A study on physical education and motion detection based on information and SSIM technology

Jian Zhu

Zhongyuan University of Technology
Henan, People's Republic of China

ABSTRACT: Information technology increasingly is applied in physical education and motion detection; thus, providing both opportunities and challenges for physical educators. The current level of physical education and motion detection should be improved. The study presented in this article is an outline and consideration of the impact of information technology on physical education and motion detection from different perspectives, according to the application of information technology in physical education and motion detection. A detection algorithm based on an improved SSIM (structural similarity) index is proposed. Experiments proved that the improved method can detect the motion of an object in video, accurately and efficiently.

INTRODUCTION

Physical education and motion detection is a subject that has developed during long-term use in sports teaching and detection. The study of physical education and detection, which is theoretically difficult, supports the accelerated development of physical education and detection as a discipline.

BASIC CATEGORISATION AND LOGICAL STRUCTURE OF PHYSICAL EDUCATION AND DETECTION

Physical education and detection is a category with the following aspects: physical education and sport, sports teaching and motion detection, teachers and students, coaches and athletes, teaching content of physical education and sports detection, teaching methods for physical education, methods and means of sports detection, as well as the objectives of physical education and the goals of sports detection technology.

The physical education and detection category is the *knot* or fastening by which people can be brought to the understanding of sports teaching and motion detection. The category linkage is the path by which understanding is reached of the teaching and detection process.

The category system is the tool that helps people to grasp physical education and detection. So, the category system of physical education and detection plays an important role in helping people to understand sports teaching and motion detection [1].

The logical structure of the categorisation system for physical education and detection is a dynamic, three-dimensional structure composed of a starting point, intermediary and terminal categories, which have mutual connection, mutual influences and interactions with each other in the process of developing from the simple to the complex, from the beginning to the end and from the abstract to the concrete.

In this structure, the starting point of physical education and detection is motion. The central category is sports teaching and sports detection. The intermediate category is the subject and object of the sports teaching and motion detection. The terminal category is the goal of sports teaching and motion detection [2].

Study on these basic categories should be expanded, in order to determine the content role and characteristic of each one. Meanwhile, each category is arranged in order and associated with each other, so that they can reproduce the logical process, which develops from the simple to the complex, from the abstract to the concrete, as shown in Table 1.

Table 1: Part of the structure index in different periods of the co-operation network.

	1912-1970	1971-1980	1981-1990	1991-2000	2001-2011
Number of organisations	1	22	114	857	2713
Selected threshold	≥ once	≥ twice	≥ twice	≥ five times	≥ ten times
Number of nodes	1	5	18	35	152
Connection number	0	1	4	32	307
Network density	--	0.1	0.0261	0.0568	0.0268
Average degree	--	--	0.28	1.656	3.782
Network clustering coefficient	--	--	0.00	0.199	0.198
Average path length	--	--	1.2	3.117	3.595
Centre point of potential	--	--	10.49 %	21.45 %	7.26 %
Intermediate potential	--	--	0.74 %	20.88 %	9.19 %
Distribution of node degree	--	--	--	logarithm	logarithm
R²	--	--	--	0.9014	0.9689

TECHNOLOGY STRUCTURE OF THE PHYSICAL EDUCATION AND DETECTION SYSTEM

The key technologies in the design of a sports education system include two broad categories: multimedia and information technology. The information network, terminal equipment and teaching resources combine to form the technical system of education, as shown in Figure 1.
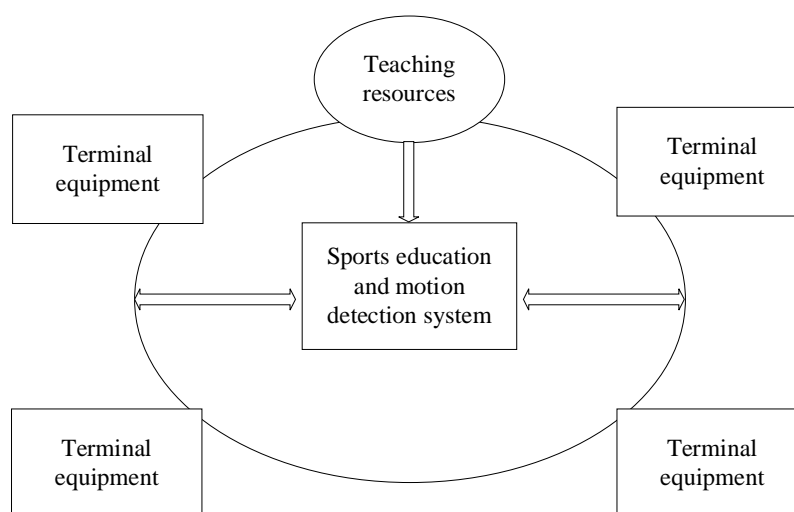

Figure 1: The physical education and detection system.

The information network and terminal equipment consists of the hardware supporting the sports detection system environment, which delivers the physical education and detection services to students. The information network connects independent terminal devices in a decentralised network, so that they can communicate and share information with each other. The terminal devices can receive, process, and make available to students, information from a variety of sources [3]. The software for the network education and detection system is at the core of the system.

Network education focuses on the active development of learners and facilitates distance learning and continuing education. Compared with traditional education, network teaching greatly improves the quantity, quality and pace of learning. In this virtual world, teaching characterised by visualisation, stereoscopic displays and other sensory inputs, stimulates students' interest in study, self-initiative and ability [4].

The department in charge should plan for the establishment of a special physical education and detection organisation to ensure effective implementation. The task of this specialised organisation is to ensure the effective development of

physical education and detection, by establishing and maintaining the three network sub-systems, which are prerequisites. These three networks are described below.

- *The network education and detection management subsystem:* this is responsible for the administration of the education, teaching and resources. It also includes quality assurance in order to help co-ordinate the various teaching and support activities, and the relationship between the education system and learning environment [5]. The main work includes planning, determining learning content, teaching requirements, teaching methods and selection of teachers.

- *The network education and detection information subsystem:* this is an instruction execution system, which includes the teaching resources database and information exchange process. The main task is to help strengthen information exchange between teachers and students. Teaching resources should be linked to support remote information communication through the network [6].

- *The network education and detection supporting services subsystem:* this is responsible for the technical operation of the network teaching system. It provides all kinds of network counselling, guidance and assistance services.

MOTION DETECTION BASED ON AN IMPROVED SSIM ALGORITHM

The SSIM (structural similarity) index is a measure of the similarity of two images. The SSIM index uses three factors: brightness, contrast and structure. It is often used in image processing, especially in image de-noising. It uses the SAR (signal to noise ratio) and PSNR (peak signal to noise ratio) for the image similarity evaluation.

An algorithm presented in this article was used to calculate the similarity between adjacent picture frames. This determined whether there are people or things entering or leaving the monitored area. The SSIM algorithm proposed was implemented using MATLAB.

The SSIM Algorithm

A problem when comparing two images is that the structural information of the objects in the images can be affected by brightness. To avoid this, the mean luminance or brightness value of the image is subtracted. Another problem is that the structural information could be affected by image contrast and, thus, the variance of the images should be normalised. After these two steps, the structural information of the image can be calculated.

The correlation coefficients of the two images can be simply calculated. However, to obtain the degree of difference between two pictures, the impact of the brightness information and contrast information should be considered. Therefore, to return the similarity of two images requires the calculation of the results of the brightness comparison, contrast comparison, and structural information comparison. The work flow chart is shown in Figure 2.
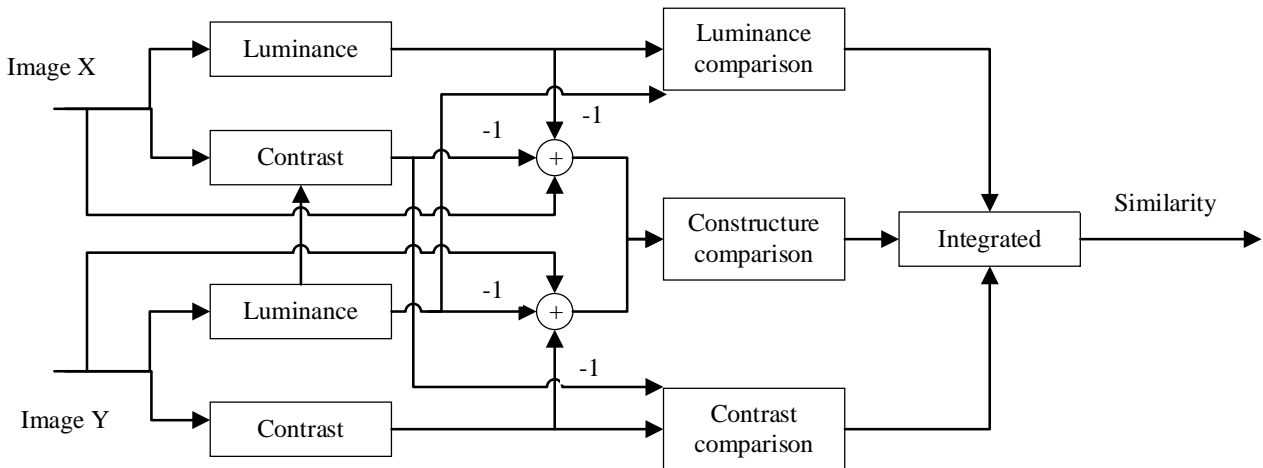

Figure 2: The SSIM work flow.

The SSIM Index Mathematical Definition

If $L(X,Y)$ is the brightness comparison function of the two frames, then,

$$L(X, Y) = \frac{2 \cdot E(x) \cdot E(y) + C1}{E(x)^2 + E(y)^2 + C1} \tag{1}$$

where $E(x)$, $E(y)$ are the mean brightnesses of the images. C1 is defined and discussed below.

If $C(X,Y)$ is the contrast comparison function of the two frames, then,

$$C(X,Y) = \frac{2 \cdot D(x) \cdot D(y) + C2}{D(x)^2 + D(y)^2 + C2} \tag{2}$$

where $D(x)$, $D(y)$ are the variances of the images. C2 is defined and discussed below.

If $S(X,Y)$ is the structural similarity comparison function of two the frames, then,

$$S(X,Y) = \frac{2 \cdot D(x \cdot y) + C3}{D(x) \cdot D(y) + C3} \tag{3}$$

where $D(x \cdot y) = COV(X,Y)$ is the covariance of the images X and Y.

C1, C2, C3 are used to ensure the stability of the result [3]. Usually, C1 = $(K1.L)^2$, C2 = $(K2.L)^2$, and C3 = C2/2 with K1 << 1, K2 <<1, and L is the maximum pixel. This is used to define the sensitivity of the monitor screen. Finally, the structural similarity index is:

$$SSIM(X,Y) = L(X,Y) \cdot C(X,Y) \cdot S(X,Y) = \frac{[2E(X) \cdot E(Y) + C1'] \cdot [2D(X \cdot Y) + C2']}{[E^2(X) + E^2(Y) + C1'] \cdot [D^2(X) + D^2(Y) + C2]} \tag{4}$$

IMPACT ON STUDENTS OF THE USE OF INFORMATION TECHNOLOGY IN SPORTS DETECTION

The Impact of Information Technology on Teaching

Information technology can provide teaching material at any time and in any location given through appropriate communications and computer support. Information technology can combine teaching material including text, images, sound and animation, to achieve the efficient transmission of educational information. This can motivate students to engage in observation, experiment, conjecture, modelling, verification, reasoning, communication and problem-solving. This can change students' learning style and role of the teacher and, hence, help construct a new relationship between teachers and students [7].

Multimedia computer-aided sports teaching and detection is of great significance in optimising sports teaching and detection to stimulate students' motivation and interest in sports detection. This enhances students' understanding of sports theory and improves the quality of physical education. With images, animation, video, voice and other media reflecting dynamic changing processes, teachers can stimulate students to learn.

The Impact of Information Technology on Students' Ability to Analyse and Solve Problems

The teaching mode predominantly adopted in traditional physical education is for students to practise, according to the teacher's explanation and demonstration. Educational psychology research shows that interest is the most practical and active factor in learning motivation. People with great interest will grasp knowledge quickly and definitely. Under the influence of the traditional mode of physical education teaching *the absolute authority of teachers* emphasises teachers' active transmission and students' passive absorption of knowledge, instead of teaching students in accordance with their aptitude. As a result, students only absorb knowledge according to the teacher's fixed mode of thinking. This limits the student's thinking and initiative.

It is better to apply modern information technology to sports teaching, putting the knowledge, techniques, technical difficulties, key points, and common wrong actions into sports teaching software. This can cultivate the initiative and enthusiasm of students, and improve their ability to analyse and solve problems in the process of discussing, proposing, and analysing questions. The application of information technology in learner-centred teaching, improves sports teaching content and methods.

The Function of Information Technology in Improving Students' Motion Skills

Some motion techniques in sport are complex and need to be performed very quickly. Using multimedia technology difficult technical actions can be clearly portrayed using animation or images together with slow motion, pausing, replay, explanation and demonstration.

The detection objects allow the technical details of every moment of the action to be seen clearly, so that teachers can explain the main points of each decomposition of the motion to demonstrate the whole action. Hence, students can grasp the key parts of the action and highlight the key points and difficulties. Information technology can highlight

technical difficulties, key points and common faults to students, allowing for analysis and comparison, with students putting forward and solving problems. This can help the detection objects in establishing faster motion representation, thus, improving efficiency in learning the correct action and, in general, improving sports skills over a short period of time.

CONCLUSIONS

The advent of the information age is closely aligned with the development of modern technology. Computers and networks are at the heart of it. Information technology increasingly is changing the mode of production, lifestyle, work and study. As modernisation of education progresses, modern information technology also is developing in the classroom.

Information technology has been applied to various disciplines, so as to improve teaching quality. It is because physical education involves multiple disciplines, with a combination of knowledge, skill and physical exercise that information technology has become an indispensable tool in sports teaching and motion detection.

REFERENCES

1. Liu, Y., Modern information technology in the sports teaching the application of exploration. *J. of Shandong Sports Science and Technol.*, 62-65 (2011).
2. Li, F.H. and Wang, Y., Competitive sports and information technology. *J. of Guangzhou Institute of Sports* (2004).
3. Huang, Q., Data mining application in sports detection guide research. *J. of Beijing Institute of Sports* (2009).
4. Zhong, Y.P., The application of information technology in sports detection and prospect. *J. of Wuhan Sports College* (2008).
5. Burton, C., The Research of Graduate. Berkeley, Los Angeles, London: University of California Press (2003).
6. Dixit, A., American graduate schools of education. *A View from Abroad, Ford Foundation* (2002).
7. Mirrlees, J.A., The theory of moral hazard and education behaviour. *Review of Educ. Studies*, 21-23 (2005).