Construction of Sports Recognition System Based on Sports Visual Image Technology under the Background of Information Technology

Shubing Zhang*
Nanchang Institute of Science and Technology, Nanchang, Jiangxi, China
*Corresponding author e-mail: zhangshubing@nut.edu.cn

Abstract. With the development of the times, sports competitions are sought after and favored by more and more people, and the judgment of athletes in the competition is becoming more and more strict and standardized. The further development of Internet technology and information technology has provided great convenience for the effective recognition of athletes' movements in sports competitions. This article aims to study the background of information technology, through the use of sports visual image technology to design and construct an action recognition system, in order to efficiently and accurately identify and judge the various movements of sports competitions, thereby effectively reducing various manpower and the cost of material resources, while improving the accuracy of the competition results. In the experiment, this article invites 100 volunteers to participate in the system's behavioral test recognition. The volunteers' simple exercises such as jumping, raising hands, kicking, turning and squatting are tested, and the result is the exercise designed in this article. The recognition system is able to recognize five sets of actions in the experiment, among which jumping is 97.66%, kicking is 98.13%, squatting is 97.62%, raising hand is 95.24%, and turning is 96.43%. Research shows that the motion recognition system based on sports visual image technology designed and constructed in this paper has high motion recognition accuracy and can recognize athletes’ movements scientifically and effectively.

Keywords: Information Technology, Visual Image Technology, Sports Recognition, System Construction

1. Introduction
The improvement of living standards and the progress of the times make people no longer satisfied with basic material life, and spiritual and cultural activities represented by physical exercise have gradually become an indispensable part of people's lives. In many sports competitions, especially in many large-scale sports competitions, we often see one or more referees. They need to capture the athletes' various movements at any time whether they meet the competition specifications, and in a complex environment, it is not easy to do this job well, a slight difference will cause a misjudgment dilemma. Therefore, it is very necessary to design a system that can effectively identify athletes'
movements. While reducing labor costs, it can also improve the accuracy of refereeing athletes' movements.

Since the sports competition entered the public eye and became popular, experts and scholars in many fields have expressed strong research interest in it. Yang K analyzed the feasibility of the growth forecast of the sports culture industry based on big data theory from the perspective of data mining, and proposed a growth forecast model of the sports culture industry based on genetic neural network, which realized the prediction of the growth law of the sports culture industry under the background of bigdata [1]. Ai Z pointed out that martial arts, as a traditional sports activity in China, has high requirements for speed, explosiveness and coordination. With the rapid development of martial arts, competitive competitions become more and more fierce, and athletes are vulnerable to difficult movements. To this end, he uses digital image technology to analyze the anatomical features, injury mechanism and pathophysiological changes of martial arts athletes' knee joints, and establishes a mathematical model through computer algorithms to accurately perceive the image quality of martial arts injuries, and finally realize the use of computers, not human vision [2]. At the same time, SM Daudpota et al. stated that the rapid growth of storage technology and data collection has greatly increased the amount of online multimedia data, identifying video clips containing specific types of videos, including sports videos [3].

Although the research on sports competition has been a hot topic for many years, so far, there are still very few researches that can effectively solve the problems related to the recognition of athletes in sports competitions. Based on the current information technology environment, this article expects to use visual image technology to design and construct an action recognition system, in order to efficiently and accurately identify and judge various movements in sports competitions, thereby effectively reducing various human and material resources. Cost investment, while improving the accuracy of competition results.

2. Sports Visual Image Technology and the Theoretical Basis of Sports Competition and Athlete Action Recognition

2.1. Visual Motion Capture System

Because the speed, direction, and form of the movement are varied and complex, it is a difficult task to capture and recognize the movement. With the development of computer technology, a system for capturing and recognizing movement has emerged. This motion capture system uses the principles of computer graphics and combines the motion characteristics of moving objects in a three-dimensional space. It can quickly and efficiently capture and recognize the movements of various dynamic objects. Its working principle is to capture the motion state of a moving object with the help of video shooting equipment, and then record the dynamic characteristics of the object in the form of an image on a computer, and after data processing, it is finally presented in the form of spatial coordinates [4]. The space coordinate (X, Y, Z) in the measurement unit is the distance between any two points in space, and the expression is:

\[d = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2 + (z_1 - z_2)^2}\]  

The existing human motion capture system can be divided into electromagnetic type, mechanical type and optical type in principle. The motion capture system is composed of sensors, signal capture, data transmission, data processing, etc. The software and hardware are coordinated to be responsible for tracking processing.

2.2. Computer Vision System

If one of the ways that humans perceive objects is through their eyes, then computer vision can also be regarded as one of the ways that machines perceive the outside world. Computer vision comes from biological vision, which stores the object information captured by the machine in the form of images and data in the cloud, and after calculation, analysis and processing, it is presented to people [5-6].
Figure 1 shows the main components of a traditional computer vision system [7-8]. Its task is to record and store the captured motion information of the target object, and obtain three-dimensional space coordinate information through computer processing of image data.

As one of the fastest growing and most widely used technologies in the field of artificial intelligence, it is like the "eyes" of artificial intelligence, exploring and researching various fields that humans cannot reach, and solving many problems that humans cannot solve [9].

![Computer vision system](image)

**Figure 1.** Computer vision system

### 2.3. Detection and Recognition of Athletes' faces

The face recognition system mainly includes the following four components.

1. **Face image collection:** that is, the digital image of the face is acquired through the camera lens. The first is to detect the face. After the face is aligned with the camera lens, the athlete’s face is scanned and detected. After the facial features are obtained, the modeling of the face is started, and the built model is matched to the input image. After data processing and analysis, it is quickly stored in the database, which completes the image collection of the face.

2. **Face image preprocessing:** Because the posture and expression of the same person in different image sequences will change, the initially collected face images are often not directly usable, plus the process of face recognition players will be disturbed by various external conditions, so the collected images will also be mixed with a lot of impurities, so it is necessary to preprocess the collected face images.

3. **Face image feature extraction:** After preprocessing the face image, the next step is to extract the face image features. The specific operation is to convert the pre-processed face image into a series of numbers through computer technology, and this series of numbers is the feature vector of the face image. The feature vectors are extracted by the distance and angle between the positions of the eyes, nose, chin, etc., and finally unified into a long feature vector.

4. **Face image matching and recognition:** After the face image features are extracted, the extracted feature data is matched with the face feature model stored in the database, and the identity is judged based on the similarity between the two. The basis of judgment is to set a threshold. As long as the similarity is within the threshold, the judgment is valid and the matching is successful [10].

### 2.4. Advantages and Difficulties of the Design of Motion Recognition System

**Advantages of face recognition**

As a high-tech in the new century, face recognition is easy to use, efficient, and highly accepted by users. It uses a general-purpose camera as a recognition information acquisition device. It can easily capture and recognize its movements and recognition without touching the target object. Moreover, this technology has high recognition accuracy and the obtained image information is clear and intuitive. Compared with other biometric technologies, it has a higher recognition level and a lower misrecognition rate [11].

**Difficulties in face recognition**

There is little difference between individuals with different similarities, all facial structures are similar, and even the structural appearance of facial organs are very similar. This feature is beneficial for using faces for positioning, but it is not good for using faces to distinguish human individuals.
Therefore, facial recognition has always been the most difficult research topic in the field of artificial intelligence, and because of its outstanding contribution to humans, it has always been the most difficult research topic in the field of artificial intelligence. Since then, it has been a hotspot that people have rushed to study. The difficulty of facial recognition is prominently reflected in the unstable appearance of the volatile face. As the most mood group of higher animals in the world, humans have the most complex emotional expressions beyond the biological world. These emotions are often reflected by the rich and diverse expressions of humans of coupled with the effect of the external environment, facial recognition of human faces is even more difficult. Under different angles and different lights, the facial images captured by the machine are very different. This is why the face image is preprocessed one [12].

3. Construction and Testing of Motion Recognition System Based on Sports Visual Image Technology

3.1. The Purpose of the Experiment
Under the background of information technology, the recognition accuracy of the motion recognition system based on sports visual image technology has not been verified when the design is completed, so a large number of experiments are needed to test the accuracy of the system for recognizing a series of sports behaviors of athletes during exercise. The experiment in this article first tests the volunteers' simple movements such as jumping, raising hands, kicking, turning, and squatting. The recognition results of these simple actions are used to further improve the movement recognition system.

3.2. Experimental Materials
The materials needed for this experiment are only the motion recognition system based on sports visual image technology and 100 volunteers studied in this experiment.

3.3. Experimental Method
(1) Randomly interview pedestrians in People's Square to understand their awareness of the motion recognition system, and ask them if they are willing to participate in the preliminary experiments involved in this article.
(2) A total of 100 volunteers were invited to participate in this experiment voluntarily.
(3) Install the motion recognition system designed in this study on an empty football field, and let these volunteers randomly perform simple exercises such as jumping, raising hands, kicking, turning and squatting on the football field for 5 minutes, and require they record the frequency of each action.
(4) Count the data recorded by the volunteers and the data recorded by the motion recognition system.
(5) Comparative analysis of the two sets of data.

3.4. Experimental Results
The variance formula used in the data analysis of this experiment is as follows:

$$\frac{(x_1-M)^2+(x_2-M)^2+(x_3-M)^2+\cdots+(x_n-M)^2}{n}$$

(2)

The data analysis of this experiment will be discussed and analyzed in the fourth part, so I won't elaborate on it here.
4. Construction of a Motion Recognition System Based on Sports Visual Image Technology and Analysis of Test Results

4.1. The Public's Awareness of the Motion Recognition System

![Figure 2](image)

**Figure 2.** The public's awareness of the motion recognition system

From the data in Figure 2, it can be seen that among the passersby randomly interviewed, 12% do not understand the motion recognition system of sports visual image technology, 65% of people only generally understand the motion recognition system of sports visual image technology, and 27% of people know the motion recognition system very well, and the remaining 8% of the interviewees said they want to learn about the motion recognition system based on sports visual image technology in the context of information technology. In general, the public has a certain degree of awareness of the motion recognition system. Therefore, before the motion recognition system designed and studied in this article is put into use in the market, the people should be popularized on the relevant theoretical knowledge based on sports visual image technology.

4.2. Recognition Results of Sports Behavior

| Method                        | Jump  | Raise hand | Kick   | Turn around | Squat down |
|-------------------------------|-------|------------|--------|-------------|------------|
| Pixel difference method       | 93.22 |            |        |             |            |
| Target tracking method        | 95.51 | 97.35      | 95.64  |             |            |
| Decision tree and SVM         | 97.78 |            | 96.94  |             |            |
| Method of this article        | 97.66 | 95.24      | 98.13  | 96.43       | 97.62      |

There are currently many recognition systems, so we have compiled three other data analysis and recognition methods in addition to this article, and compared and analyzed the motion recognition system based on sports vision image technology in this article. After obtaining the data manually recorded by the volunteers and the data recorded by the motion recognition system, multiple sets of data were integrated and compared, and a new set of statistics was obtained in Table 1. According to the data in Table 1, the accuracy of using the Pixel difference method to identify the jumping movements of volunteers is 93.22%, and the Target tracking method can identify the three movements of jumping, raising hands, and kicking, with the accuracy of 95.51% and 97.35%, respectively. And 95.64%. At the same time, the two movements of turning and squatting can be recognized and captured by the Decision tree and SVM method, and the accuracy is 97.78% and 96.94%. The motion recognition system designed in this article can recognize the five groups of actions in the experiment. Among them, jumping is 97.66%, kicking is 98.13%, and squatting is 97.62%. The recognition and capture accuracy of these three actions is better than the previous ones in Table 1. Three methods are
high. But the recognition and capture accuracy of the raised hand is only 95.24%, which is lower than the Target tracking method, and the turning motion recognition and capture accuracy is only 96.43%, which is lower than the Decision tree and SVM method.

5. Conclusion
With the improvement of material living standards, more and more people are beginning to focus on seeking their own comprehensive development. In sports, there must be rules of the game, so referees are required to monitor the athletes’ behavior in real time. According to the experimental results, the motion recognition system designed and studied in this paper can accurately recognize basic movements such as jumping, raising hands, kicking, turning and squatting, among which the accuracy of kicking behavior recognition is as high as 98.13%. The motion recognition system based on sports visual image technology under the background of information technology designed and studied in this paper can not only share part of the work for referees, but also improve the fairness of sports games. Therefore, it is hoped that the motion recognition system studied in this paper can be useful for the future Contribute to sports competitions.

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