

## *Retraction*

# **Retracted: Value Analysis of Video Image Multiprocessing Based on Vision Sensor in the Field of Football Scientific Research**

### **Journal of Sensors**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

- (1) Discrepancies in scope
- (2) Discrepancies in the description of the research reported
- (3) Discrepancies between the availability of data and the research described
- (4) Inappropriate citations
- (5) Incoherent, meaningless and/or irrelevant content included in the article
- (6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our own Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

### **References**

- [1] B. Li and G. Ji, "Value Analysis of Video Image Multiprocessing Based on Vision Sensor in the Field of Football Scientific Research," *Journal of Sensors*, vol. 2021, Article ID 9738380, 14 pages, 2021.

## Research Article

# Value Analysis of Video Image Multiprocessing Based on Vision Sensor in the Field of Football Scientific Research

Bin Li<sup>1</sup> and Gaoqing Ji<sup>2</sup> 

<sup>1</sup>*School of Physical Education and Sport Science, Fujian Normal University, Fuzhou, 350017 Fujian, China*

<sup>2</sup>*College of Electrical Engineering, Hebei University of Architecture, Zhangjiakou, 075000 Hebei, China*

Correspondence should be addressed to Gaoqing Ji; [jgq1941@hebiace.edu.cn](mailto:jgq1941@hebiace.edu.cn)

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The development and application of mobile portable video capture and image processing systems, as well as the development and improvement of computer multimedia courseware technology have made image processing technology widely used in football project scientific research services. This research mainly discusses the value of video image multiprocessing based on vision sensors in the field of football scientific research. The development and conduct of this research work require the application of sports video image processing technology software to conduct scientific experimental research and analysis on the athletes' technical and tactical level, evaluate the athletes' technical and tactical performance through qualitative and quantitative tests, and give different sports items at the same time. Humans can exchange information with the outside world through vision, hearing, and language and can express the same meaning in different ways. However, current intelligent machines or computers require programs to be written in strict accordance with various machine languages. Only in this way can the machine run. In order to enable more people to use complex machines, it is necessary to change the past situation where people adapt to machines. Instead, let the machine adapt to people's habits and requirements and exchange information with people in the way people are used to, that is, let the machine have the ability to see, hear, and speak. At this time, the machine must have the ability of logical reasoning and decision-making. Use sports video image processing technology and use examples to study and explore practical methods and means that are most in line with the scientific work of the project, and build the most scientific and useful sports video image processing system.. The CCD visual image sensor is used for signal acquisition and image processing when the motion video image processing system is established. Through logical analysis and induction, discuss and prove the intuitiveness, practicability, efficiency, and scientificity of the application of video image processing technology in the field of football scientific research. Finally, in the mathematical statistics method, the statistical software Excel 2003 in the office system is used to perform statistical analysis on all data results and analyze and compare the key kinematic parameters of some sports events. Analyzing the video images of the 2016 European Cup, the average possession rate of the Welsh team is 48%, and the average pass success rate per game is 82.7%. This research helps to improve the ability of football players to analyze, research, and evaluate sports skills.

## 1. Introduction

With the full launch of the Chinese Football Professional League, the professional development from the "Ten Year A League" to the current "Chinese Super League", in order to promote the improvement of the level of football in our country, people have carried out a lot of research work and used scientific literature. As a carrier of objective

records of scientific research results, machine vision is to use various imaging systems instead of visual organs as input means, and intelligent machines replace the brain to complete the processing and interpretation of information. The ultimate research goal of machine vision is to enable intelligent machines to observe and understand the world through vision like humans and have the ability to adapt to the environment autonomously. A typical visual system

can complete certain tasks with a certain degree of intelligence based on visual sensitivity and feedback. In many research fields, the combination of image acquisition system and machine vision technology is an important direction of research and development. The structure and function of the existing acquisition system are relatively simple, usually composed of camera equipment, control equipment, storage equipment, and transmission equipment.

After more than a century of development, football has become the most extensive and influential sport in the world today, so it has the reputation of being the world's "largest sport." Football has gradually entered all areas of human social life, and its development scale and level of development have been continuously improved, especially the organic combination of modern business and sports, which has created a broader space for the development of football. With the reform of the economic system with the continuous deepening of football, the sports reform with the reform of football as a breakthrough was highly valued by the national sports department at that time. Scientific literature is one of the most important components of the scientific information exchange system. According to the publication status and quantity of scientific literature, the development level of a certain scientific field and the achievements in a certain country can be judged. The application of image processing technology in football scientific research mainly includes a variety of ways of image technology processing and different types of video technology processing and production. The basic software and hardware requirements of the basic configuration of image processing technology must meet certain standards. Scientific literature is one of the most important components of the scientific information exchange system. According to the publication status and quantity of scientific literature, the development level of a certain scientific field and the achievements in a certain country can be judged. Therefore, analyze the situation of football scientific research literature in the core sports periodicals of our country, summarize the laws of its existence, find out the problems and deficiencies in the research, and combine with the development status of football in our country to try to find the connection between them.

Wearable sensors that accurately record head hits experienced by athletes during games could have a wide range of potential applications, including equipment improvements, player education, and rule changes. Gabler et al. believe one challenge for wearable systems is their ability to distinguish head hits from stray signals they record. He studied the development and evaluation of head impact detection systems to distinguish between head hits in football matches and false incidents. Data from the 2018 game was used to train ML models to classify head hits using kinematic data features, and his research lacked data [1]. Suarez et al. introduced a CMOS vision sensor chip using standard  $0.18 \mu\text{m}$  CMOS technology for Gaussian pyramid extraction. He presented measurements from the chip to evaluate the accuracy of the generated Gaussian pyramid in visual tracking applications. His research is superior to the traditional solution of an imager plus a microprocessor unit [2]. Guang et al. said the rise of the Internet and identity authentication

systems has brought convenience to people's lives, but also brought potential risks of privacy leakage. He first proposed an effective set of biometric signatures to describe the motion, speed, energy, and frequency signals of blinking based on the microsecond temporal resolution of event density. He then uses the neurobiometric data set to train the integrated and nonintegrated models for biometric authentication. His proposed system opens up a new approach to more secure authentication using neuromorphic vision sensors [3]. Xiao and Zhen believe that the calibration method of structured light vision sensor based on plane target cannot produce reliable and accurate results due to the inaccuracy of feature point positioning in complex outdoor lighting environment. He proposed the mathematical solution of the position uncertainty of fringe points and established the position uncertainty of target feature points and fringe points. His method is robust in the case of large deviation of feature point positioning and can achieve the same measurement accuracy as the plane target calibration [4]. Abdelali et al. focus on mPEG-7 color structure descriptor (CSD) for real-time video segmentation. He proposed a new CSD hardware architecture. He has shown that using a small number of quantization levels and frame skipping can significantly reduce complexity and ensure better computational performance, while maintaining satisfactory levels of accuracy in terms of shot boundary detection rates. This is useful for implementation on resource-constrained hardware platforms and multiprocessing applications [5]. Bolivar-Ramirez explores the challenges faced by sports writers and footballers in antioquia (Colombia) in the 1950s and 1960s as they tried to make professional football a legitimate work and spectacle. He reveals the institutional sport in which football players promote professional football and shows that professional football has become a field in which different actors compete and form regional narratives [6]. Hui believes the rapid development of artificial intelligence (AI) and machine learning has opened up unprecedented analytical possibilities for a variety of team and individual sports such as baseball, basketball, and tennis. Artificial intelligence technology has been applied to football, with the aim of better solving the new scientific challenges involved in analyzing two players' and coordinating team behavior. The research challenges associated with predictive and normative football analysis require new developments and advances at the intersection of statistical learning, game theory, and computer vision. He provides an overarching view, highlighting how the combination of these fields can form a unique microcosm of AI research, while providing mutual benefits for professional teams, viewers, and broadcasters for years to come. His duality makes football analysis a hugely valuable game-changer, not only in terms of changing the game itself but also in terms of the meaning of the field [7]. Through quantitative analysis and qualitative evaluation of the changing factors in the development and development of football, combined with the development of football in the past ten years, the relationship between the situation of football scientific research literature and the development of football is explored for scientific research. The personnel provide help and suggestions to

enable them to understand the current development of football scientific research, so as to judge the future trend of scientific research and the development direction of scientific research, so that the scientific research and development of football can effectively serve the practice and provide a strong theoretical basis and practical guidance for the development of football.

Image collection is the information source of the machine vision system. Images are collected and stored orderly through the collection equipment; the performance of the collection system directly determines the fundamental information source of the machine vision system. Therefore, from the perspective of practical application, this article first discusses the method of image acquisition and the design of the system. The development and progress of this research work require the application of sports video image processing technology software to conduct scientific experimental research and analysis on the technical and tactical level of athletes, to qualitatively and quantitatively test and evaluate the performance of athletes' technical and tactical ability and to give the methods, examples, steps, and purposes of applying sports video image processing technology in different sports. Make systematic evaluation records strictly in a certain order, and the results are described by statistics. The collected data is compared longitudinally in the time domain and then classified horizontally to analyze the characteristics of the scientific research development of football. Combining the development of football in recent years and the situation of football scientific research, we will make a comparative analysis, explore the relationship between the two, find problems, and put forward suggestions in order to better promote the development of football in our country. CCD sensor is a new photoelectric conversion device, which can store the signal charge generated by light. When a specific timing pulse is applied to the CCD, the stored signal charge can be transmitted directionally in the CCD to realize self-scanning. It is mainly composed of photosensitive unit, input structure, and output structure. It has photoelectric conversion, information storage and delay functions, and high integration, low power consumption and has been widely used in the three fields of camera, signal processing, and storage, especially in the image sensor application has made rapid development.

## 2. Research Methods

**2.1. Football Research.** Football scientific research refers to the use of scientific methods to explore the past, current situation, and the objective laws of football development, reveal the essence of football, and then guide the practice of football and improve the level of football. Sports science and technology is the source of power to promote the development of sports, and the revitalization of sports must rely on the progress of science and technology. Although the current scientific research work in Chinese football has just started, but drawing on the successful experience in other physical fitness projects, the development of football scientific research is still very fast.

However, we also found that in the application of bibliometrics theory to the research status of modern football, the content of the research is more one-sided, the application of the research method is single, the qualitative research is more, and the research of quantitative analysis is less. Most of them are from a unilateral and single perspective to superficially analyze the relevant problems that have occurred in the process of professionalization of football in our country. There is less in-depth analysis of why this problem occurs.

Assuming  $(u, v)$  is the pixel coordinates of the original image, and the perspective transformation matrix is [8]:

$$[x, y, w]_B = [u, v, w] \begin{bmatrix} a_{11} & a_{12} & a_{13} \\ a_{21} & a_{22} & a_{23} \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \quad (1)$$

Suppose that the straight line  $L$  can be expressed by the following formula [9]:

$$L = t + w_1 \times D_3, \quad (2)$$

Where  $t$  is the position of the camera and  $w_3$  is a constant. We have two cameras, which form two nonparallel straight lines in the coordinate system [10, 11]:

$$L_1 = t + w_1 \times D_1, \quad (3)$$

$$L_2 = t + w_2 \times D_2. \quad (4)$$

After the calibration operation is completed, with the help of perspective transformation, we can have two lines, which can be understood as a light taken by the football by the camera. Due to the influence of the height of the football, the actual position of the football is on a certain point on this line. For  $n$  feature maps, each map generates  $k$  nodes. The  $i$ -th mapping feature can be calculated as follows [12]:

$$Z_1 = \chi(XW + \kappa), i = 1, \dots, n. \quad (5)$$

In order to speed up the training process, enhanced nodes are obtained group by group. Compute enhanced node [13]:

$$H_j = \alpha([Z_1, \dots, Z_n]W + \beta). \quad (6)$$

Update the weight to [14]:

$${}^x W_n^m = W_n^m + (Y - AW)B, \quad (7)$$

where  $Y$  is the corresponding label with  $X$  appended. For the input data set,  $X$ , for  $n$  mapped features and  $n$  enhancement groups, the new feature structure is [15, 16]:

$$Y = [Z_1 \chi(ZW + \chi) | \dots, Z_n, \varphi(ZW + \beta)] W^n. \quad (8)$$

In order to capture the dynamic characteristics of the video sequence, the enhancement nodes in each group are



connected cyclically, and there is a feedback connection in the enhancement unit. The basic equation is now [17]:

$$Z_j(t) = \theta(tXW + \beta). \quad (9)$$

The enhanced node is [18]:

$$H_j(t) = \chi\left([Z_1, \dots, Z_n]W_j + \beta_j\right). \quad (10)$$

The final output is [19]:

$$Y(t) = [Z_1\chi(ZW + \chi)|H(t), \dots, H(t)]. \quad (11)$$

When the two frames of images have the same background or foreground similarity [20]:

$$D(i, i + 1) = \sum_{j=1}^n |H_i(j) - H_{i+1}(j)|, \quad (12)$$

where  $n$  is the number of color distribution types,  $H_j$  is the number of pixels with color distribution type  $j$  in the  $i$ -th frame [21, 22].

**2.2. Motion Video Image Multiprocessing Technology.** Motion video image multiprocessing technology is applied in various forms in the field of football scientific research, mainly including video image synchronization superposition technology, split-screen synchronization comparison technology, video background processing technology, video image two-dimensional and three-dimensional analysis system, video image automatic identification and tracking technology, video labeling system technology, computer simulation and virtual reality technology, technical and tactical field tracking and statistics technology, video nonlinear editing system technology, video measurement technology, and video multichannel synchronous acquisition and analysis technology. This is an important scientific research method that has been used for many years by generations of scientific researchers in our country to prepare for the Olympics, World Championships, or other major domestic and foreign competitions and trainings for national team athletes means, for example, by measuring the running ability of ball players to reflect the athlete's physical ability and by intercepting on-site video and nonlinear editing technology to count the basketball players' tactical ability such as stealing, passing, and cutting cooperation and scoring. Really reproduce or simulate and optimize the athlete's best competitive ability level and state through simulation technology and virtual reality technology. Motion video image multiple processing is shown in Figure 1.

**2.3. Establishment of Motion Video Image Processing System.** CCD (charge-coupled device) image sensors play an important role in digital storage, high-precision measurement, signal acquisition, image processing, and other scenarios. In this paper, the XC7Z020-CLG484 chip of the Zynq-7000 series is used as the platform of the fully programmable system, and the digital video image input by the Camera

Link interface is used as the video source. The programmable logic part of the XC7Z020-CIG484 chip realizes the collection of video images, XC7Z020. The PS part of the CLG484 chip sends the video images collected by the PL part from the DDR controller on the PS to the external DDR3 for buffering. In the PS part, we have completed the transplantation of the Linux kernel operating system and performed the video image simple processing, and then the video image is transmitted and displayed, and inside the PL and PS, the data is exchanged through the AXI internal bus. The whole process takes the XC7Z020-CLG484 fully programmable chip of the Zynq-7000 series as the core to complete the design of the video image processing platform. It mainly carries out real-time acquisition, storage and controllable feedback of the live images of the movement process, as well as the fast editing and cutting of the video images and pictures of the movement process, and the superimposition and comparison of various video forms. Video transmission and port allocation are shown in Table 1.

When the system starts working, the programmable logic part first configures the trigger mode, trigger rate, exposure time, and other parameters of the CCD camera through the serial port to meet our requirements for image parameters, then the PL part collects the digital video image accessed by the embedded operating system based on Linux kernel, managed and processed the image data, and finally transmitted the video image data to the server through Ethernet. Most of the internal PL and PS data interaction of zynq-7000 series xc7z020-clg484 chip adopt axi4 Lite bus protocol. However, due to the large amount of video image data collected by PL part to be transmitted to DDR3 of PS part, axi4 stream bus protocol needs to be used to transmit data to PS part. Xilinx's development tool provides video input to axi4 stream, Axi4 streamto video output, VDMA, and other IP cores can easily realize such functions. The logical structure of the moving video image processing system is shown in Figure 2.

After feature selection, calculate the inter-frame feature difference value  $f(t)$  at a certain moment  $1$  and compare it with the set threshold  $T$  [23]:

$$f(t) > T. \quad (13)$$

Lens shear detection [24]:

$$f(t) > T_h, \quad (14)$$

$$T_t < f(t) < T_h \wedge \sum f(t) > T_h. \quad (15)$$

The high threshold  $T_h$  is used to detect the cut of the shot. When the difference between frames at a certain moment in the video exceeds  $T$ , it is considered that the cut of the shot occurred at this time. Calculate the mean vector  $m$  of the video clip  $V$  [25, 26]:

$$m = \frac{1}{L} \sum_{i \in V} H. \quad (16)$$

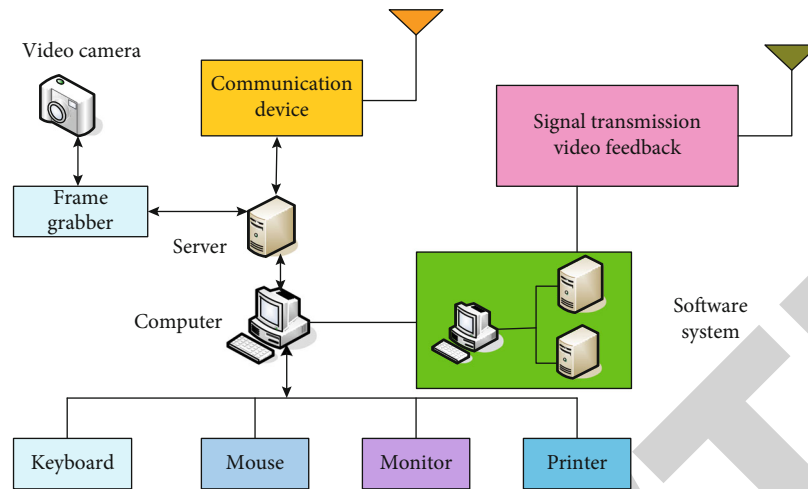


FIGURE 1: Motion video image multiprocessing.

TABLE 1: Video transmission and port allocation.

| Structure         | Port                | Number of chips | Number of connectors |
|-------------------|---------------------|-----------------|----------------------|
| Elementary mode   | A, B, C             | 1               | 1                    |
| Intermediate mode | A, B, C, D, E, F    | 2               | 2                    |
| Advanced mode     | A, B, C, D, E, F, G | 3               | 2                    |

Calculate the intraclass dispersion matrix  $S$  of the video segment  $V$  [27]:

$$S = S_1 + S_2, \quad (17)$$

where

$$S = \sum_{i \in V} (H - m)(H - m)^T. \quad (18)$$

The interclass dispersion matrix  $S_p$  of the sample set is [28]:

$$S_p = (m_1 - m_2)(m_1 - m_2)^T. \quad (19)$$

Therefore, according to the duration of the gradient lens and the sports lens, it can be expressed as [29]:

$$F = \frac{\text{trace}(S_b)}{\text{trace}(S_w)} = \frac{\text{trace}(S_b)}{\text{trace}(S_1 + S_2)} = \frac{\text{trace}(S_b)}{\text{trace}(S_1) + \text{trace}(S_2)}. \quad (20)$$

The  $F$  value of the gradual change is much larger than the  $F$  value of the lens when the object is moving.

#### 2.4. Football Scientific Research Methods

##### (1) Documentary data method

Through literature research, this paper summarizes the principles of computer programming and video image pro-

cessing technology. At present, there are many monographs and scientific research papers on the application of video image processing technology in different fields at home and abroad, but there are few comprehensive discussions on the application in the field of football scientific research. It is necessary to classify, summarize, and comment on the literature of video image processing. There is little literature on the development and compilation of these sports video image processing software systems using computer language. The focus of this literature review is to focus on the professional literature and software research on the application of video image processing technology in the field of sports.

Literature research shows that the development and application of sports video image processing software abroad are more advanced than the domestic ones, and more mature professional video image processing software for different sports events has been developed. Chinese football scientific researchers mainly developed and developed different video image processing software based on the technical and tactical characteristics of this project and the video management needs of athletes' daily training during the 2008 Beijing Olympic Games. However, the market development of these software neither the promotion nor the promotion is mature enough to form a relatively complete industrial scale. Among them, the DV coach developed is the most advanced and has formed a relatively complete product, but this software cannot accurately play in the scene. Further improvements and enhancements are needed.

##### (2) Interview method

The establishment and development of multiple video image processing technology systems for different sports require expert interviews and information consultation with old experts, professors, and coaches who have been engaged in relevant project scientific research and training for a long time, so as to obtain the most useful and useful video image processing information for this research, so as to complete the research work of this paper more scientifically and

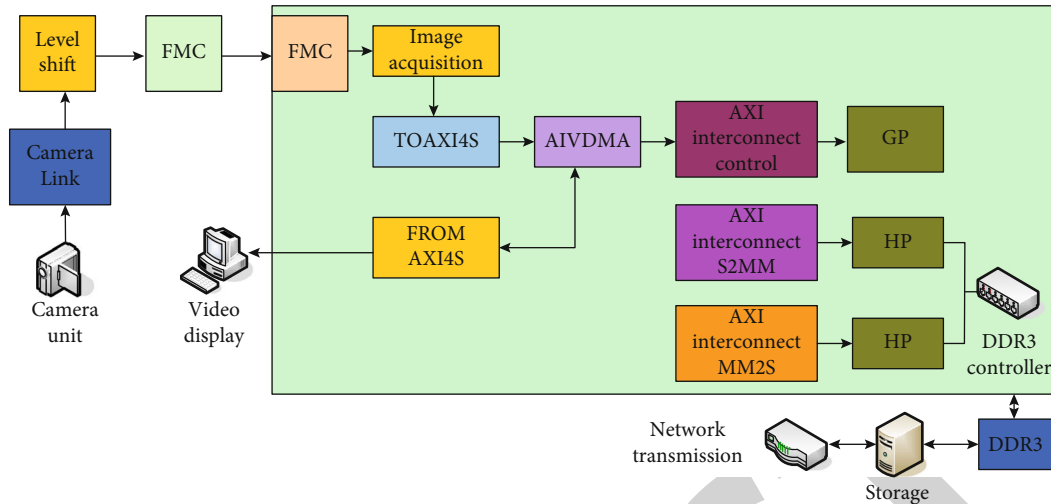


FIGURE 2: The logical structure of the motion video image processing system.

reasonably. The content of the interview is mainly about the popularity of the application of sports video image processing in football scientific research, the understanding of video image processing technical knowledge, and what kind of sports video image processing software system is particularly needed by the sports team.

After consulting and investigating with old experts, coaches, and athletes related to sports, it is found that coaches and athletes are particularly interested in sports video image processing technology. Coaches and athletes especially like to observe and analyze the video data of fierce battles and especially hope to use the video image data to qualitatively and quantitatively research, analyze, and evaluate the technical and tactical performance and ability of sports athletes.

### (3) Investigation method

The establishment of the topic of this research and the development of the research content are all based on the practical investigation of sports training. Long-term scientific research work experience and scientific research practice service process in the national football team, as well as investigations and consultations on athletes, coaches, and scientific research personnel of different sports, understand and master the current sports technology training of athletes in various national teams. It adopts the video image field collection, field observation and analysis research, and the research and analysis of the video image in the laboratory after the fact, so as to achieve the purpose of improving the athletes' technical ability. The video image processing software used is generally free windows media player and StormPlayer, etc. Athletes and coaches rarely use professional video image processing software to professionally process and apply sports video images. The main reason may be that the price of these professional video image processing software is too high, which is beyond the tolerance of athletes and coaches. At the same time, athletes and coaches do not have much time and opportunities to operate complex video image processing technology. Before the 2008

Beijing Olympics, the DV coach developed by the Institute of Computer Technology of the Chinese Academy of Sciences was given to the scientific researchers of most national teams for free. Sports management centers and football research institutes have also purchased and configured professional video image processing software systems such as dartfish and simitowin for the scientific research staff of the unit. These software systems are also often applied to the processing of moving video images.

### (4) Experimental method

The development and progress of this research work require the application of sports video image processing technology software to conduct scientific experimental research and analysis on the technical and tactical level of athletes, to qualitatively and quantitatively test and evaluate the performance of athletes' technical and tactical ability and to give the methods, examples, steps, and purposes of applying sports video image processing technology in different sports. Through the example of video image processing technology, this paper studies and discusses the practical methods and means most in line with the scientific work of the project, so as to achieve the purpose of demonstrating that the sports video image processing system is the most effective method and means for the analysis and evaluation of sports technology and tactics. This research mainly uses dartfish professional video image processing software system, DV coach professional video image processing software system, sports code video annotation and technical and tactical analysis software, Simi Scott technical and tactical analysis software, peak Motus 3D video image processing software, Simi motion 3D video analysis software Aerial 3D video analysis software, Corel video studio 12, and other video image processing software conduct video image technology processing and experimental testing, as well as the collection and extraction of key motion parameters at the motion scene, analysis, and demonstration of motion video images, etc. The moving video image demonstration is shown in Figure 3.



FIGURE 3: Motion video image presentation.

#### (5) Logic analysis method

Based on years of experience in the application of video image processing technology in the scientific research work of the national football team, as well as a large number of application examples of motion video image multiprocessing technology in the field of scientific research, this article uses logical analysis and induction to discuss and prove that the application of video image processing technology in the field of football science research is intuitive, practical, efficient and scientific.

#### (6) Mathematical statistics

Use the statistical software Excell2003 in the office system to perform statistical analysis on all data results and analyze and compare the key kinematic parameters of some sports events. This research mainly discusses football events.

### 3. Results

In terms of publication volume, there are 223 articles on football image processing published in "Liaoning Sports Science and Technology," accounting for 14.4% of the total; 186 articles published in "China Sports Science and Technology," accounting for 12.0% of the total. The ratio of the number of football scientific research papers published in these two journals to the total number is more than 10%, followed by 139 and 125 papers, respectively, published in the "Journal of Wuhan Institute of Physical Education" and "Journal of Beijing Sport University," accounting for 9.1 of the total 8.2%. The least is "Fujian Sports Science and Technology," which only published 17 articles in 15 years, accounting for only 1.1% of the total. This shows that the distribution of scientific research papers on football sports image processing in Chinese sports academic journals is uneven. The publications of journals in different years are shown in Figure 4.

Since the professionalization of Chinese football, there has been insufficient attention to the selection of football players. In the past 15 years, only 19 papers have involved research reports on the selection of football players, accounting for only 1.23% of the total number of papers, which is

inconsistent with the importance of selection. It is necessary to increase the research in this aspect in the future research, especially the theoretical basis and corresponding methods of material selection.

Looking at the research content of our country's football scientific research papers from 2017 to 2020, it basically includes all aspects of football, but there are still several notable shortcomings. The main manifestations are first, there is too little research on our country's football system. Because judging from the actual situation of football development in our country, there are big problems in our country's football competition system, football association, and club management system. At this stage, these system problems have become the main factors restricting the development of football in our country. The second is that the number of papers on the statistical analysis of these international competitions and domestic competition techniques at all levels exceeds the number of papers on football training research. However, most of the researches remain on the description of objective facts and lack in-depth rational analysis. It is difficult to accurately grasp the internal laws of football, which has caused many people and lack of innovation in the research. This phenomenon is worthy of our deep consideration. The third is that the research on football selection, which has a long research period and has entered a trough, and the number of research results is relatively small. The distribution of scientific research on football in our country is shown in Table 2.

Further statistics found that in all statistical papers, there are 1015 football scientific research papers using one or two research methods, accounting for 65.74% of the total number of papers. Although the number of papers using comprehensive research methods has increased in recent years, the number is still far less than the number of papers using a single research method. Due to the limitations and limitations of a single research method, the research results cannot satisfy the rapid development of football in our country. Strengthening the comprehensive application of football scientific research methods is the direction of the efforts of the majority of football scientific researchers. Table 3 shows the adoption of scientific research papers on football sports.

The study of high-level games will continue to be an important aspect of our football research work in the future.



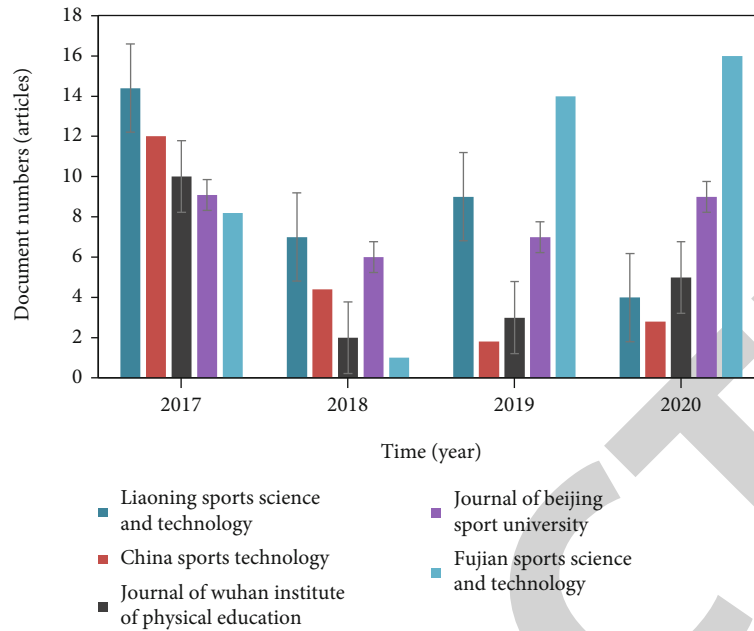


FIGURE 4: Publication of journals in different years.

TABLE 2: Distribution of scientific research on football in our country.

| Content                     | 2017 | 2018 | 2019 | 2020 |
|-----------------------------|------|------|------|------|
| Game analysis               | 23   | 27   | 29   | 38   |
| Football training           | 23   | 32   | 19   | 16   |
| Sociology                   | 10   | 2    | 0    | 3    |
| Physiology and biochemistry | 17   | 5    | 5    | 12   |
| Football teaching           | 10   | 3    | 8    | 12   |
| Psychology                  | 17   | 6    | 146  | 17   |
| Economics                   | 5    | 10   | 29   | 16   |
| Management                  | 4    | 9    | 19   | 38   |
| Nutrition                   | 1    | 155  | 0    | 16   |

TABLE 3: Adoption of scientific research papers on football.

| Types     | 2017 | 2018 | 2019 | 2020 |
|-----------|------|------|------|------|
| 1 types   | 36   | 36   | 21   | 26   |
| 2 types   | 24   | 12   | 14   | 18   |
| 3 types   | 10   | 10   | 14   | 16   |
| 3 or more | 0    | 0    | 6    | 3    |

Seeking rules from game phenomena and exploring the development direction of skills and tactics are also important ways for us to understand the laws of world football; papers that take college football as the research object are 178 papers, accounting for 11.53% of the total number of papers, indicate that as the Chinese University Student Football League is in full swing and the level of scientific research in universities has improved, university football has become another important front for the development of Chinese

football. The “combined” training model provides some theoretical foundations; in recent years, the research on adolescents and women’s football has paid more attention than before. A total of 166 papers and 98 papers have been published, accounting for 10.75% and 6.35% of the total number of papers, but compared with men’s football. Research still appears relatively weak. Especially compared with foreign countries, our weak progress in these two areas has not made up the gap with the world’s advanced level, but the gap is getting bigger and bigger. The performance of the Chinese national women’s football team in major competitions in recent years and the obvious disadvantages of the youth team in the game are good proof. Table 4 shows the situation of scientific research objects of football in our country.

The academic qualifications of football researchers are shown in Table 5. It can be seen from Table 5 that among the 398 papers with the author’s educational background, 347 authors have a bachelor degree or above, accounting for 87.19% of the total number, and 261 authors have a master’s degree or above, accounting for 65.58% of the total number, which shows that our country’s football scientific research personnel are developing towards higher education. From one aspect, it reflects the expansion of the overall scale of our country’s higher research education, the improvement of teaching quality and scientific research water.

The changes in the flexion amplitude of the left and right knee joints in the technique of forefoot light kick linear football are shown in Figure 5. According to data analysis, the knee joint flexion angle is inversely proportional to the flexion amplitude. The larger the flexion angle, the smaller the amplitude. It can also reflect that the flexion amplitude of the right knee joint is greater than that of the left knee in the straight-line technique of a forefoot kick. From the preparation stage, the angle of the knee joint showed an upward trend, the angle of the left knee joint began to decrease after

TABLE 4: Situation of scientific research objects of football in our country.

| Types                   | 2017 | 2018 | 2019 | 2020 |
|-------------------------|------|------|------|------|
| World series            | 16   | 13   | 18   | 20   |
| College football        | 11   | 4    | 10   | 9    |
| Youth players           | 6    | 12   | 12   | 14   |
| Professional league     | 5    | 9    | 7    | 9    |
| Professional player     | 3    | 3    | 15   | 10   |
| Women's football player | 2    | 2    | 4    | 4    |
| Professional club       | 16   | 2    | 3    | 4    |
| Judging rules           | 11   | 4    | 3    | 4    |

TABLE 5: Educational qualifications of football researchers.

| Degree                    | Number of people | Percentage (%) |
|---------------------------|------------------|----------------|
| Junior college            | 2                | 0.50           |
| Undergraduate             | 48               | 0.25           |
| Pursuing master           | 86               | 12.06          |
| Master                    | 164              | 21.61          |
| PhD candidate             | 29               | 41.21          |
| PhD                       | 28               | 7.29           |
| Post-doc                  | 39               | 7.04           |
| Master and PhD supervisor | 398              | 0.25           |

0.24 s, and the angle curve of the left knee joint gradually increased after 1.32 s, and then became stable. The angle of the right knee joint started to increase slightly from 0 s to 0.3 s, and the change in flexion amplitude became smaller. From 0.3 s to 1.32 s, the knee flexion angle began to decrease and gradually reached the lowest point, and then the degree gradually increased and stabilized. The above data reflects that the kicking and extension of the right knee after squatting and bending of the right knee are different, and the effect of kicking and stretching is obvious at the completion stage of kicking technique.

Compare several competition videos to verify the effectiveness of multiviews as shown in Figure 6. It can be seen that the effect of the fusion of the dual-view is much better than that of the single-view. The average accuracy of a single viewing angle is 24 pixels. The average accuracy of dual viewing angles is 12.9 pixels. This is because the players will change in size and scale when running on a wide court, and the algorithm may not be able to keep up, which will cause the difference between the tracking frame and the ground truth. The existence of dual perspective makes it better to locate the player through the two data and will not cause a huge error on the top view due to the small error of the tracking frame. The average tracking length of a single view is 33 seconds, 825 frames; the average tracking length of a dual view is 71 seconds, 1775 frames. First, the positioning of the dual perspective is more accurate, which slows down the gradual drift in the tracking process until it fails. Second, when a certain perspective fails to track, the other perspective can continue to work and even retrieve each other, which also greatly improves the success rate.

The average success plot of a single view is 53.3%. The average success plot of dual viewing angles is 82.8%. Figure 7 shows the comparison of the average success rate between single-view and dual-view.

Statistics have been widely used in the sport of football. Usually, we are accustomed to using absolute values to evaluate players. For example, we use the number of shots to evaluate the attacking ability of a forward. However, the absolute value may not be a good evaluation scale. For example, a defender cannot have as many opportunities as a forward. Some statistical data is dense in a small interval, which makes its discrimination very low. By studying the distribution graph of different statistical data, we use the comprehensive analysis of absolute value and relative value in this part to make the measurement standard more discriminative. When evaluating, we hope that the system will differentiate between different locations. There are three steps used to describe the degree of participation of a team with the ball, no participation, low participation, and high participation. The main purpose is to keep the system in a good balance. On the one hand, we hope it has a good degree of distinction. On the other hand, we hope that it can alleviate the phenomenon that the absolute value of a certain data does not change much, but the score difference caused by the huge change in ranking is too large. The mean square error of different games is shown in Figure 8.

The realization of football techniques and tactics is inseparable from physical fitness. We use the position obtained by video tracking to calculate the running distance and running speed of the players and compare with GPS to verify the correctness of the system. The comparison of test models is shown in Figure 9. Comprehensive running is an irregular pattern designed on the football field. It does not stop halfway and has a variable speed. The total distance is 140 meters. During the test, the players wear GPS vests to compare the accuracy of the video tracking system. A total of 13 players participated in the test. The broken line is divided into two parts, one is  $4 \times 10$  m, and the other is  $8 \times 5$  m. It can be seen that the highest accuracy of comprehensive running reaches 87%, and the highest precision of broken line running reaches 82%. Of course, GPS is not absolutely accurate due to sampling reasons.

Then, this research analyzes the video images of the 2016 European Cup. The Welsh team is dominated by the 343, 3421, and the 532 formation when switching defenses quickly, with Ramsey as the midfield support, connecting Bell and other offensive points. Allen and Ledley formed a solid defensive center with the three central defenders. The goalkeeper gave strong support to the back line in the elimination round. Chester and Williams flew on both wings. When the team regained possession of the ball, they could quickly advance to the front, bell as the team catalyst, roaming on both sides. Ramsey is good at creating opportunities on the edge of the penalty area.

The average possession rate of the Welsh team is 48%, and the average pass success rate is 82.7%; the main offensive points implemented by the Welsh team's fast offensive tactics include (1) the player acts as a fulcrum to attract defense, cover the offense of teammates, or choose to break through

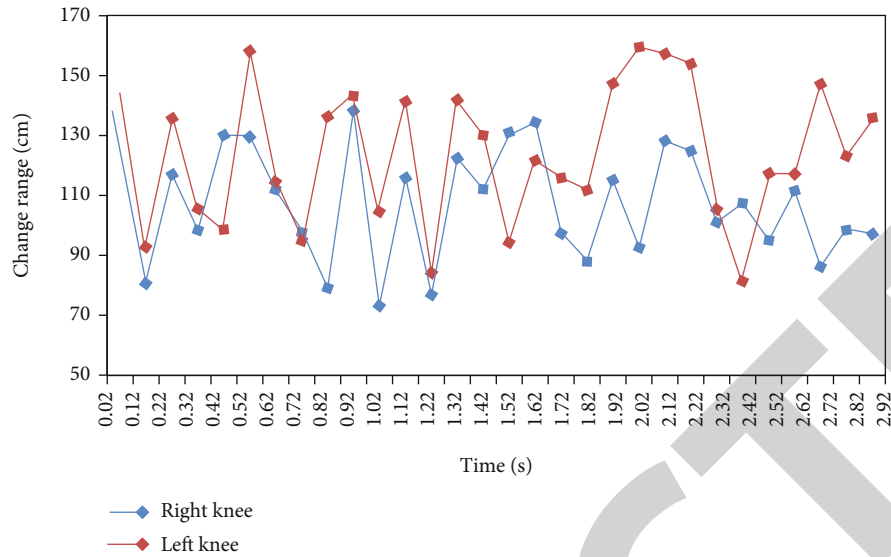


FIGURE 5: Changes in the flexion amplitude of the left and right knee joints in the technique of light kicking straight football with a straight foot.

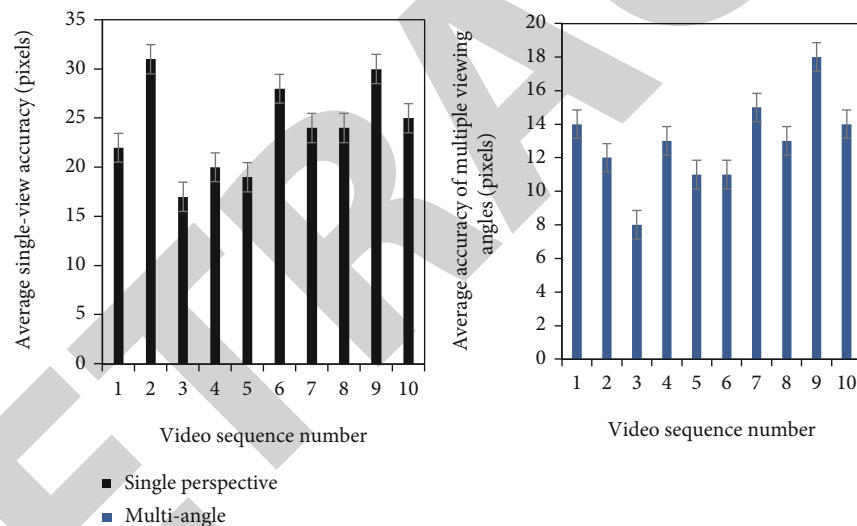


FIGURE 6: Verify the validity of multiple perspectives.

the goal. (2) When the midfielder and the midfielder launch a quick attack, move to both sides to pass the full-back, the full-back inserts the attack and crosses. (3) When launching a quick attack from the backcourt, advance to the frontcourt through the midfield excessively and quickly. The video image analysis of the Wales team is shown in Figure 10.

#### 4. Discussion

In the application of sports video image processing technology in football scientific research and practice, continuous innovation and development, exploration and experimentation, analysis and summary, verification and inspection are all for better analysis and more objective evaluation of athletes' competitive technical capabilities, all in order to improve athletes technical and tactical ability is the goal,

which is welcomed, supported, and approved by coaches and athletes in practice. At the same time, it has also obtained good economic and social benefits. It can be said that the application and development of video image processing technology in football scientific research are advancing in continuous innovation, and in continuous innovation, we are looking for methods and means that are more in line with the scientific reality of sports training. The application of video image multiprocessing technology in football scientific research is a process of continuous innovation and improvement [30].

It is necessary to broaden the thinking and strengthen the research on various fields of football, especially the research on our country's football system, youth selection and training system, and football industry, so that the scientific research of football can develop in a balanced manner.

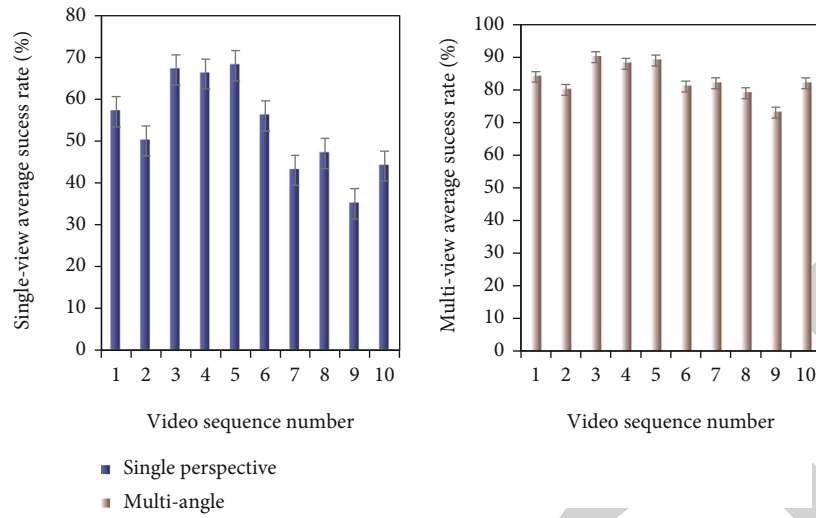


FIGURE 7: Comparison of average success rate between single-view and dual-view.

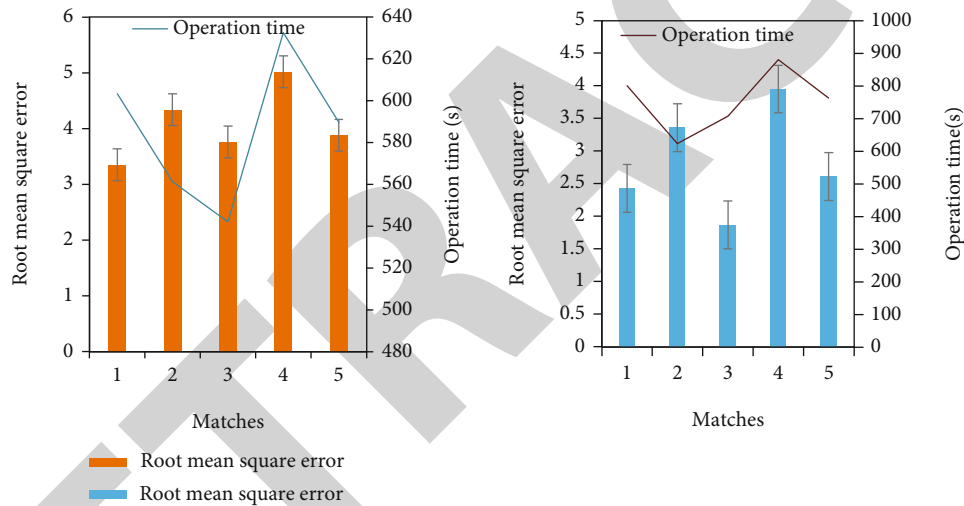


FIGURE 8: Mean square error of different games.

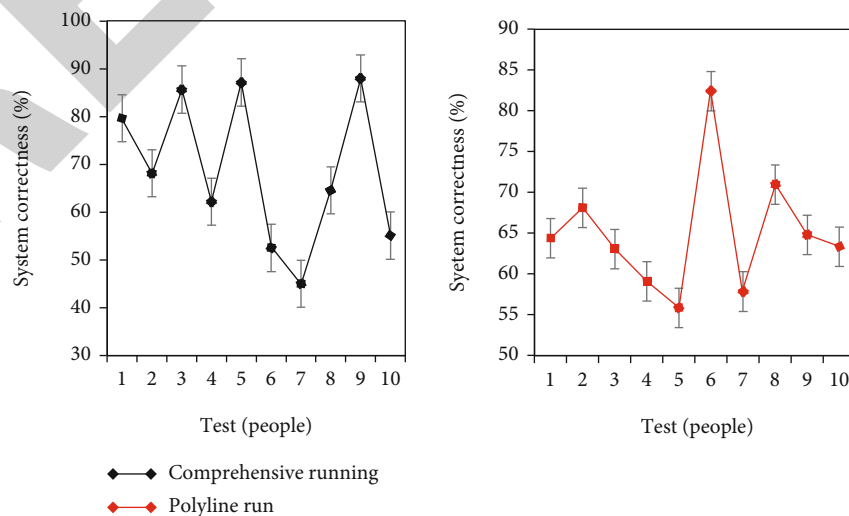


FIGURE 9: Comparison of test models.



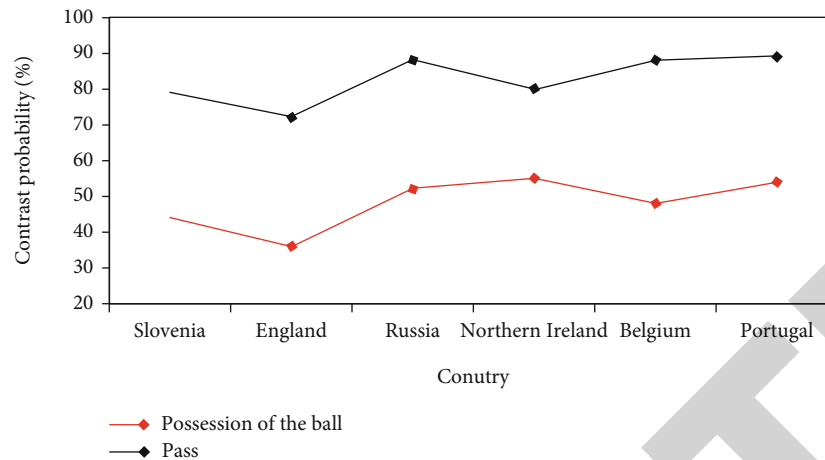


FIGURE 10: Video image analysis of the Wales team.

Decision-making departments at all levels should purposefully fund scientific research on football sports and increase investment in human, material, and financial resources in scientific research on football sports, to ensure the smooth development of football scientific research and to guide the development of football in our country in a healthy and orderly direction. Sports journals can publish more papers by authors in remote areas where the development of football is slow and the economy is relatively backward, to improve the scientific research enthusiasm of football researchers in remote areas to promote the healthy development of football in remote areas. Strengthen the cooperative awareness of football scientific research personnel, implement complementary advantages and share resources, strengthen interunit and interdisciplinary exchanges and cooperation, strengthen the learning of foreign language and nonsports subject knowledge, and further improve the level of football scientific research and the quality of papers. However, it still reflects the unreasonable knowledge structure of scientific researchers, the weak application of interdisciplinary research methods, the low utilization of instruments and equipment, and the ability to comprehensively use scientific research methods to be improved [31].

Innovation is the process of generating new ideas, new research, new designs, new products, new processes, new applications, and new results, etc. All new things and new phenomena are generated. Anything “new” can be called innovation. Innovation exists in people’s daily life, innovation exists in thought and behavior, innovation is everywhere, everyone will have innovative thinking, and everyone has their own innovative activities. There is no end to practice and no end to innovation. The history of social development shows that human society is developing in continuous innovation and advancing in continuous innovation. Sports video image multiprocessing technology in the field of football scientific research is also in continuous application, development, innovation, and improvement. For example, the production of black-and-white images of continuous pictures of traditional sports technology, to the production of color images, and then to the production of

brand-new panoramic images, embodies the course of innovation and development of motion video image processing technology [32].

## 5. Conclusion

Sports video image multiprocessing technology is the most basic, most widely used, most practical, most intuitive, and fast feedback in athletes’ daily training and is a comprehensive scientific research method that is most easily accepted by coaches and athletes. Sports video image processing technology performs initial video recording of athletes’ technical and tactical performance in training and competitions according to specific requirements and then uses multiple technical methods and means of video image processing to research, analyze, and evaluate athletes’ technical ability, tactical ability, and physical fitness comprehensive athletic ability such as level and physical fitness level. In sports competitions and training, athletes often complete actions at different times and in different places. Although the backgrounds of sports videos obtained in this way are similar, they are not exactly the same. Therefore, the synthesis technology of dynamic background sports videos is another research direction.

## Data Availability

No data were used to support this study.

## Conflicts of Interest

The authors declare that there is no conflict of interest with any financial organizations regarding the material reported in this manuscript.

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