Intelligent Recognition of Sports Athletes' Wrong Movements Based on Computer Vision Technology

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Abstract. In the process of sports athletes training and competition, they will inevitably have some wrong actions, if only rely on artificial methods to judge the accuracy of these actions, then there will be a great deviation. In the development and application of computer vision technology, it can effectively improve the accuracy of behavior identification by applying it to the intelligent identification of behavior errors. Therefore, this paper first makes a simple introduction to the computer vision technology, it can be collected image for digital analysis, and has a strong practicability. On this basis, through the analysis of athletes' motion characteristics, the use of Bayesian algorithm to realize the recognition of incorrect motion, so as to form a three-dimensional visual detection model. By testing the 3D-Visual Visual Method model, the correctness of the proposed method in incorrect behavior identification is verified, and the feasibility of the proposed method in incorrect behavior identification is verified.

Keywords: computer vision technology · A wrong action · Intelligent recognition

1 Introduction

Along with people's attention to sports, sports athletes must practice according to different standard movements in the process of training. In the process of sports, the speed of athletes will become fast, or the number of sports will become large, so the judges will identify these wrong actions, and then use a variety of high-tech means to make decisions [1, 2]. With the continuous development of computer vision technology, it has been widely used in the analysis of human body structure. In order to realize the intelligent recognition of sports athletes' wrong movements, computer vision technology has been applied [3, 4]. It can not only help players improve their competitive ability, but also can quickly and accurately detect the mistakes of players, thus enhancing the fairness of the competition. When identifying wrong movements of athletes, the main method adopted by computer vision technology is to use visual feature extraction method to first extract effective movements of athletes, and then compare and analyze them with standard movements, so as to determine whether they are wrong movements [5, 6]. Because

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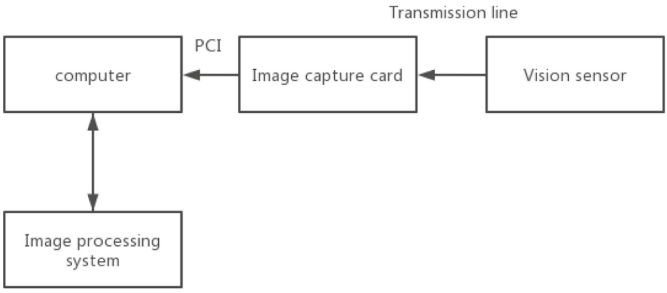

Fig. 1. Structure of a computer vision system

there are many kinds of competitive sports, the recognition of wrong movements is also different. Therefore, this paper will take Southern boxing as the main research object to discuss the intelligent recognition of athletes' wrong movements.

2 Introduction to Computer Vision Technology

Computer vision technology originated from photogrammetry. In the beginning, it was mainly used for two-dimensional image recognition and analysis. However, in the development of computer technology and computer vision technology, people gradually carried on the research of three-dimensional vision. At present, computer vision technology has developed to a very high level, the application range is very wide. The basic work of computer vision technology is: first obtain the image of the object, then extract the feature, and then make the correct judgment through analysis, processing and calculation. Figure 1 shows the infrastructure of a computer vision system. In this architecture, the computer is the most important link. It not only controls the normal operation of each function, but also performs operations on all functions and outputs corresponding data.

3 Extraction of Action Features

3.1 Determination of Coordinate Points

Generally, the length and width of the stadium involved in Nanquan are 14 m and 8 m, respectively. Therefore, taking the starting Angle of the stadium as the origin, the three-dimensional coordinate system as shown in Fig. 2 can be constructed. Since the athletes will be empty in the process of sports, the height of the stadium is set as 5 m in this paper. Then, the players can move around in the environment. In feature extraction, it can clearly reflect the various states of athletes in sports.

3.2 Marks of Key Joints of Athletes

In the description of athletes' characteristics, the relevant norms of athletes' flying foot movements will be taken as the basis, and the more important joint parts, such as shoulders, fingers, toes and feet, will be marked, so as to obtain the athletes' movements. The main tags are as follows:

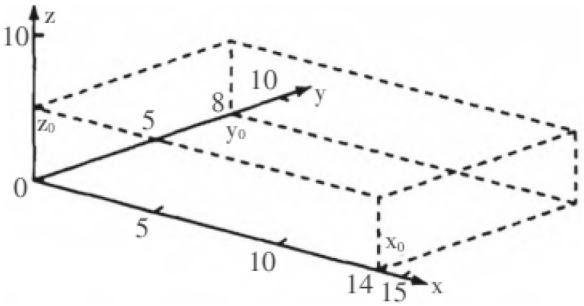

Fig. 2. Three-dimensional coordinate system

1) Coordinate points of shoulders: Shoulders are divided into left shoulder and right shoulder, so they need to be divided when marking coordinate points, the article assumes $(x_{ljb}, y_{ljb}, z_{ljb})$ Coordinates of the left shoulder, $(x_{rjb}, y_{rjb}, z_{rjb})$ The coordinates represent the right shoulder, that is, l and r represent the left shoulder and the right shoulder respectively.
2) Coordinate points of fingers: Since athletes need to put five fingers together and then hit a certain part when they finish the movement of flying feet in the air, the palm of their hand presents a flat state when they finish the movement. The palm should also be divided into the right hand and left hand, as well as the left hand and the right hand represented by l and r respectively. So $(x_{ljb}, y_{ljb}, z_{ljb})$ The coordinate points of the left hand, $(x_{rjb}, y_{rjb}, z_{rjb})$ It's the right hand coordinate point.
3) The coordinate points of the toe: also l and r represent the left and right hands respectively, so $(x_{ljb}, y_{ljb}, z_{ljb})$ Represents the coordinate point of the left toe, $(x_{rjb}, y_{rjb}, z_{rjb})$ It's the right toe coordinate point.4) Coordinate points of the foot: also l and r represent the left hand and right hand respectively, so $(x_{ljb}, y_{ljb}, z_{ljb})$ Represents the coordinate points on the left side, $(x_{rjb}, y_{rjb}, z_{rjb})$ It's a coordinate point on the right foot.

3.3 Description of Athlete Characteristics

Sports athletes must follow the standard actions during training, otherwise it will not only affect their training effect, but also have an adverse impact on the stage before and after training, and serious injury to sports. For example, when a high jumper is training, he is still in the stage of a high jump arc run-up. At this time, if he does not complete the standard movement well, his body will stand up too early in the training, which will affect his training effect and cause his body imbalance. Therefore, in the encounter of incorrect behavior, must be timely identification, and correct. The movement of flying foot in Nanquan studied in this paper also has its own standard movements, which can be divided into three steps: (1) swing kick forward and upward with the left leg, and then push off the ground with the right foot to make the body suspended in the air; ② When the player is in the air, his right leg should be raised when his left palm is in contact with the back of his right palm, and his right leg should be higher than his shoulder, and his right leg should be in contact with his legs, while his left knee is bent with the toes down; ③ When your foot lands on the ground, your other foot lands, and your left foot

lands, you can jump up. Points are penalized for missing a stroke, hitting a leg, or not reaching over the shoulder. The characteristics of athletes' error behavior are explained.

1) Percussion leg or toe not over the shoulder: assume U1 is the south fist flying foot action, and then assume s1 is percussion leg or toe not over the shoulder,

T1 is the action characteristic, and the action of this part involves four coordinates, namely the left and right toe and the left and right shoulder. By comparing the coordinates of the left and right toe and shoulder, namely the Z-axis coordinate points of the two players, it can be determined whether the athletes have this wrong action. The judging methods are as follows.

2 cases: Case 1: If the percussive or swinging leg is the right foot, then the coordinates of the right foot are $(x_{rjb}, y_{rjb}, z_{rjb})$. The coordinates of the right shoulder are $(x_{rjb}, y_{rjb}, z_{rjb})$ Then compare the Z-axis of the two coordinate points. When zrjj $\geq$ zrjb, it means that the leg has passed the shoulder; when zrjj $<$ zrjb, it means that the toe has not passed the shoulder, so it is judged that there is wrong action.

Case 2: If the percussive or swinging leg is the left foot, then the coordinates of the left foot are $(x_{ljb}, y_{ljb}, z_{ljb})$. And the coordinates of the left shoulder are $(x_{ljb}, y_{ljb}, z_{ljb})$. And then compare the Z-axis of the two coordinate points. When zljj $<$ zljb, it indicates that the leg is not over the shoulder, which is the correct action. When zljj $\geq$ zljb, the toe is over the shoulder phenomenon, so it is judged as wrong action.

2) Slap landing: U2 is assumed to be the flying foot movement of Nanquan, then s2 is assumed to be the left hand and right hand, and T2 is the action feature. The movement in this part involves four coordinates, namely the left and right fingers and the left and right feet. By comparing the coordinates of the fingers and feet, it can be determined whether the athlete has this wrong movement.

The biggest role of the above analysis is to determine whether a behavior is wrong, and then based on computer vision technology, to realize intelligent recognition of a behavior, which requires the construction of a relevant three-dimensional visual detection model. Therefore, for the recognition of action, it is a Bayesian algorithm, its implementation method is like this: with x1, x2, …, xn and (x1, x2, …, xn) T to express, W to express the mode type of action, and this method can be divided into many kinds, w1, w2, … wW to express. Therefore, we can start from x1, x2, …… In xn, W decision functions are obtained, expressed in terms of d1 (X), d2 (X), and … dW (X). According to the Bayes algorithm, the behavior mode of X attribute wi type can obtain the 3-D visual authentication function, as described below:

$$d_w(X) = W\frac{(d_1(X),\ d_2(X)) \times w_i}{(w_1,\ w_2,\ w_w) \times S_\Delta}$$

4 Simulation Results and Analysis

On this basis, some problems existing in physical education teaching in Chinese universities are discussed. First of all, select 18 students who are practicing "flying legs", and divide them into two groups. Using a kind of intelligent identification mode of "error" behavior established by machine vision technology proposed in the paper, to determine whether there is any error behavior in the group, and make corresponding notes. In order

Fig. 3. Detection results of the algorithm studied in this paper

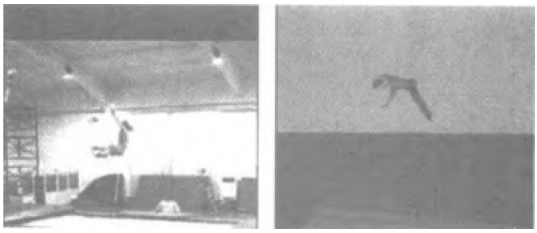

Fig. 4. Detection results based on monocular sequence

to test the advantages of the algorithm studied in this paper, it is compared and analyzed with the detection algorithm based on monocular sequence, thus obtaining the verification results as shown in Figs. 3 and 4. In Fig. 3 and Fig. 4, the left side represents the normal movement, while the right side represents the abnormal movement. As can be seen from the two charts, the algorithm proposed in this paper can clearly identify every important movement and has a high consistency with the normal movement. It can be seen that the accuracy of this method is not high, and it cannot accurately identify the abnormal motion. Therefore, the results can be obtained that the method proposed in this paper has a high accuracy in the identification of wrong behavior.

In addition, in order to better prove that the algorithm studied in this paper has better accuracy, a 3D visual detection model is built by comparing it with the traditional algorithm. After that, two different methods are tested for many times, and the test results as shown in Fig. 5 are obtained. As can be seen from Fig. 5, the accuracy of all of them exceeds 90%, while the accuracy of conventional algorithms is about 70%–77%. Therefore, the algorithm studied in this paper has higher accuracy and can control the error within a reasonable range.

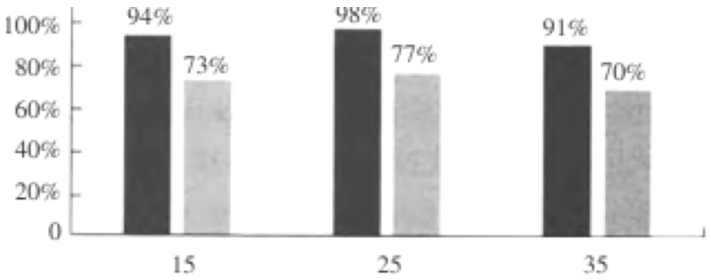

Fig. 5. Comparison of model test accuracy

5 Conclusion

In short, this paper is mainly based on computer vision technology to identify the wrong movements of athletes flying feet. After completing the 3D visual detection model, it is verified. Compared with traditional algorithms, the algorithm studied in this paper has better accuracy. Therefore, the application of computer vision technology to the wrong movement recognition of athletes can effectively improve the accuracy of its detection. However, this paper only carries out identification verification for the single action of flying foot. Because in each sport, the movements of the athletes will be very different, so there will be some differences in the process of feature extraction. However, on the whole, the process is consistent, so it can be used to identify other wrong actions.

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