Research Article

Real-Time Recognition Method of Video Basketball Technical Action Based on Target Detection Algorithm

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Aiming at the problems of poor real-time recognition efficiency and low recognition accuracy of video basketball technical movements, a real-time recognition method of video basketball technical movements based on the target detection algorithm is proposed. This study firstly collects video basketball technical action images and detects their edge contour features. Through machine vision block template matching processing, the video basketball technology motion capture results are output. Then, according to the target probability of video basketball technical action detection, the basketball video sample set is estimated and constructed, the sequence of basketball video is obtained, and the basketball video target detection algorithm is designed. Finally, the similarity between the two vectors of video basketball technical action targets is measured to realize real-time recognition of video basketball technical actions. The experimental results show that the method in this study has high accuracy in extracting feature points of basketball video image decomposition, the real-time recognition time of video basketball technical action is up to 4s, and the recognition error of basketball rotation projection technology is small, which is close to the actual value.

1. Introduction

In the process of basketball training and competition, coaches need to formulate corresponding training plans according to the individual conditions of different players to improve the players' basketball skills. Compared with other ball games, basketball has a variety of techniques and various tactical forms, the skills of the players are also very strong, and it reflects the characteristics of individual combat and coordination [1]. The traditional training method is that the coaches are based on their own training theory and training experience. This training mode is highly subjective, the coach needs to spend a lot of time analyzing the posture of the athletes, and it is difficult to objectively evaluate the training effect of the athletes. If the coach can accurately control the movement posture of the athlete, the training effect can be greatly improved. Therefore, collecting the video basketball technical movement data and accurately identifying basketball technical movements are of great significance for improving the scientificity of coaches' training plans and improving the training effect of athletes and are a new research direction [2].

With the rapid development of information storage technology and communication technology today, the amount of basketball technical data is increasing dramatically every day. The content of this information is all-encompassing, and specific information players and coaches often only need a small part of it. If the data of technical movements can be directly processed by the computer, the parts that players and coaches are really interested in can be submitted to them; thus, they can be freed from the tedious processing of technical movements and grasp the information and make reasonable decisions. *Training and Competition.* In the training and guidance of basketball sports, it is necessary to modify the basketball technical action characteristics in the video to improve the effect of basketball sports training. Combined with computer vision image processing technology, the spatial visual feature analysis method is used to capture and analyze the motion of basketball sports training. The action feature quantity of basketball sports training, the realization of basketball sports training motion capture, and the research on the real-time recognition method of basketball technical movements are of great significance in the guidance of basketball sports training [3].

Reference [4] proposed a method for identifying the difference of motion blocks in basketball images based on the optical flow method. The optical flow equation is analyzed, and the pixel change of the moving block is judged by the time domain change and correlation of the pixel intensity data in the basketball image sequence. The foreground position of the basketball image is extracted by the codebook model to avoid the interference of crowd occlusion, and the feature points are found at the foreground position. After acquiring the target feature points, the motion blocks are tracked by the optical flow method, and the optical flow motion direction data are introduced for all the motion blocks that can be tracked. The feature points of the optical flow movement direction in the same angle interval are regarded as a set of data to complete normalization processing, which reduces the misjudgment of normal motion blocks and enhances the detection accuracy. Gaussian filtering is performed on the optical flow acceleration in each interval, and the acceleration of each angle interval is accumulated, which is regarded as the acceleration of the basketball image, and the cumulative acceleration threshold is set. When the cumulative acceleration of the image block is higher than the set threshold, it is considered that there is a difference. Reference [5] proposes an adaptive positioning and recognition method for fast displacement images of basketball. The image cross-energy spectrum is inverted to compensate for the resulting background motion offset. According to the gray threshold technology, the background template and the current frame of basketball moving images are differentiated to obtain the rapid displacement area of the current frame; the seed pixel is used as the growth starting point, and the pixels similar to the seed pixel in the neighborhood are gathered to obtain the rapid displacement target. The smallest frame will complete the positioning.

In view of the problems existing in the above methods, this study proposes a real-time recognition method of video basketball technical action based on the target detection algorithm. This study first collects video basketball technical action images and extracts edge contour features. Through machine vision block template matching processing, the video basketball technology motion capture results are output. Then, according to the motion detection target probability of video basketball technology, the sequence of basketball video is obtained, and the target detection algorithm of basketball video is designed. Finally, the real-time recognition of video basketball technical actions is completed according to the similarity between the two vectors of video basketball technical action targets.

2. Video Basketball Technology Action Image Preprocessing

The outcome of a basketball game depends on the number of points scored, and its offensive and defensive skills can also be seen from the score. In general games, technical actions such as 2-points, 3-points, and free throws have obvious contributions to scoring, but they are not related to rebounds, steals, assists, blocks, turnovers, fouls, pick-and-rolls, technical fouls, interference balls, intentional fouls, breakthroughs, control Balls, passes, dunks, alley-oops, free throws, jump shots, fast-break technical moves, etc., cannot

be given a definite count. This study will use image acquisition and edge contour feature detection to analyze video basketball technical movements and provide relevant information for players and coaches to refer to, so as to achieve targeted training for athletes.

3. Video Basketball Technology Action Image Acquisition and Edge Contour Feature Detection

Data preprocessing is an essential and important stage in video basketball technical action data mining, and it is also a large part of the workload. Often the collected video basketball technical action data contain a large number of records and redundant items that are irrelevant or weakly related or even irrelevant to mining, which needs to be processed to obtain a data form suitable for mining by mining tools (software). Data preprocessing is generally to clean the collected video basketball technical action data, remove the noise of the data, and correct inconsistent video basketball technical action data. And then integrate the video basketball technical action data from multiple sources. When merging into a consistent data store, the video basketball technology action data transformations can also be used, such as specification can change the accuracy and effectiveness of mining algorithms involving distance metrics; data reduction can compress video by clustering to remove redundant features or clustering Basketball technical action data. These preprocessing techniques can greatly improve the quality of video basketball technology action data mining mode before mining and reduce the time required for actual mining.

In order to realize the real-time recognition of video basketball technical movements based on the target detection algorithm, it is necessary to first use multiresolution frame scanning technology to collect images of video basketball technical movements and perform edge contour feature detection on the collected high-resolution video basketball technical movements images [6], the training action image is collected according to the feature distribution of the three-dimensional model, the collected video basketball technique action image is $f(x, y)$, and the background component of the image is $g(x, y)$. Using the corresponding point matching method between the two-dimensional image and the three-dimensional model, template matching processing is performed on $g(x, y)$, Gaussian noise and Gaussian fuzzy feature quantities are added, and the matching template of the image is divided into a $3 * 3$ topology structure. For the reconstruction, the key feature point distribution of image acquisition is $\eta(x, y)$, and the pixel $\widehat{f}(x, y)$ in the neighborhood of the current feature point is:

$$\widehat{f}(x, y) = \begin{cases} g(x, y) - 1, & g(x, y) \geq 1, \\ g(x, y) + 1, & g(x, y) < 1, \\ g(x, y), & \text{else.} \end{cases} \tag{1}$$

Template matching is performed on the center pixel of the multiresolution video basketball technology action

image, and the edge contour feature decomposition method is combined to obtain the image feature modeling description as H and η. When the amount of information in H and η is more, it means that the ability to capture the action is better. Strong $\widehat{f}(x, y)$ will be closer to $f(x, y)$. In the global shape model, the hierarchical registration structure model is obtained as follows:

$$g(x, y) = h(x, y) * f(x, y) + \eta(x, y). \tag{2}$$

In the formula, $h(x, y) * f(x, y)$ is the key feature point of video basketball technical action positioning, and the symbol $*$ represents convolution. The feature localization of basketball training action images is performed in different regions, and the affine invariant moment is obtained as follows:

$$g(x, y) = f(x, y) + \eta(x, y). \tag{3}$$

In the formula, $\eta(x, y)$ is the noise interference item, and the basketball training motion capture and collection are realized by the method of fine registration [7].

The edge contour feature detection is performed on the collected high-resolution video basketball technical action images, and the three-dimensional model reconstruction method is used to segment the video basketball technical action. The vector quantization value in the current feature point neighborhood is $\widehat{f}(x, y) = F(x, y) + m_l$, of which $f(x, y)$ is the video basketball technical action. The edge feature points of the image pixel sequence are at (x, y) points, m_l is the reflection projection of the lth subband video basketball technology action image, $\delta 2/0$ is the local variance of the video basketball technology action image, and δ_n^2 is the LightGBM (LGB) quantized feature value, combined with residual component fusion. The method is to match the edge feature points of the video basketball technical action image and perform vector quantization decomposition on the video basketball technical action image and the grayscale matching value of the video basketball technical action image:

$$L_0(r) = \frac{L(r/2)}{2},$$
$$H_0(r) = H\frac{r}{2}, \tag{4}$$

where r and θ are the hierarchical eigendecomposition coefficients, when the correlation variable satisfies $\phi(x, y) \in \{-1, 0, 1\}$. Using the grayscale feature fusion method, the edge contour components of the video basketball technical action image are obtained as follows:

$$p(\phi(x, y)) = \begin{cases} \dfrac{r}{4}, & \varphi(x, y) = -1, \\ \\ 1, & \varphi(x, y) = 0, \\ \\ \dfrac{r}{4}, & \varphi(x, y) = 1. \end{cases} \tag{5}$$

In the formula, r is the texture feature matching value of video basketball technical action images. When the output

covariance feature of the video basketball technical action image satisfies the expected normal distribution of 0 and variance $r/2$, the grayscale edge contour feature of the video basketball technical action image is as follows:

$$p(n) = \left(\frac{rc_1}{p(\phi(x, y))}\right), \left(\frac{rc_2}{p(\phi(x, y))}\right), \dots, \left(\frac{rc_b}{p(\phi(x, y))}\right),$$

$$p(m) = \left(\frac{L_0(r)c_1}{p(\phi(x, y))}\right), \left(\frac{L_0(r)c_2}{p(\phi(x, y))}\right), \dots, \left(\frac{L_0(r)c_b}{p(\phi(x, y))}\right). \tag{6}$$

In the formula, c is the number of columns in the grayscale pixel distribution of the video basketball technology action image and b is the number of rows. Thereby, the edge contour feature matching grid model of the video basketball technology action image is obtained, and the motion training motion capture is carried out in the model.

4. Video Basketball Technology Motion Capture Output

On the basis of the above video basketball technology action acquisition and edge contour extraction, action recognition optimization is carried out, combined with the irregular triangular network model to realize the video basketball technology action machine vision block template matching processing. The template matching method of machine vision can be applied in the following occasions. First, it can be used to implement integrity checks. The purpose of integrity detection is to detect the presence or absence of an object. In addition, template matching can also be used for object recognition, that is, to distinguish different types of objects. There are many types of basketball video actions, so the template matching method can better identify technical actions. The video is performed in the Gaussian fuzzy affine space. For the Basketball technology motion capture and feature extraction [8], the regional feature distribution model of the irregular triangular network is as follows:

$$I(G) = I(p(n), p(m), p(\phi(x, y))) = . \tag{7}$$

Considering the different scales of image changes, linear reorganization is performed according to the internal texture and edge features of the multiresolution video basketball technical action, and the image enhancement results are obtained as follows:

$$p(x, t) = -\sigma \frac{\partial u(x, t)}{\partial x}. \tag{8}$$

In the formula, σ represents the texture distribution of the image, x represents the gradient pixel value of the image, and the basketball flight trajectory is predicted in the local outline and local area of the basketball training image; let $t(x)$ represent the statistical pixel distribution value of the basketball training image, using the moment invariant method, the dynamic feature detection result of the obtained image is expressed as follows:

$$L(a) = \sum_{x=1}^{\sigma} t(x) p(x, t). \tag{9}$$

In the basketball nonlinear variation model system, the basketball flight trajectory equation is as follows:

$$L(b) = \log \frac{p(x, t)}{\sum_{x=1}^{\sigma} t(x)}. \tag{10}$$

The motion capture and feature extraction of video basketball technology are carried out in the Gaussian fuzzy affine space, and the wavelet lifting technology [9] is used to obtain the optimized trajectory equation:

$$L(a, b) = I(G) \sqrt{t(x)} \, \frac{p(x, y)}{\sum_{x=1}^{\sigma} t(x)}, \tag{11}$$

where (x, y) represents the gradient pixel distribution set of the image, and through spatial pixel block matching, motion capture is performed [10].

Image enhancement technology is used to improve the resolution and adaptability of video basketball technology motion capture, and the texture distribution function $f(g)$ of video basketball technology action is obtained by using machine vision image processing method:

$$f(g) = \sqrt{L(a, b)} \, \frac{p(x, y)}{\sum_{x=1}^{\sigma} t(x)}. \tag{12}$$

The dynamic trajectory distribution of video basketball technical actions is obtained, and the dynamic trajectory distribution expression is obtained as follows:

$$\begin{cases} f(gx) = \varphi \dfrac{f(g) p(x, y)}{t(x)}, \\[2mm] f(gy) = \varphi \dfrac{f(g) p(x, y)}{t(y)}, \\[2mm] f(gz) = \varphi \dfrac{f(g) p(x, y)}{t(z)}. \end{cases} \tag{13}$$

where ϕ is given by the following equation:

$$\phi = \pi \sqrt{\frac{f(g)}{2}}. \tag{14}$$

By analyzing the pixel values of the video basketball technical actions, combined with the motion trajectory reconstruction method, the basketball training motion trajectory is described as follows:

$$G_n = (1 + f(gz))(1 + f(gy))(1 + f(gx)) G_o. \tag{15}$$

In the formula, G_n and G_o represent the grayscale trajectory components of the video basketball technical action, respectively:

$$f(G) = \begin{cases} 1, & \varphi \dfrac{G_n}{T}, \\[4mm] 0, & \dfrac{G_n}{C_i}. \end{cases} \tag{16}$$

In the formula, T is the scale eigendecomposition formula of video basketball technical action, and C_i is the texture information component. According to the above analysis, the machine vision image processing method is used to realize the optimization of motion capture of video basketball technology.

Application of target detection algorithm realizes real-time recognition of video basketball technical actions.

4.1. Basketball Video Target Detection Algorithm.
Before constructing target detection, a classifier for basketball video target detection is trained to form a detection and tracking process [11]. The training process can be expressed as follows:

$$\omega = \min \sum_{i=1}^{i} (f(x_i) - y_i) + \varepsilon. \tag{17}$$

In the formula, ϵ is the regularization parameter, ω is the number of classifiers, f is the training function, x_i and y_i are the independent variable and dependent variable of the function, respectively, and i is the number of training times. In order to prevent overfitting in the classifier training process, the optimal solution of formula (16) is taken. The calculation formula of the optimal solution can be expressed as follows:

$$\omega = \sum_{i=1}^{i} \alpha \phi(x_i). \tag{18}$$

In the formula, α represents the coefficient of the conversion solution, and $\phi(x_i)$ represents the kernel function of the training sample x_i mapped to the high-dimensional space. In the high-dimensional feature space, the correlation between the two samples can be calculated as follows:

$$\phi^{T}(x)\phi(v) = k(x, v). \tag{19}$$

In the formula, x, v represent different samples respectively and k represents the Gaussian kernel function. The value of the conversion coefficient is obtained by deriving and calculating the function relationship. The calculation formula can be expressed as follows:

$$\alpha = (K + \vartheta)^{-1}. \tag{20}$$

In the formula, K represents the element in the coefficient matrix and ϑ represents the unit matrix. Any continuous periodic signal can be composed of a suitable set of sinusoids. The grayscale spectrum of the image also belongs to a periodic signal. Fourier transform is applied to image

processing, which can display the spectral image of the original image. The Fourier transform is obtained as follows:

$$F(\alpha) = \frac{F(\alpha)}{F(k^{xx}) + \vartheta}. \tag{21}$$

In the formula, F represents the discrete Fourier transform, k^{xx} represents the first row vector of the kernel matrix, and the optimal coefficient obtained by the above calculation formula is used as the target template. When the actual target is detected, the target template is used as the new input image z, the Gaussian kernel is used to calculate the similarity between the input image and the target template, and the input image is subjected to cyclic displacement processing to construct a basketball video sample set. The processing matrix that defines the cyclic displacement is K^z, which can be expressed as follows:

$$K^z = C(K^{Xz}). \tag{22}$$

In the formula, K^{Xz} represents the first row of the K^z matrix, C represents the matrix circular movement coefficient, and the similarity between the candidate image block and the detection target is represented by $f(z)$ as follows:

$$f(z) = F^{-1}(F(K^{Xz}))\rho. \tag{23}$$

In the formula, $f(z)$ is the estimated value of the detection target probability corresponding to the candidate image block of the basketball video, and ρ is the discrete Fourier transform of the conversion coefficient. After the above calculation and processing of the target detection process, the final target detection process is obtained, as shown in Figure 1.

It can be seen from the target detection process shown in Figure 1 that, according to the particularity of the embedded basketball motion video, the histogram of the magnitude of the gradient direction in the basketball motion image unit is counted as the contour and shape information of the detection target, and the basketball motion video target is trained by calculating the histogram. The optimal solution of the classifier is detected [12], the conversion coefficient value is derived according to the functional relationship, the Gaussian kernel is used to calculate the similarity between the input image and the target template, a basketball video sample set is constructed, and the sequence result of the basketball video is obtained [13, 14]. Based on the above calculation processing, the design of the basketball video target detection algorithm is finally realized.

4.2. Real-Time Recognition of Video Basketball Technical Movements.
For the real-time recognition of video basketball technical actions, first, the features existing in the target area are counted, the discrete probability density function is constructed according to the statistical results, and the constructed function is processed in a unified manner to obtain the histogram model and the candidate target model:
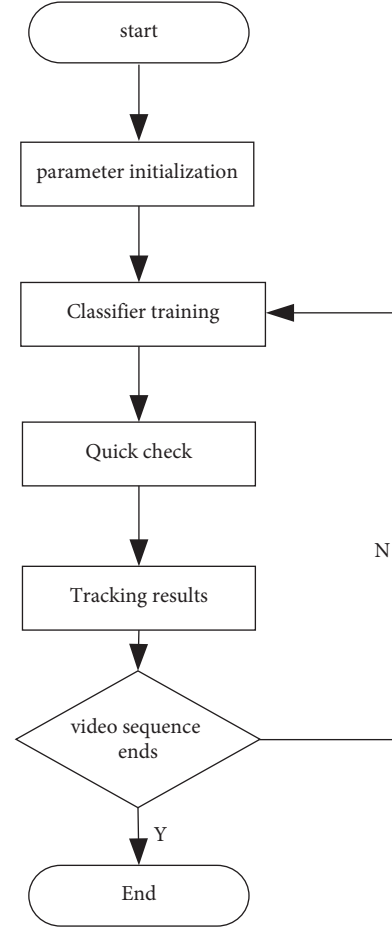

FIGURE 1: Target detection process.

$$\begin{cases} q = \{q_u\}_{u=1,2,\dots,m}, \\ p(y) = \{p_{u(y)}\}_{u=1,2,\dots,m}. \end{cases} \tag{24}$$

In the formula, $q = \{q_u\}_{u=1,2,\dots,m}$ represents the histogram model, $\{p_{u(y)}\}_{u=1,2,\dots,m}$ describes the candidate target model, and y describes the coordinates corresponding to the center of the candidate target area [15–17]. The target area is usually rectangular and oval.

Let (x_i) describe the coordinates corresponding to the point, and the kernel histogram corresponding to the target can be described by the following formula:

$$q_u = C_h \sum_{i=1}^{n} k \frac{x_i}{h} b(x_i)\tau. \tag{25}$$

In the formula, k describes the profile function corresponding to the kernel function h, τ represents the Kronecker delta function, $b(x_i)$ is a quantization function [18–20], and C_h describes the normalization coefficient, which can be calculated by the following formula:

$$C_h = \sum_{i=1}^{n} \left(k\frac{x_i}{h}\right)^2. \tag{26}$$

The histogram model $q = \{q_u\}_{u=1,2,\ldots,m}$ corresponding to the target is obtained through the above process, and according to this model, the candidate target model with position y is obtained:

$$p_{u(y)} = C_h \sum_{i=1}^{n} k\left(\frac{y - y_i}{h}\right)^2 b(x_i)\tau. \qquad (28)$$

The main function of the Bhattacharyya coefficient is to measure the similarity between two vectors [21–23]. When using the mean shift algorithm to identify the technical movements of video basketball, the Bhattacharyya coefficient can be used to calculate the similarity $d(y)$ between the models, and the similarity increases with the increase of the Bhattacharyya coefficient [24, 25]:

$$d(y) = \sqrt{1 - p(p(y), q)}. \qquad (29)$$

The specific steps of the real-time recognition method of video basketball technical action based on the target detection algorithm are as follows:

(1) The initialization processing iteration number is $k \leftarrow 0$.

(2) Obtain and calculate the color histogram corresponding to the target candidate region in the current frame, construct a target candidate model, which is the center of the region, and then obtain the similarity coefficient $p^* = \sqrt{d(y)k}$ between the target candidate model and the target model.

(3) Let w_i represent the weight coefficient, and its calculation formula is as follows:

$$w_i = \sum_{u=1}^{m} \sqrt{\frac{q_u}{q_u}k}. \qquad (30)$$

(4) Update the target position y_1, increase the number of iterations, and recalculate the similarity coefficient according to the new target position.

(5) Calculate the displacement between the new position and the old position using the following formula:

$$d = \prod(y_1 - y_0). \qquad (31)$$

Stop the iteration at $k \geq N\, d$, obtain the Babbitt coefficient $\rho(y_0)$ to determine the basketball position, and complete the real-time recognition of video basketball technical movements. The specific process of real-time recognition of video basketball technical action based on the target detection algorithm is shown in Figure 2.

As can be seen from Figure 2, first of all, this study calculates the target distribution of the probability of the candidate model and the Barthel coefficient, which is used to calculate the similarity of the target model of the action. On this basis, we calculate the weight coefficient and the position of the new target and judge whether the action displacement distance conforms to the similarity. If it matches, we get the current frame target center position. If not, we return to the step of calculating the weight
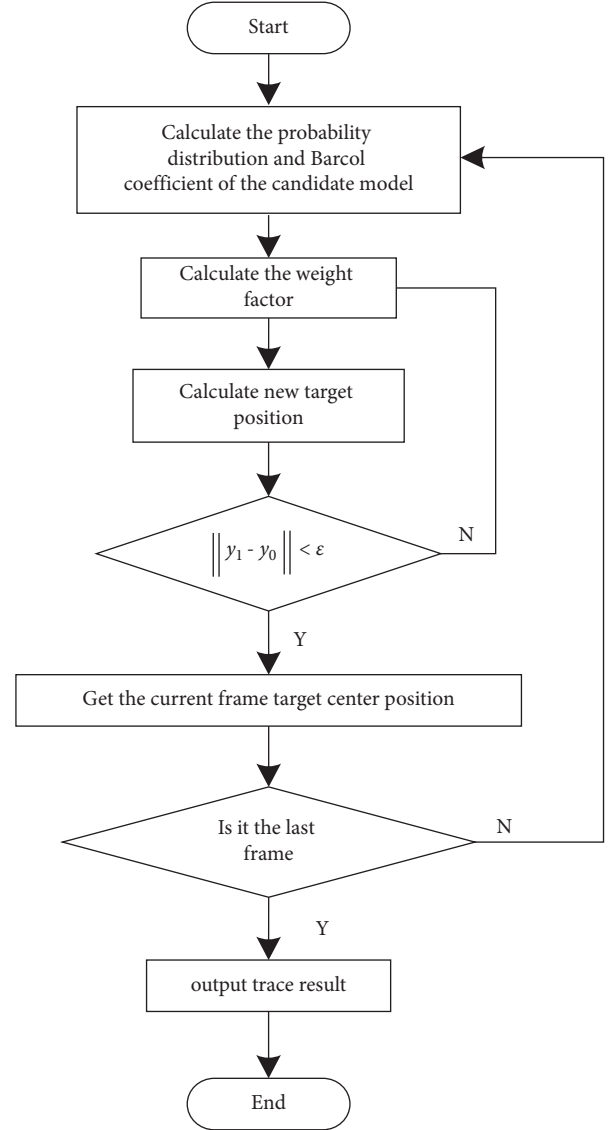

Figure 2: The real-time recognition process of video basketball technical actions.

coefficient. After obtaining the target center position of the current frame, we judge whether it is the last frame of the video and return to the first step if it is not the last frame. If it is the last frame of the video, we end the recognition of the basketball technical action.

5. Results and Discussion

In order to verify the real-time recognition method of video basketball technical action based on the target detection algorithm, a comparative experiment was designed. Matlab simulation software is used for the design and simulation analysis of the real-time recognition algorithm of video basketball technical movements. The Laser 5.0 video acquisition instrument is used for the capture of basketball video technical movements. The sampling frequency of basketball technical movements is 800 kHz and the pixel intensity is $200 * 400$.
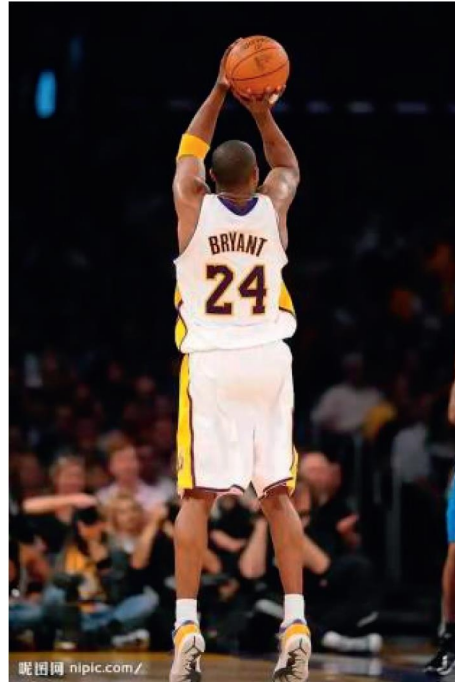
FIGURE 3: Standard shooting action.

In this study, the methods of literature [4, 5] are used as experimental comparison methods, and the effectiveness of the real-time recognition method of video basketball technical action based on the target detection algorithm designed in this study is verified by a comparison test. According to the above, the simulation environment and parameter settings are used to capture the motion of video basketball technology, and the collected video basketball technology action images are shown in Figure 3.

An embedded basketball video is selected and integrated into different datasets. The results of the dataset are listed in Table 1.

5.1. Feature Extraction Results of Video Basketball Technology Action Images.
Taking the video image of basketball technical action in Figure 3 as the experimental object, the feature extraction of the shooting technical action in the video image is carried out, and the result is shown in Figure 4.

Analysis of Figure 4 shows that the method in this study can effectively extract the body shape features of athletes shooting with the ball in the basketball technical action images, and the movement trajectory of the basketball technical actions can be clearly presented from the process. Taking the arm action of shooting basketball as an example, the method of literature [4] can identify the action of the arm, but the identification of the arm position is biased and not very accurate. The method in reference [5] can identify the movements of the tossing arm but does not identify the movements of the other arm. The method in this study can accurately identify the movements of the two arms, which shows the characteristics of the basketball technical action images. The extraction ability is good, and it also shows from the side

that its ability to recognize basketball technical movements is good.

5.2. Time-Consuming Real-Time Recognition of Video Basketball Technical Movements.
Based on the experimental objects in Table 1, the start of the method execution is taken as the time recording point, the computer appearance of the recognition frame is taken as the time statistics cutoff point, and the execution time of the three video basketball technical action real-time recognition methods is counted. The results are shown in Figure 5.

From the experimental results in Figure 5, it can be seen that with the increase of the dataset, the execution time of the three real-time recognition methods of video basketball technical actions increases. When the dataset reaches 7, the technical action recognition time of the method in Reference [4] is 8 s., the technical action recognition time of the method in Reference [5] is 11 s, while the technical action recognition time of the method in this study is 4 s. It can be seen that the technical action recognition time of the method in Reference [5] is the longest, and the technical action recognition time of the method in Reference [4] is the longest. The recognition time is second, and the technical action recognition time of the method in this study has the shortest execution time and high timeliness compared with the two reference methods.

5.3. Real-Time Recognition Accuracy of Video Basketball Technical Actions.
We keep the above experimental environment unchanged, take the number of frames in the experimental dataset as the experimental object, and set the basketball video to be in the playback process, the target to

TABLE 1: Basketball video experimental dataset.

Data set serial number	Frame number	Mark target	Video scenario description
1	1095	40	Dribble
2	976	38	Shoot
3	1341	36	Dribble
4	1367	37	Penalty
5	1143	39	Basket offense
6	1376	41	Steal
7	1209	13	Foul

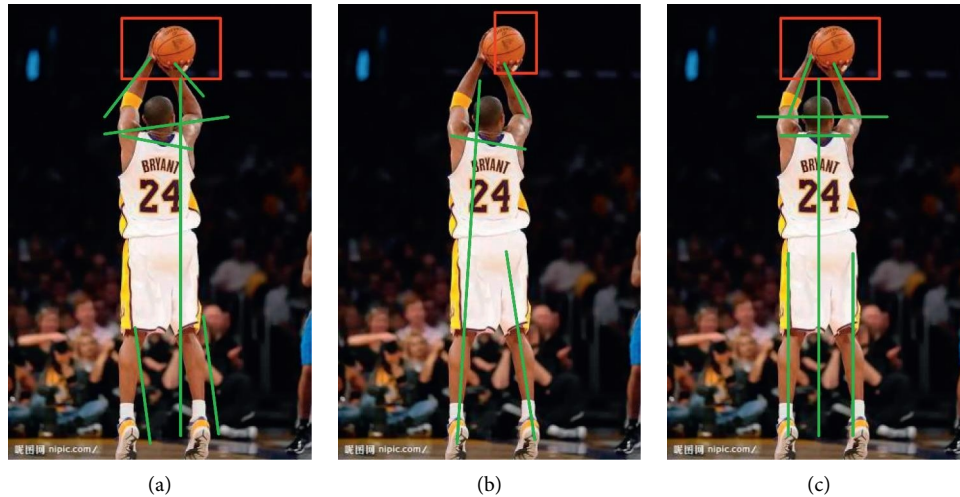(a)   (b)   (c)

FIGURE 4: The test results of the feature point extraction of basketball video image decomposition. (a) The method in Reference [4]. (b) The method in Reference [5]. (c) The method in this study.
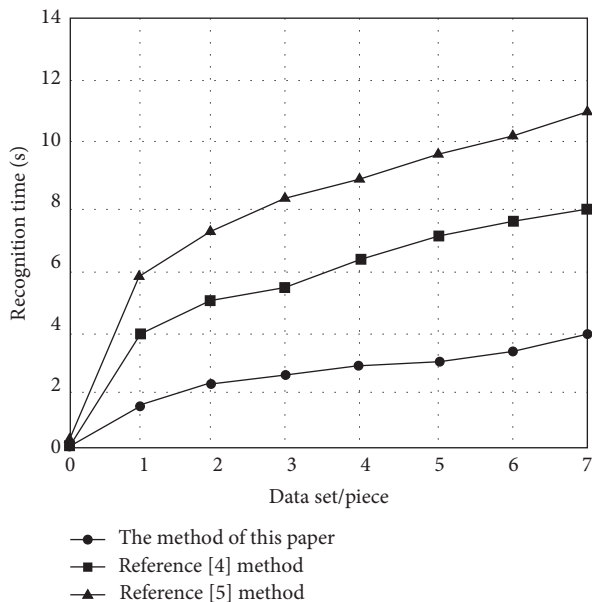

FIGURE 5: Technical action recognition time for different methods.

be identified is always within the recognition range, and it is stipulated that the target to be identified can still be locked after it is blocked. For successful identification, the number of marked targets for the three real-time recognition

methods of video basketball technical actions is summarized and counted. The number of successfully identified marked targets is listed in Table 2.

From the experimental results shown in Table 2, it can be seen that the three real-time recognition methods of video basketball technical actions show different recognition effects for the basketball video dataset prepared for the experiment. The average number of successfully identified marked targets is 15, and the number of successfully identified targets is the smallest. The average number of successfully identified marked targets of the method in Reference [5] is 24, which is more than that of the method in Reference [4], while the method in this study has a small difference with the number of marked targets and can accurately identify basketball sports videos. The marked target has the best recognition effect. To sum up, the real-time recognition method of video basketball technical action studied in this study has the shortest execution time and a large number of successfully recognized targets.

On this basis, the action of basketball rotation projection technology is recognized, and the target recognition test results of different methods are obtained, as shown in Figure 6.

Analysis of the data in Figure 6 shows that when the method of this study is used to identify the action of the basketball rotation projection technology, the displacement recognition results in the x and y directions are not much

TABLE 2: The number of targets successfully identified by different methods.

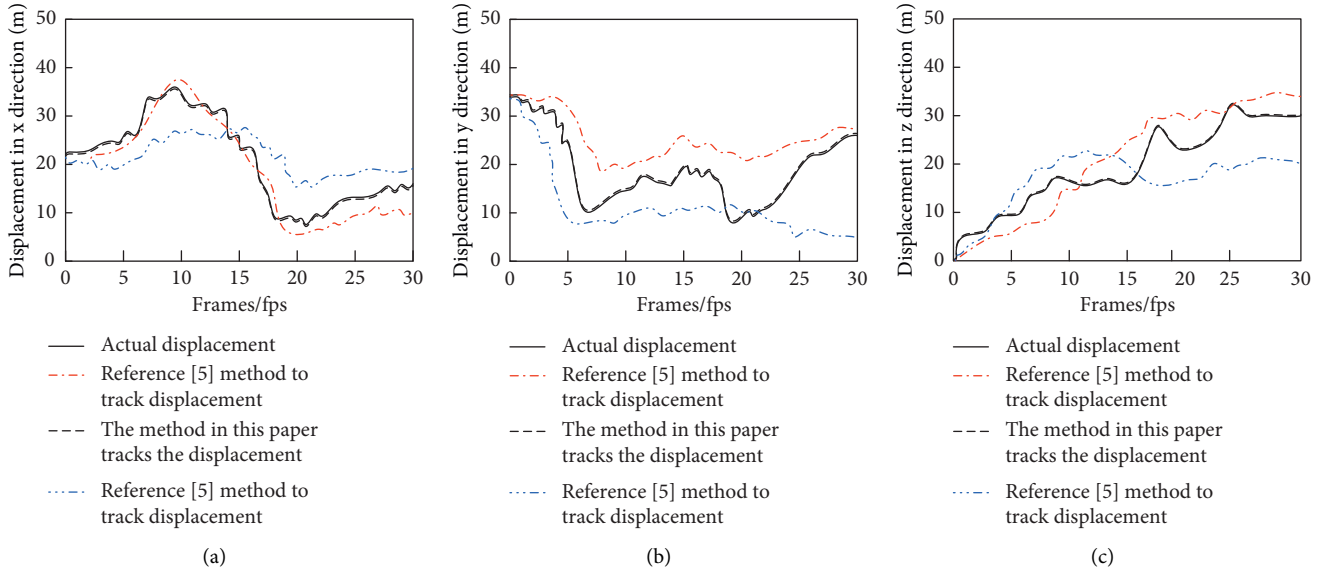| Data set serial number	Number of targets to be identified/piece			
	Target	The method in Reference [4]	The method in Reference [5]	The method in this p study
1	40	14	24	44
2	38	15	23	40
3	36	12	25	38
4	37	11	22	37
5	39	17	24	36
6	41	16	21	30
7	13	19	28	17

FIGURE 6: Target recognition test results. (a) Displacement recognition results in the x direction. (b) Displacement recognition results in the y direction. (c) Target center recognition results.

different from the actual displacement of the basketball rotation projection flight. When using the methods of References [4, 5] to recognize the action of basketball rotation projection technique, the error between the displacement recognition results in the x and y directions and the actual displacement of the basketball rotation projection technique is large. The method in this study has a small error in the recognition result of the basketball center, while the methods in References [4, 5] have a larger error in the recognition result of the basketball center. Through the above analysis, it can be seen that the method in this study can accurately realize the recognition of basketball rotation projection technology movements.

6. Conclusion

With the development of modern basketball, traditional techniques have been unable to provide comprehensive theoretical support for various technical movements in basketball. In order to improve the technical level of basketball technical analysis, the efficiency and accuracy of action recognition are improved. This study proposes a

real-time recognition method of video basketball technical action based on the target detection algorithm. Through the edge contour feature technology, the discrimination ability and self-adaptability of basketball sports training motion capture are improved, and the basketball sports training motion capture optimization is realized. According to the probability estimation of video basketball technology action detection target, the sequence of basketball video is obtained, and the target detection algorithm of basketball video is designed. Based on the algorithm, the similarity between the two vectors of video basketball technical action targets is measured, and the real-time recognition of video basketball technical actions is realized. The experimental results show that the method in this study has a better adaptability and higher accuracy of motion capture for basketball training. It has good real-time recognition efficiency and high recognition accuracy for video basketball technical movements. In the action recognition based on target detection, if the human action involves certain occlusion and interference, or if multiple targets of the same size appear in the same shot, how to better recognize the technical action is our future research direction.

Data Availability

The authors confirm that the data supporting the findings of this study are available within the article.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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