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Machine Learning-Based Badminton Pace Training Teaching

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Abstract: In teaching practice and daily training, it is found that most students pay attention to hand skills in badminton training, but do not pay attention to the training of footwork, the movement technique is not standard, and the footwork movement is not flexible. These problems can hinder the improvement of motor skills and greatly increase the risk of sports injuries. In order to solve the shortcomings of the existing badminton pace training teaching research, this paper discusses the functional equation of the machine learning SVM classification algorithm and the types of badminton pace training teaching methods, aiming at the test indicators of the badminton pace training teaching application based on machine learning. And the test environment is briefly introduced. And the design and discussion of the teaching process structure of badminton pace training based on machine learning SVM classification algorithm, and finally the average recognition rate of four badminton paces in single training, mean training and weighted training by the machine learning SVM classification algorithm designed in this paper. Experimental test, experimental data show that the average recognition rate of forehand net pick, backhand net pick, back step overhead shot and back step forehand hit high ball in a single training based on machine learning SVM classification algorithm reached 0.895, 0.871, 0.789 and 0.920, the recognition rates in mean training and weighted training are in the range of 0.91 to 0.97, so it is verified that the model designed in this paper has better classification and recognition effects in badminton pace training teaching .

1. Introduction

With the popularization of badminton and the maturity of computer technology, many colleges and universities have opened school badminton elective and compulsory courses, and pay attention to the research and practice of computer technology in badminton training and teaching.

Nowadays, more and more scholars pay attention to the research of various computer technologies and system tools in badminton pace training and teaching, and through practical research, they have also achieved certain research results. Pounra j designed a badminton pace trainer to train badminton players. To allow individuals to train independently, a badminton pace

trainer was developed. The trainer consists of a badminton stand, a stride training, a pop-up section and a tripod. This machine uses specific rice steps in the serving part to train the pace of badminton players. The trainer includes two stride test boards that are rotated by two high-speed DC AC motors. The main aspect of this pace trainer is that it can do pace moves in multiple betas. This trainer design optimizes the efficiency of the athlete's training and is less expensive to manufacture [1]. Wismanadi H investigates the forward and backward strokes of 4 badminton players in plyometric and court environments by conducting badminton pace training by plyometric and court environments. Divided into 3 groups of tests, plyometric training and field environment belt training. Players completed plyometric and field environment badminton pace training sessions. The 3 groups of test items were tested for badminton stepback hitting performance. Using advanced computer technology to determine the relationship between field environmental conditions and training, and through specific experimental tests, the results show that 6 weeks of plyometric training is more effective than resistance band training to improve badminton back-stepping performance [2]. Alikhani R developed a personal backstep forehand and backhand hitting high ball training model to improve forehand and backhand smashing ability. This model has more advantages than the traditional training model. The backstep forehand variation model is Techniques for improving the pace of badminton. The goal is to create a scientific and flexible product model for students' individual step-back forehand and backhand hitting high ball training, thereby improving forehand and backhand hitting skills, including movement and technical skills. The experimental test of pre-test and post-test is designed using the research and development method of Ga. Experimental data show that using a scientific and flexible back-stepping spiking forehand training model can improve students' forehand and backhand skills [3]. Although the existing research on badminton pace training teaching is very rich, the research on badminton pace training teaching based on machine learning still has certain limitations.

Therefore, in order to enrich the existing badminton pace training teaching research, this paper firstly introduces the functional equation of Gabor digital medical image and the concept of deep learning image semantic segmentation, and then discusses the parameter setting of badminton pace training teaching application based on machine learning SVM classification algorithm And sample data, and finally designed the badminton pace training teaching process architecture based on machine learning SVM classification algorithm, and through the experimental test of the effect of the designed model in badminton pace training and teaching, the final experiment shows that the design of this paper is based on machine learning. The effectiveness of the badminton pace training teaching model of the SVM classification algorithm.

2. Badminton Pace Training Teaching Based on Machine Learning

2.1 Machine Learning

SVM classification algorithm is a typical form of algorithm in machine learning. SVM is a classifier that classifies data by finding the decision boundary with the largest margin [4].

SVM loss function

$$\begin{cases} \min\limits_{\mu,c} \dfrac{\|\mu\|^2}{2} \\ x.y.v_e(\mu^Y u_e + c) \geq 1, e = 1,2,...m \end{cases} \tag{1}$$

In formula (1), μ is the normal vector of the badminton pace, c is the intercept of the badminton pace, u_e is the feature vector of a pace type, and m is the dimension of the pace type.

The pace type $v_e \in \{1,-1\}$ is specified, and the badminton pace test index is a positive sample [5].

(2) Lagrange multiplier

In order to facilitate the identification of the optimal form of badminton pace, a Lagrange multiplier is introduced to incorporate constraints into the loss function [6]. As shown in the following formula:

$$H(\mu,c,\beta)=\frac{1}{2}\|\mu\|^2-\sum_{e=1}^{m}\beta_e(v_2(\mu^T u_e+c)-1)(\beta\geq 0) \tag{2}$$

In the above formula, β is the Lagrange multiplier.

(3) SVM two classification

β can be solved by the SMO algorithm, then μ can be solved easily, and c can be solved by bringing μ into formula (1), so that the expression of badminton step type identification can be obtained:

$$k(u_{test})=Sign(\mu^Y u_{test}+c)=Sign(\sum_{e=1}^{m}\beta_e v_e u_e^Y x_{test}+c) \tag{3}$$

In formula (3), u_{test} is the test sample of badminton pace, $Sign(r)$ is the activation function, when $r>0$ is returned to identify as a positive sample, and when $r<0$ is returned -1 is identified as a negative sample, thus realizing the SVM binary classification [7].

2.2 Badminton Pace Training Teaching

The following are some of the more popular training methods in order from easy to difficult.

(1) One-step training

The single-step practice is the most basic technique. It divides the forward net, backwards, moves to the two sides, and jumps into the air, and then practice according to the movements of the cushion steps, parallel steps, cross steps, and jumping steps [8] . Such concentrated and targeted practice can enable a person with a certain skill in footwork to master it quickly [9].

(2) Combined footwork training

Combination footwork training builds on single-step training and utilizes two or more basic footwork at a time when moving. This method can quickly master the connection between different footwork [10].

(3) "Mi"-shaped moving footwork training

This method is a deformation of the fixed line as the base point, starting from the midline position, moving forward, left front, right front, left, right, left back, right back, and back eight directions in turn, and draw the moved line. A "mi" character is formed, so it is called "mi" shaped step [11].

3. Investigation and Research on Badminton Pace Training Teaching Based on Machine Learning

3.1 Teaching and Testing Indicators of Badminton Pace Training Based on Machine Learning

In order to test the effect of the practical application of badminton pace training and teaching based on machine learning, this paper searches and analyzes the literature according to the characteristics of the machine learning SVM algorithm and the special badminton footwork. The relevant factors affecting badminton footwork training were screened out, and the kinematics test

indicators of badminton footwork training were collected. After data sorting, the test indicators of this experiment are shown in Table 1:

Table 1: Test Metrics

Category	Test Indicator Items	Index
1	Forehand net pick	Center of gravity speed
2	Backhand net pick	
3	Step back and hit the high ball overhead	
4	Back step forehand hit high ball	

3.2 Teaching and Testing Environment for Badminton Pace Training Based on Machine Learning

(1) Hardware platform

The system hardware platform is mainly composed of five 6-axis sensors and a host computer. 5 of the 6-axis sensors are worn by the players, 2 each

1) The player's batting signal data collected by the sensor at the end of the badminton racket handle is used for batting action recognition and feature extraction.

2) The player's running signal data collected by the sensor at the player's ankle is used for the restoration and training of the controlled pace.

3) The model of the six-axis sensor is MPU6050. The collected real data includes the current sampling timestamp, the acceleration and angular velocity of the three axes, a total of 8-dimensional data information, the sampling frequency is 200Hz, and the data is accurate to 4 decimal places.

4) The data is uploaded to the host computer through the built-in Bluetooth module, and the host computer is used to realize the reception, storage, processing and display of the data to ensure the normal operation of the relevant algorithms and the host computer application program.

(2) Software platform

The system software platform is a desktop application program based on the Windows environment. The host computer application program compiled in this paper is based on the C/S structure, and mainly realizes the functions of the host computer's data reception, processing and display, batting action recognition, technical statistics and pace training.

4. Application Research of Badminton Pace Training Teaching Based on Machine Learning

4.1 Teaching Process Design of Badminton Pace Training Based on Machine Learning

Figure 1 shows the entire flow chart of building badminton pace training using the traditional machine learning SVM classification algorithm. The machine learning classification algorithms used are SVM, DT and LR. And through the machine learning SVM classification algorithm studied in this paper, the pace in badminton pace training is classified and identified, so as to provide reference for badminton pace training teaching.

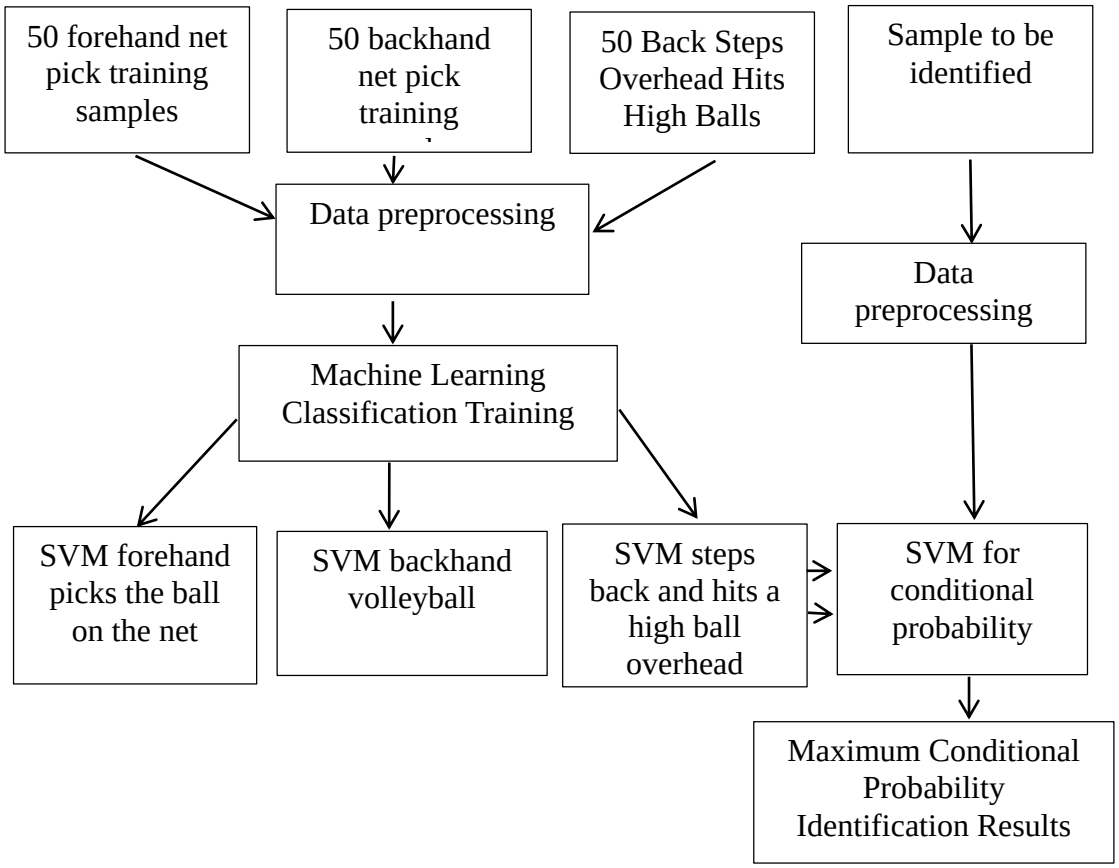

Figure 1: Process of badminton pace recognition and training based on machine learning

The sample data of the collected pace training is the data of 50 shots of each of the three pace movements, namely, the forehand volleyball, the backhand volleyball, and the backward step to hit the high ball with the top of the head. Through machine learning SVM The classification algorithm obtains the corresponding identification and training results of badminton pace training teaching, and its main process design is as follows:

(1) For any step action to be identified, the observation sequence of the step action is obtained through the data preprocessing algorithm

(2) Calculate the conditional probability of the optimal state sequence of the observation sequence under the four step action models through the machine learning SVM classification algorithm

(3) Find the model corresponding to the largest conditional probability, and the step action corresponding to this model is the recognition result.

4.2 Teaching Application of Badminton Pace Training Based on Machine Learning

In order to verify the average recognition rate of badminton pace training based on the machine learning SVM classification algorithm, the badminton pace samples of the machine learning algorithm SVM were trained through experimental tests. The four steps of ball and step back forehand hitting high and long balls are used as training and testing indicators. By testing in single training, mean training and weighted training, the average recognition rate of badminton step training based on machine learning is obtained. The specific The test results are shown in Figure 2:

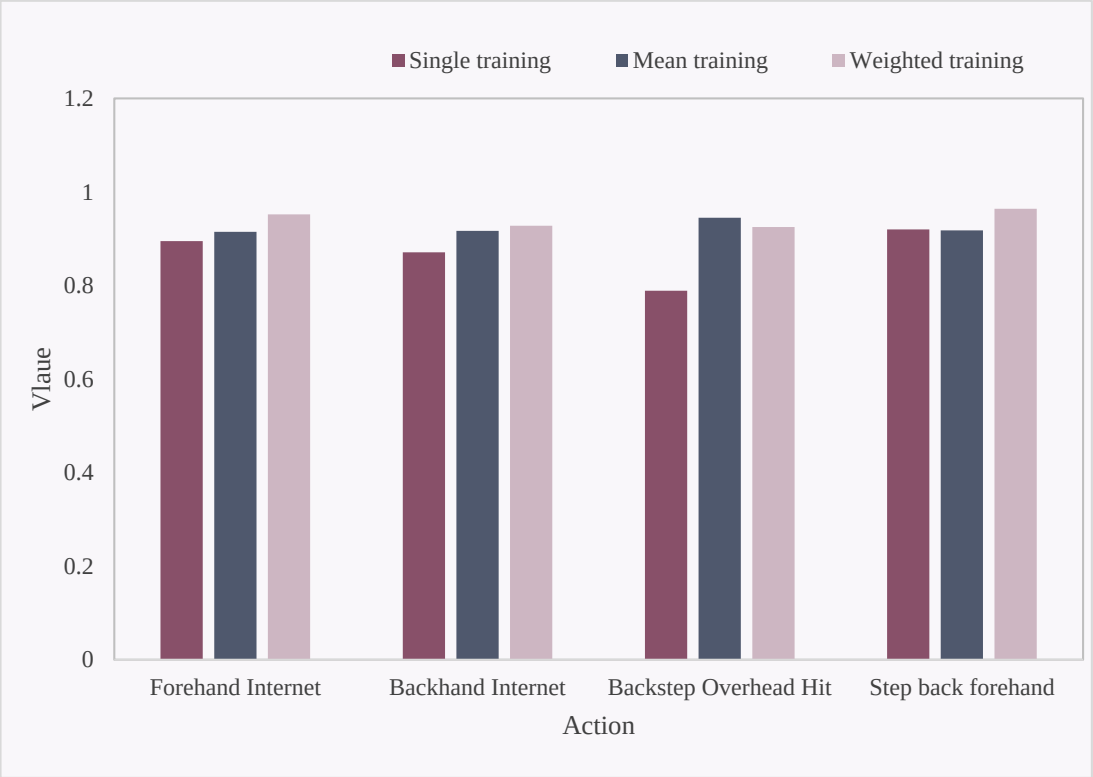

Figure 2: Average recognition rate of machine learning SVM classification algorithm training

Figure 2 shows that the machine learning SVM classification algorithm for forehand net pick, backhand net pick and back step overhead hit high ball and back step forehand hit high ball badminton pace averaged in single training and mean training and weighted training The recognition rate was analyzed, and it can be seen that the machine learning SVM classification algorithm has a badminton pace for the forehand net pick, the backhand net pick, the back step overhead shot and the back step forehand shot in a single training. The average recognition rate is as high as 0.86. In the mean training, the machine learning SVM classification algorithm has an average badminton pace recognition rate of about 0.92 in forehand net pick, backhand net pick, back step overhead hitting high ball and back step forehand hitting high ball badminton. And in the weighted training, the average badminton pace recognition rate is about 0.94 for the forehand net pick, the backhand net pick, the back step overhead shot and the back step forehand shot.

5. Conclusion

This paper specifically expounds the technical basis for the realization of badminton pace training teaching based on machine learning, including the functional equation of the machine learning SVM classification algorithm and the description of the types of badminton pace training teaching methods, as well as the application of badminton pace training teaching based on the machine learning SVM classification algorithm At the same time, it focuses on the design of the badminton pace training teaching process framework based on the machine learning SVM classification algorithm. The application of machine learning SVM classification algorithm in badminton pace training and teaching is tested experimentally, which proves the superiority of using machine learning SVM classification algorithm in badminton pace training and teaching.

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References

[1] Pounra J, Jaskar D R, Ranjith R M, et al. Consequence of Jump Rope Training and Kettle Bell Training on Selected Agility and Muscular Strength of College Men Badminton Players[J]. Xi'an Dianzi Keji Daxue Xuebao/Journal of Xidian University, 2020, 14(5):664-669.

[2] Wismanadi H, Kafrawi F R, Pramono M, et al. Rasio Interval Training Dalam Latihan Shadow Bulutangkis Terhadap Power dan Kecepatan[J]. Journal Sport AREA, 2020, 5(2):186-198.

[3] Alikhani R, Shahrjerdi S, Golpaigany M, et al. The effect of a six-week plyometric training on dynamic balance and knee proprioception in female badminton players [J]. JCCA. Journal of the Canadian Chiropractic Association. Journal de l'Association chiropratique canadienne, 2019, 63(3):144-153.

[4] A Bravo-Sánchez, J Abián-Vicén, AT Montalbán, et al. Acute effects of badminton practice on the surface temperature of lower limbs introduction [J]. Archivos de Medicina del Deporte, 2018, 35(4):239-244.

[5] JA Pérez-Turpin, Elvira C, Cabello-Manrique D, et al. Section III -Sports Training Notational Comparison Analysis of Outdoor Badminton Men's Single and Double Matches [J]. Journal of Human Kinetics, 2020, 71(2020):267-273.

[6] Nirendan J. Effect of shadow training on motor fitness components of badminton players [J]. International Journal of Physical Education, Fitness and Sports, 2019, 1(2):04-06.

[7] Nugroho S, Nasrulloh A, Karyono T H, et al. Effect of intensity and interval levels of trapping circuit training on the physical condition of badminton players[J]. Journal of Physical Education and Sport, 2021, 21(3):1981-1987.

[8] Pounraj, Jaskar D R, Ranjith R M, et al. Consequence of Jump Rope Training and Kettle Bell Training on Selected Agility and Muscular Strength of College Men Badminton Players[J]. Xi'an Dianzi Keji Daxue Xuebao/Journal of Xidian University, 2020, 14(5):664-669.

[9] Baydin A G, Pearlmutter B A, Radul A A, et al. Automatic differentiation in machine learning: A survey [J]. Journal of Machine Learning Research, 2018, 18(153):1-43.

[10] Butler K T, Davies D W, Hugh C, et al. Machine learning for molecular and materials science[J]. Nature, 2018, 559(7715):547-555.

[11] Malta T M, Sokolov A, Gentles A J, et al. Machine Learning Identifies Stemness Features Associated with Oncogenic Dedifferentiation [J]. Cell, 2018, 173(2):338-354.