Incremental Update Algorithm of Athlete Physical Training Information Under Dynamic Iterative Sampling

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Abstract. An incremental update algorithm of athlete physical training information based on dynamic iterative sampling is proposed to address the problems of lack of real-time and low computational efficiency in the process of athlete physical training information analysis. The dynamic iterative sampling technique is combined to collect large-scale athlete fitness data, obtain athlete fitness training information based on the incremental update framework, map the existing athlete fitness training data input values into the high-dimensional feature space of the informational network, and combine with the incremental learning algorithm to perform fast updates to better understand the athletes' fitness status. The experimental results show that the root mean square error, the average relative error and the correlation coefficient of the samples after the application of this algorithm are better. It reflects the athletes' physical training situation more accurately and has certain application value.

Keywords: Athletes · Physical Training Information · Dynamic Iterative Sampling · Incremental Learning · Update Algorithm

1 Introduction

An important feature of High-performance sport is the need to constantly explore the athletes' sports potential, so as to develop athletes' sports skills. From the first Olympic Games to the present, sports training has roughly gone through four stages: the natural development stage, the new technology stage, the high-sport stage, the multidisciplinary integrated utilization stage, and the scientific training stage. The goal of each stage of progress and training is to promote the improvement of athletes' physical fitness level to reach the best level. With the continuous improvement of modern sports, the development of athletic ability reaches its maximum. As one of the main components of athletic ability, the level of physical development is increasingly prominent in modern sports. In this context, exploring and studying the basic theory and methods of developing athletes' physical fitness, seeking the best theoretical model of physical fitness training, making physical fitness training more scientific, athletes' physical fitness training information

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network and optimization, has become the goal of modern sports training pursuit. Physical fitness is the basic athletic ability of the human body expressed through physical abilities such as strength, speed, endurance, coordination, flexibility and agility. It is an important part of athletes' competitive ability. The purpose of physical training is to meet the needs of all kinds of sports competitions. Through adopting targeted training methods, we strive to maximize the physical fitness of athletes and achieve the goal of physical training. In recent years, many scholars at home and abroad have conducted various studies on physical fitness and have made many research results. However, in general, they still lag behind the existing research on training practices and have not yet formed a complete understanding of the information network of physical fitness training for athletes.

For the whole body, physical training helps to improve the coordination of the central nervous athlete physical training information network, so that the body can be more coordinated between the active muscle synergistic muscle and the antagonistic muscle during contraction during exercise. More and more scholars, researchers and physical training coaches gradually pay attention to the important value of high-tech achievements in physical training and have made many useful attempts, but there are some problems such as lack of real-time, low computational efficiency, etc. [1–3] for the update of information on athletes' physical training, for example.

In order to solve these problems, this paper discusses the incremental updating algorithm of athletes' physical training information under dynamic iterative sampling, which provides an effective application method for improving athletes' training level. By introducing dynamic iterative sampling technology, online learning and real-time response can be achieved by continuously sampling and updating data during the training process; combined with incremental learning algorithms, athletes' physical training data can be updated more effectively to improve the training effect.

2 Database Update Algorithm Based on Incremental Learning Algorithm

Athletic physical fitness training refers to the process of implementing scientific and systematic physical fitness training for different projects, requirements, and individual characteristics in sports training, and improving athletes' physical, technical, and psychological qualities through certain methods and means. The necessity of athlete physical fitness training is that athletes need to display their best state and performance in competitions, and the improvement of good physical fitness, technical ability, and psychological quality is the key to ensuring that athletes achieve excellent results.

Strong stamina and good endurance performance is required as athletes are constantly running, jumping, turning and changing direction during the race. Physical fitness training can help athletes continuously improve their endurance and endurance performance, allowing them to better adapt to the intensity and rhythm of the competition, and thus achieve better results. In addition, physical fitness training can also help improve the physical fitness of athletes, such as stability, flexibility, coordination, etc., thereby improving their performance level; Reducing muscle soreness and strain, preventing minor and severe injuries to athletes. Physical training can reduce muscle tension and

reduce the tension of the body's muscles through activities. Professional physical fitness coaches establish scientific methods to comprehensively improve athletes' physical fitness, strengthen the strength and flexibility of ligaments, tendons, and muscles, while avoiding excessive injuries to athletes, thereby maintaining health and reducing injuries. Therefore, athletes' physical fitness training is necessary to ensure their physical health.

Physical training can help athletes improve their technical abilities. Physical coordination is a crucial factor in athletes' athletic skills. Physical fitness training can enhance athletes' physical coordination, enabling them to better grasp and apply technical movements, thereby better exerting their technical level in competition and improving their performance. From this, it can be seen that athlete physical fitness training information is constantly increasing and there is redundancy. At the same time, incremental information updating refers to comparing newly obtained information with known information and effectively updating it based on the newly obtained information to improve the efficiency and accuracy of the information system. In today's rapidly developing information society, information systems need to be constantly updated with changes in information to ensure their effectiveness and accuracy. Therefore, incremental information updates have the following necessity:

(1) Improving information update efficiency: Incremental information updates can reduce the time and cost of information updates, while quickly comparing and updating new information with existing information, thereby improving the efficiency and speed of information updates.
(2) Higher accuracy: Traditional batch update methods can only compare and update new information with all known information, which consumes time and effort. However, incremental update of information can quickly compare and update new information with known information, reduce information redundancy, and improve information accuracy and accuracy.
(3) Improving system security: Incremental information updates can regularly compare and update the security policies in the system with the latest security updates, effectively improving the security of the information system.
(4) Improving user experience: Incremental information updates can reduce the time users need to wait for information updates, thereby improving user experience and satisfaction.

In summary, incremental information updates can improve the efficiency, accuracy, and security of information systems, while also improving user experience. Therefore, it is of great necessity in information systems.

2.1 Incremental Update Framework

Due to the lack of an informative and intelligent physical training system to command athletes' physical training information network. Therefore the relevant theoretical research work is slowly updated, the relevant disciplines do not reveal enough about the basic laws of physical fitness training, and some researchers lack accurate understanding and testing of the characteristics of professional sports. Many factors that constitute training and competition are dynamically changing. Exploring the dynamic balance between various factors involves a wide range of aspects and is really difficult to achieve; In

addition, the cultivation of outstanding athletes is a long-term and complex process, including the content of basic theories related to body science, as well as the profound connotations of sports humanities and sports sociology; Some factors are controllable and predictable, but there are also many unforeseeable changes; There is measurable data, but there are also hidden unknown factors. These uncontrollable, non quantitative, and unpredictable factors need to be studied, and there is currently no landmark research. At the same time, there is a problem of a large amount of information overload and a large amount of duplicate and invalid information in the original network information. Directly selecting information related to users from network information can easily lead to query errors [4, 5]. Therefore, a complete incremental update framework is needed, Meet the requirement of utilizing dynamic iterative sampling.

(1) In order to maintain the normal operation of the athlete physical training information network, it is necessary to use the permission management module to manage and maintain the information network of athlete physical training. The specific functions include user information management (such as user registration, login, user permission settings, etc.). Authorization management involves assigning permissions to roles, and there are many corresponding relationships between accounts, roles, and permissions. Figure 1 shows the permission management module

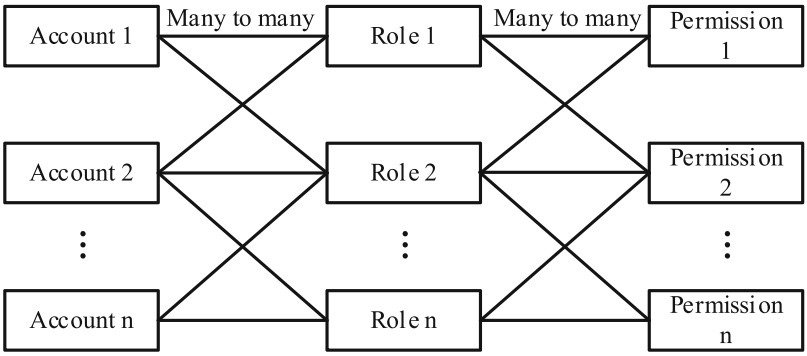


Fig. 1. Permission Management Module

In Fig. 1, the work of adding, deleting, and modifying user information in the athlete physical training information network is mainly completed, and the list mainly shows important fields such as number, real name, user name, department, role, creation time, and account status [7].

A pop-up window displays the new user interface function, and if the interface information is too much, the page can be reopened to display it. In addition to creating a new account, it is also necessary to make changes to the existing account (editing function in the operation bar), but the user's real name, username, and other information cannot be changed during the change process. Instead, it is necessary to change the real name and username to editable status according to the actual needs of the project.

Creating a new role is the process of describing that role and giving it permissions. If changes are allowed, select them from the drop-down list. If the number of permissions is large and the classification is complex, you can display it as a list of groups and let the user select it via the selection box. It is recommended to add a select all/reverse feature to simplify the operation. The edit feature in the toolbar is used to modify the existing roles, you can change the role name, description, status and permissions. After each modification, the update time is recorded.

In the case of a large number of permissions and complex types of permissions (page permissions, operation permissions, data permissions) in the athlete physical training information network, the permissions management page is presented in the form of a list with the number of permissions, name, type, description, creation time, etc., in order to ensure the convenience of the administrator and reduce the possibility of errors [8, 9].

The entry page for new permissions has different requirements for the athlete physical training informatics network, some of which require the development of the input code, some of which require the product manager to enter the URL of the new permission, and some of which do not show the new permission entry in the athlete physical training informatics network.

(2) The indicator management module is mainly used for browsing, searching, adding and deleting evaluation indicators, and experts or managers can adjust the evaluation indicator system through this module.

(3) The collaboration and communication module provides a variety of communication methods for evaluators, and the forum communication is used to provide feedback on evaluation results and evaluation problems so that managers or experts can make adjustments to the evaluation index system, and this module can be implemented through the forum. Fancy aliases are replaced by human names and displayed in a tree shape, making it easy for users to find. Self-developed multiple communication methods to ensure customer needs and secondary development, helping enterprises to realize QQ/MSN-like communication methods. Timely processing of foreign emails to ensure normal communication with customers. During the outbound period, you can notify related matters through SMS to ensure the normal work of relevant personnel.

2.2 Data Information Abstraction Based on Dynamic Iterative Sampling Technology

In each module, a series of data information is often abstracted into a mathematical theory-based information network for description. In the process of abstracting data information into information network graphs, the information nodes are mainly abstracted as points, while the relationships between different information nodes are abstracted as network edges. In the process of studying data mining and learning. Athlete physical training information network as a kind of special network that can more reflect heterogeneous relationships [10, 11],mainly consists of network nodes, node

relationships and node relationship attributes, etc., for which dynamic iterative sampling techniques are introduced to represent the given spatial dimensional set and spatial data point set settings as follows, respectively:

$$H = \{h_1, h_2, \cdots, h_n\} \tag{1}$$

$$K = \{k_1, k_2, \cdots k_m\} \tag{2}$$

In the formula, H represents the given spatial dimension set, K represents the spatial data point set, h represents the spatial dimension, k represents the spatial data point, n represents the total number of spatial dimensions within the set, and m represents the total number of spatial data points within the set. According to the maximum value of the data space boundary, perform a query on the data contour of the real estate registration space, and calculate the length of the envelope in each spatial dimension at the initial time:

$$\begin{cases} C(h_a) \cdot \varpi = L \\ C(h_b) \cdot \varpi = 0 \end{cases} \tag{3}$$

In the formula, C represents the envelope, ϖ represents the initial time, L represents the maximum value of the data space boundary, h_a, h_b represents two data space dimensions, and a, b represents the spatial dimension. Among them:

$$1 \leq a \leq n,\ b \in \{1, \ldots, n\},\ b \neq a \tag{4}$$

When a contour point is found, the remaining contour points may only exist in the remaining query space. On a long-term dimension, time series reconstruction can be randomly simulated through temporal order. Combining the given time, perform multi-step prediction on the model:

$$f_{i+p} = G^h(X_d) \tag{5}$$

In the equation, f_{i+p} represents the multi-step advance prediction value of step i and step p forward; X_d represents the error value of a single prediction. Follow the principle of minimizing structural risk to process the given sample set and establish a regression function equation:

$$y(x) = w^T p(x) + b_i \tag{6}$$

where, r $y(x)$ epresents the loss function value of the sample data set; w^T represents the operational weight vector; And $p(x)$ represents a nonlinear spatial mapping function; b_i represents the input offset. To solve the goal planning problem, map the existing input values to a high-dimensional feature space:

$$\begin{cases} \min G(w_d, p_i) = \frac{\|w_d\|^2}{2} + \frac{\xi_m \sum_{i=1}^{n} p_i^2}{n} \\ s.t. y_i = w^T p(x) + p_i \end{cases} \tag{7}$$

where, $G(w_d, p_i)$ represents the optimization objective function of regularization, where w_d and p_i represent the input and output vectors of samples respectively; ξ_m is the relaxation factor of the sensitive loss function; y_i represents the value of the regression function. Therefore, during the contour point query process, the space that has already been queried is represented as:

$$S_1 = \{1 \le h_a \le L, 0 \le h_b \le C(h_b)\} \tag{8}$$

In the formula, S_1 represents the queried space. The remaining query space can be calculated based on the entire data space:

$$\begin{gathered} S_2 = S - S_1 \\ = \{1 \le h_a \le L, 0 \le h_b \le L\} - \{1 \le h_a \le L, 0 \le h_b \le C(h_b)\} \\ = \{1 \le h_a \le C(h_a), C(h_b) \le h_b \le L\} + \\ \{C(h_a) \le h_a \le L, C(h_b) \le h_b \le L\} \end{gathered} \tag{9}$$

In the formula, S represents the entire data space, and S_2 represents the remaining query space.

3 Storage and Filtering of Athlete Physical Training Information

The specific storage structure is shown in Fig. 2.

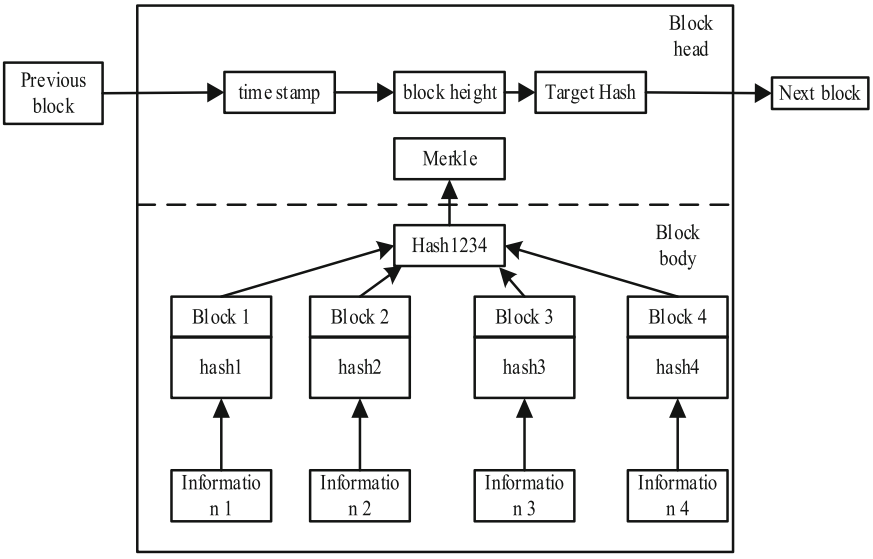


Fig. 2. Blockchain storage structure diagram of athlete physical fitness training information

Each block in the blockchain contains a block and its head, and the blockbody is the foundation, forming the entire blockchain through a large blockbody. At the same time, the target block is generated by combining the hash value of the previous block with a random number. Genhash verified the authenticity of the transaction and confirmed that there were no false transactions. Each block will store each transaction data separately and determine the structure of the transaction data based on the functionality of the blockchain. Blockchain contains a lot of information about transactions. A large amount of data is displayed in the Merkle tree, and these data are saved in the tree structure. In blockchain storage, an incentive mechanism is used to enable each node to effectively reach a consensus. In order to achieve maximum benefits, both parties will not change the authentication results of other blocks. In the actual storage process, when power companies request storage from edge devices, they can choose to store data on any node and only send storage requests to that node for a certain period of time. After receiving the request, the storage node sends back the response from the storage and provides the service sequence number of the storage to the storage node. When the storage node is received, the storage node can perform data filtering. After filtering the updated data through a temporary database, it is also necessary to check the location of the updated data. Only after the graphic data is checked and found to be correct can the real estate registration database be considered updated. Import accurate updated data directly into the current database and store it uniformly with historical data. Unlike temporary databases, the implementation of current database updates requires two steps: one is to replace the updated layer with data, and the other is to adjust the replaced data to historical data for subsequent calls. In addition, the update methods for the two databases are the same, except that the current database no longer requires feature filtering.

4 Experiments

A certain team has 20 athletes, and their physical and training data are shown in Table 1:
During the experiment, the algorithm related parameters were:

(1) Training Plan:
   1) Training time: 5 days per week;
   2) Training content: dribbling, shooting, defense, rebounding, physical fitness training, etc.;
   3) Intensity: Adjust according to personal situation;
(2) Incremental update algorithm for information:
   1) Input data: Weekly training data and body data, which need to be adjusted and modified according to actual situations;
   2) Output data: adjusted training plan;

Table 1. Body Data and Training Data

Sportsman	age	Height (cm)	Weight (kg)	Body fat percentage (%)	Weekly training frequency	Training intensity	Physical fitness score
1	20	185	75	15	5	8	80
2	22	180	80	12	6	7	70
3	25	175	70	18	4	6	60
4	23	190	90	13	5	9	90
5	19	170	65	16	4	6	70
6	21	185	80	10	6	8	80
7	24	195	100	20	5	9	90
8	20	175	70	14	4	6	60
9	22	180	75	12	5	7	70
10	23	185	80	16	6	8	80
11	19	170	65	13	4	6	70
12	20	185	75	15	5	8	80
13	22	180	80	12	6	7	70
14	25	185	70	18	4	6	60
15	23	190	90	13	5	9	90
16	19	180	65	16	4	6	70
17	21	185	80	10	6	8	80
18	24	195	100	20	5	9	90
19	20	185	70	14	4	6	60
20	22	180	75	12	5	7	70

Experimental steps:

(1) Collect basic information about athletes, including age, height, weight, body fat percentage, etc., and divide them into different groups according to their characteristics.
(2) Set a training plan, including weekly training time, training content, and intensity, and guide athletes in groups.

(3) Adopting information incremental update algorithm and Reference 3 Deterministic learning based gain recognition algorithm, the training plan is dynamically adjusted based on the training data of each athlete every month to adapt to changes in their body and needs.
(4) Using root mean square error, average relative error, and correlation coefficient as evaluation indicators for the algorithm, the effectiveness and superiority of the algorithm are evaluated by comparing the data before and after updates. The calculation formula is:

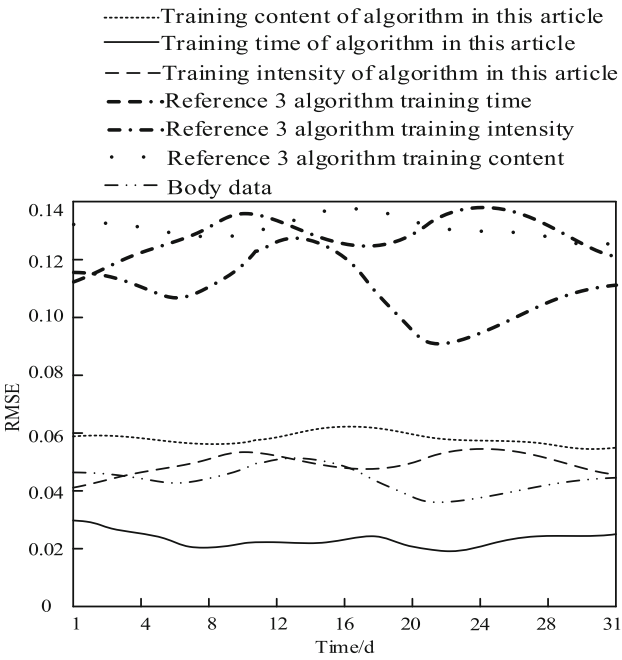
$$E_{RMSE} = \sqrt{\frac{1}{N_m}} \sum_{i=1}^{n} (p_i - p_j)^2 \tag{10}$$

$$E_{MAPE} = \sqrt{\frac{1}{N_m}} \sum_{i=1}^{n} \left| \frac{p_i - p_j}{p_i} \right| \tag{11}$$

$$R_k = \sqrt{\frac{\left(N_m \sum_{i=1,j=1}^{n} p_i p_j - \sum_{i=1}^{n} p_i \sum_{j=1}^{n} p_j\right)^2}{\left(N_m \sum_{i=1}^{n} p_i - \left(\sum_{i=1}^{n} p_i\right)^2\right)\left(N_m \sum_{j=1}^{n} p_j - \left(\sum_{j=1}^{n} p_j\right)^2\right)}} \tag{12}$$

In the formula, E_{RMSE} represents the root mean square error and E_{MAPE} represents the average relative error. The smaller the values of the two, the higher the accuracy of the algorithm; N_m represents the total amount of data; p_i and p_j represent actual data and monitoring data, respectively; R_k represents the correlation coefficient, and the closer this value is to 1, the better the fitting effect of the algorithm. Using the above formula, obtain the error of the algorithm to determine the performance of different algorithms.

The experimental comparison results are shown in Fig. 3:



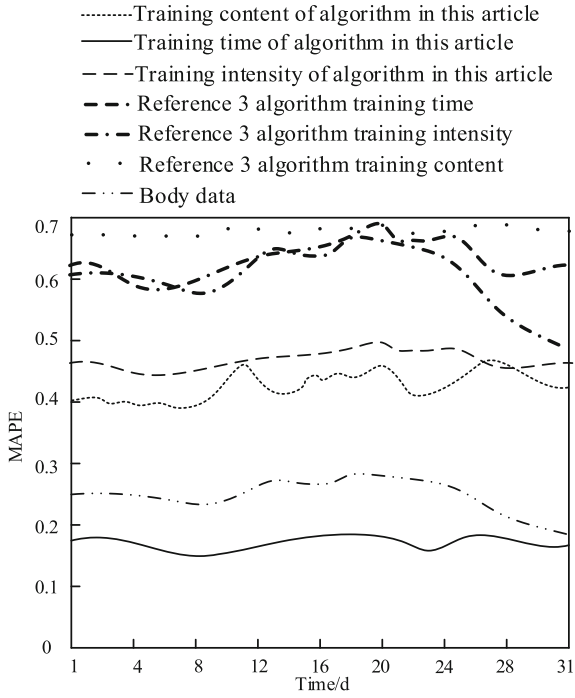
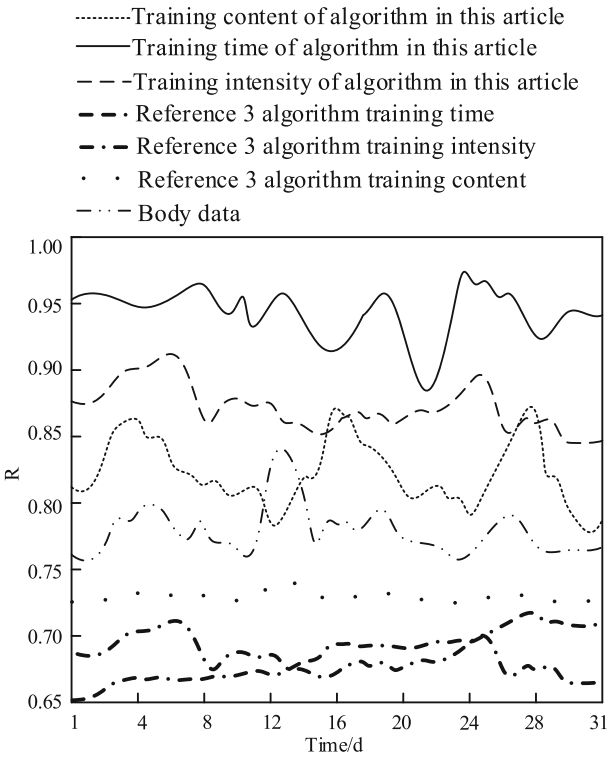


Fig. 3. Algorithm Performance Test Results



(c) Correlation coefficient

Fig. 3. (*continued*)

In Fig. 3, the difference between the predicted physical performance and actual performance of athletes using information incremental update algorithms is relatively small, with smaller RMSE and MAPE, and a larger correlation coefficient. This indicates that the updated and filtered information in the database meets the requirements of training plan adjustment, and the adjustment results are good, indicating that the incremental update algorithm has good application effects.

5 Conclusion

A dynamic iterative sampling based incremental update algorithm for athlete physical fitness training information is proposed. Build a multi-module incremental update framework, based on dynamic iterative sampling technology to abstract analyze data information, effectively filter out a large amount of information overload and repeated invalid information in the original network information, thereby avoiding the occurrence of user information query errors, and meeting the requirements of dynamic iterative sampling. Apply a database update algorithm based on incremental learning algorithm, combined with a blockchain storage structure for athlete sports training information, to store and

filter athlete sports training information. After filtering the updated data through a temporary database, Huqiu updates the location of the data to accurately predict the future physical performance of athletes and achieve dynamic updates of training information.

In the future, we will further explore the application of incremental update algorithms for athletes' physical fitness training information in more fields. For example, it can be applied to the training of other sports events, or applied to the monitoring and management of athletes' physical condition, which will further improve the algorithm, improve its prediction accuracy and training effectiveness, and achieve better results in practical applications.

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