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INNOVATIVE SYSTEM FOR ASSESSING THE QUALITY OF PERFORMANCE OF A MANDATORY GYMNASTIC PROGRAM BASED ON IT TECHNOLOGY MOTIONCAPTURE

Shohimov Jonibek
Lecturer of the Department of Interfaculty Physical Culture and Sports,
Bukhara State University, Republic of Uzbekistan

Annotation
Motion Capture (MoCap; motion capture) is a technology for recording human movements, which are then used in computer graphics. Since the human body is complex, it is much easier and cheaper to record movements, for example, of athletes, and then translate them into three-dimensional models in a computer for analysis than to animate three-dimensional models by hand

Keywords: innovative system, Motion Capture, StickMan

It is proposed to use a computer system, which, using the technology motion capture (MoCap), will allow for regular assessments of the quality of gymnastics performance by athletes. MoCap technology allows you to analyze the video recording of an athlete's performance and create on a computer using computer graphics a model of the dynamic movement of a "computer man" (StickMan "stick man") This dynamic model mirrors on a computer all the real movements of the athlete recorded on the video. The quality assessment methodology assumes that there is a record of the exercise performed by the master of sports, which is considered a reference. From this recording, a StickMan reference motion model is created, with which the motion models obtained from student videos will be compared. As a result of the comparison, it is possible to calculate the rating of the quality of the exercise as a whole, as well as the rating of the correct movement of individual parts of the athlete's body. Based on the results of the trainings, a database will be kept, characterizing the tendencies of improving the quality of this exercise by this athlete.

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Currently, MoCap technology is used primarily for animation in films and computer games. The paper proposes to use a comparison of movement in a computer for two athletes - the first model of movement is built according to the performance, for example, of a master of sports, and is a reference or basic model. The second model of movement, built on the video recording of the student's performance, is compared with it. The comparison result characterizes how well the student performed the exercise - both in general and in terms of the movement of individual body elements.

The history of MoCap technology and its applications

Motion Capture (MoCap) technology - or "motion capture" - a method that allows you to control the movements of characters in computer graphics (for example, in computer games) based on copying the movements of people that are recorded from video cameras.

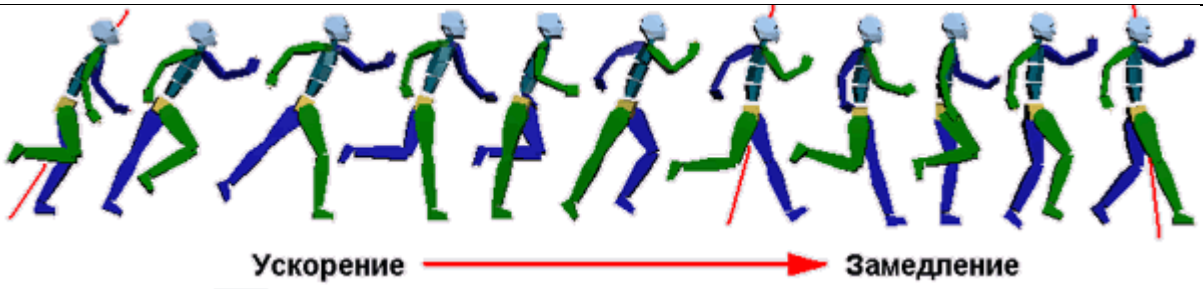

Fig. 1 An example of a dynamic StickMan movement when recording an athlete's run

Applications of technology [1]

• Capturing human movement for transferring to spatial (3D) animation characters, with subsequent visualization of this character either directly in the 3D environment, or for mixing with video.

• For shooting actors directly against a blue or green background for the subsequent replacement of this background with a 3D scene or painted photorealistic background.

MoCap technology implementation

There are two main types of systems. The system of the first type is built on the basis of markers (sensors). A special tracksuit with sensors is used; the coordinates of the spatial movement of the markers are recorded by cameras and are sent to the computer for processing, where a spatial model is created that copies the movements of the athlete (see [2] the use of MoCap to create animation in a Russian cartoon).

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The second, markerless MoCap technology is based on computer vision and pattern recognition technologies [3]. The athlete can perform in normal clothes, which allows filming complex movements (falls, jumps) without the risk of damaging the markers. There are already commercial markerless systems [4], including desktop grade software for markerless motion capture [5]. In this case, no special equipment, special lighting and space are required. The survey is performed using conventional cameras from several positions so that spatial coordinates can be calculated.

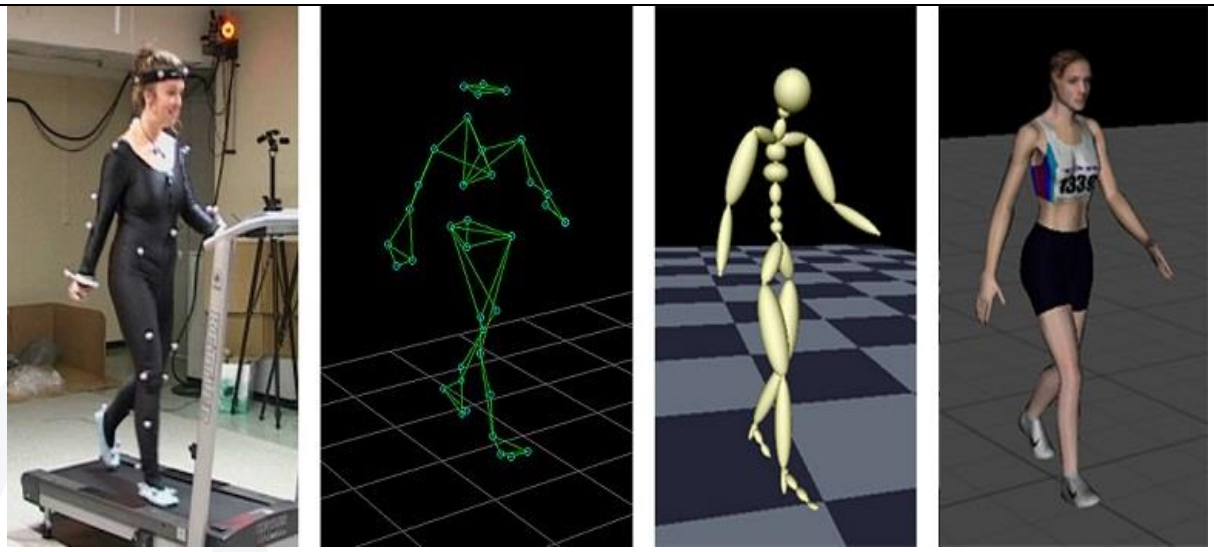

Fig. 2. Markers on athlete's clothes and computer body model - StickMan

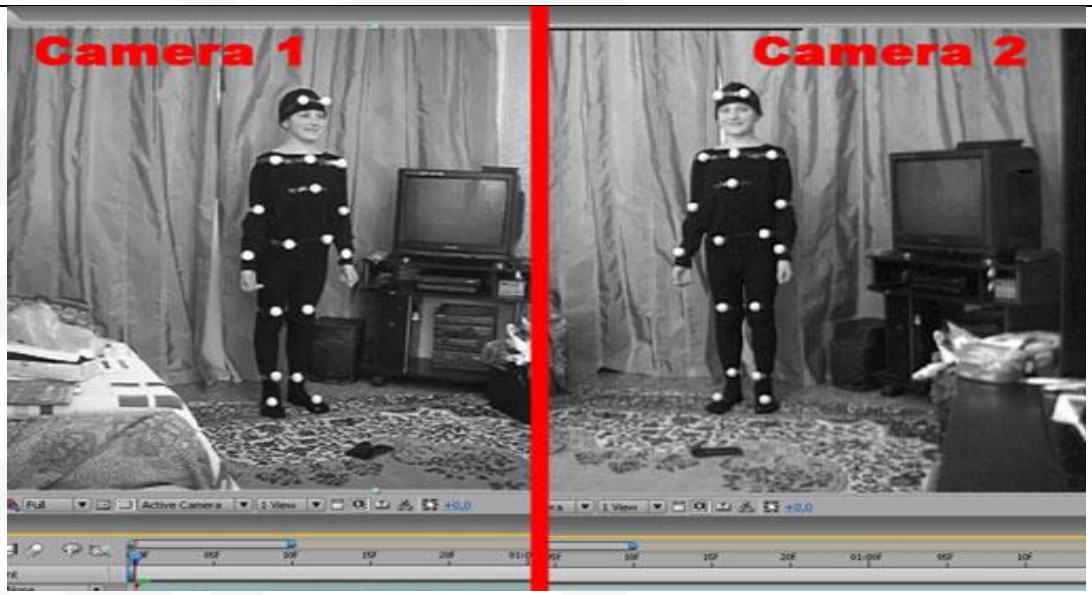

Fig. 3 View of a person with markers from two different positions where the video cameras are located.

On the pros and cons of Motion Capture [6]

Economic benefit:

• Mocap saves man-hours on character animation - one actor working during the day (and then the technical staff handling the models) can create so much animation that traditional animators would have to spend months.

• Mocap can capture "secondary" movements that classic animators might not be able to reproduce for lack of time or skill. Mocap can accurately capture complex physical movement such as hitting or jumping.

• Mocap reproduces human movements easily, the filming process is interactive and allows you to correct the process of building dynamic models in a computer already at the first stage.

On the other hand,

• Mocap requires special software and time to clean up the noise effects of the captured data.

• Motion capture equipment costs tens and hundreds of thousands of dollars, staff must be paid for, and all this investment may one day become obsolete when new, better software and equipment are invented.

• Most film studios and game development companies contract with firms specializing in Mocap to save "now" and save for the future development of the IT industry

Application of MoCap technology in sports

Mocap technology is ideal for a wide range of sports sports in research, rehabilitation, physical education and practice. Physical limitations and movement optimization are of great interest to athletes, coaches and doctors. Motion capture allows us to learn more about injury mechanisms and prevention. It can also be used to improve a player's technique for better performance in a variety of sports.

Modern portable systems [7] make it easy to install Mocap equipment in different arenas or gyms. Objective, quantitative data can be obtained to calculate articular angles, acceleration, moments, forces, elasticity, deformations, body position, balance and other parameters.

We suggest using StickMan dynamic movement data to assess the similarity of movements, for example, for a sports master and her student performing the same gymnastic exercise. To do this, from a mathematical point of view, you can use the spatial coordinates of each StickMan element: left arm, right arm, left leg, right leg, torso. Each of these elements in the StickMan motion model forms a sequence of positions - a time series. Pairwise comparison of the elements of the basic row (for

example, the right hand of the master) and the analyzed row (the right hand of the student) will allow calculating the measure of similarity of movements for a given StickMan element - the right hand. Pairwise comparison is carried out for all StickMan elements - and we get a vector of motion similarity characteristics for each StickMan element. By aggregating the elements of this vector, we obtain a general characteristic of the quality of movement of the student when performing a given gymnastic exercise.

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