Automatic Detection of Image Features in Basketball Shooting Teaching Based on Artificial Intelligence

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Abstract. In order to weaken the limitation between the adjacent nodes of shooting action teaching image and fully expose the necessary image features, an automatic detection method of shooting action teaching image features based on artificial intelligence is proposed. Starting from the decomposition of shooting teaching action, the practical attribute of shooting teaching image is defined, and then the standardized image detection environment based on artificial intelligence is built according to the action essentials of consistent shooting. On this basis, through the way of extracting the characteristics of teaching image, calculating the characteristic scale value of shooting action, combining with the feature description principle of automatic detection, the design of automatic detection method of shooting action teaching image characteristics is completed. The experimental results show that, compared with the traditional feature method, the UTI traction coefficient between the adjacent nodes of the image increases to 0.33, while the matching time required for detection decreases to 17.5 mm, so as to fully expose the necessary features of the shooting action teaching image.

Keywords: Artificial intelligence · Shooting action · Image features · Automatic detection · Action decomposition · Characteristic scale · Detection characteristics · Traction coefficient

1 Introduction

Artificial intelligence stands for artificial intelligence. It is an emerging technical science to research and develop theories, methods, techniques and application systems that simulate, extend and extend human intelligence. Artificial intelligence is a branch of computer science. It tries to understand the nature of intelligence and produce a new kind of intelligent machine that can react in a way similar to human intelligence. Research in this field includes robotics, language recognition, image recognition, natural language processing and expert systems [1]. Since the birth of artificial intelligence, its theory and technology...
have become increasingly mature, and its application field has also been expanding. It is conceivable that the technological products brought by artificial intelligence in the future will be the “containers” of human intelligence. Artificial intelligence can simulate the information process of human consciousness and thinking. Artificial intelligence is not human intelligence, but it can think like a human, and may surpass it.

Feature detection is a concept in computer vision and image processing. It refers to the use of computer to extract image information and determine whether each image point belongs to an image feature. The result of feature detection is to divide the points on the image into different subsets, which are often isolated points, continuous curves or continuous areas. So far, there is no universal and precise definition of features. The exact definition of a feature is often determined by the problem or application type. Feature is an “interesting” part of a digital image, which is the starting point of many computer image analysis algorithms [2]. Therefore, the success of an algorithm is often determined by the characteristics it uses and defines. Therefore, the most important feature of feature detection is “repeatability”: the features extracted from different images of the same scene should be the same.

With the popularization of basketball teaching methods, how to analyze the characteristic behavior of the formed image according to the existing shooting action so as to realize the automatic detection has become the main research direction in related research fields. In order to solve the above problems, the traditional feature method checks whether each teaching action pixel represents a feature through primary operation. If it is part of the extended image algorithm, then this pixel point is only used to check the feature area of the image. However, the actual detection accuracy of this method is very low, and it is difficult to meet the increasingly strict shooting action teaching task. Based on this, the concept of artificial intelligence is introduced to design a new type of shooting action teaching image feature automatic detection method, and through the edge pixel point statistics and other methods, the detection indicators are debugged to the best application state.

2 Standardized Image Detection Environment Based on Artificial Intelligence

The construction of standardized image detection environment is the basic link of the realization of the automatic detection method of shooting action teaching image characteristics. Under the support of artificial intelligence theory, according to the operation process of shooting teaching action decomposition, shooting action teaching image practical definition and consistent shooting action essentials analysis, the specific construction and processing methods are as follows.

2.1 Shooting Teaching Action Breakdown

Artificial intelligence is a subject that studies how to make computer simulate some thinking process and intelligent behavior (such as shooting action) of human beings. It mainly includes the principle of realizing intelligence by computer, manufacturing computer similar to human brain intelligence, and making computer realize higher-level
application. Artificial intelligence will involve computer science, psychology, philosophy and linguistics. It can be said that it is almost all disciplines of natural science and social science, and its scope is far beyond the scope of computer science. The relationship between artificial intelligence and thinking science is the relationship between practice and theory. Artificial intelligence is at the technical application level of thinking science, and is an application branch of it [3]. From the point of view of thinking, AI is not only limited to the logical thinking of shooting action, but also considers the image thinking and inspiration thinking of teachers to promote the breakthrough development of AI. Mathematics is often considered as the basic science of image feature detection. Mathematics has also entered the field of language and thinking. The subject of AI must also borrow mathematical tools to realize the teaching of shooting action Directional perception of image features (Fig. 1).

![Fig. 1. Breakdown of shooting teaching action based on Artificial Intelligence](image)

### 2.2 Practical Definition of Shooting Action Teaching Image

The mathematical basis of AI is “Statistics”, “information theory” and “Cybernetics”, including other non mathematical subjects. This kind of shooting teaching needs a strong dependence on “experience”. The computer needs to acquire knowledge and learning strategies from the experience of solving a class of problems. When encountering similar image feature decomposition problems, it uses the experience knowledge to solve problems and accumulate new experience, just like the action of committing a project that has been accumulated for many times. Such a processing method is called “continuous learning” in artificial intelligence [4, 5]. But in addition to learning from experience, teachers can also create, that is, “jumping learning”. In some cases, this is called teaching “inspiration” or “Epiphany”. For a long time, the most difficult thing in the field of artificial intelligence is “Epiphany”. Or strictly speaking, it is difficult for teachers to learn “qualitative change of actions that do not depend on quantitative change” in learning and “practice”, and it is difficult to go directly from one “quality” to another “quality”, or from one “concept” to another “concept”. Because of this, the “shooting teaching practice” here is not the same as the practice of artificial intelligence image. Suppose $q$ represents the statistical coefficient of shooting action teaching image based on the field of artificial intelligence, $y_1$ represents the upper scale range of image features, and $y_2$ represents the lower scale range of image features. Combining the above
physical quantities, we can define the practical characteristic indexes of shooting action teaching images as follows:

\[
\lambda = \int_{y_1}^{y_2} \frac{q^2 |r_1 \times r_2|}{\bar{u}^2} \quad (1)
\]

Among them, \(r_1\) represents the continuous learning coefficient in shooting teaching, \(r_2\) represents the practical learning coefficient in shooting teaching, and \(\bar{u}\) represents the average counting condition of characteristic pixels in the image.

### 2.3 Key Points of Continuous Shooting

There are two aspects of shooting technique, one is the body posture when shooting, the other is holding the ball. When shooting in situ, open the front and back of your feet naturally, bend your knees slightly, lean your upper body forward slightly, and place your weight between your feet. It is easy to focus on the shooting force, but also conducive to change other movements. In the process of catching and jumping shots, dribbling and stopping shots or shooting shots during moving, the step catch and take-off should not only be connected, but also be braked quickly, so that the center of gravity of the body can be moved to the center of the supporting surface as soon as possible, so as to ensure the vertical take-off. The correct body posture can ensure that the movement of the body’s center of gravity is consistent with the direction of shooting, and can maintain the body balance. Controlling body balance is the basic condition to ensure the accurate direction of the ball [5]. When shooting, no matter with one hand or two hands, when holding the ball, the five fingers should open naturally and the palm should be free. Touch the ball with the finger root and above the finger root to increase the contact area of the ball, so as to maintain the stability of the ball and control the shooting direction of the ball. For the teaching implementers, the shooting skills can be summed up in two directions: chest shooting with both hands and shoulder shooting with both hands.

#### 2.3.1 Two Hands Chest Shot

Although the shooting point is low, the stability is good before the shot, the strength of the shot is large, it is easy to combine with passing and breakthrough, and it is mostly used for long-distance shooting. Movement method: holding the ball with both hands is basically the same as passing the ball in front of the chest with both hands. Drop your elbows naturally, place the ball in front of your chest and look at the aiming point. Open the front and back or left and right feet, slightly bend the knees, and place the center of gravity between the feet (As shown in Fig. 2).

#### 2.3.2 Shoot with Both Hands and Shoulders

This kind of shooting points high, not easy to cover, easy to combine with the head pass. But the center of gravity is high, the speed of shooting is slow, and it is easy to shake the center of gravity of the defensive side. Hold the ball on the head with both hands,
Fig. 2. Analysis of the characteristics of the chest shooting with both hands

bend the elbow naturally, open the feet obliquely, bend the knees slightly, and place the center of gravity between the feet. When shooting, the two arms are extended forward and upward along with the leg pedaling, the two wrists are turned outward at the same time, the left hand is pressed down, and the right thumb is used to control the direction of the ball. There are index finger and ring finger at the moment of release. After the ball is released, the lower body should be relaxed.

3 The Automatic Detection Method of Shooting Action Teaching Image Characteristics

Based on the theory of artificial intelligence, according to the processing flow of teaching image feature extraction, shooting feature scale calculation and automatic detection feature description, the successful application of shooting action teaching image feature automatic detection method is completed.

3.1 Feature Extraction of Teaching Image

The feature nodes of each layer in the shooting action are taken as the initial image to construct the automatic detection scale space, and the sub group scale space including two inner layers and two middle layers is constructed for it, and the image of this layer is taken as the first inner layer image in each sub group. In each subgroup, each action middle layer is distributed between two adjacent inner layers. Each inner image is obtained by 0.5 times lower sampling of the upper inner image. The first middle layer is obtained by 1.5 times down sampling of the first inner layer image, and the other middle layer is obtained by 0.5 times down sampling of the previous middle layer [6]. If the coverage between the scale nodes of the shooting action teaching image is not considered, the detection characteristic value of the feature to be extracted can be expressed as the parameter space as shown below.
Table 1. Feature extraction value set of shooting action teaching image

| Feature extraction value | Action layer | Teaching layer | The image layer | The data layer | Parameter layer |
|--------------------------|-------------|----------------|----------------|----------------|----------------|
| 1                        | 0.38        | 20             | 0              | 0.829          | 0              |
| 2                        | 0.42        | 35             | 0              | 1.513          | 121            |
| 3                        | 0.45        | 37             | 0              | 2.391          | 113            |
| 4                        | 0.51        | 123            | 113            | 3.791          | 96             |
| 5                        | 0.59        | 37             | 20             | 3.453          | 89             |
| 6                        | 0.66        | 44             | 34             | 4.326          | 115            |
| 7                        | 0.73        | 51             | 21             | 3.187          | 128            |

According to Table 1, when the shooting angle, rotation direction, angle of view, image features and noise remain unchanged, the necessary execution data always has strong robustness, and at the same time, it can achieve some actual image node matching operations that the initial behavior cannot complete. And this improved method between the numerical value and the numerical value can fundamentally alleviate the coverage between adjacent node layers, so that the image features to be detected are fully exposed.

3.2 Calculation of Shooting Characteristic Scale

In order to speed up the detection accuracy of teaching image features, firstly, according to the characteristic scale of the input shooting action, the appropriate block processing is carried out. Secondly, multi threads are used to construct new scale space in block image, and necessary numerical feature points are extracted. According to the matching requirements, select a certain number of characteristic nodes in each block area to organize, build the set of characteristic points, and then use multi threads to build the set of characteristic vectors. Then, the feature vector set is processed by two-way matching and eliminating mismatches [7, 8]. Finally, according to whether the number of matching points is greater than the set detection value, if it is greater than, the matching is successful. Otherwise, rebuild the set of feature points and repeat the above process. Let \( \bar{w} \) represent the average value of scale space in the image vector set of shooting action teaching, and \( \Omega \) represent the value space of image vector set. The joint formula (1) can express the calculation result of shooting characteristic scale as follows.

\[
E_{\Omega} = \frac{\int I_{\uparrow}^\uparrow \lambda (U_1 - U_0)^2 \right|_{I_{\downarrow}}}{\int I_{\uparrow}^\uparrow \bar{w} \cdot ||d + d'|| \right|_{I_{\downarrow}}}
\]

Among them, \( I_{\uparrow}^\uparrow \) represents the maximum behavior authority value of the characteristic node scale of the shooting action teaching image, \( I_{\downarrow} \) represents the minimum behavior
authority value of the characteristic node scale of the shooting action teaching image, \( U_1 \)
represents the characteristic image node parameter, \( U_0 \) parameter value supplementary
description condition, \( d \) represents the characteristic image vector value, \( d' \) represents
the vector value supplementary description condition.

### 3.3 Automatic Detection Feature Description

In the field of artificial intelligence processing, the automatic detection of scale invariant
features is an important attribute. Traditional feature detection algorithms are based on
linear Gaussian pyramid to extract feature points. For example, feature method uses the
method of building the frame structure of Gaussian differential scale space, surf algorithm
uses the box filter method of approximate Gaussian differential. These methods use
Gaussian blur to construct the image Gaussian pyramid, but Gaussian blur not only does
not retain the boundary information of the object, but also smooths the details and noise
to the same degree on all scales, thus losing the positioning accuracy [9]. In order to deal
with the image data of shooting movement teaching, the method of feature detection
and description in nonlinear scale space has been proposed. However, the traditional
method is based on the forward Euler method to solve the nonlinear diffusion equation,
which has the advantages of long convergence step, long time and high computational
complexity. In order to solve the above problems, an automatic feature detection method
based on non-linear scale space is introduced and implemented, which can detect and
match shooting action images with the support of multi-scale nodes. Let \( g_1 \) represent
the scalar characteristic value in the shooting action teaching image, and \( g_2 \) represent
the vector characteristic value in the shooting action teaching image. The simultaneous
formula (2) can define the automatic detection characteristic description as.

\[
K = \exp\left(-\frac{g_1 g_2}{E_\Omega^2}\right) \cdot \frac{\sqrt{\Delta l^2 - 1}}{\beta f^2}
\]

In the above formula, \( \Delta l \) represents the comprehensive behavior change of the shooting
action teaching image characteristic value in unit time, \( \beta \) represents the vector index
coefficient of the automatic detection behavior, and \( f \) represents the vector linear error
condition carried by the image characteristic node. So far, we have completed all previous
calculations and debugging of numerical error results, and completed the construction of
automatic detection method of shooting action teaching image features with the support
of necessary AI behavior instructions.

### 4 Practical Application Detection

In order to highlight the practical difference between the automatic feature detection
method based on artificial intelligence and the traditional Feature method, a compar-
ison experiment is designed as follows. In the course of shooting teaching, we select
the necessary movement features as the reference object, and take the host computer of
the new automatic detection method and the traditional Feature method as the param-
eter recording equipment of the experiment group and the control group. In the same
detection environment, we study the specific changes of the image feature indexes of
the experiment group and the control group.
4.1 Detection Application Environment

In order to ensure the absolute fairness of the experimental results, the ball selection processing in the whole experimental process is completed by the artificial intelligence robot. The relevant teaching participants are only as the detection and verification personnel to supervise and inspect the ball selection operation of the robot (Figs. 3 and 4).

![Artificial intelligent ball selection](image1)

**Fig. 3.** Artificial intelligent ball selection

![Characteristic image of shooting action teaching](image2)

**Fig. 4.** Characteristic image of shooting action teaching

4.2 UTI Traction Coefficient

The UTI traction coefficient directly affects the final detection results of shooting action teaching image features. Generally, the greater the value level of the former, the higher the accuracy of the latter, and vice versa. The following table reflects the specific comparison of UTI traction coefficient between the experimental group and the control group.

Table 2 shows that as the experiment time goes on, the UTI traction coefficients of the experimental group keep increasing and decreasing alternately, the global maximum is 0.34, the minimum is 0.07, and the difference between them is 0.27.
Table 2. UTI traction coefficient of experimental group

| The experimental time/(min) | UTI traction coefficient | The average |
|----------------------------|--------------------------|-------------|
| 5                          | 0.07                     | 0.20        |
| 10                         | 0.28                     |             |
| 15                         | 0.09                     |             |
| 20                         | 0.31                     |             |
| 25                         | 0.09                     |             |
| 30                         | 0.30                     |             |
| 35                         | 0.07                     |             |
| 40                         | 0.34                     |             |
| 45                         | 0.08                     |             |
| 50                         | 0.33                     |             |
| 55                         | 0.07                     |             |
| 60                         | 0.31                     |             |

Table 3 shows that the UTI traction coefficients of the control group increased steadily in the early stage of the experiment, and kept stable for 20 min after reaching the extreme value. The global maximum was only 0.17, which was 0.17 lower than the extreme value of 0.34. In conclusion, with the application of automatic feature detection method.
based on artificial intelligence, the UTI traction coefficient increases obviously, which promotes the accuracy of automatic feature detection to some extent.

4.3 Detection of Matching Time

In general, the longer the time of feature matching is, the worse the precision of the detection results is, and the worse the quality of the detection results is. The following figure reflects the specific changes of the matching time in the experimental group and control group under the same experimental environment.

Fig. 5. Experimental group detection matching time

Fig. 6. Matching time in control group

Compared with Figs. 5 and 6, the peak value of the matching time of the experimental group was only about 20 mm, and the limit value did not have the ability of periodic existence; the peak value of the matching time of the control group was more than 25 mm, much higher than that of the experimental group, and the limit value had the ability of periodic existence. In conclusion, with the application of automatic feature detection method based on artificial intelligence, the matching time of feature parameters decreases obviously, and the accuracy of automatic feature detection is improved properly.
5 Conclusion

Along with the application of artificial intelligence technology, the automatic feature detection method of shot motion teaching image not only redefines the concept of attributes of relevant indexes, but also analyzes the algorithm based on the conditions of detection and processing from the point of view of coherence, which not only constrains the vector scale value of shot feature, but also reduces the influence of unnecessary error value on the final detection precision. From the point of view of practical application, the matching time has been effectively controlled, and the UTI traction coefficient has been moderately improved, which solves the problem of inadequate exposure of image features left over by the traditional Feature method.

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