Research on Background Segmentation Method for Sports Video

Zhao Yibo* and Lu Zhengdao**

* Sports Institute, Hebei Normal University, Shijiazhuang, China
** Sports Institute, Lang Fang Teachers University, Langfang, China

Abstract — **Background difference method is important method of moving object in video image sequence, in order to solve the problem such as illumination change, in the background of each sentenced to establish single Gaussian model for background pixel, is put forward through a hypothesis test method to estimate the IIR filter background updating coefficient alpha, updates to the background. And the traditional video image background subtraction model on the basis of the analysis of the background noise and movement target grey value distribution characteristics, in view of the traditional single threshold segmentation of background difference method of some deficiencies, this paper puts forward a more reasonable model of background subtraction: through the bright and dark sides of background difference image separate processing, at the same time use Otsu (the between-cluster variance) algorithm to find out about the two best threshold to achieve better video image segmentation. The experimental results show that the method proposed in the research has lower complexity, high computational effectiveness and low computational amount. It can get better extraction effects on video image.**

Keywords - Background Segmentation, Gaussian Model, Sports Videos, Video Processing, Background Updating

I. INTRODUCTION

Along with the rapid development of ITS in China, the traffic information collection system based on video is widely used in the intelligent transportation system. However, because of the complexity and diversity of video image information, and the special requirements of video processing, video image segmentation technology is not mature and perfect [1].At present, the common methods of video image segmentation are based on Calman filtering, video segmentation based on probability statistics, video segmentation based on background subtraction and video segmentation based on differential and curve transformation. In recent years, motion and video computing has become a new research hotspot in the field of computer vision. In addition to the traditional visual motion analysis based on video sequences, such as optical flow computation, 3D motion and shape structure, motion information in video sequences is also widely used in video synthesis, video segmentation, video compression, video registration and video surveillance and monitoring. In addition to the video data, such as colour, edge and texture, the video data has the characteristics of time sequence, that is, there is motion information in the video. Therefore, compared with the traditional image analysis technology, the video based motion information analysis can play a more important role in the above fields [2]. However, in practical application, the background motion caused by camera motion, camera jitter, irregular motion of foreground object and so on.

Background segmentation is one of the most important fields in computer vision field. It is an important technology in the field of computer vision. It is widely used in intelligent surveillance, human-computer interaction, motion analysis and virtual reality. In spite of the past ten years, people have done a lot of useful work to this problem, however, so far, there is no general algorithm can be applied to the segmentation of moving images in a variety of environments.

At present, the research work of the background segmentation of human motion picture is proposed by some specific application problems.

Human motion analysis is one of the focus in the field of computer vision in recent years. It has been widely used in the field of intelligent monitoring, human-computer interaction, motion analysis, virtual reality and so on. Especially in the emerging field of sports analysis of the field is much concern. Background segmentation is the first step of human motion analysis, and the segmentation results have a great impact on human motion analysis. Human motion analysis refers to the use of certain means to track, capture the movement of the human body, to obtain the movement parameters of the human body and reconstruct the structure and posture of the human body, its ultimate goal is to achieve the understanding of human movement [3]. Human movement is a typical connected non rigid body movement, and in the past ten years, scholars have made a series of research on the motion analysis of computer vision. Compared with the rigid motion, non rigid motion analysis is still very immature stage [4]. As a hot research topic, the complexity and application of human motion analysis has attracted many researchers at home and abroad.

It is important to provide a quantitative analysis tool based on computer system for coaches to improve the level of training and to accomplish the innovation of high difficulty. Coach according to motion analysis results do further detailed analysis, combined with the specific body blind sports domain knowledge, explicitly pointed out that there exist what disadvantages, problems and causes in technology, gives the improved direction, for the improvement of sports technique to provide more help.

Therefore, the video based human motion analysis system is suitable for the sports industry. Background segmentation of human motion picture is a sequence of human motion video sequences. It is human motion analysis in the process of the first few steps, is the human visual

analysis of the low-level processing part [5]. The quality of the results of the stage directly affects the progress of the follow-up work, the results of the segmentation of the final human movement analysis results. So the background segmentation of human motion image is very important.

In many computer vision applications, it is a basic and important link to segment moving objects from video sequences. Usually the method is background subtraction, the most simple form of the reference image in the method is the initial time average of the background image [6]. There are many problems in this method, and it can't be a moving target in the initial training period. The method also cannot solve the scene of the light gradient problem. Many adaptive background modelling methods are proposed to solve these problems. Some of these methods cannot well deal with the problem of moving or moving objects from the background, and some calculation is too complicated.

Based on probability statistics, the proposed algorithm is effective in the presence of low computational complexity, fast and slow [7]. The proposed algorithm can overcome the problem of low computational complexity, high computational complexity, low computational complexity, fast and slow. The proposed method is effective. But it can overcome the influence of the traffic image sequences. Based on probability statistics, the proposed method has a very good segmentation effect. Based on probability statistics, the proposed algorithm can overcome the impact of the proposed algorithm. On the basis of probability statistics, the proposed algorithm can overcome the influence of the traffic image sequences. Based on probability statistics, such as probability statistics, the visual segmentation has a very good segmentation effect [8]. It is able to overcome the influence of slow moving objects and shadow. It is difficult to produce good segmentation results. The video segmentation method based on differential and curve transform can handle the situation of sudden moving target in a sequence, and the background adaptive update, but the method can provide the initial background and the calculation is more complex. Compared with previous video segmentation method, the video segmentation based on background subtraction is concerned by the domestic and foreign experts and scholars. It is suitable for the fast segmentation of video images.

II. BACKGROUND DIFFERENCE METHOD FOR SPORTS VIDEOS

A. The algorithm of the background difference method

The method of background subtraction is a method of making a difference between the current image and the background image. Algorithm is simple, easy to achieve. Usually, this algorithm can be used as a background image in the video, but most of the real situation does not meet the conditions. The selection of the background image has a great impact on the segmentation results. Also some algorithm using the first frame of the image as a background image, the requirements of video first shooting without a target motion scene useless. This way also exist fatal defects, when the frame contains the moving object, segmentation results also contains virtual shadow. In order to overcome

this shortcoming, some improved algorithms are given to the background image, and the improved algorithm is adaptive, but it is still powerless to change the background and the background of the background elements.

Regardless of any moving target detection algorithm, it is possible to meet any image processing requirements, but due to the complexity of the scene, unpredictable nature, as well as various environmental interference and noise, such as the sudden change of illumination, the actual background image in some of the fluctuations, camera jitter, moving objects out of the scene, such as the impact of the original scene.

The traditional background difference method is mainly applied to the camera fixed. And the background image is relatively static, and a frame image is used to calculate the absolute difference between the current image and the background image, and then complete the image segmentation by setting a good single threshold. The main work flow is illustrated in Fig.(1). And $F(i, j)$ is the current frame. $G(i, j)$ is the background figure. And the detailed segmentation method is as follows.

$$D(i, j) = \left| F(i, j) - G(i, j) \right| \tag{1}$$

$$R(i, j) = \begin{cases} 0 & D(i, j) \leq Th \\ 255 & D(i, j) \leq Th \end{cases} \tag{2}$$

The traditional video segmentation method considers background difference image $D(i, j)$ is composed of background noise and moving object. The background noise is 0, and in most cases it is assumed that the noise is normally distributed, and the moving target is far from the noise pixels, so the distribution of background noise is selected from the noise. From traditional background difference method for video segmentation, the video segmentation method has such a few problems: in the differential image and to obtain the absolute value of the operation is the bright and dark targets (here bright, alluding to the background than the bright and dark) mixture. The reason is that the light dark target is about the background symmetry.

Aiming at this problem, this paper proposes an improved background difference model, and uses Otsu algorithm to determine the threshold of the background image to achieve the separate and the two parts of the image, to a certain extent, solve the shortcomings of the traditional single threshold segmentation.
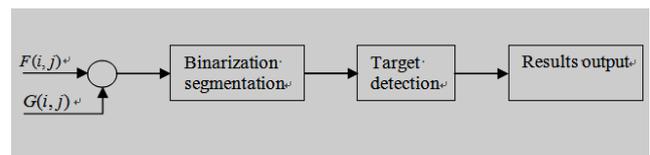

Fig. (1): The main work flow of the background difference method

Background subtraction method is one of the most widely used methods in moving target detection. It is a technique that uses the current frame image and the background image difference to detect the change region. $I_k(x,y)$ is set as the video sequences in the k image collection. $B_{k-1}(x,y)$ is for the frame update background image point set. $D_k(x,y)$ is for difference image point set. And T is the threshold segmentation.

$$D_k(x,y) = \begin{cases} 0, if\ |I_k(x,y)-B_k(x,y)| \le T \\ 1, if\ |I_k(x,y)-B_k(x,y)| \ge T \end{cases} \quad (3)$$

It can be seen from two aspects: on the one hand, the background image and the current frame image are bad, and the background image must be built and updated, which is important for the detection of background difference. Since the effectiveness of the former is based on the background image can truly reflect the static area, the acquisition and updating of the background image is very important for the whole detection algorithm.

B. The method based on the background model

The key method of background model is to describe the model background image background model, which is the background segmentation of the foreground. The background model mainly includes single-mode (Unimodal) and multi-mode (Multimodal). The former can be used to describe the colour distribution of each background pixel, which can be described by a single distribution probability model. And the latter is more dispersed. The probability density model (probability density function) of the most commonly used to describe the colour distribution of the scene background is Gauss (normal distribution).

Background model based method is the most commonly used method of background segmentation, which is based on the current image and background model matching. Using background model, the background image sequences, and the background noise is white noise. The background model is based on the background model, which can be used to adapt to the slow illumination changes. But it cannot deal with sudden illumination changes (such as lightning) and background disturbance. Since most of the visual monitoring system is based on the background model, many researchers are working on the performance of various background models, so as to reduce the impact of the dynamic changes of the scene.

Non-regression background model algorithm is a dynamic use of observation data from a certain time to the current period of time as a sample to carry out background template modeling. In background modeling, it is usually only used to store the closest observed data in the cache, so called non regression background modeling method. The regression algorithm has no need to maintain the buffer of the background in the background estimation, which is based on the input of each frame to update the background model.

Background segmentation algorithm based on background segmentation algorithm for video image processing flow can be shown in Fig.(2). The pre-processing, background foreground Detection and post processing (Validation Data) are the four process groups. And background modelling and moving target image segmentation are treated as the focus of this paper, will be in the post to make a further study.

III. THE BACKGROUND UPDATING ALGORITHM

A. Getting the initial background

The initial background is an indispensable part of target detection based on background subtraction. The main methods are as follows: direct access method, average method, Surendar algorithm, etc.. The average method is obtained from the background of the image sequence in a period of time. As shown in the following expression, N is the frames of the image, and the value of N normally has the effect on the general background.

$$B_0 = \frac{1}{N}\sum_{n=1}^{1} M_n \quad (4)$$

B. The updating of the background

The common background updating method is multi frame average method, the choice of update method, the random update method, etc.. Multi frame average method is simple, but the calculation is huge, and it cannot achieve satisfactory results in the case of multiple moving objects and moving objects. The selection method has a strong adaptability to the changes of light, but in the case of light changes, or when the whole scene is changed, it will cause the whole image area to be considered as moving objects and not to be updated, and the influence of the threshold selection is relatively large.
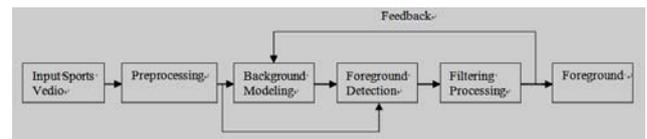

Fig. (2): The background segmentation algorithm for video image processing flow

IIR filter method has achieved the initial background, when the acquisition to a frame of the new image, the use of the background update is as follows:

$$B_k = (1-\alpha)B_{k-1} + \alpha f_k \quad (5)$$

This method can improve the average method to take up memory, it is necessary to store the previous background image B_k and the current frame f_k, however, it is difficult to give a quantitative selection criteria, which is usually based on experiments or experience, and to a large extent on

the specific issues. From the formula (3) it can be seen that the smaller the α, the current frame f has little influence on the background, the background of B_{k-1} is mainly derived from the previous background image B_k. The background update is relatively slow. Otherwise, the current frame f_k has a larger impact on the background, the background update is faster. Background updating based on the Gauss model is the case of the Gauss model of the image, and the update of the background model is the renewal of the Gauss distribution parameters of the image points. And the introduction of a constant update speed of the said (update rate) α, the parameters of the Gauss distribution of the update process can be expressed as:

$$\mu_k = (1-\alpha)\mu_{k-1} + \alpha f_k \qquad (6)$$

$$\sigma_k^2 = (1-\alpha)\sigma_{k-1}^2 + \alpha(f_k - \mu_k) \qquad (7)$$

Then the new μ_k and σ^2 substitution distribution function $\eta_t(g_t, \mu_t, \sigma_t)$ to determine whether it is less than a certain probability threshold, is sentenced to prospect and vice versa for background. For many Gauss background model updating, the situation is more complex, not only to update the parameters of multiple Gauss model, update the weights of the model, but also to re arrange these models, and re select the model as the background model. At the same time, considering the problems mentioned in the establishment of multi Gauss background model, the estimation method based on this kind of background is seldom used in real time system, which is used to establish the initial background model.

IV. EXPERIMENTAL RESULTS AND ANALYSIS

This section will empirically assess our proposed spectral clustering based on spectral clustering for sport video analysis. The experiment steps are as follows. First, collect data according to experiment design; second, model the data and extract the feature; third, train the model and evaluate its performance.

At the beginning of the video, the background is set up by means of statistical averaging method, and a single Gauss model $\eta_t(g_t, \mu_t, \sigma_t)$ is set up, and the background update coefficient α of IIR filter is estimated. Steps are as follows:

(1) The background gray level of each coordinate position $S(x, y)$ obtained from the zeroth frame to the N frame is used to estimate the single Gauss model for each background pixel using the moment estimation method;

(2) Testing the hypothesis that the renewal factor is determined. The time set for each location background pixel is considered as a single positive table.

(3) After the first $2N$ frame, the IIR filtering method is used to update the background $B_k = (1-\alpha)B_{k-1} + \alpha f_k$.

The update coefficient α is a horizontal α_s of all background pixels.

In this way, the current background model can be achieved. And then the current image with background model subtraction is used, so as to produce a difference image, the difference image threshold segmentation.

From the Fig.(3) can be seen that in the case of outdoor light changes, background model can be updated in real time, using this experiment to achieve the human detection system, experimental results show that the scheme is feasible and effective.
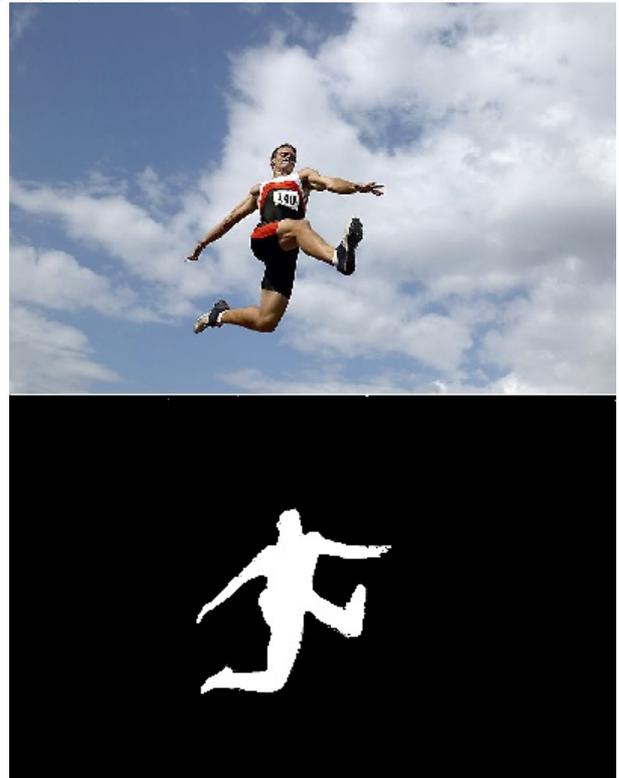

Fig. (3): The Identification Results of Background Segmentation in Sport Videos

V. CONCLUSIONS

By establishing the model of single mode Gauss in background acquisition and using statistical methods to test the hypothesis of a single background pixel level, and then obtain the IIR filter background update coefficient, achieve the automatic acquisition of the update coefficient, reduce the degree of artificial interference, compared with the background update method based on Gauss model greatly improved real-time, relative to the statistical average recursive method and greatly reduce the memory overhead. Experiments show that the method is simple and effective for obtaining and updating the background.

The proposed algorithm can better extract the sports video image sequence, but still have a lot of difficulties in view of the feature extraction of image segmentation. So

how to improve the extraction of more image feature information is still the focus of the further research.

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