

Study on the Detection of Moving Target in the Mining Method Based on Hybrid Algorithm for Sports Video Analysis

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Abstract: Moving object detection and tracking is the computer vision and image processing is a hot research direction, based on the analysis of the moving target detection and tracking algorithm in common use, focus on the sports video target tracking non rigid body. In sports video, non rigid athletes often have physical deformation in the process of movement, and may be associated with the occurrence of moving target under cover. Media data is surging to fast search and query causes more difficulties in data. However, the majority of users want to be able to quickly from the multimedia data to extract the interested content and implicit knowledge (concepts, rules, rules, models and correlation), retrieval and query quickly to take advantage of them, but also can provide the decision support problem solving hierarchy. Based on the motion in sport video object as the object of study, conducts the system research from the theoretical level and technical framework and so on, from the layer by layer mining between low level motion features to high-level semantic motion video, not only provides support for users to find information quickly, but also can provide decision support for the user to solve the problem. *Copyright © 2014 IFSA Publishing, S. L.*

Keywords: Tracking of moving video, Target detection, Histogram equalization, Image process.

1. Introduction

In recent years, with the development of science and technology, the moving target detection and tracking technology is R mature. But in sports video site, athletes and the background color may quite similar, each block still exist between athletes [1]. Unique sports video poses a great challenge to the target detection and tracking technology. Therefore, the purpose of this paper is to propose motion target detection and tracking algorithm is efficient, and built a simulation system to verify the correctness of the algorithm. Because of the accuracy and memory of the machine vision is better than the human eye, can quickly capture a moving target, and can target motion data record [2]. Through the collection of

high level athletes in training and competitions in a large number of video image information, for the information to be effective analysis, to change the previous coaches only by manual observation and experience skill coach is insufficient, can greatly improve the training effect [3].

Moving target detection and tracking system is the intelligent recognition system based on the technology of digital image processing, pattern recognition, computer vision based. This system can be widely used in traffic management, the observation of celestial bodies, biomedical research, traffic statistics and sports fields [4]. In the field of sports video analysis, technical detection and tracking of moving object more play an essential role, followed by real-time detection of athletes in action,

you can analyze the motion trajectory, convenient and correct athletes in training or human in the game was unable to detect subtle action differences, so as to improve the training effect and competition results [5]. Therefore, combining the research topic detection and tracking, the target of sports video of the in-depth study and discussion, the other moving object tracking based on the field also has a positive impact, has very important theory and application value [6].

This paper mainly in the detection of sports video tracking is the focus of the study, proposed a novel hybrid algorithm, and the extracted images are simple pretreatment, reduces interference of ingredients for the late key algorithm. In addition, this paper also presents detection in sports video tracking simulation system, verified the feasibility of the theory. In the analysis of the basic characteristics of sports video based on the proposed framework, mining basic motion features, and briefly introduces the function of each part of the framework, and the basic characteristics of the corresponding extraction technology. The basic features include: extracting trajectory extraction, extraction of moving object position, and the direction of movement of the extraction. This paper presents a hybrid tracking method mean shift algorithm and color histogram based algorithm, and introduces the principle of two kinds of algorithms. The hybrid algorithm can effectively avoid the interference problem of the moving object in complex background, greatly improve the detection accuracy of athletes. The MATLAB simulation results prove that the theory has an ideal effect.

2. The Related Theory and Algorithm of Target Detection

2.1. Image Preprocessing Method

Each pixel of the color image is usually represented by 3 bytes, each byte corresponds to the RGB component of the brightness, and a pixel gray level image transformed by a byte to represent, the little gray value greater brightness is bright; smaller values, brightness is black. Conversion between the commonly used formula [7]:

$$\text{Grey}(i,j)=0.1*r(i,j)+0.59*g(z,j)+0.3*b(i,j), \quad (1)$$

The input value of gray level higher than the compressed into narrow output image in lighter gray level, the output is high contrast images:

$$S = T(r) = \frac{1}{1 + (m/r)^E}, \quad (2)$$

According to the formula, histogram equalization (x, x) on the input gray level executive changes the output gray level S.

$$s = T(r) = \int_0^r p_r(\omega)d\omega, \quad (3)$$

In the formula (W) representation of the probability density function of the gray level in a given image, W is the 11 sub variable integral. You can get the probability density function of the output gray level is homogeneous:

$$p_s(s) = \begin{cases} 1, & 0 \leq s \leq 1 \\ 0, & \text{else} \end{cases}, \quad (4)$$

Image filtering is the most commonly used method of elimination image noise, common noise with salt and pepper noise, impulse noise, Gauss noise. In order to eliminate the noise or highlight some features of image, on the need for smoothing or sharpening images. Commonly used methods of median filter, mean filter, Gauss filter [8].

2.2. Filter Processing

Image filtering is the most commonly used method of elimination image noise, common noise with salt and pepper noise, impulse noise, Gauss noise. In order to eliminate the noise or highlight some features of image, on the need for smoothing or sharpening images [9, 10]. Commonly used methods of median filter, mean filter, Gauss filter.

The filtering process is the first two-dimensional sliding template selection of specific structure, and then will be arranged according to the size of pixel values in the form template, the data sequence monotone. The output formula of two dimensional median for:

$$G(x,y)=\text{Mid } f(x-i, y-j), (i,j), \quad (5)$$

Gaussian smoothing filter is a widely used algorithm in image processing, mathematical expressions for Gaussian smoothing filter:

$$f'(x, y) = f(x, y) * g(x, y), \quad (6)$$

$$g(x, y) = \frac{1}{\sqrt{2\pi\sigma}} \exp\left(-\frac{x^2 + y^2}{2\sigma^2}\right), \quad (7)$$

2.3. Mathematical Morphology Processing

Methods of mathematical morphology for image processing based on the geometry, it focuses on the research of image collection structure, this structure can be expressed on the macroscopic properties of objects, can also be said of the microscopic properties, structural elements and its basic idea is to use a certain structure and characteristics to measure image morphology. By using the basic operations of mathematical morphology, image processing, in order to improve the image effect.

Let X and B is the set of integer space in the Z, where A is the original image, and the B structure element.

a) B on the expansion of A operations is defined as:

$$A \oplus B = \{z | (\hat{B})_z \cap A \neq \emptyset\}, \quad (8)$$

b) Corrosion of B on A to define operations:

$$A \circ B = (A \ominus B) \oplus B, \quad (9)$$

c) B on A open operation is defined as:

$$A \Theta B = \{z | (B)_z \subseteq A\}, \quad (10)$$

2.4. Moving Target Detection Methods

Moving object detection in image sequence is a difficult research field, and is very important in general, target detection in sports video is mainly to identify and analyze video moving object in the stream, filter out image and moving target irrelevant information, the moving object is separated from the scene.

Three towel character difference method the mathematical expression formula is as follows:

$$m_i(i, j) = |f_{i-1}(i, j) - f_i(i, j)| \times |f_i(i, j) - f_{i+1}(i, j)|, \quad (11)$$

$$M_i(i, j) = \begin{cases} 255, m_i(i, j) > T \\ 0 \end{cases}, \quad (12)$$

2.5. Kalman Filter

In the target tracking process, because the two towel character image is a short period of time, the state of the target changes very little, it can be assumed that the target in a time interval keeps uniform motion, so the movement velocity as a parameter to reflect the target.

Because the goal of hook speed in unit time interval, so the definition of state transition matrix:

$$A = \begin{pmatrix} 1 & 0 & \Delta t & 0 \\ 0 & 1 & 0 & \Delta t \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{pmatrix}, \quad (13)$$

Type in ΔT and time T-1 said time interval, the system state and the observation state know, observation matrix:

$$H = \begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \end{pmatrix}, \quad (14)$$

3. Proposed Method of the Motion Feature Mining

3.1. Frame Theory Level and the System of Sports Video Motion Mining

Sports video mining research scholars in the area of relatively small, content is relatively single, mainly focus on the research content is either mining content based video, or is the extraction of motion features, so, must have the thorough research to it, must be some basic concepts are clear.

Sports video mining to extract the relevant data from the database or data warehouse, the motion analysis for motion characteristics, using certain data mining method, get the hidden patterns or knowledge. The motion features in SVMM can be the basic features of the motion characteristics of movement, which does not contain semantic information, can also be the motion characteristics include semantic, though the two are movement characteristics, but their effect on the extraction of implicit knowledge is not the same. Of course, in reality, motion features not containing semantic information does not exist. Multimedia mining, video mining SVMM compared with the traditional still exists a certain difference, the comparison are given in Table 1.

Table 1. SVMM compared with the traditional still exists a certain difference.

Type	Feature type	Contains range	Objective	Mining method
Multimedia mining	Text, audio, visual, motion, multimodal features fusion	All media files	Query, the acquisition of knowledge	Statistics, clustering, Association
Video mining	Color, texture, shape, motion, semantic features	Video files	Query, the acquisition of knowledge	Statistics, clustering, Association, SVMM
SVMM	Motion characteristics	Sports video files	Query, knowledge acquisition	Statistics, clustering, Association

3.2. The Theoretical Level

According to the analysis of SVMM, this paper will be divided into the following three levels: basic level, model, event layer and knowledge layer. Three levels of three levels and in multimedia data mining is the opposite, as shown in Fig. 1, the basic characteristics of layer corresponding to the lower layer, model, event layer corresponding to the middle layer, knowledge layer corresponding to the semantic layer.

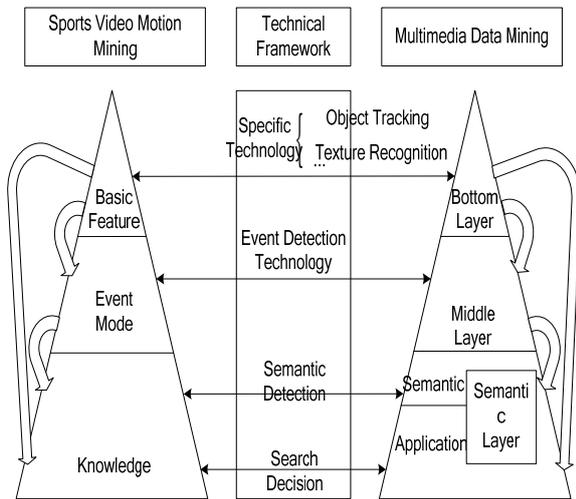


Fig. 1. Three levels of three levels and in multimedia data mining.

3.3. Moving Objects Detection Based on Hybrid Tracking Algorithm

Model, event layer contains event detection technology, through the event detection, model, we can get some basic, primitive knowledge; in order to obtain some advanced, implicit knowledge, must be obtained after analysis, at the same time, obtain knowledge, these knowledge and feedback, can to provide users with inquiry and assistant decision-making function. The specific technical route was shown in Fig. 2:

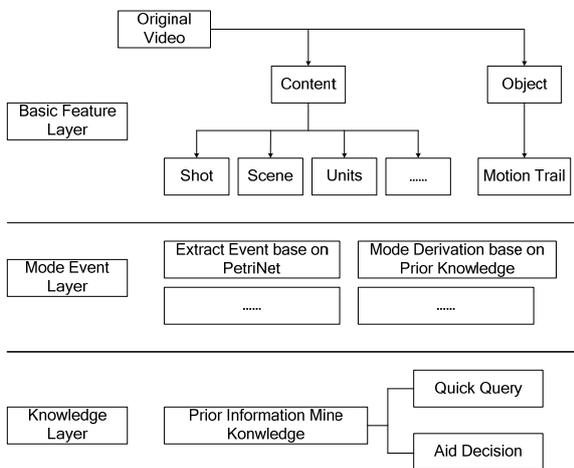


Fig. 2. The specific technical route.

3.4. Extraction Correcting Trajectory

Through the detection and moving object tracking of the object, can the original trajectory of the object is obtained, in order to get the trajectory and motion direction effectively, it must first be original corrected trajectory, trajectory correction. As shown in Fig. 3, the moving object is a video sequence of the trajectory, it is difficult to reflect the real motion of moving objects.

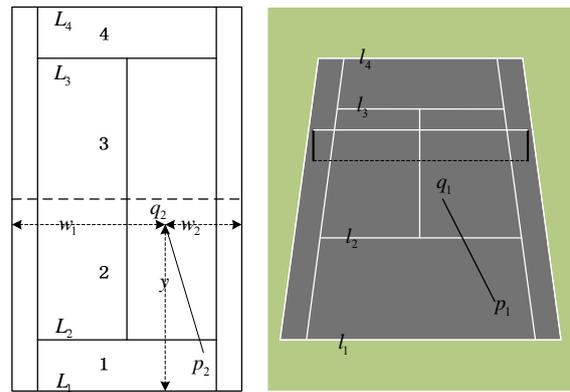


Fig. 3. Real court and changed court.

4. Results and Simulation

4.1. Mining Basic Motion Characteristics

The motion characteristics of mining, the main steps for design reference system framework, the main process was shown in Fig. 4. In the analysis of object detection and object tracking process, we found that the object detection and tracking can not effects each other to provide the necessary information, this is a big disadvantage, therefore, this paper designed a detection and tracking of moving objects will be combined to analyze the case. In the scheme of object detection can provide both the initial tracking window for target tracking, make up for the deficiency of the traditional algorithm for semi automatic properties, and can be lost in target tracking, detection and correction in time; at the same time, accurate target tracking the target detection limit in a very small movement area, avoid the influence of the bring the non target in video scene. Target detection and target tracking can provide the necessary information for each other, is the core of the program and the starting point.

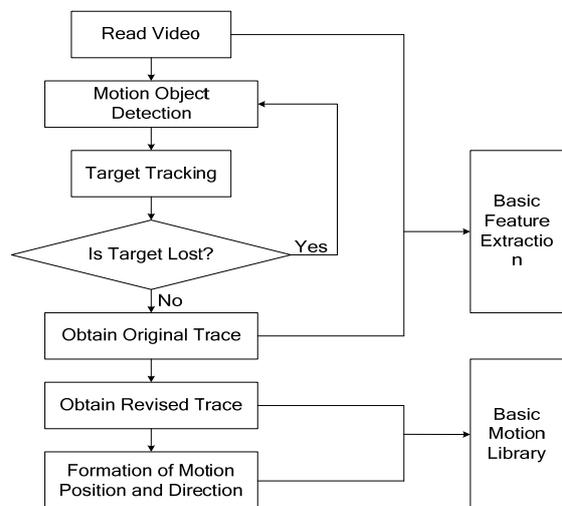


Fig. 4. The main motion process characteristics of mining.

4.2. Detection of Moving Objects

Step one: target tracking initialization of the model of the current frame.

Step two: the candidate target window initialization of a new meal in the image. The candidate target initialization process, the initial target center position and the target pixel, and according to the formula (12), (13), (14) the shape and color feature of initial candidate targets are calculated.

Step three: Bhattacharyya coefficient P calculated the candidate target and target model.

Step four: if according to the mean shift algorithm to update the candidate target position according to a shape, V color histogram algorithm to update the candidate target.

Step five: repeat step two and step three, until the $P_i < P_{i-1}$. Finally get to meet the new position of the Bhattacharyya coefficient to maximize the target tracking.

This paper verified to the effect of the algorithm, in the MATLAB platform for the game of golf video tracking simulation experiment. Tracking results of tennis game was shown in Fig. 5.

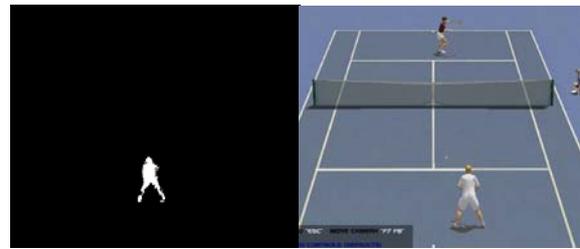
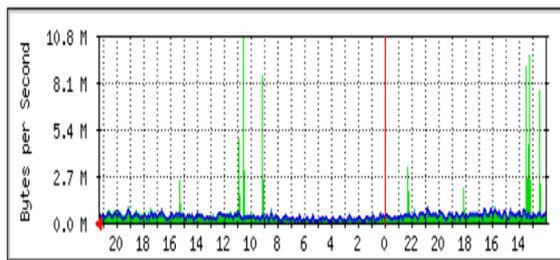


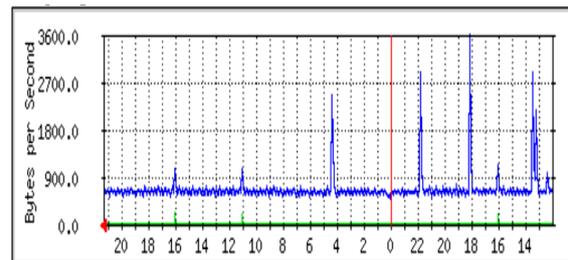
Fig. 5. Tracking results of tennis game.

Local information and local features represent the target, usually located on the object boundary or said a small surface can be resolved in the region, such as high curvature points (also called corner).

Local features are calculated at the apex angle and the adjacent side length to obtain, is also useful for local contour sequence method to get in there, occlusion or image is not complete, local features using the target is more effective than global features with the target, but the local feature is more sensitive to noise. The use of target tracking algorithm and feature extraction was shown in Fig. 6.



(a)



(b)

Fig. 6. The use of target tracking algorithm and feature extraction.

4.3. Experimental Results and Analysis

SVMMP mainly consists of extraction is the basic characteristic, mode, event, knowledge mining (MEK mining) and query of three parts. Among them, the basic feature extraction is based on MEK mining,

MEK mining is the basic purpose of feature extraction and representation, both of which can provide the query service, query function reflects the hierarchical characteristics of sports video mining, can meet the needs of different users. Fig. 7 shows the design idea of SVMMP.

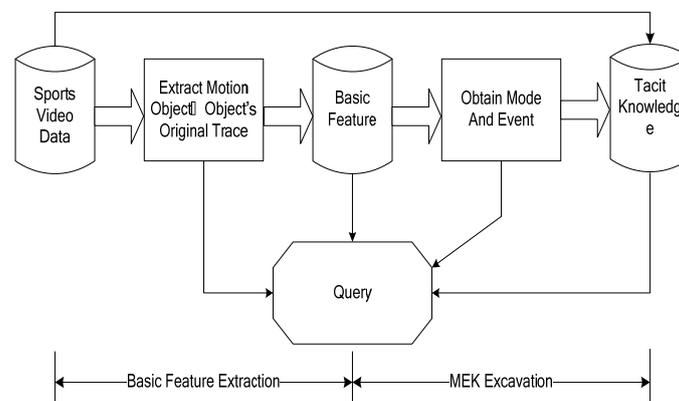


Fig. 7. The design idea of SVMMP.

Color information is compared with other feature information of target rotation, translation, deformation, occlusion is not sensitive, and compared with other feature information more convenient, is widely used in image processing, image segmentation, target detection and tracking in computer vision. In a video image, color distribution was shown in Fig. 8.

The algorithm by adding the prediction of target motion position, ensure the target space movement in the process of consistency and coherence, successfully completed the target tracking. The experimental results show that the effectiveness of the improved mean shift algorithm, prediction of target position in the joint space motion of, and satisfactory results were achieved. The motion target distance matching degree was shown in Fig. 9.

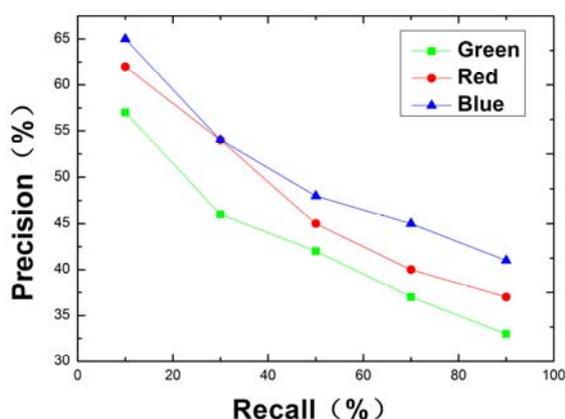


Fig. 8. Color distribution in a video image.

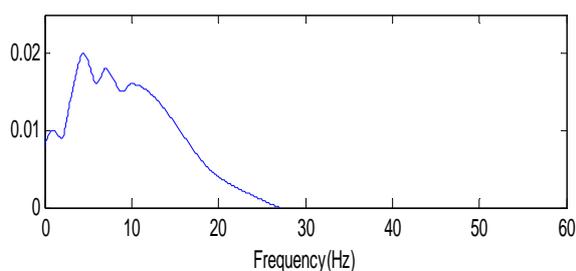


Fig. 9. Motion target distance matching degree.

The algorithm by adding the prediction of target motion position, ensure the target space movement in the process of consistency and coherence, successfully completed the target tracking. The experimental results show that the effectiveness of the improved mean shift algorithm, prediction of target position in the joint space motion of, and satisfactory results were achieved.

Feature extraction is an important link of moving target tracking, according to the target feature selection for the research object and the object of the environment is also a key step. This paper summarizes the features in visual target tracking, is

often used in statistical characteristics, transform coefficient characteristics and algebraic feature. After feature extraction target, is to choose a suitable search to achieve the goal in each image matching algorithm.

5. Conclusion

In this paper, the sports video was the research object, to a certain extent, the method of sports video mining. Sports video mining hierarchical structure is a Pyramid shaped: the basic feature of layer, model, event layer and knowledge layer, which corresponds to the multimedia data mining in the low level features, mid-level features and high-level semantic mining. On the base of sports video motion features in-depth analysis, proposed the motion feature includes a motion track, direction and a plurality of moving target relative position, this paper mainly studies the movement of the position, direction of motion of two aspects. The basic steps in the basic characteristics of motion mining first briefly introduces the basic sports video feature mining method; then introduces the detection and moving objects tracking moving objects in SVM; finally, mainly introduces the correct trajectory.

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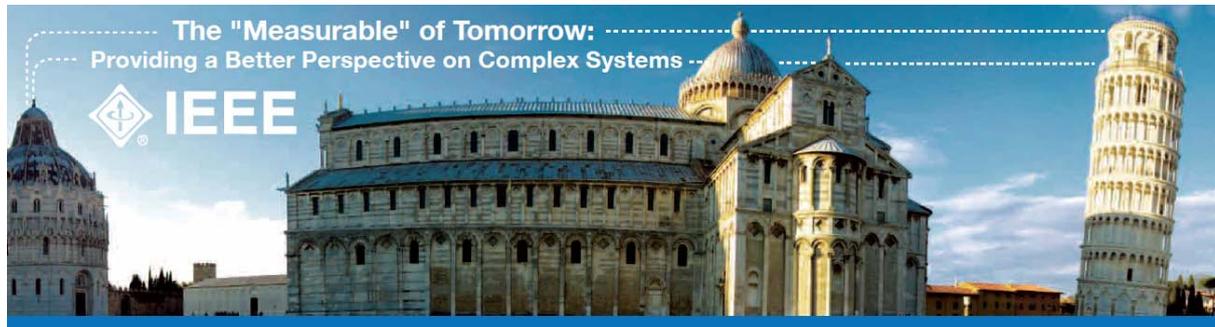
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