Study and application of computer information big data in basketball vision system using high-definition camera motion data capture

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Abstract. Contemporary computer big data technology is developing rapidly, and it has played a role in promoting the intelligent development of sports. Based on this research background, the thesis revolves around the application of computer big data artificial intelligence in the field of basketball training. The study found that computerized big data in basketball training and teaching is mainly reflected in the following aspects: high-definition camera motion data capture, player analysis to obtain assisted training system, etc. The final paper uses a basketball vision system as a case study to analyze specific applications of big data for computer information.

Keywords: computer big data, basketball training, basketball vision system.

1. introduction
In the 19th Party Congress, General Secretary Xi Jinping clearly proposed to accelerate the construction of a strong sports nation. For this reason, it is particularly important to develop sports and enhance the physical fitness of the population in this golden age. In the process of building a strong sports nation, computer big data information processing technology plays an indispensable role as a revolutionary technology for the advancement of sports in China. With the application of artificial intelligence technology in economic sports such as the promotion of big data, how to accurately obtain the physical condition of each athlete throughout the game to assist the coach to adjust tactics in a timely manner and develop a more accurate training model for athletes is an important research topic, based on this research background, the thesis revolves around the application of computer big data artificial intelligence in the field of basketball training.

2. A Review of Computer Information Big Data Technology in Basketball

2.1. Aspects of player analysis
In terms of professional basketball league stats in terms of player fitness and how the game plays out on the court, this is crucial for teams to pick players. All players will undergo a fitness test before they go through the screening draft. These fitness tests cover basic physiological values, bouncing ability, sprint bursts and more. This data is then combined with the player's previous league scoring data to predict the player's value and future potential.
In addition computer big data technology is able to predict how players will score in tournaments. The technology is able to take the player's ability and court fit, etc. and get the scoring in this tournament by building a relevant data model. We use here a Spurs game as a case study where Parker was predicted to score 0.95 on this possession by the model developed in the paper with 9.3s left in the event. On Parker's break with the ball, the pre-snap score is reduced to .82. The specific data are shown in Table 1.

**Table 1.** Spurs' pre-ball points vs. time statistics in a given game

| times | Pre-ball rights expect to score |
|-------|--------------------------------|
| 9.3s  | 0.95                           |
| 7.2s  | 0.82                           |
| 6.6s  | 1.38                           |
| 5.8s  | 1.72                           |

We were able to analyze the offense in this game and get that the players did not make baskets in the final minutes, but the breakaway layups were able to help the players indirectly benefit the team. For this reason we were able to conclude confirming that computerized big data can be very useful for teams to analyze player value.

### 2.2. HD camera motion data capture for basketball robot

A basketball robot with multiple training targets performs movement breakdown after capturing motion information and makes continuous final observations of specific training metrics during the training process. The basketball robot will give feedback to the basketball player once it finds that the player has deviated from the training goal by comparing the tracking indexes in the actual training, so as to help the basketball player return to the correct training track and thus improve the skill level of the basketball player.

The motion data capture basketball robot functions in the following ways: firstly, the sensor technology to measure the relevant motion index data of the human body during the movement. The second is that the sensor acquires the data and then performs a computational analysis to obtain the motion specifications. The third is to give real-time motion information back to the athletes quickly and effectively during the exercise process to help correct their wrong movements. The fourth is that after the motion is completed, the robot collates the motion data and then simulates and models it, and feeds back any relevant issues that were not identified during the motion. The architecture of the HD camera motion data capture basketball robot system is shown in Figure 1.
2.3. Basketball Decision System

The proposed concept is divided into three main layers: the data layer, the decision layer, and the display layer. The data layer is the foundation of the whole system, providing data support for the decision layer and the display layer; the decision layer is the central part of the whole system, responsible for using computers, etc. to organize, calculate and analyze the basic data, and refine the hidden information; the display layer is the visual display of the processed decisions.

The data layer is not simply a collection of basic basketball data, but an integration and consolidation of multiple aspects of data, reorganized according to different needs, with the aim of facilitating later decisions. The information to be collected are: Player base data, daily training data, in-game data and other image files. The integration is divided into three types of repositories: coaches' information, players' information, and tactics.

The role of the decision layer is to process the various data provided by the data layer. Firstly, the required knowledge information is fully mined through data mining techniques, combined with computers, a professional model library is built, and the model is optimized using artificial intelligence. Data mining is the extraction of information and knowledge implicit in fuzzy, numerous and random data. In the actual field of play, to dig out a reasonable player on the field, you can take an online analysis, for example, two players A and B, because they often cooperate, the passing success rate of 80 when they are on the field at the same time, and when the player A takes a physical rest, the other players on the field with B's passing success rate is significantly reduced, while consuming B's physical ability, affecting the efficiency of the next A-B cooperation, then this adjustment is unreasonable. Conversely if player B is fit and the player replacing A on the pitch has a high match rate with him, even higher than A, then this substitution arrangement is productive. By mining the data for similar correlations and modeling them with artificial intelligence, the most logical tactical substitutions can be obtained by inputting the data on the spot in time for the game.

The building of the model base in the decision layer is the most critical element and requires a combination of expert-level experience and mined data to build. I divide it into static model and dynamic model. The static model is easier to build, mainly the individual ability model of both players, which can be collected before the match; the dynamic model needs to collect on-site data, such as the formation of both sides on the field, the alignment of both players, etc. The real-time data will be collected and input, and then combined with the coach's experience, the decision of the need for targeted substitution will be derived. The display layer is the result of the decision analysis by creating various types of topics, integrating the different topics, and after obtaining the optimal solution, the
tactics of both sides are reflected by electronic means and the most suitable offensive as well as defensive routes are simulated.

3. Basketball Vision System

3.1. Robot Vision System Components
We have designed a basketball vision system that is capable of motion control, vision control, and test functions such as ejection devices. The hardware system as shown in Figure 2 covers the HD camera. The system is capable of dynamic capture of basketball movements.

![Basketball robot](image)

**Figure 2. Basketball robot**

3.2. Analysis of the processing flow
The environment in which the basketball is placed during basketball practice may be influenced by the surrounding environment. In order to avoid environmental interference, we have adopted processing methods such as color thresholding and edge detection in the design of the basketball vision robot.

3.2.1. Color thresholds. The method works by thresholding the color images captured by the basketball robot according to the three planes R, G and B. In practice, however, the R, G, and B colors are unevenly distributed spatially, and the three components are highly correlated. If we use only linear transformations we cannot eliminate all correlations. For this reason in this mode even the same color varies widely in color components under different lighting conditions. If we use HIS nonlinear components for color separation, it is easier to classify colors in some environments with uneven illumination. The HIS color space is processed based on three color components: hue, saturation, and intensity. The method matches fairly well with the human eye's ability to perceive color. For this reason we chose HIS for color segmentation to implement a basketball robot color capture processing application.
In basketball training we preload an image and in turn click on the color threshold function to access the interface. After calling the function we take a partial color sample on the basketball sphere and set the color threshold option card. The specific interface diagram is shown in Figure 3. Thresholds for hue are 250-16; for saturation, 114-238; and for intensity, 22-100.

![Figure 3. Settings for the Color Threshold Setup tab](image)

3.2.2. Edge detection. After color thresholding the image is not affected by uneven illumination, but given the unclear image edges will lead to unclear image gray gradients, resulting in larger weight values for some gray gradients that have little effect. This will affect the effective detection of basketballs by the basketball vision robot. So the edge detection operator is needed to process it. The edge detection algorithms are mainly classified into three main categories, Sobel operator, Laplacian operator and Roberts operator. Given that the basketball vision robot deals with the motion state of the ball all the time during the image inspection. For this reason we have chosen the Roberts operator here. The algorithm draws relevant conclusions based on the gradient principle, the difference of adjacent pixels in the diagonal direction of the motion. Thus the following formula is expressed.

\[
G(i, j) = \left[ f(i, j) - f(i+1, j+1) \right]^2 + f(i, j+1) - f(i+1, j) \right]^{1/2}
\]

Using the convolution formula, Eq. can be turned into

\[
G(i, j) = |f(i, j) - f(i+1, j)| + |f(i, j+1) - f(i+1, j)|
\]

(1)

Where the sum is obtained from the following template.
\[ G_i = \begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}, \quad G_j = \begin{bmatrix} 0 & -1 \\ 0 & 0 \end{bmatrix} \]  

Equation (3)

The two templates are \( f(i, j) \) first-order differences in the i- and j-directions, with appropriately chosen thresholds and the following judgments. \( G(i, j) > T \), then \((i, j)\) are the step-like edge points and \( \{ f(i, j) \} \) is the edge image. The Roberts operator uses the difference value calculated as the difference between two adjacent pixels in the diagonal direction, which is \([i+1/2, j+1/2] \) approximation of the gradient value at the point, rather than the expected point \([i, j] \) approximation at the point. The advantage of this algorithm is that it has high localization accuracy, but the algorithm also has some disadvantages. That is, the algorithm is poorly resistant to noise. The effect of the processing after edge detection is shown in Figure 4.

**Figure 4.** Effect of edge detection processing

4. **Conclude**

The use of computer information big data in basketball training has greatly improved the efficiency of basketball training. Compared to normal training, the use of computerized big data technology can help coaches to identify the wrong movements of athletes and correct them in time. The basketball vision robot algorithm proposed in this paper is capable of monitoring athletes' sports movements in real time and assessing the risk of sports injuries. For more accurate, three-dimensional information, the training can use a multi-training target robot. For this reason, computer information big data can be applied in any aspect of basketball training to achieve the purpose of protecting players' bodies and improving their training effectiveness.

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