on the acquisition of action video, the Gaussian mixture model is used to complete the feature extraction, and then the high-dimensional feature is obtained by fusion. Using the model to select the important features, the support vector machine for action classification can be obtained. In the application of the algorithm, we can know that the feature vector $X_1 = [x_1, x_2, \ldots, x_{Ti}]^T$ is extracted from the video, and the high-dimensional matrix is $X_1 = [x_1, x_2, \ldots, x_m]^T$. Projection in the low-dimensional space can get the reduced dimensional motion feature set $V^{RP} = \left[v_i \in R^d\right]$, d refers to the reduced dimension, R^d refers to the low-dimensional space, and R^d refers to the reduced motion features [11, 12]. The probability of motion features obtained by dimension reduction in Gaussian element is estimated, and the estimation formula is as follows:

$$r(i) = \frac{w_i p_i - v_i}{\sum_{i=1}^{k} w_i p_i(v_i)} \tag{5}$$

In formula (5), p_i refers to the probability assigned to the i Gaussian cell, and w_i is the mixing weight, according to the model parameters and the gradient vector, the gradient values can be cascaded to get the motion feature vector set after dimension reduction. Using the reduced dimension set to train the support vector machine, identify the correct and wrong action feature vectors, and complete the output of action category value, and get the detection results of wrong track and field actions.

2.4 Implementation of Evasive Correction of Wrong Track Movements

According to the above process, the causes of students' wrong track and field movements are analyzed and corrected after the transformation of students' wrong track and field movements.

First, make sure that the students have a correct idea of the technology. Secondly, find the reason from the physical quality. If the practice students have the correct concept of technology, but still can not correctly complete the movements, we should know about the physical condition of students [13, 14]. Then, find the reason from psychological factors.

Some people in a separate operation, can better complete the action, in the presence of many people or teachers, because of tension and can not complete the action. Some people in a large number of occasions full of energy, can better complete the action, when the quality of action is not high, and even the wrong action [15]. Still others are afraid to run because of the uneven ground. Bad weather will also lead to the wrong action. Finally, look for the reason from the whole factor of action [16]. Every part of any track and field skill is an organic and inseparable whole, and there is an internal connection between the movements, and the emergence of any movement is not isolated [17]. Therefore, in the search for the cause of the error, but also from the overall technical starting point, check the previous stage of action or action related to the action of other problems. In addition, we should consider students' technical proficiency. In the teaching process, the technical action which the student learns, must achieve the skilled degree, needs certain time. In the beginning stage of technology is not consolidated, this or that kind of wrong action is unavoidable, can not be overly demanding, act too hastily [18].

In view of the above analysis of the causes of students' wrong track and field movements, action correction [19]. When correcting the wrong action caused by unclear technical concept, we should further explain the technical essentials, and with the correct demonstration or see the picture, so that students have a correct understanding of the technology. When correcting the wrong actions caused by poor physical quality, we should change the conditions and requirements of teaching in class so as to realize and master more correct techniques. When correcting the wrong actions caused by psychological reasons, we should give psychological guidance to the students, explain the aim and significance of learning, enhance ideological understanding, eliminate ideological concerns, and educate them to cultivate their own bravery and tenacity and overcome difficulties [20, 21]. At the same time, we should improve the conditions of teaching and practice. From the overall technical point of view, from the most important aspects. Once the primary error is corrected, its subordinate errors can be resolved [22, 23]. If the wrong action is caused by an incomplete or imperfect previous action, it can be corrected by improving the previous action. For example, in the long jump can not jump up, the movement performance is too forward, which is the run-up the last few steps too forward and the cause of the last step is too small. According to this situation, correct the last few steps of running posture and running method, you can solve the above mistakes. For the technical unskilled and the wrong action, do not start to correct, the practice to emphasize its correct approach, repeated many times can be gradually resolved.

Through the above content, this paper completes the research on the teaching method of track and field error motion avoidance based on multimedia video.

3 Experimental Results

3.1 Experimental Preparation

In this case study, the experimental group is based on the multimedia video, and the experimental group is based on the existing teaching methods of track and field. By comparing the two groups of subjects in the verification cycle after the end of the standard level of track and field movements to evaluate the effectiveness of the two teaching methods.

The research objects are the students of the physical education college of a university. A total of 40 students are selected from Class 2 and Class 3 of the male sports training major class of the university in 2017. Before the experiment, the two groups of students were tested for the difference of body shape and physical quality. During teaching, the two groups were consistent in the number of students, teaching content and practice amount. In the last class, experts will test the standards, skills and theories, and check and ratify according to the relevant track and field action assessment standards. From two parallel classes, 20 students from Class 2 were selected as the control group, and 20 students from Class 3 were selected as the experimental group. According to the syllabus of the School of Physical Education of the university, the teaching was carried out according to the teaching schedule. The experiment period was 4 weeks, with 2 classes per week and 4 class hours, a total of 16 class hours. In the last class, the students were tested for reaching the standard, technical evaluation and theoretical knowledge.

Before the experiment: Carries on the experiment two groups of schoolmates to carry on the body shape and the physical quality pre-test examination. The Table 1 shows the test results of the subjects before the teaching begins.

Table 1. Analysis table of test results of physical form and physical fitness indexes of students before the experiment (n = 40)

Groups	Numbers	Height/m	Weight/kg	30 m/s	The standing long jump/m	Forward shot put/m
		$\bar{x} \pm s$	$\bar{x} \pm s$	$\bar{x} \pm s$	$\bar{x} \pm s$	$\bar{x} \pm s$
Experimental group	20	177.4 ± 5.50	68.19 ± 6.36	4.15 ± 0.22	2.79 ± 0.07	9.00 ± 1.12
Control group	20	175.4 ± 4.558	65.275 ± 5.11	4.34 ± 0.37	2.79 ± 0.07	8.815 ± 1.1
t	–	1.251	1.611	1.962	0.064	0.515
p	–	0.22	0.12	0.06	0.95	0.61

Table 1 The results of the test show that there is no significant difference between the two classes in the body shape and main body quality indexes ($P > 0.05$). The experiment is suitable for this subject, which ensures the high validity of the experiment.

In the experiment, the experimental group and the control group were both taught by the same person. The teaching progress, teaching hours, exercise intensity and practice amount of the two groups were consistent.

After the experiment, the students were tested for reaching the goal of track and field action, skill evaluation and teaching technique theory knowledge, and the data of control group and experimental group were tested statistically. Analyze the experimental data and draw corresponding conclusions.

3.2 Results

After the experiment in the first teaching stage, the results of the experimental group and the control group were analyzed as Table 2:

Table 2. Comparison and analysis table of the scores of the experiment group and the control group (n = 40)

Groups	Attaining result	Performance evaluation (score)
	$\bar{x} \pm s$	$\bar{x} \pm s$
Experimental group	19.95 ± 2.585	68.95 ± 5.346
Control group	18.80 ± 1.795	69.70 ± 6.071
t	1.634	0.415
p	0.110	0.681

Table 2 shows the comparison between the two groups of students after the 2nd class, which shows that the average score of the experimental group is 19.95 and the standard deviation is 2.585. The average score of the control group was 18.80, the standard deviation was 1.795, the average score of the experimental group was 68.95, and the standard deviation was 5.346. The average score of the control group was 68.70, and the standard deviation was 6.071, $P > 0.05$. There was no significant difference between the control group and the experimental group.

After the experiment in the second teaching stage, the results of the experimental group and the control group were analyzed as Table 3:

Table 3. Comparison and analysis table of the scores of the experiment group and the control group after the 5th class (n = 40)

Groups	Attaining result	Performance evaluation (score)
	$\bar{x} \pm s$	$\bar{x} \pm s$
Experimental group	32.35 ± 3.760	77.15 ± 5.122
Control group	28.40 ± 2.664	72.40 ± 3.202
t	3.834	3.516
p	0.015	0.021

The results showed that the average scores of the two groups were 32.35, the standard deviation was 3.760, the average scores of the control group was 28.40, the standard deviation was 2.664, the average scores of the experimental group was 77.15, the standard deviation was 5.122. The average score of control group was 72.40, and the standard deviation was 3.202. Judging from the results of the second stage, the control group in the track and field reached the standard and technical evaluation results are lower than the experimental group. There were significant differences in experimental data. The results showed that the use of multimedia video in motor skill learning had an impact on the prevention and correction of motor skills, and the students in the experimental group had obvious progress.

After the experiment in the third stage, the students in the experimental group and the control group had the following results and analysis:

Table 4. Comparison and analysis table of the scores of the experimental group and the control group after the 8th class (n = 40)

Groups	Attaining result	Performance evaluation (score)
	$\bar{x} \pm s$	$\bar{x} \pm s$
Experimental group	40.15 ± 4.120	83.55 ± 5.155
Control group	31.70 ± 3.197	78.40 ± 3.604
t	7.246	3.662
p	0.017	0.010

Table 4 shows the comparison and analysis of the results of reaching the standard of track and field movements and technical evaluation after the course, we can see that the average score of the experimental group is 40.15, the standard deviation is 4.120, the average score of the control group is 31.70, the standard deviation is 3.197, the average score of the experimental group is 83.55, the standard deviation is 5.155, the average score of the control group is 78.40, the standard deviation is 3.604. The results of the experimental group were significantly better than those of the control group. The experimental data showed that the multimedia video teaching method was better than the conventional teaching method.

To sum up, the online intelligent teaching method of track and field error avoidance based on multimedia video studied in this paper can effectively improve the standard degree of students' track and field movements when applied to teaching, and obtain better teaching effect.

4 Conclusions

Traditional teaching method can not meet the needs of modern track and field teaching. In order to correct and avoid students' wrong track and field actions in time, this paper studies the intelligent teaching method of track and field actions avoiding online based on multimedia video. Compared with the traditional teaching method, the method of this paper can effectively improve the accuracy of students' track and field movements, ensure the standard of students' track and field movements, and achieve better teaching results.

References

1. Bezodis, N.E., Willwacher, S., Salo, A.: The biomechanics of the track and field sprint start: a narrative review. Sports Med. **49**(9), 1345–1364 (2019)
2. Jacobsson, J., Ekberg, J., Timpka, T., et al.: Developing web-based health guidance for coaches and parents in child athletics (track and field). Scand. J. Med. Sci. Sports **30**(7), 1248–1255 (2020)
3. Wang, P.: Analysis and design of applying artificial intelligence in educational video. E-educ. Res. **41**(03), 93–100+121 (2020)
4. Li, J.: Computer course teaching mode based on multimedia mobile platform. Modern Informationn Technology 4(02):162–163+166 (2020)
5. Guo, R.: On innovation of multimedia teaching model based on WebRTC technology. J. Daqing Normal Univ. **39**(06), 70-75 (2019)
6. Zhang, S., Lan, S., Bu, Qi., et al.: A survey of action recognition based on deep learning. J. Commun. Univ. Chin. Sci. Technol. **26**(05), 43–49 (2019)
7. Ma, J.: Design of multimedia sharing system for multi-node networked intelligent teaching. Mod. Electron. Tech. **42**(14), 157–160+164 (2019)
8. Zhao, Z.: Application countermeasures of demonstration method in track and field teaching in higher vocational education. Contemp. Sports Technol. **10**(13), 69+71 (2020)
9. Macdonald, B., Mcaleer, S., Kelly, S., et al.: Hamstring rehabilitation in elite track and field athletes: applying the British athletics muscle injury classification in clinical practice. Br. J. Sports Med. **53**(23), 71–85 (2019)
10. Fu, W., Liu, S., Srivastava, G.: Optimization of big data scheduling in social networks. Entropy **21**(9), 902–908 (2019)
11. Liu, S., Bai, W., Zeng, N., et al.: A fast fractal based compression for MRI images. IEEE Access **7**(1), 62412–62420 (2019)
12. Liu, S., Li, Z., Zhang, Y., et al.: Introduction of key problems in long-distance learning and training. Mob. Netw. Appl. **24**(1), 1–4 (2019)
13. Sánchez-Nielsen, E., Chávez-Gutiérrez, F., Lorenzo-Navarro J.: A semantic parliamentary multimedia approach for retrieval of video clips with content understanding. Multimedia Syst. **25**(3), 337–354 (2019)
14. Liu, Y., Dhakal, S., Hao, B.: Multimedia image and video retrieval based on an improved HMM. Multimedia Syst. **3**, 45–52 (2020)
15. Zaimi, I., Boushaba, A., Houssaini, Z.S., et al.: A fuzzy geographical routing approach to support real-time multimedia transmission for vehicular ad hoc networks. Wirel. Netw. **25**(3), 1289–1311 (2019)
16. West, L., Srivastava, D., Goldberg, L.H., et al.: Multimedia technology used to supplement patient consent for mohs micrographic surgery. Dermatol. Surg. **46**(12), 15–23 (2020)
17. Omrani, T., Becheikh, R., Rhouma, R.: Towards a real-time image/video cryptosystem: problems, analysis and recommendations. Multimedia Syst. **26**(2), 339–362 (2020)
18. Ullah, H., Islam, I.U., Ullah, M., et al.: Multi-feature-based crowd video modeling for visual event detection. Multimedia Syst. **5**, 15–21 (2020)
19. Zhang, Y.: Interactive intelligent teaching and automatic composition scoring system based on linear regression machine learning algorithm. J. Intell. Fuzzy Syst. **40**(2), 2069–2081 (2021)
20. He, H., Yan, H., Liu, W.: Intelligent teaching ability of contemporary college talents based on BP neural network and fuzzy mathematical model. J. Intell. Fuzzy Syst. **39**(9), 1–11 (2020)
21. Dong, S.: Intelligent English teaching prediction system based on SVM and heterogeneous multimodal target recognition. J. Intell. Fuzzy Syst. **38**(153), 1–10 (2020)

22. Wirthmüller, F., Schlechtriemen, J., Hipp, J., et al.: Teaching vehicles to anticipate: a systematic study on probabilistic behavior prediction using large data sets. IEEE Trans. Intell. Transp. Syst. **14**(12), 1–16 (2020)
23. Yahyaabadi, M., Aslani, F., Vahidi, B.: A novel hybrid method based on teaching–learning algorithm and leader progression model for evaluating the lightning performance of launch sites and experimental tests. Electr. Eng. **101**(4), 619–633 (2019)