The Study of the Application of the Video Processing Software in Physical Training

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Abstract. Based on literature research and the application development of the computer video image processing software, this paper studied the application of the image processing technique in physical training. It mainly includes the four parts: introduction of the image processing technique; the newly invented techniques and their development when applying it in physical training; the ways to apply this technique in track and field training and the main forms and effect that this technique fed back to training, and the required equipments both for hardware and software and the main objects. It is estimated that in the future, the image processing technique will be widely applied to the physical research and service.

1 The Working Procedure of the Application of the Video Image Processing Technique in Physical Training

Both the application of the image processing technique and the application of the living examples of image processing in the items of track and field training are widely adopted. Based on our experience of researching and serving, we have the following conclusions:

1.1   The Application of Pictures of Sports Skills

1.1.1 An action series is usually got by shooting a whole stroking technique, and then collecting the pictures of the movements at key phases continuously, making them into the action series and then displaying it to the athletes to feed back. In this way, the athletes may observe their stroking technology clearly. This method has been adopted by the researchers for many years[1]. For example, Li Meiju, the excellent female shot putter, has the best score of 18.78m in the Olympic trial, and her movement was shot and produced as the action series of the key phases, so it was easy to observe and analyze the features of her movements at any phases directly. (Picture.1)

Picture 1 Li Meiju's action series of her stroking technique

1.1.2 The Composite Picture of Action Series at Key Phases

Under the same background, to put many continuous movements pictures at key phases into one picture to form a completed technical picture. The advantage is to observe the change of the movement under one background more clearly. For example, picture 3 is the composite picture of Liu Xiang's skills of 13.06s. By this picture, the integrity of Liu's movement when clearing thebar can be well observed. (picture 2)

Picture 2 Composite picture of Liu Xiang's skills at key phases when he run 13.06s

1.1.3 The Comparison between Two Pictures of stroking technique

It may be of one athlete or different athletes in different contests or training. By opposing two pictures up and down or left and right, we can clearly find the technical distance and shortcomings. For example, in order to study the supporting of the ankle when touching the ground[2], we compared the picture of stroking technique of Liu Xiang with that of another athlete of hurdle race. And we find that Liu's plantar flexion angle of his ankle is obviously bigger than that athlete, which means that Liu's ankle supporting ability and falling angle are much better than that athlete. (picture 3)
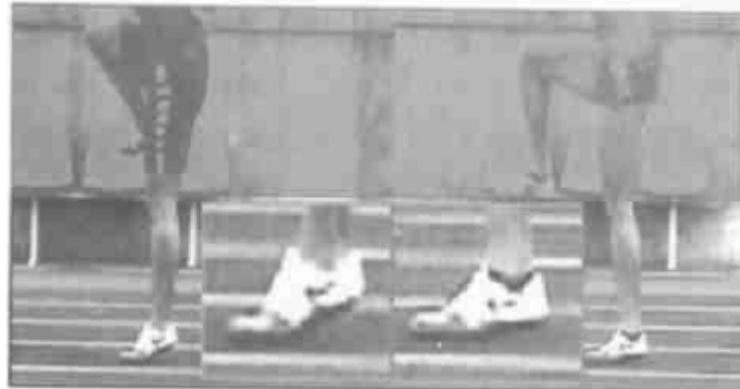

Picture3 the comparison between the two pictures: Liu Xiang's plantar flexion angle and that of another athlete of hurdle race

1.1.4 The Comparison among Multitude Pictures of stroking technique

If needed, we can use multitude pictures of stroking technique to compare, which focus on one action performed by 3 or 4 athletes. And the technical shortcomings and the ways to improve may be detected by this comparison.

1.1.5 Composite Pictures of techniques, key parameter and data curve

By using image processing software or the professional image editing software, the picture of stroking technique, key parameters and the curves can be linked together organically. And that will produce a complete picture of stroking technique to reflect the skill from many aspects[3]. This method may help the athletes and the coaches to master the feature of a sport skill deeply. Take Liu Xiang and Shi Dongpeng as an example, we want to study the change of the angles of their hip joint (or other parameter data), so we can do it by setting the video as "analyze characteristics of angle parameter with time-varying", and then got the synchronization display of the hip motion curve, in this way, the key point of the study will be highlighted. (picture 4)
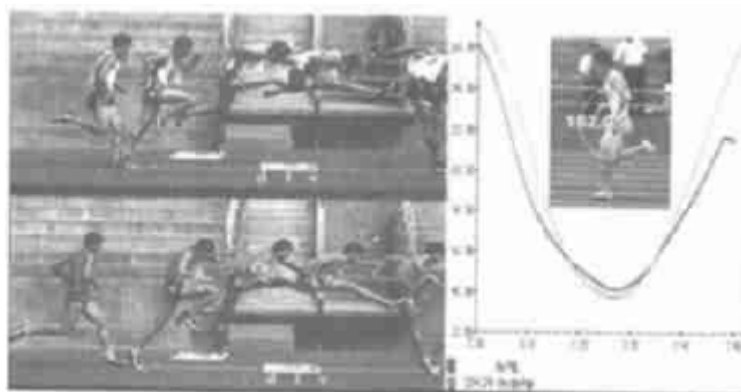
Picture 4 the change of Liu Xiang, Shi Dongpeng's hip joint with time varying and their curves

1.1.6 3D Simulated Picture of Stroking Technique

By analyzing of the picture of stroking technique from three dimensions, we can get the simulated 3D picture of sports skills. It means that it is possible to get the simulated picture of stroking technique from different angles, so that it is easy to observe and analyze the integrity of sports skills. Moreover, the simulated picture can combine with the real picture of sports skills, then produce various types of composited pictures, which may contain more technical information of the movement.

1.1.7 The Recognition of the Key points of the Sports Skills and the Moving Orbit

When analyzing the sports skills through 2D or 3D pictures, it is necessary to know the key points during the movement, and to use the orbit curve to show the change of the key points. This method may reflect the sports skills technique well. So far, there are two ways to do the recognition, manual operation and automation. The advantage of manual operation is that it is easy to mark on the picture accurately, there are still some shortcomings and defects for the automatic recognition, for example, it cannot do the tracking and recognition accurately, the technology needs further improvement. The adoption of the technique of image recognition can show clearly the changes of the moving orbit at key points, which effectively reflect the features of the sports skills[4].

When study Liu Xiang's technical action of clearing the bar, the technique of image recognition can be used to record the moving orbits of the hip joint of the kicking leg to study its amplitude of swing and fluency.

1.1.8 The Processing of the Background of the Sports Skill Picture.

If needed, there is professional image processing software to remove, add or change the background of the moving subject. That is to say, the subject may be abstracted from the background according to its color, contour features to have other technical processing.

1.2 The Application of Video Image Technique

1.2.1 Video Multi-image Interception Persistence in One Picture

To intercept the images of key points of the same movement and then persist in the same visual image, so when display, we can find several images of technical movement just in one picture. Production of a series of the video image interception persistence may enable us to observe the features of the continuous change of the sports skills. For example, picture 5 is the multi-image interception persistence in one visual image, and these images are abstracted from the video of Ji Fangqian, who is an athlete of hurdle race from Beijing Team.
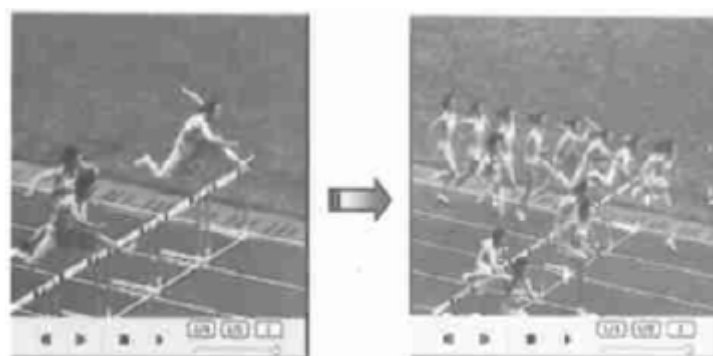
Picture 5 the interception persistence of the video image of Ji Fangqian's skill

1.2.2 Video Overlapping

When overlapping two video images of sports skill directly, first we should synchronize the two video images, and adjust the clarity to highlight the overlapped subjects. This technique includes the direct overlapping of the static background on the same site; overlapping after removing the moving background on the same site; direct overlapping of the static background on different site; overlapping after the removing of the static (or moving) background on different site; the direct overlapping of the scanned images; the overlapping of the background removed scanned images etc. This technique will clearly show the technical advantages and disadvantages between two players. And it is often adopted in the field of track and field training research and service.
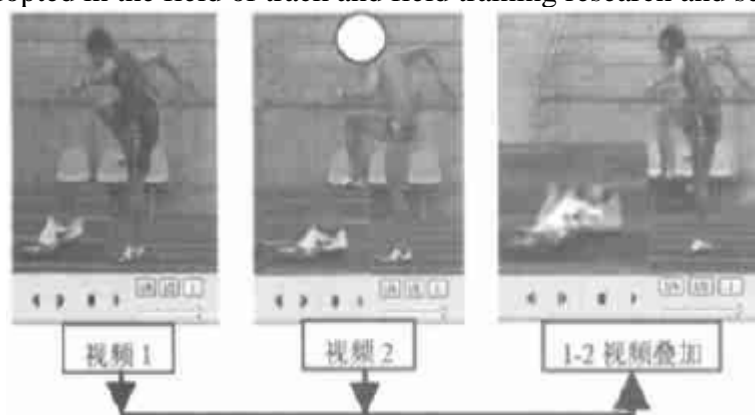
Picture 6 the overlapping of the videos of Liu Xiang and another athlete of hurdle race

The synchronized comparison of the multi-screen display of the video images mainly includes overlapping comparison of video images; comparison of video images displayed in multi-screen, comparison of the video images from many angles displayed in multi-screen and overlapping comparison of video images from many angles displayed in multi-screen[5]. And it also can have two or three or even more athletes' one action shot and then have the overlapping and multi-screen comparison. For example, in 2004, Liu Xiang ran the best score of 13.06s in Tianjin, and during that race, three cameras shot from three angles and then by using professional image processing software three video images are produced and they are displayed in one picture to have the synchronized comparison. So the feature of his sports skills is well presented from three angles. (picture 7)
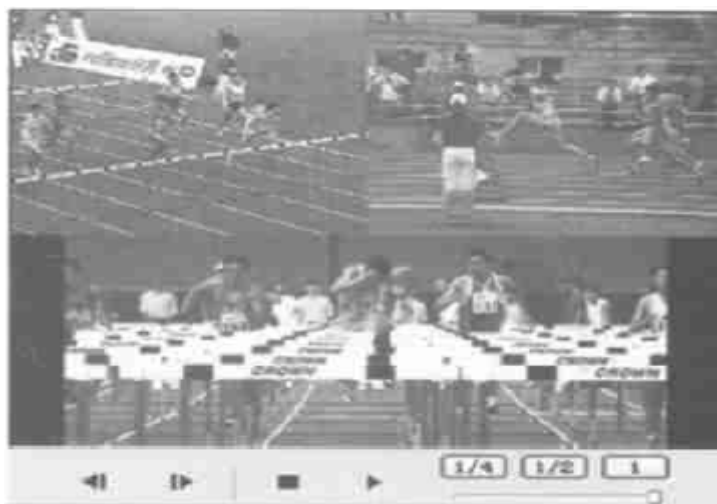
Picture 7 the three machines' multi-screen display of the synchronized comparison of Liu Xiang's skill when he ran 13.06s

1.2.3 The Speed of Displaying the Video Image

As to the video image, we can have it displayed as slow as possible, so certainly, the displaying speed of these files may be adjusted to meet the needs of the athletes and coaches, which make the displaying speed more suitable to observe and study.

1.2.4 The Enlargement of the Video Image at Many Levels

As to the moving subject in one video image, some key points can be enlarged, and put these enlarged images into one picture to display. This method may emphasize these key points, and make them easy to be observed and analyzed.

1.2.5 The synchronization of the simulated image of the videos, graphs and curves means all these factors may appear in one picture simultaneously, such as the 3D video image, 3D simulated motor image, the graph of the change of the key parameters and the parameter curves, which enrich the video image with more beneficial information, and wholly feed back the qualitative analysis and quantitative analysis of the sports skills. For example, the 3D video was shot when Song Aimin was training, and the video was made into the 3D simulated images and the curve of the discus changing with time. And these were output simultaneously, which enable the coexistence of the original video image, the simulated image from different angles and the curve of the discus in one picture. Then the video images were output to meet the needs of the coaches and athletes for observing and analyzing. This method can ensure the improvement of sports skills. (picture 8)

Picture 8 the 3D simulated picture of Song Aimin throwing discus

1.2.6 The Format of the Video of Sports Skills—VCD and DVD

The videos which have been processed or the original digital video can be saved as video files (by the format of avi, mpeg-1, mpeg-11 or DVD, which may be repeated on the computers, home video equipments, or these can be made into continuous animation to be uploaded to the internet by the format of Gif).

1.2.7 the Computing of the Key Parameters of the Video Images

As to the video images, we can employ the coordinate markers, the gauge and the angulation etc, to calculate the parameter data of key points that may change with the time such as distance, the even speed, angle and so on. In this way we can have the quantitative study of the features of sporting skills.

1.2.8 The Making of Multimedia and the Output System of the Mix of Pictures and Words

The forms of the making of multimedia and the mix of pictures and words mainly include the overlapping of the videos; the synchronized comparison of the videos; the mix of the video, moving orbit and curve; the mix of words, animation, bar graph and orbit, curve and so on. The forms of the output are screen display, CD burning, and video tapes, data package transmission, PPT, technical pictures and technical video images etc.

Video image processing technology is widely used in the track and field training, and has already got the practical benefits, and it may have much development in the future. As to the application in other fields, we won't go into details.

2 The Main Object of the Application of the Video Image Processing Technology in Track and Field.

During the research service for the training of track and field items, it has significant effect on the improvement of athletes' training level if the various forms of video image processing techniques have been adopted, because it can feed back directly and quickly about the skills of the athletes. It is possible that the image processing technology may be widely applied in other fields. Its application objects are as follows:1)the timely feedback of the video image on the site of the physical training；2）the diversity of the forms of feedback of the video image processing and technical image making on the site of the skill training；3）the direct perception of the information procession of the video image of the sports skills；4）the scientificity and practicality of the comparison of the video image of the sports skills；5)the comprehension of the qualitative diagnosis, the quantitative evaluation of the parameter of the key sports skills and the ways of feedback such as multimedia;6)the speedy feedback, the object perception and the diversity have great effect on the improvement of the training level.

3 The Outlook of This Technology

So far, video image processing hasn't been widely applied in the physical training because of the price of the software and hardware and the application of the portable recording collection and image processing system. In the future, if we want to get the speedy video image feedback on the site of the sports training, not only the computer technology should be improved but also the clarity of the video image. But it is urgent to develop a system software of video image processing which is more portable, powerful, easy to operate and practical.

With the increasing development of the physical scientific training in our country, and the fast growing of the level of competitive sports in the world, and the increasing development of computer technology and professional image processing software, video image processing technique, being the most direct, speedy and effective auxiliary means for physical training will get more and more attention.

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