

## *Retraction*

# **Retracted: Sports Video Panorama Synthesis Technology Based on Edge Computing and Video Shot Boundary Detection**

### **Wireless Communications and Mobile Computing**

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1].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] X. Chen, "Sports Video Panorama Synthesis Technology Based on Edge Computing and Video Shot Boundary Detection," *Wireless Communications and Mobile Computing*, vol. 2022, Article ID 4060852, 9 pages, 2022.

## Research Article

# Sports Video Panorama Synthesis Technology Based on Edge Computing and Video Shot Boundary Detection

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The development requirements for sports panorama synthesis technology, which rely on modern network technology, abandon traditional basketball training forms, and make effective use of the application and development of video panorama technology in the actual training process, are not only an important response to the current characteristics of students' physical education learning and physical and mental growth but also an important response to the current characteristics of students' physical education learning and physical and mental growth. In sports video analysis technology, a sports video panorama is a technical tool that converts an action video into a static action panorama to achieve the effect of action freezing and make overall analysis and mastery of the action easier. Shot segmentation is the foundation of hierarchical video structure, and it necessitates the accurate detection of all types of complex edited shot boundaries, as well as the effective distinction of motion changes in shots, in order to avoid shot boundary recognition being hampered. The synthesis technology for sports video panorama is investigated in this paper using edge computing and video shot boundary detection. After obtaining the boundary feature that describes the video shot, a comparison of this feature with a predetermined threshold value can be used to determine whether there is shot shear.

## 1. Introduction

In recent years, using the video images of athletes' training and competition as the reference of sports training, it is an effective method to analyze sports at home and abroad [1]. The development requirements of sports panorama synthesis technology, relying on modern network technology, abandoning traditional basketball training forms, and making effective use of the application and development of video panorama technology in the actual training process, are not only an important response to the current characteristics of students' physical education learning and physical and mental growth but also a positive reflection of the current sports teaching reform and innovation development. Sports video panorama, which transforms an action video into a static action panorama to achieve the effect of action freezing, is an important technical means in sports video analysis technology [2, 3]. Sports videos use the research hotspots in many fields, such as image processing of panorama synthesis technology, human simulation, and

computer vision. Taking athletes as research objects, qualitative and quantitative analysis is carried out to achieve the purpose of scientific training [4]. The solutions to global motion analysis problems can be divided into two categories, namely, differential method and feature comparison method. Differential method mainly uses the velocity field in image pixel domain, while feature comparison method mainly uses the feature correspondence between different images. The basic principle of feature comparison method is to find enough image point coordinates from the same object in different perspectives in two consecutive frames and to obtain the global motion parameters by solving the superlinear equation [5].

Video is the most complicated multimedia data type. It does this by combining images, voice, text, and other data into a single binary bit data stream [6]. Effective video retrieval is difficult due to the large amount of data and unstructured nature of video. The foundation of hierarchical video structure is shot segmentation. Correctly detecting various complex edited shot boundaries, effectively

distinguishing motion changes in the shot, and eliminating their interference with shot boundary recognition are all required [7, 8]. The key frame is not only a representation of the shot but it also serves as a foundation for video retrieval. The main motion and changes in the shot should be reflected in the key frame. Previously, video retrieval relied primarily on users manually defining keywords for key images in the video and locating the segments they needed. At the moment, the most common video data browsing mode is sequential fast forward and backward [9, 10]. A continuous image frame recorded by the camera from opening to closing is referred to as a lens. It is the smallest physical unit in video. Within the lens, the characteristics of adjacent and similar video frames are similar and change little, but at the lens conversion, the characteristics of video frames often change significantly [11]. Shot segmentation, also known as shot transformation detection, is the basis of video retrieval. Shot transformation refers to the change of scene content in video sequence. Key frames play the role of similar keywords. Key frames are extracted from the segmented shots to represent high-level semantic and visual features such as scenes and stories, so as to make the video more concise [12].

An acceptable and good video shot boundary detection algorithm should meet the following conditions: reasonable computational complexity is relatively easy to realize the robustness of video shot gradual change detection and applicability to real-time problems [13]. The main principle of this algorithm is that the law of inertia can be well satisfied in the interior of video shot due to the continuity of video capture, while the law of inertia will no longer be satisfied because the manually added video shot boundary will break the natural continuity, so as to judge whether there is a shot boundary by this principle. The abrupt change detection of video shot is relatively simple, and there are many effective methods at present. After obtaining the boundary feature describing the video shot, the conclusion whether there is shot shear can be drawn by comparing this feature with a certain threshold value [14]. Therefore, the selection of the closed value plays a very important role in correctly detecting the abrupt change of the shot. However, for some extreme influence factors that cannot be eliminated even if insensitive features are adopted, such as the sudden change of instantaneous brightness with high intensity, some additional information is needed to assist the detection [15].

## 2. Related Work

According to reference [16], both feature matching and differential algorithms for global motion estimation of motion video have flaws at the moment. The estimation accuracy is often not high, and sometimes, serious estimation errors are caused by the athlete's dominated foreground motion, noise in the captured image, and incorrect recognition caused by the algorithm itself. Furthermore, any current estimation method will result in a significant number of calculations. It can be seen that the speed and accuracy of the global motion estimation algorithm for motion video can be improved. Background subtraction technology, as a

moving target detection method, is closely related to high-level semantic foreground target tracking, target classification, and behavior understanding, according to reference [17] through the big data analysis method, sports video panorama synthesis technology, and background subtraction technology as a moving target detection method. These two elements have an impact on one another. The basic link is the moving target detection method, and the accuracy of its detection results has a direct impact on high-level semantic information processing. According to the current application status of sports video panorama synthesis technology in sports discipline construction and project training, the application of panorama synthesis technology is conducive to improving the effectiveness and overall level of sports video panorama synthesis technology, as evidenced by the characteristics of sports video training [18]. Reference [19] proposed that, as the most widely used method in the current fixed camera vision system, this algorithm uses the difference between the current image and the background image to detect the foreground moving target in the sports video image sequence and completely remove the indifferent background. Reference [20] through the big data analysis method, as a new training technology with intelligent and information characteristics, the application and promotion of panorama synthesis technology in sports video activities are conducive to improving the scientificity and standardization of the training process and the effectiveness of sports video teaching. Reference [21] studies show that sports video images usually contain a lot of information, and the information concerned by coaches is often only the key technical actions of athletes in the foreground. Because the background subtraction algorithm is fast and easy to implement, the above motion panorama generation technology can be effectively realized. Reference [22] puts forward that in the training process of sports video panorama synthesis technology, panorama synthesis technology can effectively play its role as a media platform and help students understand the principle of sports video panorama synthesis technology more deeply in various forms such as sound, image, graphics, video, or animation. Reference [23] through the method of big data analysis, in the process of sports training, coaches and athletes do static analysis on the completion of movements, master the essentials of technical movements from the overall situation, realize the essentials of coherent movements, correct wrong movements and wrong timing of exertion, reduce blind repetition, improve training efficiency, and reduce the possibility of injury to athletes. Reference [24] research shows that in the process of sports video, the athletes' skills and movements in different stages and scenes are simply superimposed on the static scenes through the video panorama, and the athletes' movement tracks and technical details in the practice process can be fully displayed with the help of frozen work effects. Reference [25] pointed out that the research work of sports panorama technology in China is still in its infancy, mainly including sports simulation and sports analysis system for diving and trampoline developed by Institute of Computing Technology, Chinese Academy of Sciences. The system can complete the work of obtaining human motion parameters of diving

video, computer simulation of three-dimensional human motion of diving, and comparison of athletes' videos on the same screen.

This paper studies the sports video panorama synthesis technology based on video shot boundary detection. The research and development of sports panorama technology are of great significance. It superimposes the technical actions of athletes with different timing in a static scene to achieve the effect of action freezing, so as to fully show the details of the movement track and the change of human posture. Compared with the video itself, panorama provides more intuitive and comprehensive information. Panorama synthesis technology has been well applied in virtual reality, image coding, and other fields. In traditional applications, panorama captures the static and nonmoving background in the scene.

### 3. Principle and Algorithm of Video Shot Boundary Detection

Shot boundary detection is the basis and important step to realize content-based video retrieval, and video segmentation into shots is the first step to realize content-based video analysis. The lens transition can be divided into abrupt changes. Sudden change refers to the direct switch from one shot to another, with no time transition in the middle. Gradient is to add some editing effects in space or time, and the previous shot is gradually transformed into the next shot. In the introduction, we mentioned that a shot is a sequence of frames produced by a camera during a shooting. Therefore, the contents of the frames in the same shot are similar or similar, for example, they have a common background and a common scene. There are two kinds of lens boundaries: abrupt change and gradual change. Catastrophe, also known as shear, is the most common boundary type, and the switching of shots is completed between two consecutive frames. According to the content intensity, videos can be divided into programs, scenes, lens groups, shots, and key frames. It is an orderly combination of scenes in time.

A scene is a group of shots that are semantically related and temporally adjacent. A shot group is a group of shots that are adjacent in time and similar in content. First, we must select features and establish appropriate measurement criteria to describe the discontinuity of video content, so as to detect the video shot boundary. Therefore, it is still not enough to select only the features that are not sensitive to these factors. For example, because usually, flash is a change in brightness, and in the case of some sudden brightness changes with high intensity, all color components will change, resulting in high discontinuous measurement values even using histogram method, which is easy to be mistaken for the transformation of video lens. Adding more information to detect the transformation boundary of a video shot is a good way to reduce the impact of these factors. The main feature of this additional information is that it is based on other metrics that can characterize whether there is shot transformation in a video frame sequence rather than a comparison of discontinuity measurements and threshold values. Many feature descriptions have been proposed in the

research of various methods. The pixel-based method is the simplest way to measure visual content discontinuity, while the most common method is to use the histogram of each frame as the feature, as well as some edge-based methods. The content of the previous lens gradually fades away, while the content of the next lens gradually appears, until the image's content is entirely made up of the content of the next lens. Fade in refers to the gradual and even appearance of the first frame of the next shot from a completely black screen. The last frame of the previous shot fades out gradually and evenly until it disappears. When a shot slides in, the first frame of the next one gradually passes through and covers the last frame of the previous one. Gradient is created in postproduction by video editors. The structure diagram of the detection lens boundary is shown in Figure 1.

Due to the sports video panorama synthesis technology of video shot boundary detection, the underlying features of the image include many kinds, and the texture features only belong to one of them, which cannot effectively represent the substantive characteristics of the frame image. Therefore, only using texture can get the surface features of the image, which is equivalent to the color and shape characteristics. It is only the bottom sensory characteristics and cannot establish a good mapping relationship with the high-level features related to the image content. Therefore, in order to avoid the problem that the image content cannot be fully expressed due to the single extracted features, the two bottom features are weighted and fused to obtain the comprehensive information features of the video frame. The flow chart based on video shot boundary detection is shown in Figure 2.

The histogram difference of frame images in video is primarily used by the shot inspection algorithm to judge the similarity of images and reveal whether there is any change in shot. Consider the  $f_m$  and  $f_n$  images, where  $H(f_m, i)$  and  $H(f_n, i)$  represent the histograms of each color component, respectively. The histogram column difference can be used to determine the similarity of two frames of images. If the histogram difference between the two images is significant, it indicates that the lens has changed, as shown in the formula below.

$$D(f_m, f_n) = \sum_{i=1}^n |H(f_m, i) - H(f_n, i)|, \quad (1)$$

$$D(f_m, f_n) = \sum_{i=1}^n \frac{[H(f_m, i) - H(f_n, i)]^2}{H(f_n, i)}. \quad (2)$$

When the difference  $D(F_M, F_N)$  between two adjacent frames is greater than a certain threshold, it can be judged that the boundary of a shot is detected. This method is very suitable for trimming lens, and the inspection of gradient lens will miss due to the slow change of interframe difference, so it is not suitable for the detection of gradient lens. Assuming that the weights of  $X$ ,  $y$ , and  $Z$  are  $a$ ,  $B$ , and  $C$ , respectively, the weight coefficient phasor  $\vec{W}_r = (a, b, c)$  is

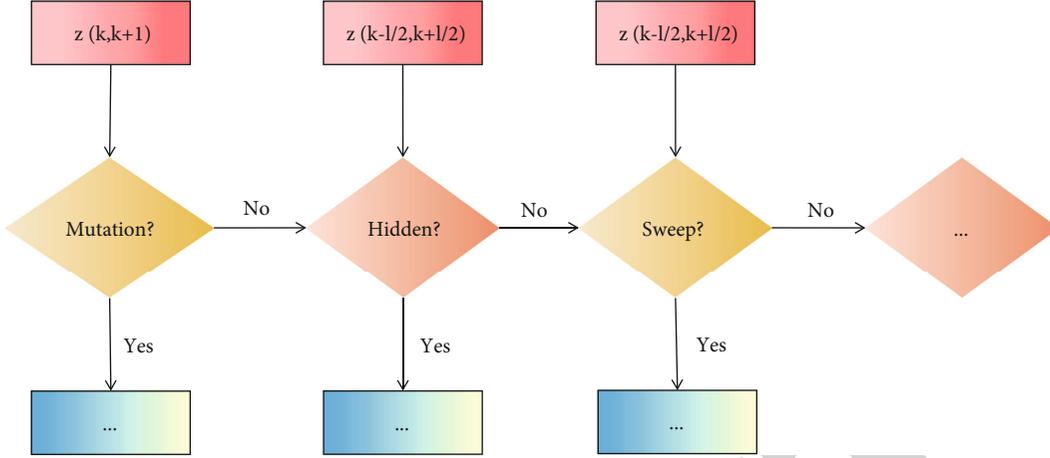


FIGURE 1: Structure diagram of video shot boundary detection.

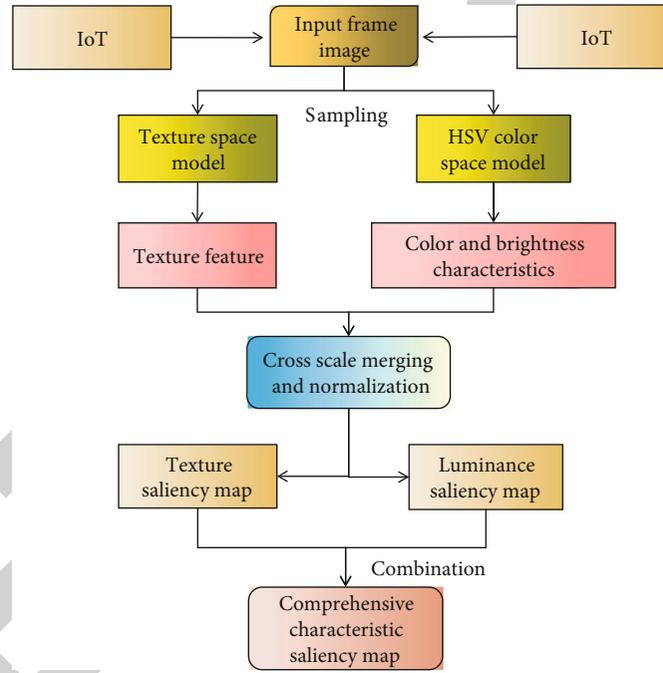


FIGURE 2: Flow chart of video shot boundary detection.

formed. GLCM is used to represent the fused texture features. The process of texture feature fusion is as follows

$$GLCM = \vec{W}_r \cdot \vec{T}^T. \quad (3)$$

Assuming  $fb$  represents the  $m$ th frame of the video, and the resolution of each frame of the video is set to  $M \times N$ , the following formula can be used to detect the lens change.

$$D(m, m+1) = \frac{\sum_{x=1}^M \sum_{y=1}^N |P_m(x, y) - P_{m+1}(x, y)|}{M \times N}. \quad (4)$$

For color frame images

$$D(m, m+1) = \frac{\sum_{x=1}^M \sum_{y=1}^N \sum_c |P_m(x, y, c) - P_{m+1}(x, y, c)|}{M \times N}, \quad (5)$$

where  $P_m(x, y)$  denotes the gray level of the pixel at the  $(x, y)$  position of the  $m$ th frame;  $C$  denotes the color component index; and  $p_m(x, y, c)$  denotes the color component value of the pixel at the  $(x, y)$  position of the  $m$ th frame. The difference between the  $m$ th frame and the  $m+1$  frame is represented by  $D(m, m+1)$ . It can be determined that a shot switch has occurred when  $D(m, m+1)$  exceeds a certain threshold value. The biggest advantage of this method is that it is simple to use, but it requires a lot of calculations, which can lead to video shot misjudgment.

In the model of video clip, editing effect model, editing result model, and assembly model are three main parts. The model representation of fade-in/fade-out lens edge detection is given below.

$$S(x, y, t) = S_1(x, y, t) \left(1 - \frac{t}{l_1}\right) + S_2(x, y, t) \left(l - \frac{t}{l_2}\right), \quad (6)$$

where  $S_1(x, y, t)$  and  $S_2(x, y, t)$  are the edited versions of the original shots. The editing lens  $s(x, y, t)$ , the number of frames  $L_1$  and  $L_2$  in the edited lens  $S_1$  and  $S_2$  in the editing lens, and the editing result lens  $s(x, y, t)$  in the editing lens. The established mathematical model can be matched with the original video data, for example, during fade in/fade out shot edge detection. It can be concluded that this is fade in/fade out shot transformation when the matching degree reaches a certain upper limit.

Calculating the difference in absolute values of corresponding pixels between two adjacent frames is the most straightforward way to determine video content discontinuity. For example, in the process of lens overlap, the change curve of the discontinuity value of the frame frequently takes the shape of a downward parabola, so the overlap can be judged based on whether it meets the downward parabola characteristics. The improved method considers whether the shot boundary in a video frame sequence exists or not. Using different detection domain values for different frames, for example, is a form of prior information, and this adaptive closed value ensures that detection performance is stable when processing new sequences. According to the characteristic values used, various video shot boundary detection algorithms can currently be classified into the following categories.

- (1) The method based on pixel difference has the advantage of simple calculation, but it is sensitive to noise and motion
  - (a) Feeling
- (2) Statistics-based methods such as window-based gray mean and variance
- (3) Methods based on image features, such as methods based on image edges
- (4) The method based on gray-scale and color histogram is widely used, especially in barium video shot detection
  - (a) In the process of change, the accuracy can reach the above
- (5) The method in compressed domain can speed up the calculation and can directly utilize some
  - (a) Information that has been extracted during the compression process

(6) *Area Block Method*. This method uses the comparison of several area blocks in the image instead of the comparison of the whole image

(7) *Spatiotemporal Flow Method*. Tangent the plane to the video data along the time axis, so as to obtain the spatiotemporal flow image, and find the shot transition point on the spatiotemporal flow image

This method can improve the detection speed of video shot conversion points, but this method is easy to be affected by local noise. Therefore, some improved methods are proposed, that is, only those pixels that change significantly and exceed the preset closed value are calculated, while those points less than the preset threshold are not changed. In the reconstructed image, those points from multiple subblocks of the original video frame are called overlapping points, those that cannot be covered by the reconstructed points are called unfilled points, and those outside the frame image are called overflow points. Therefore, the set can be counted as the basis for judgment. The more elements in the set, the more serious the destruction of the inertia law, that is, the greater the possibility of video shot mutation.

## 4. Research on Sports Panorama Synthesis Technology

*4.1. Sports Video Panorama Synthesis Technology Based on Video Shot Boundary Detection*. In sports video, in order to track athletes' movements, the camera lens needs to move and zoom quickly, and the foreground represented by athletes usually has obvious movement relative to the background environment. These characteristics bring great difficulty to the synthesis of moving panorama, and the system involves image mosaic and foreground extraction technology. Taking basketball as an example, the application of sports video panorama technology based on video shot boundary detection in basketball training is conducive to ensuring students' learning enthusiasm and training effectiveness. Obviously, the application of sports video panorama technology in basketball training conforms to the development trend of basketball training activities, and it is also more in line with the training and development rules and physical and mental development characteristics of students at this stage. In the process of sports training, athletes and coaches can statically analyze the changing process and track of movements, master and analyze the completion of movements as a whole, understand the essentials of coherent movements, and correct wrong movements and wrong timing of exertion. Strengthening the construction of video panorama technology and equipment effectively, providing good technical guidance and support for the application of video panorama technology, and ensuring the efficiency of basketball training activities at this stage also show extremely important practical significance. The task of the panorama system is how to effectively extract the technical movements of the athletes in the foreground in time series and clearly superimpose them on the same background image, so as to completely show the details of the athletes' trajectory and

the changes of human posture. At the same time, the application of the panorama technology of sports video based on video shot boundary detection also stimulates the students' initiative in the training process to a certain extent, relieves the negative emotions such as fear of difficulties and slackness in the training process to a certain extent, ensures the effectiveness of basketball training activities, and creates favorable conditions for the further improvement of basketball training level.

The discontinuity caused by the change in video content creates a shot boundary for the audience. As a result, the video shot boundary detection algorithm should detect a boundary that is consistent with the discontinuity in the audience's visual content. The algorithm must be able to deal with a variety of shot boundaries, according to the first criterion. Because different shot boundaries require different numbers of video frames and different types of change, the number of video frames required and the specific forms of change are also different. As a result, the video shot boundary detection algorithm must be independent of the boundary type. The second requirement is that the algorithm be able to adapt to different types of videos. It adjusts application steps like regular technical learning, updating, and supplementary adjustment of sports video panorama technology and provides guarantees for the application and updating development of advanced training technology in the form of rules and regulations, for example, to effectively ensure the timeliness of updating the current sports video panorama technology in the application process. Furthermore, a large-scale video retrieval system based on content must deal with large-scale video data. Shot boundary detection technology must process data quickly as a first step. As a result, the algorithm's processing speed must also be investigated. However, starting with the practical needs of basketball training, relevant departments should strengthen the introduction of talents using advanced training technologies such as sports video panorama technology for video lens boundary detection and appropriately adjust existing talent introduction and training standards, in order to lay a solid talent foundation for the application of video panorama technology in training activities. When training personnel and management departments use video panorama technology to conduct training activities, they should consider how panorama synthesis technology has been used in sports such as swimming, ball games, and other sports. For example, we should always keep the rhythm of training activities consistent with the advancement of advanced training technology. The advantages of panorama technology application can be further stimulated by strengthening the construction of video panorama technology equipment and the external environment. It can not only help trainers better serve their clients' interests but it can also help athletes more consciously summarize their training experience after the course. A shot is made up of a series of frames taken by the camera in a continuous loop. It is the most fundamental physical and semantic unit in video. The first step in content-based video retrieval and indexing is video shot boundary detection, which is an important way of structuring video content.

*4.2. Experimental Results and Analysis.* In the experiment, the gray histogram and the weighted block histogram were used as features to experiment on four videos in the section, and the detection effect and distribution of the recall evaluation algorithm were compared in three experiments, as shown in Figures 3 and 4.

From the comparison between Figures 3 and 4, it can be seen that directly using the histogram as the eigenvalue, the algorithm is vulnerable to the interference of moving objects in the lens. Using the weighted block histogram as the feature, the recall and precision have been improved to a certain extent. The weighted gray histogram can not only reflect the global color features of the picture but also reflect the local features of the picture. It can effectively prevent the influence of moving objects in the lens and the movement of the lens on the algorithm. It can be seen from the experimental results in Figures 3 and 4 that the improved algorithm has high accuracy for "sports clips," because there are many abrupt shots in the two videos. The accuracy of "science and technology video" and "film clip" is relatively close, indicating that the resolution has little effect on the algorithm; cartoon clips are less accurate than others because there are more gradient shots in cartoon clips. Because the gradual transformation of the lens and the movement of the object camera will make the difference between video frames change slowly, this paper uses the feature extraction method of texture and tone product fusion and then compares the frame difference, and it is easy to judge which are false detection lenses, because it is found that one or several video images are all black when fading in and out.

Here, we use several videos of movies as experimental objects to demonstrate the detection accuracy of the above algorithm. And compare it with the algorithm "Multi-feature adaptive algorithm" that my team output before. Three experiments were conducted with distributed machine learning algorithm, data mining algorithm, decision tree algorithm, and this algorithm. The detection results are shown in Figures 5–7.

The accuracy of the algorithm proposed in this paper is higher than that of machine learning, data mining, and decision tree algorithms, according to the detection results. Furthermore, the processing method is proposed to avoid possible false detection due to the sudden change in flash and brightness. The detection of video shot gradient, on the other hand, is much more difficult. It has not produced the same results as mutation detection so far. In general, the video shot mutation is detected first, and the remaining portion, which could be the shot boundary, is sent to the next level processing module to continue detecting whether the shot is gradually changing and judging the type of gradual change. When the video shot abruptly changes, there will be significant differences between the front and back shot frames, with a large difference value. To detect the sudden change shot, set a high threshold. However, a sudden flash or violent movement of the object will cause a large difference in the video frame, causing the shot to be misidentified. After in-depth study of the principle of dual model, this paper proposes an improved method based on nonuniform block color histogram discontinuity for video frame feature

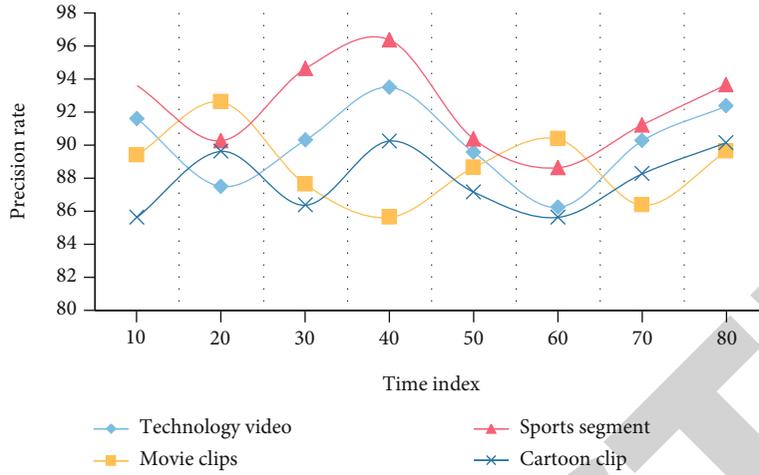


FIGURE 3: Gray histogram detection results.

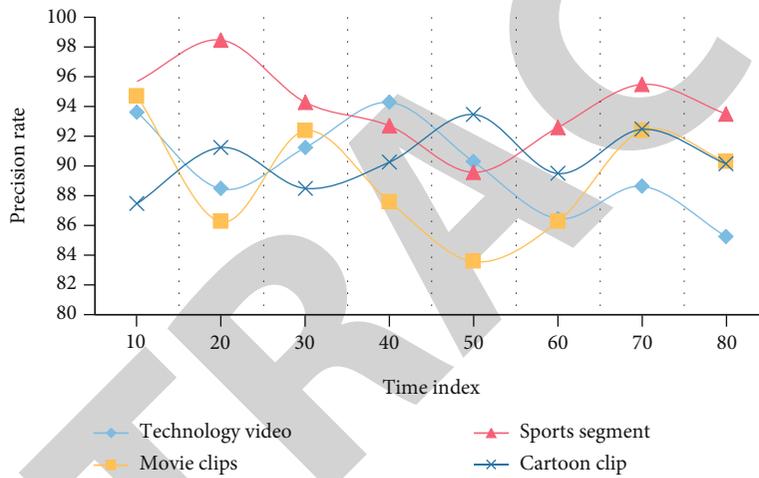


FIGURE 4: Detection results of weighted block histogram.

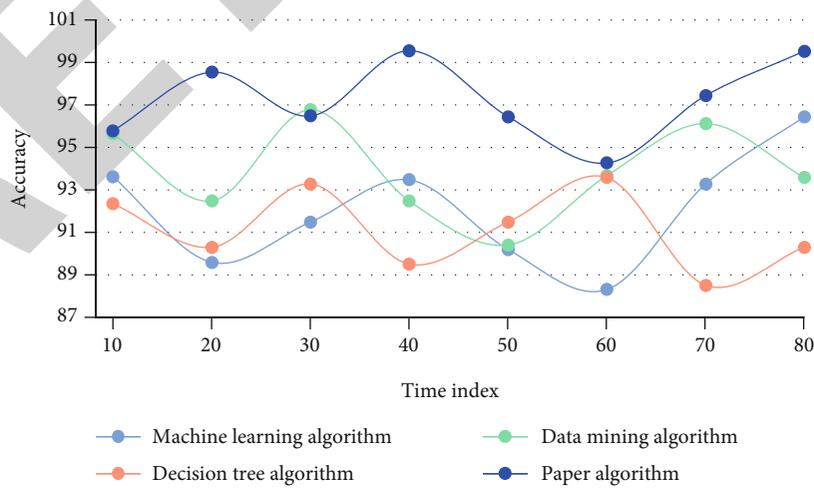


FIGURE 5: Accuracy of detection rate of different algorithms.

extraction, and adaptive binary search method for video shot initial detection to obtain all possible places of video shot transformation, and then according to the position informa-

tion of shot transformation, the adaptive double threshold reinspection of multifeature fusion is carried out to distinguish which are the mutation and gradient of video lens

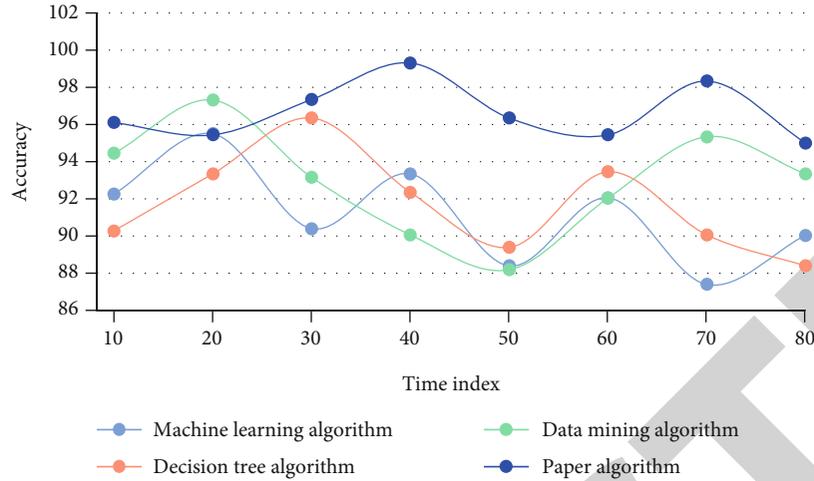


FIGURE 6: Accuracy of detection rate of different algorithms.

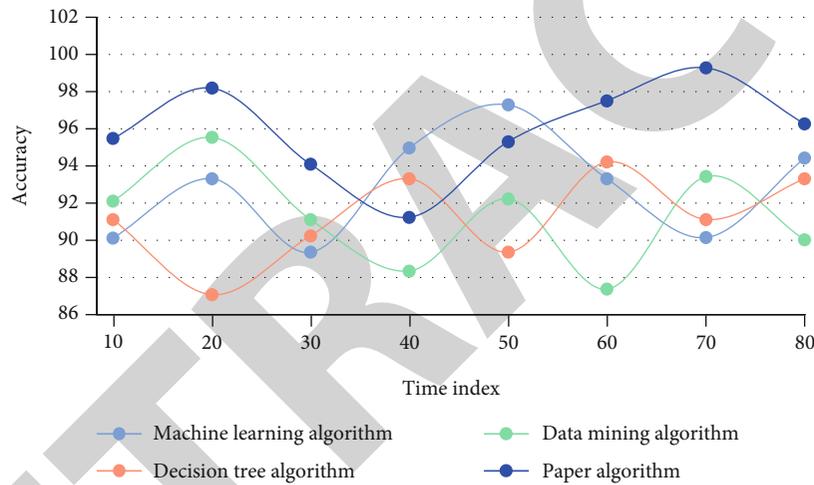


FIGURE 7: Accuracy of detection rate of different algorithms.

and the false detection of video lens caused by the movement of camera or the movement of objects in video lens.

## 5. Conclusions

This paper primarily focuses on the application research of video feature extraction technology, video shot edge detection technology, and video key frame extraction technology to some problems in video retrieval. Shot boundary detection technology is the foundation of a content-based video retrieval system, and it is the key to implementing a large-scale video retrieval system that can accurately and quickly detect shot boundaries. The functional modules, interactive design, data structure, video acquisition hardware system, and other aspects of the sports video panorama system are detailed based on the flow chart of video shot boundary detection. Color features, texture features based on cooccurrence matrix transformation, and motion texture features are extracted and applied to four different ball sports videos' classification algorithms. A method for detecting video boundaries based on histogram features is proposed. To

obtain the histogram difference sequence and the average luminance sequence, it first calculates the luminance histogram for each frame of the video stream, then the histogram difference between two adjacent frames and the average luminance of each frame from the histogram. The superiority of panorama technology application can be further enhanced by strengthening the construction of video panorama technology equipment and the external environment. It can not only help trainers better serve their clients' interests but it can also help athletes more consciously summarize their training experience after each session.

## Data Availability

The data used to support the findings of this study are included within the article.

## Conflicts of Interest

The author does not have any possible conflicts of interest.

## References

- [1] B. S. Rashmi and H. S. Nagendraswamy, "Video shot boundary detection using midrange local binary pattern," in *2016 International Conference on Advances in Computing, Communications and Informatics*, pp. 225–229, Jaipur, India, September 2016.
- [2] J. Li, T. Yao, Q. Ling, and T. Mei, "Detecting shot boundary with sparse coding for video summarization," *Neurocomputing*, vol. 266, pp. 66–78, 2017.
- [3] M. He, J. Liao, P. V. Sander, and H. Hoppe, "Gigapixel panorama video loops," *ACM Transactions on Graphics*, vol. 37, no. 1, pp. 1–15, 2018.
- [4] S. Chakraborty, A. Singh, and D. M. Thounaojam, "A novel bifold-stage shot boundary detection algorithm: invariant to motion and illumination," *The Visual Computer*, vol. 4, pp. 1–12, 2021.
- [5] Z. M. Qian, S. H. Wang, X. E. Cheng, and Y. Q. Chen, "An effective and robust method for tracking multiple fish in video image based on fish head detection," *BMC Bioinformatics*, vol. 17, no. 1, p. 251, 2016.
- [6] T. Kar and P. Kanungo, "Motion and illumination defiant cut detection based on weber features," *IET Image Processing*, vol. 12, no. 10, pp. 1903–1912, 2018.
- [7] E. E. Geertsema, G. H. Visser, M. A. Viergever, and S. N. Kalitzin, "Automated remote fall detection using impact features from video and audio," *Journal of Biomechanics*, vol. 88, pp. 25–32, 2019.
- [8] Y. Yuan, Z. Xiong, and Q. Wang, "An incremental framework for video-based traffic sign detection, tracking, and recognition," *IEEE Transactions on Intelligent Transportation Systems*, vol. 18, no. 7, pp. 1918–1929, 2017.
- [9] R. K. Purwar, S. Verma, and A. Jain, "Crowd abnormality detection in video sequences using supervised convolutional neural network," *Multimedia Tools and Applications*, vol. 1, pp. 1–19, 2021.
- [10] N. Gayathri and K. Mahesh, "Improved fuzzy-based SVM classification system using feature extraction for video indexing and retrieval," *International Journal of Fuzzy Systems*, vol. 22, no. 5, pp. 1716–1729, 2020.
- [11] Y. Yuan, Z. Lu, Z. Yang et al., "Key frame extraction based on global motion statistics for team-sport videos," *Multimedia Systems*, vol. 1, pp. 1–15, 2021.
- [12] X. Zhang and F. Q. Yang, "Machine learning-based multitarget tracking of motion in sports video," *Complexity*, vol. 2021, 10 pages, 2021.
- [13] A. Gaur, A. Singh, A. Kumar, A. Kumar, and K. Kapoor, "Video flame and smoke based fire detection algorithms: a literature review," *Fire Technology*, vol. 56, no. 5, pp. 1943–1980, 2020.
- [14] A. Ben Abdelali, M. Hannachi, L. Touil, and A. Mtibaa, "Adequation and hardware implementation of the color structure descriptor for real-time temporal video segmentation," *Journal of Real-Time Image Processing*, vol. 13, no. 4, pp. 739–758, 2017.
- [15] Y. Xiao and A. Bin Abas, "A review on fatigue driving detection," *ASP Transactions on Internet of Things*, vol. 1, no. 3, pp. 1–14, 2021.
- [16] L. Chen, D. Zhu, J. Tian, and J. Liu, "Dust particle detection in traffic surveillance video using motion singularity analysis," *Digital Signal Processing*, vol. 58, pp. 127–133, 2016.
- [17] H. Wang, Y. Zhang, and X. Fan, "Rapid early fire smoke detection system using slope fitting in video image histogram," *Fire Technology*, vol. 56, no. 2, pp. 695–714, 2020.
- [18] H. Kim, T. Mei, H. Byun, and T. Yao, "Exploiting web images for video highlight detection with triplet deep ranking," *IEEE Transactions on Multimedia*, vol. 20, no. 9, pp. 2415–2426, 2018.
- [19] D. Lin, D. Cao, Y. Lv, and Z. Cai, "GIF video sentiment detection using semantic sequence," *Mathematical Problems in Engineering*, vol. 2017, 11 pages, 2017.
- [20] F. Guo, W. Wang, J. Shen et al., "Video saliency detection using object proposals," *IEEE Transactions on Cybernetics*, vol. 48, no. 11, pp. 3159–3170, 2017.
- [21] H. Dong, D. K. Prasad, and I. M. Chen, "Accurate detection of ellipses with false detection control at video rates using a gradient analysis," *Pattern Recognition*, vol. 81, pp. 112–130, 2018.
- [22] D. Wesierski and A. Jezierska, "Instrument detection and pose estimation with rigid part mixtures model in video-assisted surgeries," *Medical Image Analysis*, vol. 46, pp. 244–265, 2018.
- [23] S. H. Zhong, Y. Liu, T. Y. Ng, and Y. Liu, "Perception-oriented video saliency detection via spatio-temporal attention analysis," *Neurocomputing*, vol. 207, pp. 178–188, 2016.
- [24] J. Zhao, M. Han, C. Li, and X. Xin, "Visibility video detection with dark channel prior on highway," *Mathematical Problems in Engineering*, vol. 2016, 21 pages, 2016.
- [25] M. Uzair, R. S. Brinkworth, and A. Finn, "Bio-inspired video enhancement for small moving target detection," *IEEE Transactions on Image Processing*, vol. 30, pp. 1232–1244, 2021.