Research Article

Evaluation Model of Football Players’ Training and Teaching Actions Based on Artificial Intelligence

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Football is a sport that needs to combine the physical stamina and physical characteristics of athletes. It needs to pay attention to the differences in different individuals and then conduct targeted training. In this regard, this article introduces artificial intelligence technology into the teaching actions of football player training and analyzes the teaching elements according to the characteristics of the football player’s body. Through the analysis of fog computing under artificial intelligence, this article aimed to study the related effects of combining intelligent technology on the basis of athletes’ original training. This article proposes the establishment of a system model and quantitative analysis of different frames of football players’ movements. According to the combination of two-phase analysis, it can be concluded that after the introduction of artificial intelligence technology, the ability of football players in various indexes has increased by 20%.

1. Introduction

With the development and application of computer technology, artificial intelligence technology has been widely used in sports training. Under the premise of improving the competitiveness of football, it is very urgent to seek to improve the level of training. Observing a lot of training data can show that the commonality of basic training needs to be strengthened. Therefore, in the context of the improvement of the global football level and the diversification of the training process, the lack of personalized training methods and content has been unable to adapt to the trend of football development. This method will affect the improvement of athletes’ abilities to a certain extent, and it is very necessary to introduce artificial intelligence technology into football training.

On the one hand, by visually expressing the training content of the vertical and horizontal movements of football in the form of data, the research is conducive to the improvement of the training ability of football telemobilization under the condition of artificial intelligence. In turn, it provides a theoretical basis for football coaches to provide more effective contact methods during training; on the other hand, it provides more diversified training methods for athletes in future training, so that players have higher interest and enthusiasm in training, so that athletes can be more professional and precise in football performance. At the same time, it provides a certain theoretical basis for the sports group and opens up new research points for the study of football player training and teaching. Based on the above related content, Hassabis et al. found that the fields of neuroscience and AI have a long history [1]. In addition, Raedt et al. believed that intelligent agents interacting with the real world will encounter individuals, courses, test results, etc., need to reason about the attributes of these individuals and the relationship between them, and deal with uncertainty [2]. At the same time, Rongpeng et al. believed that 5G is a key enabler and infrastructure provider in the ICT industry by providing various services with different needs [3]. In addition to the abovementioned views on AI, Thrall et al. believed that it is driven by the availability of large data sets (“big data”), significant advances in computing power, and new deep learning algorithms. Global interest in artificial intelligence (AI) applications, including
imaging, is high and growing rapidly. In addition to developing new AI methods themselves, they are also faced with better ways to share image data and standards for validating the use of AI programs across different imaging platforms [4]. Since this article mainly introduces artificial intelligence research, Glauner et al.’s main research direction is to use artificial intelligence (AI) to solve different problems. Finally, it investigated these research works in a comprehensive review of the algorithms, features, and data sets used [5]. In view of the fragility of the above content, and in view of the great interest in artificial intelligence by Seyedmahmoudian et al., it links football and artificial intelligence technology together. Extensive research has been conducted on various ways of football. According to the robust, reliable, and fast performance of the artificial intelligence-based MPPT method, the motion posture of the human body is discussed under various conditions [6]. Wang and Liang obtained the upper limb trajectory in 3D space and realized the upper limb trajectory extraction [7]. Because artificial intelligence and algorithms are inevitably inseparable, Patel and Savsani proposed a Stirling multi-objective optimization strategy and introduced the multi-objective TS-TLBO algorithm to get the real Pareto frontier. By comparing the optimization strategies between different algorithms, the relevant research methods of artificial intelligence are proposed, and the best combination with the teaching design of football players is obtained and then put forward the relevant model establishment formula to quantify the athlete’s movement posture [8].

The innovative points of this article are as follows: (1) computer technology is used to establish a systematic study of the actions of football players. Personalized research on athletes with different personal information is conducted, collected system management information is managed, player training content is recorded, and model analysis on the collected information is performed. (2) The constructed network model is used to design and develop different teaching systems. Through this system, it can help the analysis of football players to quickly understand their own advantages and problems in the process of sports, so as to help football players optimize their movements during the sports process and improve the hit rate of kicks. Through this system, it can help analyze football players to quickly understand their own advantages and problems in the process of sports, so as to help football players optimize their movements during the movement, increase the hit rate of kicks, and finally increase the ability by 20%.

2. Evaluation Model of Football Player Training and Teaching Action Based on Artificial Intelligence

2.1. Artificial Intelligence

2.1.1. Fog Calculation. Fog computing is a decentralized computing infrastructure that can utilize one or more IoT devices close to the user edge to collaboratively perform a large number of communications, control, storage, and management tasks. Data transmission has extremely low latency, and fog computing has a vast geographic distribution and a large-scale sensor network with a large number of network nodes. At the same time, through the connection between the fog node and the device, fog computing can reduce the processing burden of resource-constrained devices, meet the requirements of delay-sensitive applications, and overcome the bandwidth limitation of centralized services. The basic framework of fog computing is similar to cloud computing, but its lower-level architecture has special components that are sensitive to time response. With this feature, you can further control and enhance services such as sports. Figure 1 shows a mode of fog calculation.

In Figure 1, there are three layers as a whole: cloud layer, fog layer, and user layer. Combining the fog calculation with football sports can provide timely feedback of sports-related data, thereby forming a benign closed loop. The cloud layer is a computing cluster composed of large servers, located at the top of the entire architecture. The fog layer is mainly composed of various embedded computing devices, located between the user and the cloud, mainly provides a deployment environment for delay-sensitive applications, and responds quickly to user requests. According to the physical distance between the fog layer device and the user, the fog layer device is subdivided into multiple sublayers, and the closer to the user side, the lower the network delay of the sublayer. The network communication overhead between devices in the same sublayer is significantly lower than the cross-layer network communication overhead [1, 9]. The user layer directly interacts with the user, sends the collected data to the upper layer, and receives the returned result after the upper layer processing, as shown in Figure 2.

The fog is located between the terminal device and the cloud and builds a bridge between the terminal device and the cloud. Fog computing, like cloud computing, can provide computing, storage, and network services for terminal devices. Unlike cloud computing, fog computing is closer to terminal equipment. The main characteristics of fog computing are shown in the figure: short-distance, distributed deployment makes fog computing have many advantages, including low latency, location awareness, and mobile support. The performance advantage of fog computing [10] can just make up for the deficiencies of cloud computing and provide real-time computing services for large-scale and distributed terminal devices. In the smart factory, the low-latency characteristics of fog computing are used to realize rapid analysis of manufacturing data, timely determine the operating status of processing equipment, and provide real-time maintenance for the equipment, thus avoiding the production line shutdown due to equipment failure.

![Diagram](image-url)

2.1.2. System Model. Based on the design idea of microservices, the application is modeled as a set of services, and the calling relationship between services is expressed in the form of a directed acyclic graph.

\[ y^i_{\lambda k} = \sum_k \frac{y^i_k \wedge D_j}{d(k)}. \] (1)
In formula (1), $\lambda_k$ represents the $i$th device, and $\lambda_{i}^{k}$ represents the $k$th user’s request rate for the service, where $d(k)$ is the set of devices on the path from the accessed device to the cloud layer by user $k$.

For computing resources of type $R$, the resource consumption on the device $\lambda_k$ can be expressed as $T^{p}_{\lambda_{i},x}$, and the total amount of resources on the device $\lambda_k$ is $W^{ap}_{\lambda_{i},x}$, and the utilization rate of type $R$ resources on the $\lambda_k$ device $\eta_{x}^{\lambda_{i}}$ is defined as follows:

$$\eta_{x}^{\lambda_{i}} = \frac{T^{p}_{\lambda_{i},x}}{W^{ap}_{\lambda_{i},x}}.$$  \hspace{1cm} (2)

If the device set of the cloud layer in the fog computing is $G$ and the number of devices is $|F|$, then the resource utilization rate $\eta^x$ of the system is the arithmetic average of the utilization rates of all devices [11]:

$$\eta^x = \frac{\sum_{\lambda_i} \eta_{x}^{\lambda_{i}}}{|F|}.$$  \hspace{1cm} (3)

In the case of considering multiple resources, it is impossible to guarantee the maximum utilization of $n$ types of resources. When calculating the fogging resources, the resource consumption of the fogging equipment is as follows:

$$R^{m}_{\text{fog}} = \sum_{\lambda_i} R^{p}_{\lambda_{i}} \forall A_i \in F.$$  \hspace{1cm} (4)

Based on the above analysis, the system average heterogeneous resource utilization $\eta_{ave}$ is defined as the weighted average of all types of resource utilization $[12]$. The solution goal of the service placement strategy is to maximize the average resource utilization of the system:

$$\text{Max} \eta_{ave} = \sum_{x} A^{k}_{x} \cdot \eta^{x}.$$  \hspace{1cm} (5)

Regarding the placement of microservices in the fog layer, if only the service quality indicators are considered in the modeling process, the resources on the fog layer equipment cannot be fully utilized, resulting in a decrease in the resource utilization of the fog layer equipment. Therefore, the task allocation problem under resource constraints is more in line with the fog computing environment.

2.1.3. Artificial Intelligence Builds a Network Model. For smart factories, information technology and smart manufacturing equipment are the keys to smart manufacturing. The implementation of smart factories needs to consider the current status quo, and production technology requirements, based on the current status quo, proposed a cloud manufacturing system-oriented smart manufacturing architecture $[13, 14]$ and established a multi-agent manufacturing system prototype platform. The cloud computing-based manufacturing system architecture can realize the service-oriented manufacturing system function. Under the combined action of demand-driven and disturbing factors, the cloud processing, analysis, and decision-making ensure resource utilization and system flexibility. The seamless integration of fog computing and cloud computing provides an improved cloud-fog architecture solution. The architecture includes four levels, from bottom to top, the terminal layer, the network layer, the platform layer, and the application layer.

At the terminal layer, the number of devices is very large, and the types are also very diverse, with very strong heterogeneity. To accelerate the realization of manufacturing through artificial intelligence, modular manufacturing units are introduced into the smart factory. Today, by improving performance, the network layer, platform layer, and application layer are processing the collected data. The application layer processes the collected relevant data. After the application layer collects the football player data, after the calculation of the fog calculation, the integration and interaction of various information are realized through the technical integration of multiple networks. The technology integration of multiple networks realizes the integration and interaction of various information. The fog computing of
short-distance and distributed deployment not only inherits cloud computing services but also has the advantages of low latency, low energy consumption, mobility, and location awareness [15].

2.2. Football Player Training Management System. Football is a ball game in which the feet dominate the ball. Football is highly antagonistic, and athletes use various actions permitted by the rules in the game, including running and rushing, which are equivalent to rivals for fierce competition:

(1) Football training should be based on the physical fitness, basic conditions, and environmental factors of different players to develop relevant training plans. In addition to some basic training items about football skills and physical fitness training, training should also be carried out according to different players’ positions and personal abilities. After the introduction of artificial intelligence-related technologies, better calculations and manual modifications can be made to develop a training plan that is most suitable for each player’s stage. An example of the management of the training of different football players is shown in Figure 3.

Physical fitness trainers can help players get better physical fitness and deal with more emergencies or different game conditions on the court. Players playing different positions on the court require different physical fitness patterns. In addition to the position factor, the physical fitness of a player also determines which aspect of physical training he needs.

The purpose of frame selection [16] is to extract frames that contain a large amount of motion information to improve the recognition effect. According to the sequence structure of the action, the frame with a small amount of action information is extracted at the beginning and end of the action. Then, the formula representing the amount of change from frame to frame is as follows:

\[ S = \sum_{i=1}^{n} (d_i)^2. \]  

(6)

In this formula, \( d \) represents the angular distance between frames, and \( S \) refers to the total angular change between the current frame and the next frame.

For the same person, there will be various differences between the same actions, so the difference in the size of different samples cannot be directly used in the algorithm. To compare the angular distances in different samples on a uniform scale, and to express the principle of the frame selection algorithm more vividly, the normalized representation of the accumulated data of various motions is as follows:

\[ AMD(i) = \sum_{j=1}^{i} \sum_{t=1}^{T} (d_{ij})^2. \]  

(7)

From this, we normalize the obtained ADM (admin, refers to the super administrator) for normalization:

\[ AMD(i)_{\text{tol}} = \frac{AMD(i) - AMD_{\text{min}}}{AMD_{\text{max}} - AMD_{\text{min}}}. \]  

(8)

Among them, \( AMD(i) \) represents the cumulative size of \( S \) at the \( i \)th frame, \( AMD(i)_{\text{tol}} \) is the cumulative size after normalization, \( AMD_{\text{max}} \) is the minimum value in the cumulative sequence, and \( AMD_{\text{min}} \) is the minimum value in the cumulative sequence.

In order to be able to select a suitable frame, a suitable threshold value \( \delta \) needs to be selected. The threshold value \( \delta \) is a constant between 0 and 1, and then, the following formula can be used to determine whether it is a suitable frame:

\[ AMD(i)_{\text{tol}} - AMD(i - 1)_{\text{tol}} \geq \delta. \]  

(9)

Through the formula, the frame larger than \( \delta \) can be used as a suitable frame so that the remaining frames can be removed. The effect can be identified according to the size of the threshold in the figure, as shown in Figure 4.

As can be seen in Figure 4, with the gradual increase in the threshold, the fluctuation of the recognition rate is not very large. It can be seen that changes in the size of the threshold [17] will have a small microscopic impact, and the recognition rate is the best when the threshold is around 0.16. Therefore, the threshold can be controlled at 0.16 during the experiment, so that the experimental data will be more rigorous.

(2) Frame Selection Model

An action is composed of many consecutive frames, but each frame is not equally important due to delays and other reasons. Therefore, redundant frames in each action sequence need to be removed. A frame selection model is proposed for the selection of suitable frames.

For the detection of different segmentation points of continuous actions, the detection is performed according to the sliding window and then described by a scoring system. Then, the score of an action sequence \( n \) in the \( i \)th type of action is as follows:

\[ \text{Sco}_i(n) = K(n, y_i). \]  

(10)

According to the above formula (10), the continuous action sequence data of the test are extracted into the scoring system according to the sequence fragments extracted by the sliding window, and the score size of each category corresponding to each frame can be obtained.
When nodes in different frames receive different types of tasks from outside the system, the sum of the proportion of offloading to other nodes that allow assistance and the proportion of local processing is 1 [18, 19]. It can be expressed as follows:

$$
\sum_{i \in \mathcal{I} \mid K_{i}^{m} = 1} \mu_{mon}^{i} = 1.
$$

(11)

In the formula, because some nodes do not allow certain tasks to be processed, when different frames $m$ are allowed to be processed in cooperation with the transmission type, they can be transmitted to the nodes through various paths. The sum of the proportions of all path allocations is 1, so it can be expressed as follows:

$$
\sum_{k \in \mathcal{K}^{i}} \lambda_{monk}^{i} = 1, \quad \forall j, n \in \{i, n|K_{n}^{i} = 1\}.
$$

(12)

After making a decision, to optimize the system, the frame node is not allowed to offload tasks to perform collaborative processing. Then, the condition that the ratio of the data sharing capacity of each transmission path of the slave node is summed to 1 will not exist or be meaningless. Arranging the above two situations can be expressed as follows:

$$
\zeta_{\min} \sum_{k \in \mathcal{K}^{i}} \lambda_{monk}^{i} = \lambda_{monk}^{i}, \quad \forall i, n \in \{i, n|K_{n}^{i} = 1\}, m \in M.
$$

(13)

(3) Football Action Analysis Model

In this paper, an improved OpenPose network model is used to analyze the body movements of athletes during kicking with both feet [20]. The network model is a flexible way that the database model is conceived as representing objects and their relationships. Its characteristic is that it can be viewed as a graph whose object type is node and relationship type is arc, and it is not limited to a hierarchical structure. Then, combined with OpenPose, you can observe the changes in the posture of the human body in real time. Then, the data are preprocessed to obtain the coordinate data of the key points of the limbs in the process of robust rope skipping. Because the coordinates of the key points of the body movements are a time series and have a certain connection with each other, this study finally applies the ALSTM-LSTM model to the analysis of the body movements through the algorithm transformation method in the multi-label classification algorithm. The ALSTM-LSTM (time-series forecasting method) model is applied to the analysis of body movements, as shown in Figure 5.
2.3. Football Player Training and Teaching Actions Based on Artificial Intelligence

(1) With the help of artificial intelligence for football players' training and teaching actions, detailed plan design and implementation can be carried out. Under this technology, it can be simply divided into the following modules [21]. First, the relevant data of football players are entered into the server, and the topological structure is managed according to the relevant operation of the server, as shown in Figure 6. As shown in Figure 6, the server is used as a node to manage different related data of athletes, and the logical processing server of the system structure is expanded into athlete management, athlete-related data, trainer management, and background management and is timely feedback based on different changes each time to improve the athlete's training.

(2) Deep Belief Network

DBN algorithm is a kind of neural network of machine learning. It can be used for unsupervised learning and supervised learning. DBN is a probabilistic generative model. Compared with the traditional neural network of discriminant model, the generative model is to establish a relationship between the observation data and the label. For the input feature data, usually the data are fitted with a presumption of what distribution it conforms to, and then, it is trained and solved according to its assumed distribution model. Many distributions can take advantage of the unique properties and learning process of the energy model, limiting the Boltzmann machine [22, 23] to be transformed from the energy model. Then, the energy definition is as follows:
obtain from the image. The global information of the data in the image is extracted, and a global feature extraction model [25, 26] is established. In action recognition, the position changes in key parts of the human body in the action sequence are generally used for estimation. The specific training management system for the human body is shown in Figure 7.

3. Experiment and Analysis

3.1. Data Analysis of Artificial Intelligence. Although movement is an external manifestation of the ability to collaborate, the completion of technical movement is the result of the coordinated work of nerves, muscles, and sensations. According to the related theory of cooperation ability, the football player’s physical cooperation ability is defined. In the understanding of artificial intelligence, it mainly relies on receipt data for timely feedback. For the understanding of our neural network, we must also rely on the calculation of the network and the establishment of the model. In-depth understanding of various data can be adjusted in various physical indicators [27]. Table 1 shows the impact of different groups of people on the impact of the introduction of artificial intelligence technology in football.

From the data in Table 1, we can see whether the impact on football players after the introduction of artificial intelligence will increase the interest of the players, and most importantly, it will bring about huge changes in improving the training quality of the players. Through the investigation of a large number of samples, it is found that there will be an 85% impact on improving the quality of training. Of course, there are other impacts similar to the use of artificial intelligence technology to record relevant data of athletes and then provide better feedback based on the content obtained. After receiving the relevant feedback, the athlete can adjust the relevant training plan in time. Then, after receiving the relevant feedback, the athlete can adjust the relevant training plan in time. In addition to the relevant changes in the training, the athlete can adjust the action in time during the training to reduce the physical injury.

3.2. Training Behavior of Football Players. After the introduction of artificial intelligence, athletes will reduce their usual mistakes, etc. The impact of improving on the basis of existing levels by trainers is shown in Table 2.

According to the data in the table, the influence of the research objects of different competition levels can be observed. First of all, certain research is conducted on whether the changes brought about by the introduction of artificial intelligence will have an impact. Experimental data show that after the introduction of artificial intelligence, the changes brought about by both professional leagues and campus leagues are very large. For example, for school leagues, the main impact is about 30%. In addition, the changes brought by the training team members introducing artificial intelligence technology for training are shown in Table 3.
According to Table 3, it can be seen that artificial intelligence equipment has a great auxiliary effect on football. After using artificial intelligence, based on the related training of the original football players, it can improve the training efficiency of football players and improve the enthusiasm of the players in training. In addition to the intensity of the original training, it can also reduce the chance of athletes being injured.

Through the adjustment of big data, certain feedback from athletes can be obtained. In turn, the formation of a good training closed-loop promotion can not only improve the training efficiency of the athletes but also help the athletes to increase their interest in many aspects [28].

Through the above table method, the introduction of artificial intelligence in football can bring about very big
It is not only reflected in the behavioral teaching of football players’ training but also can better stimulate the physical performance to a new height. At the same time, it is not only reflected in sports competitions but also in protecting the athletes’ bodies to ensure that they will not be harmed. This timely feedback can help trainers and athletes to collaborate better.

3.3. Experimental Football Players’ Ability Test Results after Artificial Intelligence Training. After the experiment, the analysis of the test results of football players’ personal ball control is to detect the antagonistic personal ball control of different groups of players using a paired sample test. \( K_1 \) is the preexperimental test result of the number of successful transfers after the athlete gets rid of the test, \( K_2 \) is the test result of the number of athletes successfully shed the ball in the test before the test, and \( K_3 \) is the test result of the athlete’s catch-and-stop quality before the test in the test, as shown in Table 4.

From Table 4, it is observed that in the test about athletes’ antagonistic personal ball control, the number of successes after the athletes get rid of the number of transfer experiments is basically between 10. According to the data in the experimental group, the lowest number of successes is 7 times, and the lowest number of successes in the control group is 6 times. The comparison shows that the number of successes of the experimental group is significantly better than that of the control group. Therefore, according to the results of this experiment, it can be seen that the introduction of artificial intelligence technology can improve the athlete’s antagonistic personal ball control ability.

From the perspective of different experimental groups and control groups, there is a gap in the number of athletes’ confrontational escape transfers. Observing the data in the chart, we can see that the data of the experimental group are more stable, and at the same time, it is better than the experimental group, as shown in Figure 8.

Because football is a long-term sequence analysis [29] process, it is necessary to use a sliding window to segment different data. Therefore, to find the appropriate length of the sliding window, the accumulated coordinates in different frames are obtained, as shown in Figure 9.

4. Discussion

This article is dedicated to introducing artificial intelligence technology into the teaching behavior of football sports training. The research in the article shows that when
computer technology and football are combined, certain advantages can be obtained in the individual physical indicators of athletes, and better feedback can be obtained during training to form a closed-loop virtuous circle. Through the analysis of different frame numbers, the athlete’s range of activities is captured, and then, quantitative analysis is carried out, so that football training can get rid of purely relying on experience and enter the era of theory and digitalization.

5. Conclusions

The data acquired by each device can simulate the entire process of the athlete from before touching the ball to after ejection. The height and distance of the virtual football flight are simulated according to the football players’ exertion habits and contact points during sports. Artificial intelligence technology actually simulates the physical characteristics of football players’ height, body shape, etc., according to their joints and their spatial positions, and appears in the simulated environment at a specific speed. Through the introduction of artificial intelligence technology, the use of multi-person whole-body positioning and interaction systems, and online training, you can see the actions of other operators and load and update the training scene in real time. Football training or games can be carried out online, which can help users visually analyze the on-site situation and make correct decisions about passing height, angle, and time.

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare that there are no conflicts of interest with respect to the research, authorship, and/or publication of this article.

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