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Research on Detection and Tracking Technology of Moving Objects in Sports Video Based on Data Mining

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Abstract. The uniqueness of sports video brings a great challenge to target detection and tracking technology. The tracking of moving objects in sports videos is characterized by complexity, which is manifested in complex scenes, complex moving directions and so on. In the process of tracking moving objects, there will be various disturbances, which will affect the tracking accuracy. To improve the tracking accuracy, it is necessary to choose the appropriate target detection and tracking algorithm. In order to improve the tracking accuracy of moving targets, an intelligent tracking method of moving targets in sports video based on data mining technology is proposed, and the improved background update difference method is used to detect moving targets. This method can track the moving target in sports video accurately and quickly, and the real-time performance of moving target tracking is better than other tracking methods.

Keywords: Sports video; target tracking; data mining

1. Introduction

With the improvement of sports competitive level, how to understand athletes' training level conveniently and quickly, extract sports parameters, and provide help for athletes' daily training has become an urgent problem for sports workers [1]. In the training video of athletes, coaches can obtain human motion parameters by using relevant processing methods such as segmentation and tracking [2]. Through the real-time tracking of athletes and the analysis of athletes' movement trajectory, it can change the training mode that coaches only rely on manual observation and experience to guide athletes' technical movements [3]. Moving target tracking involves the selection of motion features, the elimination of interference from complex background in motion, and the processing of multi moving target occlusion. To improve the accuracy of tracking, more scientific, reasonable and advanced methods must be adopted [4]. The object tracking algorithm of sports video based on tracker needs to extract object features, and the classical features mainly include object contour and optical flow [5]. This kind of algorithm requires that the moving object is always visible. If the moving object is eliminated in the visual range, it can not achieve the accurate tracking of sports video object, so the practical application range is relatively narrow [6]. The traditional video monitoring system generally only records the video of the monitoring scene, and then uses the operator to observe the potential



danger in the scene [7]. This kind of video monitoring system needs huge human and material resources to realize the observation and processing of massive data.

Among the environmental information perceived by people, visual information accounts for a large proportion, and dynamic visual information is the main component [8]. Compared with the target detection in static images, moving target detection is to determine whether there is a foreground target in the video image sequence. Through automatic analysis of the image sequence captured by the camera, the target in the scene can be located, recognized and tracked [9]. It is of great practical significance to analyze and study the sports video and find out the shortcomings of the other party or itself for making training plans and competition plans [10]. Moving object tracking is an important aspect of sports video analysis, which has attracted people's attention. By using computer vision, pattern recognition, machine learning and data mining to process video data, the intelligent video monitoring system can detect the interested objects and behaviors in the monitoring scene, and then realize the classification, identification, efficient storage and retrieval of objects and behaviors [11-12]. In order to improve the tracking accuracy of moving objects, this paper proposes an intelligent tracking method of moving objects in sports video based on data mining technology. The improved background update difference method is used to detect moving objects.

2. Moving object detection

The detection of moving objects in sports videos is mainly to identify and analyze the behavior characteristics of moving objects in videos, and filter out other redundant information irrelevant to moving objects in the detection, so as to realize the separation of moving objects from scenes. This technology was first widely used in military guidance. After it was introduced into the monitoring system, the tracking object generally refers to people or other targets with relatively slow moving speed, so the tracking method is simpler than before. The video surveillance system judges the type of motion by automatically analyzing the detected moving pixels, and finally decides whether there is any unexpected situation and gives an alarm. The frame difference method is the simplest algorithm to detect moving objects, but it does not consider the background update problem, and has high requirements on the number of frames taken and the speed of moving objects. Once the moving objects move too fast or the interval between frames taken is too long, there will be areas that cannot be completely covered between frames, which will eventually lead to the inability to accurately segment moving objects. A video image is a two-dimensional projection of a three-dimensional image. Although a two-dimensional image cannot completely reflect a real three-dimensional object or scene, its two-dimensional projection image will change accordingly when the three-dimensional image changes [13]. The scene of continuous video stream also has continuity. If there is no motion, there will be little change between consecutive frames. On the contrary, if there is motion, it will cause significant frame difference. Compared with other tracking algorithms, the region matching tracking algorithm can get more image information because it extracts a relatively complete target template, so it is widely used in tracking small targets or targets with poor contrast, and it is a tracking algorithm widely used in military field. Figure 1 shows the framework of sports detection and tracking system using area matching tracking algorithm and data mining technology.

When the motion of the moving target changes greatly in sports video, the average value is very close to the background gray value in the same period of time, and the average image can be used as an ideal background model graph. This algorithm is simple, easy to calculate and can achieve the ideal effect. A large number of experiments on the adjacent frame difference method show that although the target can be detected in the detection results of the adjacent frame difference method, it is not sensitive to the gradual change of light in the scene, and generally can not completely extract all the relevant feature pixels, so it is easy to produce holes in the moving entity. Matching and full-image search on gray-scale images are computationally intensive. Unless there is special hardware support, this algorithm is very time-consuming and cannot meet the real-time requirements of video surveillance in practical applications. The ideal situation of obtaining background image is that there is no moving object in the scene, but in practical application, a "pure" background image is always difficult to obtain,

and the outside light changes and the background contains slightly disturbed objects. If the tracking target changes due to rotation, light and motion, especially the large-area occlusion phenomenon, the matching point may not be found at this time, resulting in wrong matching, which is one of the problems that this method needs to overcome.

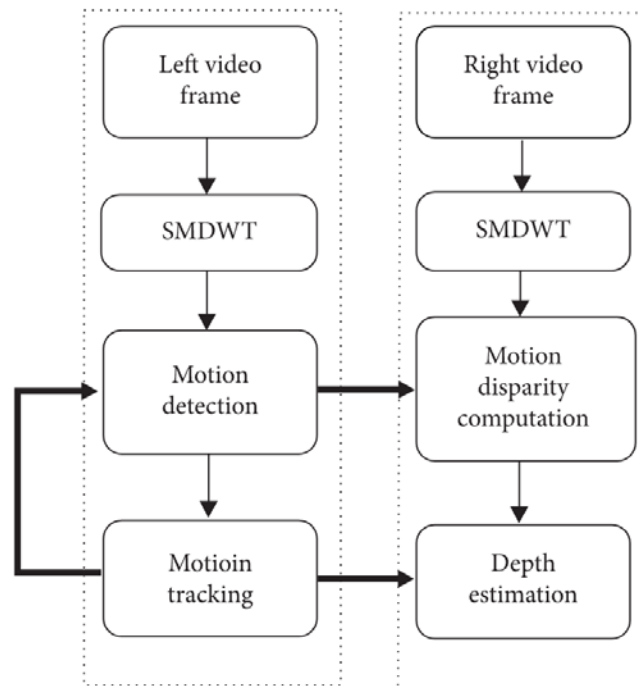


Fig.1 Sports detection and tracking system framework

3. Feature extraction of moving object

Tracking algorithm based on target recognition determines the position of the target object identified in the image, so as to achieve the goal of target tracking. This algorithm includes two steps: target recognition and target matching. The tracking algorithm based on motion detection tracks by detecting and locating the position of the moving target. This method can detect any object without considering the shape and size of the target. Because of the complex shape of the moving target itself, the complex scene and other moving objects around it, it is more difficult to track the moving target. In order to simplify the tracking process of moving objects, it is necessary to select the features of moving objects first, so as to achieve accurate and ideal tracking results. Sports video moving objects will show different gray scales on their surfaces under different light sources. This surface gray scale distributed according to a certain space is called the gray scale mode of moving object images. When people observe a moving object, the gray pattern will flow like light, and its moving speed is called optical flow [14]. Optical flow not only shows the changing characteristics of images, but also contains the information of moving objects. Therefore, by extracting the optical flow characteristics of images, we can detect and determine the movement of moving objects. The basic idea of feature-based tracking algorithm is to make full use of the unchanging features of moving objects in the process of tracking, such as color, texture, corners and so on.

In video image processing, mathematical morphology has the characteristics of smooth outline, filling holes, connecting split regions and so on, which is often used in the subsequent processing operations of various video images. Figure 2 is a manual detection program for image processing.

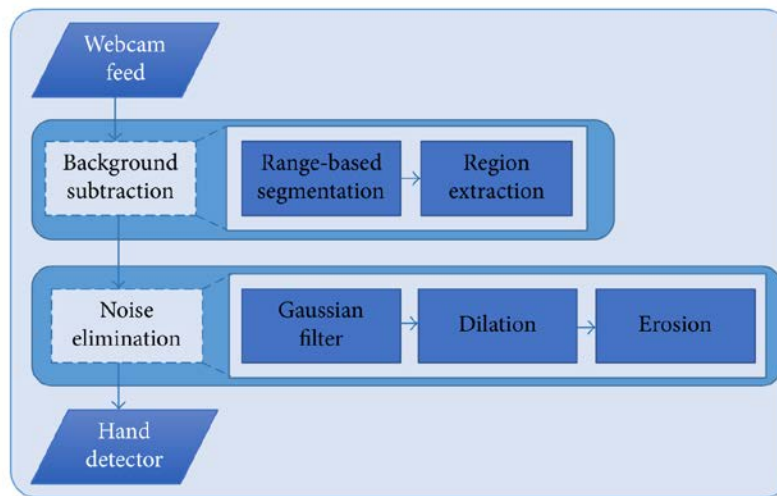


Fig.2 Manual detection procedure

X_k is the moving target vector at the k-th moment, and Z_k represents the system observation vector. Then the moving target state and observation equation are:

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

$$Z_k = H_k X_k + v_k \quad (2)$$

In the formula: $A_{(k+1)/k}$ is the state transition matrix from k to k + 1; w_k is the random noise vector; H_k is the observation matrix; v_k is the observation noise vector.

Compared with other features, texture features are easier to observe and are widely used in video analysis. There are many methods to extract texture features, among which the gray level co-occurrence matrix method is a representative one, which can express texture features by constructing co-occurrence matrix to extract statistics that can represent target texture. Because the density distribution model of pixel sampling can not be determined in advance, we can only make full use of the latest sampling information to model its density distribution. For complex practical application scenarios, because of the above properties of Markov chain model, it can effectively simulate the dynamic changes of pixel sampling in time domain and space domain, and has good characterization ability and adaptability to complex dynamic background. It is difficult to determine the representative feature set of a moving object. If the selected features are relatively few, the moving object can not be effectively distinguished from other moving objects, and it is easy to cause tracking failure. On the contrary, if too many features are selected, it will cause the system to take time and increase its strength, reduce its efficiency, and make mistakes easily.

4. Tracking algorithm of moving object

In sports videos, the speed of moving objects is often faster, and the background is more complex than that of general videos. The commonly used single moving object tracking algorithm can not achieve a good tracking effect. The mean shift vector iterative search method is used to determine the position of the target in the current image frame, so as to track the target. It should be noted that in the process of tracking the target with this method, the clutter background in the sports field itself will affect the gray features of the target. Therefore, in the whole tracking process, the target model must be constantly updated to enhance its robustness. For large-size moving targets, because of the complexity of background, it is difficult to achieve the goal of accurate segmentation, so it is impractical to use centroid tracking. At the same time, due to the careful selection of feature points, the influence on the matching accuracy can be minimized when the light changes and the target geometry changes.

Because the mean shift vector algorithm can't match the target accurately in the case of serious occlusion or continuous tracking, the color histogram method is used to segment the target accurately. This method takes the color features of the target as the basis of segmentation, and segments by the probability of color appearance, which has strong stability. Figure 3 is the framework of the method for estimating the height of moving objects in sports video.

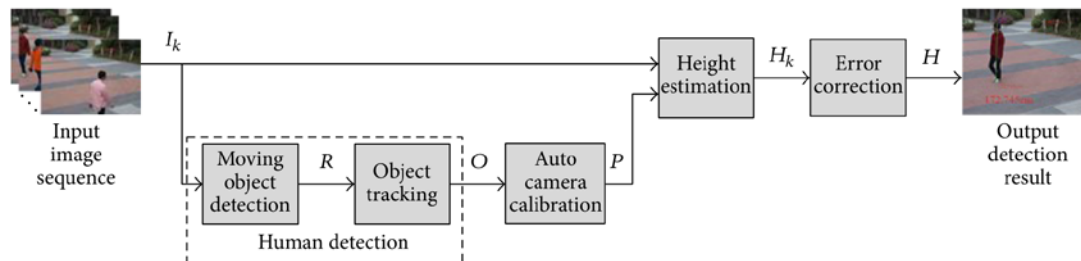


Fig.3 Human body height estimation method framework

Compared with other feature information, color information is insensitive to the rotation, translation, deformation and occlusion of the target. The color distribution in the image is the most reliable feature in the image, which can be described by color histogram [15]. And the color histogram method has good adaptability to dynamic video, image rotation and observation viewpoint change, so it is widely used in video tracking [16]. The selection of feature points is the key of this algorithm, which should be insensitive to the size, position, direction and light changes of the target, be located in the same position in different video frames at different times, and be the midpoint of the center with large gray level changes, so it is also the main difficulty of this algorithm to select representative feature points. In the process of tracking and modeling moving objects in sports video, moving objects in video should be detected first, and there are many moving object detection algorithms at present. Compared with other methods, the background update difference method has less computation and faster detection speed, and can obtain better moving target detection results. Combined with the characteristics of sports video moving targets, the traditional background update difference method is improved accordingly.

5. Conclusions

In sports videos, non-rigid athletes often have body deformation in the process of sports, which may also be accompanied by the hiding of moving targets. Target tracking is an important direction in sports video analysis and research. In order to provide valuable reference information for sports training and competition, an intelligent tracking algorithm for moving targets in sports video is designed, and several data are selected for verification test. It is difficult to determine the representative feature set of a moving object. If the selected features are relatively few, the moving object can not be effectively distinguished from other moving objects, and it is easy to cause tracking failure. In the complex background model, it is a difficult task to track the object in real time and continuously for a long distance. The basic idea of feature matching tracking is not to track the whole motion area as a whole, but to track the feature points with invariant properties in a group of motions, such as corners or boundary lines. The detection method, feature extraction method and tracking algorithm proposed in this paper have been improved to a certain extent, which can achieve ideal tracking effect.

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