Detection of Moving Target Capture Analysis in Shooting Testing System

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ABSTRACT: *The capture and analysis of moving targets in shooting testing systems is a key technique that helps to determine the accuracy and reliability of shooting. The detection process mainly involves the recognition, tracking, and data analysis of moving targets. This detection method requires the use of efficient image processing and computer vision technology. In shooting testing systems, efficient algorithms are used to identify moving targets from video or image sequences. These targets may be bullets, projectiles, or other dynamic objects. By using image processing techniques with high sensitivity and specificity, moving targets can be effectively separated from the background. The capture and analysis of moving targets in shooting testing systems is a powerful technique that can provide important information about shooting effectiveness. By using advanced image processing and computer vision technology, recognition, tracking, and data analysis of moving targets can be achieved. This information is crucial for evaluating the accuracy and reliability of shooting.*

Keywords: The Background Difference Method, Shot Detection, Object Detection

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1. Introduction

Basketball has been widely loved by people. With the continuous development of basketball, the demand for the detection technology of shooting techniques is higher. [1] But there are many disadvantages in the original fixed-point shooting test algorithms, such as difficult installation, trouble making, and low accuracy. [2] So we use the background different method in this study. Background subtraction method not only has the characteristics of real-time and high accuracy, but also has good robustness to the uncertain velocity of moving objects and the motion detection of elastic objects. The specific step [3] is to detect the object by collecting each frame image in the image sequence and comparing it with the background model, which is a way to detect the target object.

In this shooting test, the main information to judge whether the shots hit is to obtain the current position of basketball. [4] Human access to external information is nothing more than visual, auditory, and tactile. However, the most intuitive and greatest of these approaches is vision. With the development of computer, more and more computer technology is used, and a great deal of technology can replace people's sense acquisition. [5] So, our purpose of this study is to obtain the external object motion image through the computer camera and the analysis of the image to achieve the actual analysis and application ability of the shooting target. [6], so that it can be accurate, convenient and reliable for basketball detection analysis.

2. State of the Art

In this series of studies, we need to detect moving objects. [7] Moving target detection technology originated from developed countries such as Europe, America, researched by scholars and researchers in recent years, the moving target detection technology developed rapidly. In China, the application of this technology is mainly in universities and research institutes, and has not been widely used in daily life. [8] So our research promote the Moving target detection technology development.

After moving target detection is completed, we use background subtraction to analyze and dispose the moving image. Background subtraction method is a image that using the background model and the current image frame difference compared to obtain the moving target detection. A good background reference model is obtained by using the camera in the stationary state, and then the trajectory is completely distinguished. [9] This will be real-time, and can be widely used in the study of the trajectory of the movement. Due to it starts early and development rapidly in foreign countries, so our study draws on many examples of application in foreign countries. [10]. So, the detection technology of basketball, the current detection technology on the market has been far from meeting the needs of the current basketball detection.

3. Methodology

3.1. Construction of Shot Detection Algorithm based on Background Subtraction

In this study, we use the background difference method; we need to detect shooting, our main operation processes from the background difference method of basic thought, basic establishment process and background modeling. Then we analyze and compare the state of basketball in the process of shooting, combined with the characteristics of basketball, through the following formula to do the calculation.

$$I_{object}(x,\ y)=\begin{cases} 1 & \left|I_{Current}(x,\ y)-I_{background}(x,\ y)\right|\geq Threshold \\ 0 & \left|I_{Current}(x,\ y)-I_{background}(x,\ y)\right|<Threshold \end{cases} \tag{1}$$

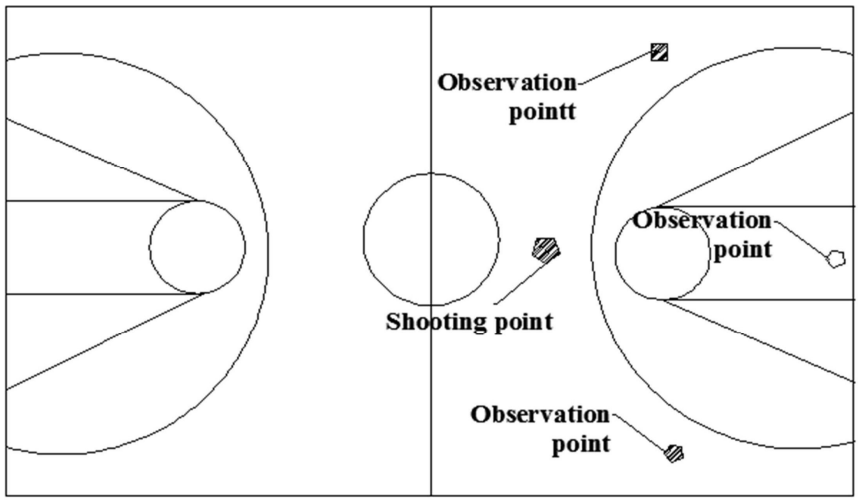

Figure 1. Schematic diagram of virtual stadium model

In the formula, (x, y) refers to any point in the image of a pixel, we use the collection of $x = 0....M\text{-}1,...$ $Y = 0.....N\text{-}1...$, I background (x, y) as the reference feature model reference values in the background, I is Current (x, y) capture of photo pixels in real time the threshold is considered as a function of setting the adaptive threshold. When =1, it means when the motion is at the base point. When it is =0, it means that the difference between the grey value of the background point and the ball point is within a certain range, and then we can judge the trajectory of the ball and the place after which it runs. Our algorithm is the most effective method in the background subtraction method, and it can also reflect the actual use of our object. So, our research will be the most advanced research methods, and the most advanced computer processing. We make the virtual stadium model as shown in Figure 1 by simulating the specific data of the stadium.

After the above formula, we need to establish the process of the algorithm. The main advantage of the background subtraction method is that it can segment the whole trajectory of a target in precise positioning and fast computation. But this method is mainly through the contrast with the background image pixels, so the background image change is very keen; we need to update the background image of the background model in real-time. So, we need to process the background image before moving target detection. The so-called pre-processing is to transform the image, and then the model is used as the reference background image, and finally carries on the existing image and background reference, the image in each frame of the difference is distinguished, the specific process as shown in figure 2:

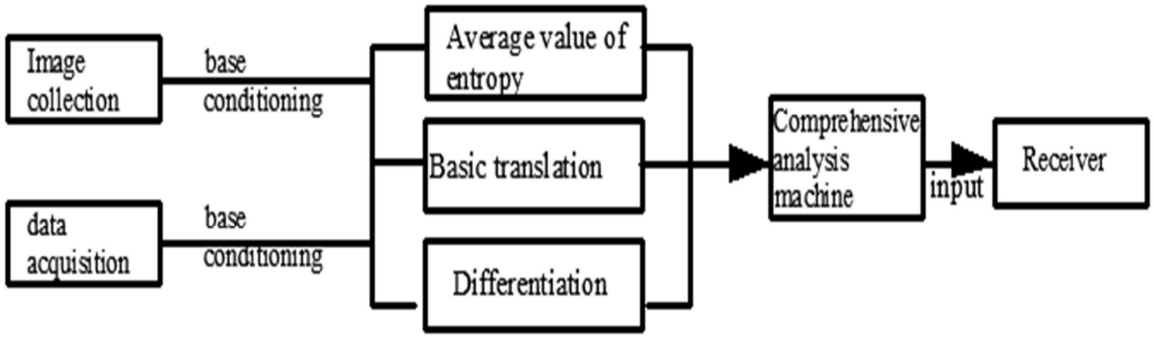

Figure 2. The whole basketball trajectory division process

When the scene changes with time, we need to update the background model and image in real time. Therefore, the model we studied needs to be improved and optimized on the basis of the original, in order to better serve our project. We used the mean method background modeling method, because the shooting situation of basketball model is relatively simple. The average method is a statistical method based on the filter, within a period of time to process high-speed image taken by the camera, and then the frequency value by cumulative capture, we can get an average value, and then the average value as our background model. We can use the following formula to calculate:

$$B_{\mathrm{n}} = \frac{1}{N}(\mathrm{f}_{\mathrm{n}} + \mathrm{f}_{\mathrm{n\text{-}1}} + ... + \mathrm{f}_{\mathrm{n\text{-}N+1}}) \tag{2}$$

In the formula, N is the average number of frames for the current target motion, image $(f_n + f_{n-1} + ... + f_{n-N+1})$ coefficients contain the current frames, can save the Bn as the basis for the current image of the N frame collected as a model of the background, impact of changes when the scene is affected by illumination model and produce and other factors so, in the moving target run after a period of time we will do the background model to update, update formula as follows:

$$B_{\mathrm{n}} = B_{\mathrm{n\text{-}1}} + \frac{1}{N}(\mathrm{f}_{\mathrm{n}} - \mathrm{f}_{\mathrm{n\text{-}N}}) \tag{3}$$

In the upper form, it is explained that each new background model is based on the background model calculated on the last time. The current frame number FN and $fn\text{-}N$ image were deduced, which can be the background model is updated, apparently under this algorithm we can choose the maximum image frames of the background of the current reference.

In order to accurately extract the feature position of basketball and basketball appearance information through the image sequence of pixels, we need to carry on the two value processing to the image before and after the difference. The two value of the image is to set the gray value of the pixel on the image to 0 or 255, that is to say, the whole image presents obvious black and white visual effects. An image including the object, background and noise, to extract directly out of the target object from the digital image and multiple values, the threshold *T* the most commonly used method is to set a global, *T* image data is divided into 2 parts: the pixel group is greater than *T* and less than *T* pixel group. The pixel value of the pixel group greater than *T* is set to white (or black), and the pixel value of the pixel group less than *T* is set to black (or white). We need to determine a threshold before a grayscale image is processed by a two value. The threshold means the limit, so the threshold is also called the critical value, which means the minimum or maximum value that an effect can produce. In the conversion at the same time, the choice of the threshold is very important, in the choice of the threshold when the election is very much, we can work in the extraction of a lot of complex operations. The selection method we adopted in this paper is a new threshold segmentation method proposed by Kapur in 1988. This method is to define and segment the threshold by entropy. Will appear in a probability in all the time all the sources of information happens, if the entropy is maximized when the source of information when the uncertainty of the situation we will use the method of maximum entropy segmentation value, comparing the maximum entropy and by foreground and background. It can be expressed in the following mathematical expressions:

$$P_{\mathrm{i}} = \frac{N_{\mathrm{t}}}{M \times N} \tag{4}$$

On the *M*N* says is the size of the gray image, *Ni* is expressed in the grey image grey level is the total number of *I* points, and *PI* is the probability of grey. So, we can express the entropy of the target and the background region by the following mathematical expression:

$$H_{\mathrm{f}} = -\sum_{\mathrm{i\text{-}1}}^{T} \frac{P_{\mathrm{i}}}{P_{\mathrm{t}}} \log \frac{\mathrm{p_i}}{\mathrm{p_t}} \tag{5}$$

$$H_{\mathrm{b}} = -\sum_{\mathrm{i}=T+1}^{L} \frac{P_{\mathrm{t}}}{1-P_{\mathrm{t}}} \log \frac{\mathrm{p_t}}{\mathrm{1-p_t}} \tag{6}$$

$$P_{\mathrm{t}} = \sum_{\mathrm{i}=1}^{T} \mathbf{P}_{\mathrm{i}} \tag{7}$$

In the formula, Hf said in target region entropy, which L said is in a grey level image, the background region entropy we denote by Hb, through the above method we can calculate appropriate entropy, and we performed two in differentiation through this entropy as the threshold value will be collected data. The entropy method is a mathematical method used to judge the degree of dispersion of an index. The greater the degree of dispersion is, the greater the impact of the index on the comprehensive evaluation is. Entropy can be used to judge the degree of dispersion of an index. The average entropy is calculated as shown in table 1.

Background subtraction is a method to detect moving objects by comparing the current frame and background reference model in image sequences. Its performance depends on the background modeling technology used. In moving target detection based on the background subtraction method, the accuracy of modeling and simulation of background images directly affects the detection effect. Any moving target detection algorithm, as much as possible to meet the requirements of image processing of any scene, but due to the complexity of the scene, unpredictability, and the existence of a variety of environmental interference and noise, such as light, a sudden change in the actual background image in some motion and camera jitter, the moving objects in the scene the influence of the original scene, the modelling and Simulation of the background become more complex. Background subtraction is fast, accurate and easy to implement, and the key is obtaining background images. In practical applications, the stationary background is not easy to obtain directly. At the same time, because of the dynamic change of the background image, it is necessary to estimate and recover the background through the inter-frame

Grey level	Entropy	Over-dispersion	Average entropy	Threshold
0-40	3.6	2.2	2.9	2.9
40-80	7.3	3.4	5.35	5.35
80-120	2.3	5.3	3.9	3.9
120-160	1.4	4.7	3.05	3.05
160-200	2.3	5.3	3.8	3.8
200-250	7.3	3.4	5.35	5.35

Table 1. Table of Calculation Results of Average Entropy

information of the video sequence, that is, background reconstruction, so it is necessary to update the background selectively.

After a series of modelling above, we will use the MATLAB software to build the algorithm model. Built-in software and hardware environment of human-computer interaction platform, and each module of the algorithm model is studied in detail by high-speed camera design, we can capture the moving image after the end of basketball, the screen by high-speed computer and a background image of each frame were analyzed, and then the resulting the data were analyzed and compared, the shot detection results we need. This result has three advantages: accuracy, effectiveness and stability compared with the previous algorithm model.

4. Result Analysis and Discussion

In the process design of the whole algorithm, we consider each module's different rules and the overlap's impact. In the verification process of the algorithm, the location is in the local university indoor basketball court. this time we choose to design a special algorithm based on the data analysis will make a bunch of series in the video image, and then to the basketball position and the characteristic information of the current analysis, to determine whether the shooting. The data algorithm in the process has been used to reflect the actual situation. First of all, data query is one of the important applications of databases, so we first test according to the query function. Because in the coverage of information processing, the task base is large, we can handle results through 500 tasks, 1000 tasks, 1500 tasks, 2000 tasks and 2500 tasks at the same time; the results are as shown in Table 2:

Project	500	1000	1500	2000	2500
Information acquisition time	3	6	9	11	14
Information processing time	3.1	3.2	3.3	3.4	3.5
Feedback result time	2.2	2.2	2.6	2.8	3.0
Correct evaluation of time	7	7.1	7.2	7.3	7.4

Table 2. Processing Time Test Chart based on Data Algorithm

As shown in the table above, when the overall workload is only 500, the whole feedback time of the algorithm is 3S, and when the amount of tasks increases to 2000, the feedback time of the whole algorithm is 7*s*. The little difference in time almost negligible, it is easy to see that, with the increase of the task size, with little increase in the feedback time of the whole algorithm, so, the system in the feedback time and efficiency is under no pressure, the whole algorithm is feasible.

To further investigate the accuracy of the algorithm of data, because our algorithm is associated with the test data, the data

must be correct; our starting point is to catch a can provide answers to the test results, so we used 40 groups of image data were analyzed as shown in table 3:

Name	Layup times	Actual goal	Judgement goal
4	21	9	10
8	19	8	9
12	20	9	10
16	22	7	8
20	18	10	10
24	23	15	15
28	17	8	8
32	22	11	11
36	21	16	16
40	20	11	12

Table 3. Racy of Research Table

From the table, we can see that the system's accuracy can be as high as 90%, basically meeting the requirements of our detection, the main reason is the missed and false detection test system using the above test in there are some loopholes. So, we add the judgment condition of the system in the follow-up work, which is to improve the judgment method of the system.

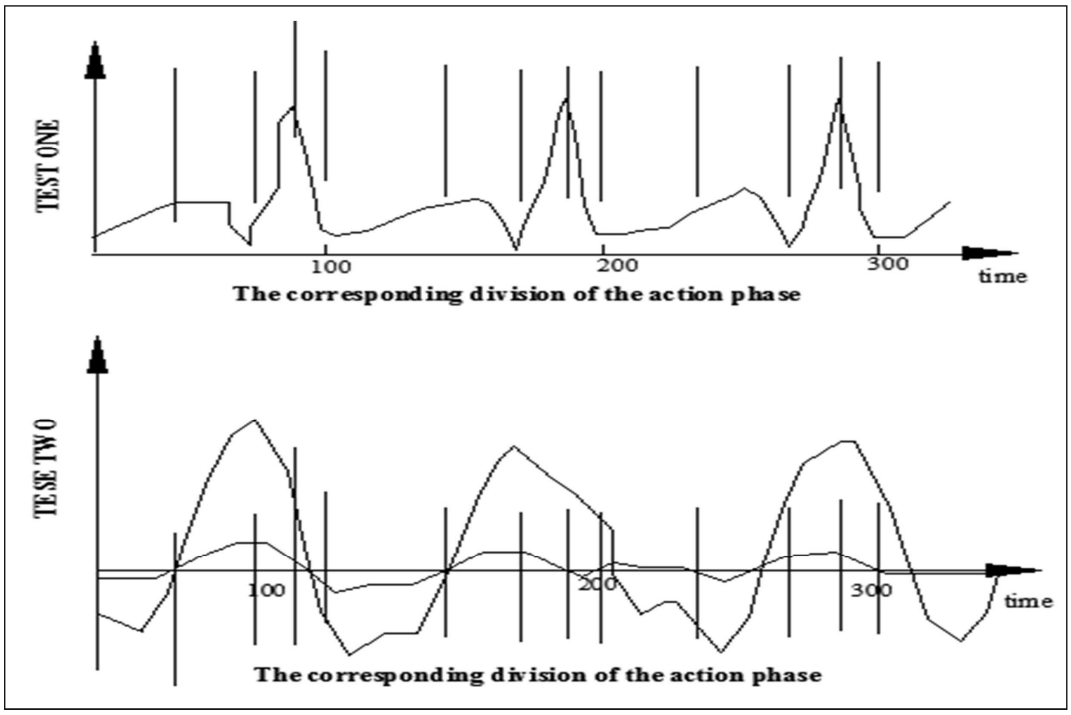

Figure 3. Image processing speed of two different video segmentation

The algorithm model needs to be tested in real-time, so this study solves the problems in the previous system. I believe that

our research and the application of motion capture technology it will greatly promote its practical application and make up for the lack of basketball detection technology. It can make timely analysis and processing in the event, so the treatment duration determines the real-time algorithm model; we need the following test, the running time of each module of Test One and Test Two in the video of the operation processing, the system in the process of each frame time is the time of each module, through the statistics we drew as shown in Figure 3 Schematic diagram.

From the picture above, we can see that the two kinds of image processing tools we have used have good graphics processing ability.

5. Conclusion

In recent years, with the rapid development of computer technology, the technology capture of moving targets has also been widely used in real life and many high-tech fields. In view of the current testing system for shooting improvement purposes, we will use the moving target detection technology to capture a moving target in this study, and the background subtraction method is used to study and comparison, we use the technology to detect shot. The research shows that the method used in this paper can record and evaluate the shot detection in real time and accurately. Finally, through 30 groups of real data testing system, we analyze and evaluate the automatic identification of shot from three aspects of accuracy, effectiveness and stability. Whether it is computer video technology or multidisciplinary high-tech products, it is necessary to play its practical value in practice. This research is only the tip of the iceberg, because of the time and energy and other objective factors, this study also has the potential of deep research and technical strengthening. The study of computer science still needs us to further explore, and believe that in the near future there will be a huge technological breakthrough, so that computer technology better serve our daily life.

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