World Scientific Research Journal (WSRJ) ISSN: 2472-3703
www.wsr-j.org

Development and Research of "Set Shoot" Basketball Teaching Course based on MC Technology

Honglong Xu[1, *], Qian Li[2]

[1]Department of Physical Education, Beijing International Studies University, Beijing, China

[2]Sports Department, University of International Business and Economics, Beijing, China

[*]57672476@qq.com

Abstract: Aim: To develop a "set shoot" basketball teaching course based on MC technology. Methods: MC technology, background difference method and basketball shooting characteristics are combined. A shooting detection algorithm based on the background difference method is proposed to assist the teaching process. During the detection process, only the position and status characteristics of the basketball in the basket area need to be judged. Aiming at this problem, using the method of region segmentation, the detection region is not automatically segmented, and the shooting detection system is completed. Results: From three aspects of accuracy, real-time and stability, the automatic shooting recognition system further accelerates the detection speed of the system. Conclusion: The recognition system can effectively speed up the shooting recognition.
Keywords: MC technology, Set shoot, Basketball teaching.

---

1. INTRODUCTION

Set shoot is an important scoring method for basketball and is the basis for other scoring techniques. Mastering good shooting skills and maintaining a high shooting percentage will enable athletes to take the initiative in the game. In the teaching of set shoot, students tend to deform their shooting movements due to nervousness, resulting in shooting errors. In the process of shooting teaching, the judgment of basketball characteristics and position during the process of judgment is the key to the whole process. As we all know, human beings mainly obtain external information through sight, hearing, touch and so on. However, the most external information obtained in these sensory organs is vision. Therefore, the information acquired by vision plays a very important role in human life. With the continuous development of science and technology, computers can replace the human eye and brain to perceive and analyze external information. This has become a very challenging and tempting study of the moment. Computer vision is a discipline that uses computers to simulate human visual systems. The ultimate goal of its research is to let the computer use the external image acquired by the

camera to understand and analyze the image to obtain external information [1]. So, can computer vision technology be used to extract the position information of basketball in the basket? The branch of computer vision technology, the moving target detection technology, was researched, analyzed and verified. It is proved that the method can not only obtain the position information of the basketball, but also obtain the appearance characteristic information of the basketball. This fundamentally solves many of the shortcomings of previous test systems.

In the process of shooting detection, the judgment of basketball characteristics and position information is the key to the whole system. How to detect, calculate and judge the position of basketball has become the focus of research in this system. In the current automatic test system, mechanical micro switches or sensors are mainly used to detect basketball shots. However, the biggest drawback of these two methods is that they are easily damaged, have a high replacement rate, and are difficult to install and manufacture. In addition, test scores may be affected. Therefore, a reliable, stable, and simple method of shooting detection needs to be proposed to replace the previous method, which is the most urgent need at present.

2. STATE OF THE ART

There are many methods for detecting moving targets [2]. With the continuous development of computer vision technology, the methods of moving target detection technology are constantly innovating and improving. With the support of the EU EULTR, the INRIA organization of the French National Institute of Computer Science and Control jointly researched and proposed an image processing-based monitoring system [3]. Funded by the Defense Advanced Research Projects Agency (DARPA), the David SARNOFF Research Center and Carnegie Mellon University have collaborated to develop the video surveillance and surveillance system VSAM [4]. LMaryland University has developed a real-time video surveillance system, the W4 system. The system can not only achieve the positioning of the human body part, but also achieve multi-person tracking [5]. CDVP (Distributed Vision Engineering) is used in remote conferences, smart communities, smart TVs, etc. [6].

3. METHODOLOGY

MC (motion compensation) technology is also known as motion estimation technology. The MC processes the entire image in real time. The computing power and data read and write speed requirements are relatively high. Moreover, as the resolution of the image increases, the requirement for the operation speed is increased by a multiple. Motion compensation is a method of describing the difference between adjacent frames (here, neighbors are adjacent in coding relationship, and two frames are not necessarily adjacent in the playback order). Specifically, it describes how each small block of the previous frame moves to a certain position in the current frame. This method is often used by video compression/video codecs to reduce airspace redundancy in video sequences. It can also be used for deinterlacing and motion interpolation operations.

The advantage of the background difference method is that the position is accurate and the calculation speed is fast, and the complete moving object can be segmented. However, the algorithm is sensitive to changes in the background image, and the background model needs to be updated in real time. The current image is first pre-processed before the detection of the moving object in the image. The first step in preprocessing is to convert the image and suppress the noise. Then, a background reference model is created using the initially captured image. Finally, the background reference model and the current frame image can be differentiated, and other subsequent processing is performed. The specific detection process is shown in Figure 1.

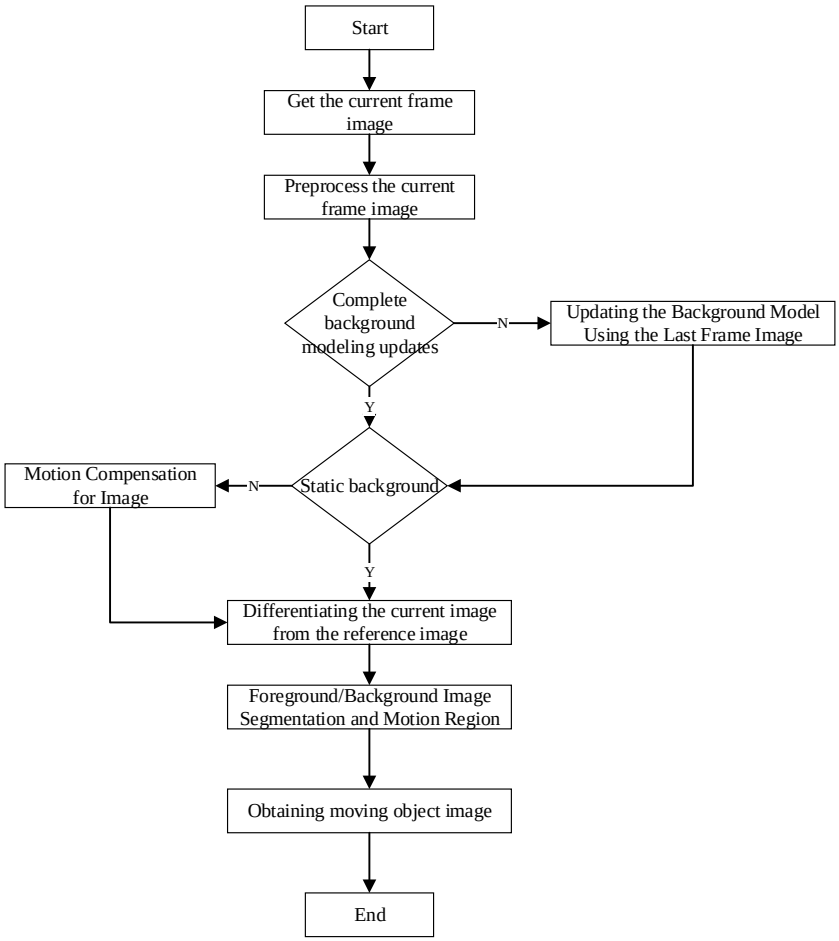

Fig 1. The specific detection process

4. RESULTS AND DISCUSSION

4.1 Shooting detection algorithm

The basic flow of the shot detection algorithm includes image capture, preprocessing and background modeling. First, MC technology is used to process background. Then, the detection method in the still scene is used to complete the detection of the moving object in the image. Image differentiation and image binarization are performed. After the above steps, the image is processed and the feature data of the basketball is extracted. Among them, min(x), min(y), max(x), and max(y) respectively represent the minimum and maximum pixel point

coordinate values in the X and Y directions of the basketball. Ball_Inforx, Ball_Infory represents the total number of pixels in the diameter of the basketball in the X and Y directions, respectively. Through this difference, the diameter of the basketball can be calculated, and the calibration coefficient of the pixel corresponding to the actual size of the object is m_CamDistance. Ball_R is the diameter of the basketball. Ball_Center (x, y) is the position coordinate of the center of the basketball in the image. K is a ratio coefficient of Ball_Inforx and Ball_Infory, which represents the ratio of the pixel difference values in the X and Y directions. For example, Ball_X and Ball_Y represent the diameter in the X direction and the diameter in the Y direction, respectively.

The most important thing in extracting features is the detection of the coordinate points in the X and Y directions of the basketball in the image. All calculations are based on these four coordinate points for analysis.

$$Ball_{Inforx} = \max(x) - \min(x) \tag{1}$$

Ball_Infory is the same.

$$Ball\_R = \frac{Ball\_Inforx + Ball\_Infory}{2} \times m\_CamDis\tan ce \tag{2}$$

$$Ball\_X = Ball\_Inforx \times m\_CamDis\tan ce \tag{3}$$

Ball_Y is the same.

4.2 Judgment method

There are three conditions in the system to determine whether a goal is scored. If any of the conditions are not met, it is considered that the basketball is not thrown, and the image is re-captured for detection until the end of the test time.

Condition 1: The calculated size of Ball_Y or Ball_X must be less than 24cm. Because the diameter of the basketball is 24.6cm, if it is greater than 25cm, it means that the basketball is only on the ball frame and is not put into the basketball box.

Condition 2: Comparing Ball_Inforx with Ball_Infory, if the ratio coefficient K of the two is greater than 1.1 or less than 0.9, it may only detect noise in the image or just a part of the basketball, indicating that the basketball is not all above the basket.

Condition 3: If both of the above conditions are met, the Ball_R is compared with the diameter Ball_r of the basketball goal obtained during the commissioning process. When Ball_R is smaller than Ball_r, the basketball is thrown into the basket, and the system automatically increments by 1.

In the test, the basketball shooting is judged by these three conditions. If it is judged to be a goal, the system will delay 0.3ms. This is because after the goal, it is still possible to detect the basketball that was previously judged as a goal. Therefore, the purpose of the delay is to wait for the previous one to pass through the basket to avoid false positives.

4.3 Evaluation and comparison of system performance

The accuracy of the system was analyzed and evaluated by continuously testing 30 sets of data. The data is shown in Table 1:

Table 1. Evaluation of the accuracy of the test (%)

Name	Noise factor	Missing detection rate	Accuracy rate
30 sets of data	6.66%	3.33%	90.01%

The accuracy evaluation mainly refers to the accuracy of the system in the detection process. It mainly includes false detection rate, missed detection rate and accuracy rate in the test system. The accuracy of the system can reach 90%, which basically meets the requirements.

Table 2. Evaluation of real-time of the system

Name	Image pixels	Target number	Image capture	Processing link	Output display	Total time	frame rate
Test One	320*240	1	0.0029	0.058	0.000005	0.061	16.4
Test Two	320*240	1	0.0028	0.060	0.000005	0.063	15.9

(Image Size Unit: Pixel; Frame Rate Unit: Number of Frame/Second Targets: Number; Other Units: Second/Frame)

Real-time is the ability to analyze and process this matter in a timely manner when something happens, but the processing time may be long or short. If the processing time is short, real-time performance is good. Correspondingly, if the processing time is long or the response is slow, the real-time performance is bad. In video processing, the real-time nature of the system means that when an event occurs in the video, the time that the system responds to the event in time should be as short as possible. Due to the video processing and analysis, it is generally considered that the speed of the processed data of the video is 10-15 frames per second, and the system can be considered to be close to the real-time system.

As can be seen from Table 2, the frame rate of the system processing local video can reach 15 frames/second above. Therefore, the system can be considered to meet the real-time requirements of the video processing system.

Stability refers to the ability of the system to overcome interference, handle emergencies, and recover from normal errors. In general, to evaluate the stability of a system, the system should be run in different environments for a long time. The stability test of the system is to run the software for a long time. Due to certain objective factors, the system can work for 8-10 hours temporarily.

The system performance comparison is mainly based on the current system and the set shoot automatic detection system (the existing Hunan Sports College Entrance Examination equipment) to compare the same scene. The performance of the system and the advantages of the current testing equipment are obtained. The disadvantages are further improved.

The existing equipment detected 30 shots. The data is shown in Table 3.

Table 3. Existing shooting statistics

Name	Layup times	Actual goal	Judge goals
1	21	9	9
2	19	7	7
3	21	6	6
4	21	5	5
5	20	7	7
6	22	4	4
7	18	7	7
8	20	3	3
9	21	7	7
10	23	8	8
11	18	9	9
12	19	6	6
13	17	7	7
14	23	6	6
15	22	8	8
16	21	7	7
17	21	6	6
18	20	2	2
19	22	5	5
20	21	3	3
21	23	5	5
22	22	7	7
23	21	8	8
24	18	7	7
25	19	8	8

Table 4. Evaluation of the accuracy of the test (%)

Name	Noise factor	Missing detection rate	Accuracy rate
30 sets of data	6.66%	0%	93.34%

At present, the accuracy of physical examination equipment is higher than that of shooting detection system based on background difference method, and the accuracy rate reaches 93.34%. However, as can be seen from Table 4, the misdetection of the existing test system mainly appears in the latter data. The number of shots is increasing, and the accuracy of existing test systems will drop dramatically. The false detection and missed detection based on the background difference shooting test system are random. It does not reduce accuracy due to the increase in the number of shots. If the number of system detections is higher, the accuracy of the detection system based on the background difference method will be higher than that of the existing test system. In real-time, both the current detection system and the background-based shot detection system can achieve real-time requirements. In terms of stability, the existing test system will drop sharply due to the increase in the number of shots. Through the system's three performance evaluations, the system not only works well, but also fully meets the real-time requirements of processing video.

5. CONCLUSION

Based on the MC technology, the moving target detection technology realizes the design and development of the basketball shooting automatic recognition system, thus assisting the "set shoot" basketball teaching course. Only the basket area is detected. Thus, when multiple targets appear, the phenomenon of the system extracting the wrong basketball feature data is overcome. In addition, the operating speed of the system is indirectly improved. Then, combined with the characteristics of basketball in the shooting process and the idea of background difference method, the shooting detection algorithm and detection process are determined. Through experiments and analysis, the feasibility and accuracy of the shooting detection algorithm are verified. The automatic shot recognition system is designed. However, due to the influence of time, energy and other objective factors, the depth of research needs to be strengthened and expanded.

REFERENCES

[1] Turkmen M, Ozkan A, Kul M, et al. Investigation of the Relationship between Physical Activity Level and Healthy Life-Style Behaviors of Academic Staff. Educational Research & Reviews, 2015, 10(5):577-581.

[2] Babic M J, Morgan P J, Plotnikoff R C, et al. Physical Activity and Physical Self-Concept in Youth: Systematic Review and Meta-Analysis. Sports Medicine, 2014, 44(11):1589-1601.

[3] Kushwaha A K S, Srivastava S, Srivastava R. Multi-view human activity recognition based on silhouette and uniform rotation invariant local binary patterns. Multimedia Systems, 2016, 23(4):1-17.

[4] Garcia-Rodriguez J, Orts-Escolano S, Angelopoulou A, et al. Real time motion estimation using a neural architecture implemented on GPUs. Journal of Real-Time Image Processing, 2016, 11(4):731-749.

[5] Walha A, Wali A, Alimi A M. Video stabilization with moving object detecting and tracking for aerial video surveillance. Multimedia Tools & Applications, 2015, 74(17):6745-6767.

[6] Bousetouane F, Vandewiele F, Motamed C. Occlusion management in distributed multi-object tracking for visual-surveillance. Pattern Recognition & Image Analysis, 2015, 25(2):295-300.