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Research Article

Design and Implementation of Intelligent Analysis Technology in Sports Video Target and Trajectory Tracking Algorithm

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The object tracking is an important task to future generations to find accurate information from frame (sports or any cctv). The available models like RFO, DT, Xboosting, Gradient boosting, and CNN are outdated for sports video tracking using video. The target and trajectory finding are very important for accurate tracking. Therefore, for crossover, the above limitation's intelligence analysis is performed with ANN. The video tracking can be very simple and efficient with proposed model. As a result, this ANN offers a sports camera target detection system based on an upgraded grey neural network. This research uses the automatic threshold technique to divide the target object of sports camera and derive the designated target of sports video based on the pixel grey difference of the target image in sports video. The moving objects are tracked by the object tracking algorithm, and features are extracted to obtain the results. The performance measures like accuracy of 95.23%, sensitivity of 94.45%, and recall of 93.34% had been attained.

1. Introduction

Video game analysis, a cutting-edge invention, is now being employed in physical fitness training and teaching. There is a problem, however, with the technology's advancement because of the prohibitive costs of equipment and use. It is good for students to employ sports video analysis technologies as long as they can learn from their classmates. In addition to improving students' combat abilities in the actual world, this course will also teach them about sports technology and performance [1]. As a consequence, the development of a sports video database may support the expansion of sports education and the creation of lifelong sports awareness. Students who can see their own technological behavior and tactics right after learning will be able to obtain quick and accurate analysis; teachers' and students' on-site interaction will tremendously enhance the efficacy of physical education teaching by turning language-based training guidance into intuitive photographs [2].

Analysis and research of sports films to discover the flaws of the opposing party or one's own to the design of guidance programmers and challenging models are of significant practical importance. There has been a lot of interest in sports target tracking as part of sports video analysis [3, 4]. Target tracking in sports videos is very difficult because of the interference caused by the shifting angles and illuminations of the cameras used to record the action. There are now two types of sports video target tracking algorithms: those used by the tracker and those used by the detector. A tracker-based algorithm for sports video target tracking necessitates the extraction of target attributes. The contour and optical flow of the object are the most common classical aspects. As a result, this technique demands that the moving object remains clearly visible. It is impossible to accurately monitor a sports video objective when there is no moving target in sight. As a result, the scope of possible uses is somewhat limited.

Dynamic targets may be identified in every image by using a dynamic panel model. Offline training is necessary to match the effectiveness of sports video target detection in real time. The advancement of controls' appropriate objectives has led to the study of goal tracker techniques such as background differences, Kalman filter algorithms, and mean shift algorithms. There are findings demonstrating

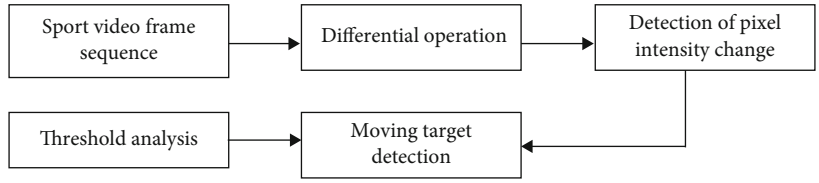

Figure 1: Workflow of background updating deference method.

that they improve target tracking in sports videos, but when the scene of a target detection changes drastically, the tracking effect and robustness of sports videos decrease dramatically.

The tracking accuracy of fast-moving objects in sporting events may now be improved with the use of an intelligent tracking technique. Moving objects are first identified using the background updating difference technique. Afterwards, the Kalman filter technique is used to keep track of the moving object. Further testing has shown this method's ability to follow moving objects precisely and swiftly, making it superior to existing approaches for doing so in real time.

For sports professionals, understanding players' training levels and extracting sport metrics has become a pressing issue as the level of competition in sport has increased. Shown in Figure 1, athletes may be segmented and tracked using applicable processing algorithms in training videos to acquire motion metrics. An athlete's movement trajectory may be tracked in real time, which allows coaches to use their own observations and expertise to direct their players' technical motions. The choice of moving characteristics, the reduction of background motion interfering, and the functioning of multiple movable object obstruction are all part of moving target tracking. A more scientific, rational, and sophisticated procedure must be used in order to increase tracking accuracy. Classical elements include object contour and optical flow for object tracking in sports videos based on a tracker.

In order for this method to work, the moving item must be always visible. Because it is unable to accurately track a sports video item if a moving object is removed from the viewing range, the practical application range is limited. In most cases, a standard video surveillance system just collects footage of a particular monitoring scenario before using an operator to identify possible dangers. Video surveillance systems like this one need a large amount of human and material resources in order to see and analyze a large amount of data effectively.

Visual information, particularly dynamic visual information, makes up the majority of people's perceptions of the surroundings. To determine whether or not someone's foreground object can be discovered in a clip, motion object identification is employed instead of single-view target detection. The object in the picture may be discovered, recognized, and tracked automatically by image sequence analysis acquired by the camera. Analyzing sports footage is of tremendous practical importance for formulating training and competing preparations. Many people have been interested in sports video analysis because of the importance placed on following moving objects. In order to detect and categorise the items and behaviors of interest in the monitoring scene, the intelligent video monitoring system employs image processing techniques, pattern classification, ML, and DM. Monitoring motion components in sporting events videos may be improved by using DM techniques, and this study gives a smart strategy for doing so. Detecting moving objects makes advantage of the enhanced background update difference approach.

In this proposed work, intelligent analysis technology in sports video target and trajectory tracking algorithm has been designed and implemented. In this work, moving object detection is done by the efficient object tracking algorithm and background issues are rectified and pixel grey difference of the target image is performed; then, the feature extraction is carried out. Finally, the results will be obtained.

2. Literature Survey

According to Zhang [1], a smart monitoring strategy for changing targets in games footage is presented to increase tracking accuracy. In terms of real-time performance, this approach outperforms other tracking methods in tracking a moving object precisely and fast. Moving object tracking in sports footage now has a new study tool [1].

According to N. Liu and P. Liu [2], an enhanced Camshift target tracking method is finally developed to identify and recognize basketball goalie use in real time. There are considerable inaccuracies in the identification of basketball goals when using backdrop and interframe differencing. In this study, an enhanced picture intelligent recognition method can match the basketball's shape extremely well, and the smallest circle's fitting effect is optimal [2].

According to Fang [3], to improve the tracking performance of multiple targets in sporting video, an intelligence tracking technique based on DM technology employs an improved foreground updating differential approach for detecting motion information. This method outperforms earlier monitoring algorithms for monitoring moving targets in sports video in real time [3].

According to Li et al. [4], a multialgorithm fusion target tracking technique is suggested in this work to tackle the issue. Initial rough matching is done using a SIFT feature method to establish a target's approximate location. In order to gain a more precise idea of the target's location, the excellent mean shift algorithm is then used [4].

According to Zhao and Pan [5], a technique for capturing the movement process of athletes is being developed due to obtaining the watching knowledge for normal people using Intelligence target tracking technology (ITTT). Athletes' movement patterns may be studied. As a result, this kind of system must be supported by sufficient data before

it can be used to anticipate fall points. The design of intelligent sports control facilities may be aided by the suggested system [5].

According to Yang [6], tracking multiple targets in an interior environment may be improved by using a particle filtering-based technique that automatically builds and updates the Wi-Fi fingerprint database and conducts fusion placement without the need for any offline data collecting. The multitarget tracking system based on machine vision in this work has excellent outcomes from simulated experiments [6].

According to Yu et al., this research is aimed at developing an adaptable hybridized nonrigid object tracking strategy combining a histogram-based methodology and the MS algorithm. The goal of this project is to build a mean shift algorithm to design a tracking method for monitoring sports object features. Using the suggested technique, the tracking and recognition accuracies are 96% and 97%, respectively. The results of the experiments show that the method given in this study is effective .

According to Li et al. [7], image segmentation using the AL algorithm was used to investigate if image recognition science might be applied to athletes in this article (IPAIT). Results show that compared to previous models, the suggested IPAIT model improves recognition by 98.08 percent, an outcome rate of 97.07 percent, and an accuracy ratio of 95.9.percent [7].

According to He et al. [8], an algorithm's ability to analyze long jump scenario and comprehensive quantitative analysis of athletes' key indicators is shown by experimental findings based on measured data. School physical education and guidance training may benefit greatly from the findings of this study, which can also serve as a reference for other forms of competitive video analysis [8].

According to Yunwei and Shiwei [9], analysis and classification of badminton footage are investigated. Moving items are adaptively separated using the adaptive threshold technique, a particle filter prediction-based approach. To monitor the future motion video frames, the location of the critical joint points is anticipated based on this. The badminton training video uses the conditional random field approach for motion recognition, which results in a better rate of motion detection and a lower rate of false separation [9].

According to Hu [10], an improved spatial-temporal convolutionary NN is proposed in response to the present crowd anomalous detection models' excessive complexity, the difficulties of conventional CNN to extract time-related characteristics, and the scarcity of training cases. The aberrant behavior detector in the board level exam is based on our deep intelligence analysis system. Most improper activities can be identified, and the alert message may be sent under real-time monitoring [10].

According to Ma et al. [11], images may be recognized and tracked using image processing and object monitoring algorithms, which are utilized in a broad range of sectors including security monitoring and augmented reality because of their ability to recognize and track objects. Training-state athletes, their individual sports function characteristics, training plan arrangement by coaches, and brain function state and schedule physiological and biochemical indicators, as well as nutrition regulation, as well as nutrition regulation, are all analyzed in revealing the changing the rules of different training indicators [11].

According to Yan [12], motion detection and recognition, the mean shift method, and the histogram algorithm are all used in the tracking technique. Hybrid algorithms are more successful for sports video monitoring because they are able to accurately locate and identify the target, as well as tackle the problem of nonrigid object shapes, according to simulation and experimentation findings [12].

According to Ning [13], the simulation software's accuracy may be improved. Simulator training is compared to more conventional methods. Traditional training should remain the primary technique of training, notwithstanding the various benefits of training. As the training goes on, the emphasis needs to be adjusted dynamically to account for changing conditions. Both benefit from and contribute to one another in a positive way. Finally, the system's performance is evaluated [13].

According to Meghana et al. [14], to find and determine the trajectories of players on the field, monitoring techniques such as Kalman and extended Kalman filters may be utilized. One hundred percent accuracy rates have been achieved by implementing the object detection, motion detection, and Kalman filter algorithms. Detection accuracy and tracking accuracy are reduced when players are crowded together and occluded, according to results quantification and performance monitoring [14].

According to Wang et al. [15], a large number of sports-related applications have already been developed using these approaches, including text-based video search and highlight production. Another step toward creating an AI coach system for individualized sports instruction is taken in this research. Especially for sports where the quality of training is heavily reliant on the accuracy of human postures captured on film, our extensive user testing shows that the proposed strategy may lead to a substantially better user experience and training [15].

According to Hui [16], the real time and durability in real-time of feature extraction utilizing mean shift (MS) are important features of the technique. The target's beginning position may be predicted using the mean shift method prior to repeating the computation process. According to studies, the mean shift technique avoids a global search, while the upgraded algorithm increases the number of iterations, lowers computing complexity, and decreases the amount of time necessary to execute the algorithm [16].

According to van der Kruk and Rejine [17], the purpose of this evaluation is to provide investigators with the information they need to make an educated choice about the best performance capture technologies to utilize in sports. To maintain the database's long-term survival, we encourage researchers to undertake an accuracy test before to completing an experiment and add to the chart and system overview (online, open access) [17].

According to Ahmed et al. [18], video object tracking for surveillance has gotten a lot of interest lately from the computer vision research field because to improvements in

camera technology and machine learning approaches. In this work, we have summarised the above-mentioned applications using the approaches discussed above. Survey's major objective is to describe the current state-of-the-art video object tracking systems utilized in both inside and outdoor surveillance [18].

According to this research compares and contrasts two important strategies for extracting silhouettes from monocular video footage of a moving object (a leaping human) in various settings. Using different video footages of varying quality, we found that silhouette extraction's performance varied greatly.

In most of the existing systems, object tracking is done with less number of players, and it is mainly dependent on the camera vision so it produces lower accuracy rate. In order to improve the accuracy rate, this method is proposed.

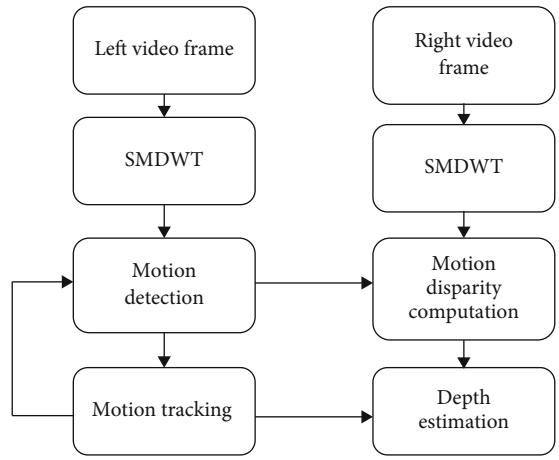

Figure 2: Tracking system framework and sports detection.

3. Methodology

3.1. Moving Object Detection. What is most important is to monitor and evaluate the features of motion tracks in sports films in order to separate them from their surroundings, so as to achieve a clear distinction between sceneries and moving objects. Military guiding was the first major use for this technology. Now that the tracking object is used for targets that move at a pretty modest pace, the tracking process is much easier than it was previously. The video surveillance system analyzes the observed moving pixels to determine the kind of motion and then determines whether there is an unexpected circumstance and issues an alert. An algorithm that uses the frame difference approach to identify moving objects does not address the background update issue and has a large number of frames captured as well as a fast moving object's velocity to meet its criteria. After a certain point, it will be impossible to cover the whole region between frames, making it impossible to precisely segment moving objects, depending on how quickly or how long the moving items travel. A picture in three dimensions is translated into a two-dimensional video image. An item or scene in three dimensions may be difficult to depict in two dimensions, but the projection picture of a 3Dimages or videos on a 2D surface will vary as the three-dimensional image changes.

There is continuity in the scene of a continuous video broadcast as well. Sequential frames will have minimal difference if there is not any movement. Motion, on the other hand, will result in a noticeable frame difference. As a result of its ability to extract a reasonably comprehensive target template compared to further motion tracking techniques, the region matching tracking algorithm is commonly utilized in the military sector to track tiny targets or targets with weak contrast. Using a region corresponding monitoring techniques and DM technologies, the sports identification and tracking system in Figure 2 are shown.

The average picture may be utilized as a backdrop model graph when motion of the moving object fluctuates substantially in games footage. This is an easy-to-calculate method that may provide the desired outcome. According to huge number of investigations on the side frame difference approach, it is possible to identify a moving object using this technique; however, due to the lack of sensitivity to a slow variation of illumination in the video; it is very simple to make holes in the moving objects. Gray-scale image matching and full-image search need a significant amount of computing power to complete. This algorithm takes a long time to run and cannot be used for video surveillance in real time without specialized gear. The ideal backdrop picture scenario is one in which there are no moving things in the scene, but this is impossible to achieve in practice since the light outside varies and the background includes a few somewhat disturbed objects. Tracking a target that varies in orientation, light intensity and motion might cause the matching point to be incorrectly identified. This is one of the issues that this technology has to solve in order to be successful in the long term.

3.2. Feature Extraction of Moving Object. In order to perform target tracking, an algorithm based on object detection calculates the location of the track item in the picture. The first stage is to identify the goal, and the second is to find a match between the two. The motion-detection-based tracking method follows a moving object by detecting and determining its location. This technique is capable of detecting any item regardless of its form or size. There are many moving things in an otherwise complicated scene, making it more difficult to keep track of a moving object. Simplifying the process of following moving objects begins with selecting their characteristics, which allows for more precise and optimal tracking outcomes. Under various light sources, moving sports video objects will seem to have varying grey scales on their surfaces. The grey scale mode of moving object pictures refers to this surface grey scale that is spread according to a certain space. When a traveling element's greyish patterning moves with lighting, it is referred to as "optical flow." Images change throughout time, and optical flow captures that change as well as the motion of objects. As a result, we can track the motion of moving objects by analyzing the pictures' optical flow properties. To begin, the concept behind a feature-based tracking algorithm is to take use of the characteristics of moving objects that do not change over time.

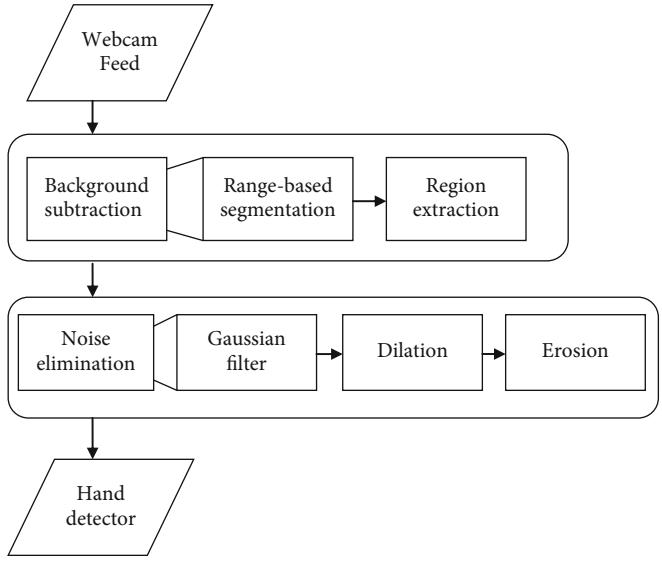

Figure 3: Manual tracking process.

Smooth contour, filling gaps, uniting divided sections, and so on are aspects of mathematical morphology that are often employed in subsequent processing processes on different video pictures. Figure 3 shows an image processing detecting software that may be used manually.

Moving target X_k and system observation Z_k are both represented by the k-th moment's corresponding vectors. Therefore, the following is the state of the moving target and the observation:

$$X_{k+1} = A_{(k+1)/k} X_k + w_k, \tag{1}$$

$$Z_k = H_k X_k + v_k. \tag{2}$$

An $A(k+1)/K$ state transition matrix from k to $k+1$, where H_k is the observation matrix and kv (observation noise) is the vector of random noise show in equation (2).

It is easier to detect textural elements than some other video review components. The gray-level cooccurrence matrix approach is one of various ways for obtaining textural properties and may represent texture characteristics by constructing a cooccurrence matrix to obtain statistics that represent the desired texture. We can only use the most recent sampling data to replicate the pixel density distribution since it cannot be anticipated in advance. The Markov chain model can successfully mimic dynamic changes in pixel sampling in the time and space domains and has high characterisation ability and adaptation to complicated dynamic backdrops for actual situations that are more complex than simple. A moving object's representative feature set is difficult to establish. If just a few attributes are used to identify the item, it will be difficult to tell it apart from other moving objects, which might lead to tracking issues. Choosing too many features, on the other hand, will slow down the system, increase its strength, decrease its efficiency, and raise the likelihood of errors.

3.3. Tracking Algorithm of Moving Object. It is common for sports videos to include a more intricate backdrop and faster-moving items than in other films. The most frequent tracking method for a single moving item does not work well. An iterative search approach called mean shift vector iteration is used to find the target's current location in the picture frame. It is important to keep in mind that the sports field's clutter will distort the target's grey characteristics while using this approach to track it. Since tracking is a continuous process, it is essential that the target model be regularly updated. Centroid tracking is challenging for big-sized travelling objects due to difficulty of the backdrop, making precise segmentation impossible. Changing light and target shape have no effect on the matching accuracy because of the careful selection of feature points.

If there is significant occlusion or continuous tracking, the mean shift vector technique will be unable to segment the target effectively. In these cases the colour histogram approach is utilized. Separation is based on the likelihood of colour appearance, which has a high degree of stability, using the target's colour attributes as a foundation. As shown in Figure 4, the technique for determining the height of moving objects in sports footage is laid out.

Colour information is less affected by the target's rotation, translation, deformation, and occlusion than other feature information. Using a colour histogram, it is possible to explain the distribution of colours in a picture. In addition, the colour histogram approach is extensively utilized in video tracking because of its capacity to adjust to dynamic video, picture rotation, and observer perspective shift [15]. When it comes to this method, it is all about the selection of feature points, which must be insensitive to the target's size and location in relation to light changes and be the midpoint of the centre with big grey level variations. This is the most challenging part of the algorithm. Moving object identification is the initial step in the tracking process and modelling motions of targets in the sports footage, and there are now a number of methods for this purpose. Moving

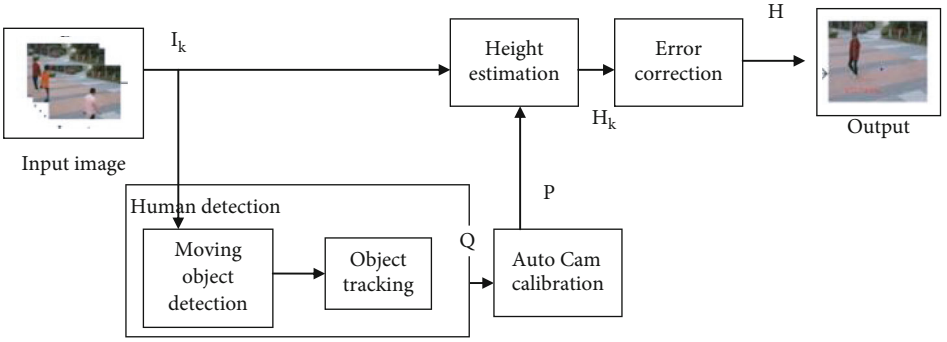

Figure 4: Human body height estimation method framework.

(a) (b) (c) (d)

Figure 5: Comparison of tracking results of sports video.

target detection results may be improved by using the background update difference approach since it requires less processing than other methods. Using moving targets in sports videos, the standard backdrop update difference approach is enhanced.

4. Results and Discussions

4.1. Test Platform. Use an Intel®4 Core 3.0 GHz CPU, 32 GB RAM, Windows 7 Operating System PC. To illustrate the supremacy of the intelligence tracking algorithm for sporting footage, MATLAB 2012 R simulations toolkit was used to simulate and test the mean drift method and particle filter methodology, respectively, to conduct comparative tests.

4.2. Performance Analysis of Ordinary Video. The clever tracking algorithm is tested on a video of an everyday nature. Figure 5 shows the tracking results for all methods.

Figure 5's analysis reveals the following:

(1) This method has the poorest tracking results, as the real moving target location deviates substantially, making it unable to follow the moving target correctly and hence of little practical use

(2) This is a significant improvement over the mean shift algorithm's tracking result, which enhances monitoring performance of the moving target. Due to the PFA (particle filter algorithm) ability to track moving targets dynamically, it is able to continually alter the target route to achieve a superior tracking effect

(3) The suggested algorithm's object target tracking performance is superior than that of the contrast algorithm. So that moving objects may be successfully tracked with high accuracy, this approach takes use of both the background updating difference method and the KFA (Kalman's) to maximise moving object tracking performance and to address the drawbacks of the comparison algorithm

4.3. Test Platform. Figure 4 shows the results of a tracking test on a variety of games video targets. Figure 5 shows that the suggested algorithm's tracking performance is superior

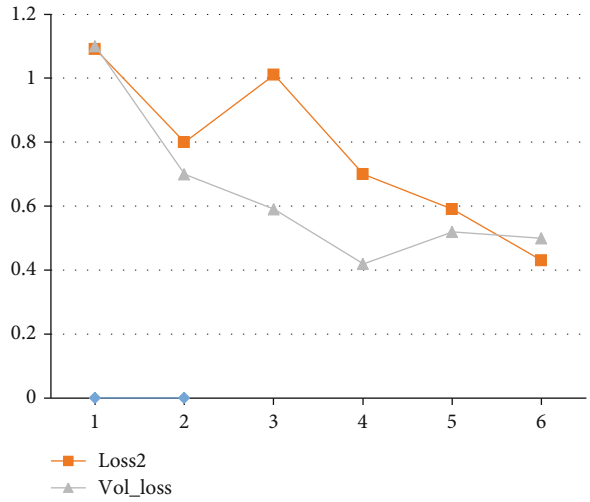

Figure 6: Time comparison of moving target tracking.

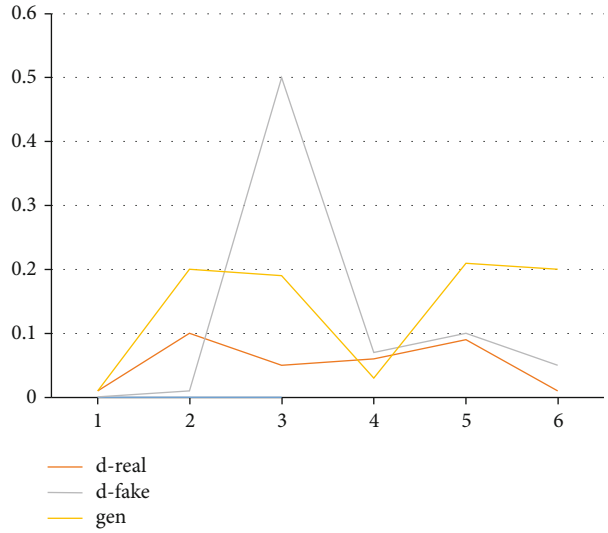

Figure 7: Graphical loss analysis.

to the comparison algorithm's. It is more accurate in its tracking and more adaptable to its surroundings.

4.4. Target Tracking Real-Time Analysis. Video moving object tracking relies heavily on speed. When it comes to video object tracking, this is a key metric to keep in mind. The tracking speed of a moving object tracking analysis technique is chosen, as is the real-time tracking performance. Figure 5 depicts the average tracking time for several sports video moving objects, as indicated.

Particle filter and mean shift algorithms take longer on average than the suggested technique, as seen in Figure 6. Compared to other algorithms tested, this one has a faster tracking speed and better real-time tracking performance in sports video.

There are various issues with tracking range limitations in sports video target tracking in sports games, such as poor tracking effect, low precision, low anti-interference capability, and moment. This method can normalize the target

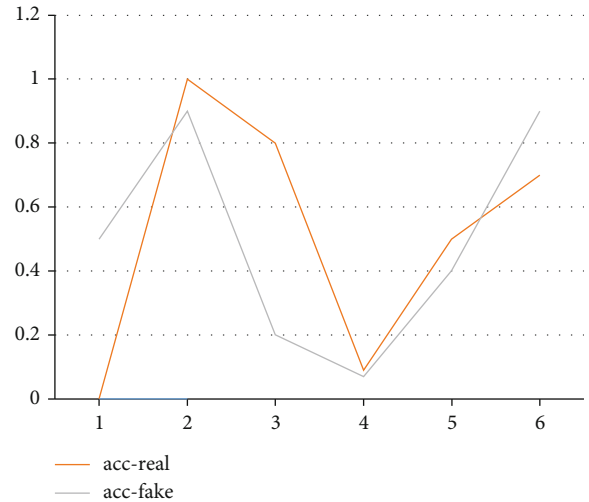

Figure 8: Graphical accuracy analysis.

area's grey level, create the target area's producing sequence, and gather the basketball video's target data. By using single frame visual difference analysis, it gets the feature output matrix of the basketball video target based on the geometric dispersion of the target picture and extracts the main feature points of the sports video target. It also employs an upgraded grey neural network to track and find the feature points of the sports video target, as well as rebuild the basketball video target picture with video equipment, to achieve basketball video target tracking. The results of the experiments show that the proposed algorithm has a strong sports video target detection impact, can definitely improve target detection reliability as well as progovernment capability, and can decrease target detection duration shown in Figures 7 and 8.

5. Conclusion

Monitoring a target is an essential part of sports video research and analysis. One of the primary goals of this project is the development of a new, more accurate way to monitor and analysis sports footage in order to provide valuable information for training and competitive purposes. Tracking a moving object with this method is very accurate and fast enough to meet the real-time demands of sports video analysis thanks to the background updating difference and Kalman filter algorithms. To accomplish sports video target tracking, it also uses an improved grey neural network to monitor and discover the feature points of the sports video target and also reconstruct the sports video target image using video equipment. Experiments reveal that the proposed approach has a significant influence on sports video target detection, can significantly increase target detection reliability as well as prounion capacity, and can significantly reduce target tracking length. The performance measures like an accuracy of 95.23%, a sensitivity of 94.45%, and a recall 93.34% had been attained. In future studies, the tracking efficiency of the objects is improved by efficient object tracking mechanism for obtaining perfect results.

Data Availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Conflicts of Interest

The authors state that this article has no conflict of interest.

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