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# *Research on Sports Training Mode Based on Artificial Intelligence*

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***Abstract:*** Against the backdrop of the continuous development of competitive sports and the widespread popularity of national fitness activities, traditional sports training methods often rely on coaches' personal experience to make decisions, which have problems of slow feedback and insufficient adaptability, making it difficult to meet the development needs of scientific training. Artificial intelligence technology provides critical support for upgrading training modes by combining machine learning, computer vision, and the Internet of Things. This article proposes a new sports training model based on artificial intelligence, which establishes a closed-loop structure consisting of data collection, intelligent analysis, and decision-making applications. It overcomes a series of technical challenges such as multimodal data fusion and small sample learning, effectively improves training efficiency, and helps reduce the risk of sports injuries for athletes.

## 1. Introduction

Currently, competitive sports are increasingly pursuing the goal of "higher, faster, and stronger", and the training process is also paying more attention to science and precision. At the same time, it is widely advocated in the promotion of national fitness that everyone should engage in "precise health management". Under the combined influence of these two trends, traditional sports training models are gradually showing some shortcomings. The rapid development of artificial intelligence technology has provided new possibilities for solving the problems of traditional sports training. This technology can utilize machine learning algorithms to discover hidden patterns from large amounts of training data; Accurately analyze motion actions through computer vision; And rely on sensor networks to monitor the physiological state of the human body in real time. It is with the support of these technologies that artificial intelligence is driving sports training from relying on experience in the past to a new model that now relies on data and intelligence. Therefore, it is necessary to analyze the specific application methods of artificial intelligence technology in sports training, the training mode changes it brings, and the implementation methods, in order to provide a new development idea for promoting scientific training practice.

## 2. Limitations of traditional training modes

Firstly, in sports training, coaches often rely on personal experience for decision-making and lack sufficient scientific support. For example, when evaluating athletes' potential, arranging training loads,

or correcting technical movements, subjective experience and visual observation are often relied upon, making it difficult to accurately compare the effects of different training methods. Taking squats and hard pulls as examples, it is difficult to quantify their respective effects on explosive power. This ambiguity can easily lead to two problems: one is practicing too much, causing fatigue and injury; The second reason is that the training is not enough, and the athlete's potential has not been fully realized.

Secondly, the existing training feedback is often not timely enough and difficult to adjust at any time. The technical data of athletes, such as swimming and swimming efficiency, reaction time at the start of short runs, and physical indicators such as heart rate changes and blood lactate thresholds, usually need to be measured after watching videos or entering the laboratory after the competition. Due to delayed feedback information by several hours or even days, it is difficult to make immediate adjustments to the training plan[1].

Finally, traditional training methods do not fully consider individual differences and often treat everyone with the same plan, which affects the training effectiveness. Many training programs are designed based on the average level of the general population, such as requiring all adolescent athletes to undergo the same physical training, but ignoring individual differences in age, gender, genetic characteristics, and injury history. In this way, some athletes may lack training, while others may overtrain.

## 3. Core architecture and key technologies of sports training mode based on artificial intelligence

### 3.1. Core architecture

This system adopts an artificial intelligence training mode centered on athletes, and its core architecture is based on a three-layer framework of "data collection intelligent analysis decision application", forming a data-driven "perception analysis decision" closed-loop system.

The data collection layer is responsible for comprehensively obtaining multidimensional information. This layer systematically collects multi-source information including physiological, exercise, environmental, and historical data through a multimodal sensor network. Specifically, physiological data includes heart rate variability, maximum oxygen uptake, and electromyographic signals, which can reflect muscle fatigue status. Sports data mainly includes parameters such as motion trajectory, velocity, acceleration, and joint angle, which are generally obtained through visual sensors or inertial measurement units. Environmental data refers to external factors such as temperature, humidity, and altitude at the training site, which may affect athlete performance. Historical data integrates athletes' past training plans, competition results, and injury history records to provide a foundation for long-term comparative analysis of the system.

The intelligent analysis layer relies on machine learning and computer vision algorithms for deep processing of raw data. This layer has four core functions: firstly, analysis of movement techniques, such as determining whether the angle of the swimmer's palm entering the water during swimming is within the optimal range of 30 °to 45 °; The second is load intensity assessment, which identifies whether the current training belongs to basic endurance, lactate threshold, or anaerobic burst type by analyzing the distribution of heart rate intervals and changes in blood lactate concentration; The third is injury risk prediction. For example, when abnormal electromyographic signals are detected, such as imbalanced quadriceps activation, or when fatigue indicators show HRV decreasing by more than 15% for three consecutive days, the system will issue an early warning, indicating the possibility of injury risk; The fourth is to predict the training effect, using regression models to evaluate the impact of different training methods on sports performance [2].

The decision application layer is responsible for transforming the analysis results into executable training recommendations. For example, the system can generate the following instructions: "Suggest

reducing the strength training load from 80% 1RM to 75% 1RM tomorrow to alleviate excessive fatigue", or "Need to correct the step size deviation of the last two steps of the long jump run-up". These suggestions can be provided in real-time through coach terminal applications or athlete wearable device interfaces, and presented clearly in visual form.

### 3.2. Key technological breakthroughs

The core problem that multimodal data fusion technology needs to solve is how to effectively merge data from different sources, such as images captured by cameras and values measured by heart rate sensors. This technology first requires time synchronization, aligning data from different modalities, and then establishing connections between features. Taking swimmers as an example, combining visual data with electromyographic signals recorded at the same time for analysis can accurately determine the reason for the athlete's low swimming efficiency: whether it is the incorrect angle of the arm entering the water or insufficient force exerted by the pectoralis major muscle.

Small sample learning algorithms are particularly suitable for the research of high-level athletes, as they have limited personal data but require personalized analysis. For example, a particular movement performed by a gymnast may only have a few hundred training videos. At this point, transfer learning methods can be used, first using a large amount of general gymnastics movement data for pre training, and then fine-tuning the model to adapt to the target athlete; Alternatively, virtual training samples can be generated using generative adversarial networks to improve the model's generalization ability when data is limited.

Real time edge computing is to directly process high-definition video streams captured by the local computer by deploying edge computing devices, such as portable artificial intelligence processing units, on the spot, such as real-time recognition of the rotation direction and impact point of table tennis [3]. This approach eliminates the need for data to be uploaded to the cloud and then returned, significantly reducing the system response time from 3-5 seconds to within 200 milliseconds, thereby achieving near real-time feedback.

## 4. Typical application scenarios of artificial intelligence sports training mode

### 4.1. Competitive sports

In the field of competitive sports, the "precision preparation" of elite athletes increasingly relies on the help of artificial intelligence technology. At present, artificial intelligence has been widely used in the training of national teams and has become an important technical means to improve competitive level.

Taking track and field sprints as an example, artificial intelligence systems can use high-speed cameras to record starting movements and accurately calculate athletes' starting reaction time, which is the time from the firing of the starting gun to their feet leaving the starting block. At the same time, this system can also monitor the changes in step frequency and stride length during the acceleration process in segments, and establish an analysis model using historical competition data to provide suitable starting parameters and mid run rhythm strategies for individuals. The application of this technology can effectively reduce starting reaction time and improve sprint performance.

In swimming events, artificial intelligence visual recognition systems capture athletes' technical movements in real time through high-speed cameras installed underwater, quantitatively evaluating their swimming efficiency, which is the ratio of the distance pushed in one stroke to the speed of body movement. The system can also accurately recognize the angle of the hand when turning and touching the wall, and determine whether the optimal mechanical conditions have been reached, such as whether the palm is perpendicular to the pool wall. In response to individual technical weaknesses,

artificial intelligence can develop targeted training programs, such as detecting and correcting incorrect movements such as premature arm deployment during paddling, thereby improving overall paddling efficiency[4].

In ice and snow sports, the artificial intelligence posture analysis system can capture the body posture parameters of athletes during cornering with millisecond level accuracy, including important indicators such as body tilt angle and the depth of the ice blade cutting into the ice surface. The system also combines aerodynamic data obtained from wind tunnel experiments and uses multi-objective optimization algorithms to calculate the optimal sliding route and body posture combination to achieve minimum air resistance. This technology can effectively improve the speed of cornering and significantly enhance the performance of athletes in competitions.

### 4.2. Mass fitness

For the general fitness population, the main problems usually focus on two aspects: poor mastery of training methods and non-standard movements. With the widespread use of artificial intelligence technology, it is now easier for people to obtain professional fitness guidance, and even if they practice on their own, they can effectively avoid making mistakes in their movements.

When exercising at home, users can use mobile software with computer vision and artificial intelligence algorithms to monitor and analyze their movements in real time through the phone camera. This type of system can accurately identify over 92% of common errors, such as knee adduction during squats and waist collapse during plank support. Once the action is found to be incorrect, the software will use voice prompts to remind the user to adjust immediately. In addition, users can also input their fitness goals and body data, and artificial intelligence will automatically generate a personal training plan based on these, such as "three times a week, 40 minutes each time", and dynamically adjust the training intensity based on the user's previous completion status, such as gradually increasing the weight of dumbbells.

Smart watches and sports software can also provide scientific support during outdoor activities. For example, the Huawei Sports and Health app, when combined with a smartwatch, can monitor various running data in real-time, including step frequency, stride length, and ground contact time. If it is found that the ground contact time is not within the ideal range due to a large stride, resulting in braking effect, the system will automatically issue suggestions to guide the user to reduce the stride and increase the step frequency[5]. At the same time, with the help of GPS trajectory data, this platform can also recommend better routes for off-road runners, helping them avoid steep slopes or gravel roads, thereby reducing the possibility of injury.

## 5. Conclusion

Nowadays, artificial intelligence is profoundly changing the way sports training is conducted. Its ability to rely on data perception, intelligent analysis, and precise decision-making completely changes the traditional training methods that relied mainly on experience, slow feedback, and insufficient adaptability in the past. Artificial intelligence is increasingly playing a key role in competitive sports, mass fitness, and other fields. In the future, with the progress of multimodal perception technology, the strengthening of edge computing ability, and the participation and cooperation of more interdisciplinary talents, artificial intelligence is expected to become the core force to promote sports training to become scientific.

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