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*Retraction*

# Retracted: A Method of Using Data Mining and Edge Computing to Calculate the Standing Efficiency of Basketball Games

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This article has been retracted by Hindawi, as publisher, following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of systematic manipulation of the publication and peer-review process. We cannot, therefore, vouch for the reliability or integrity of this article.

Please note that this notice is intended solely to alert readers that the peer-review process of this article has been compromised.

Wiley and Hindawi regret that the usual quality checks did not identify these issues before publication and have since put additional measures in place to safeguard research integrity.

We wish to credit our Research Integrity and Research Publishing teams and anonymous and named external researchers and research integrity experts for contributing to this investigation.

The corresponding author, as the representative of all authors, has been given the opportunity to register their agreement or disagreement to this retraction. We have kept a record of any response received.

## References

[1] Z. Wang and Y. Liu, "A Method of Using Data Mining and Edge Computing to Calculate the Standing Efficiency of Basketball Games," *Security and Communication Networks*, vol. 2021, Article ID 9732171, 8 pages, 2021.

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*Research Article*

# A Method of Using Data Mining and Edge Computing to Calculate the Standing Efficiency of Basketball Games

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The continuous improvement of basketball tactics has high requirements for athletes' position selection. This article proposes an intelligent method for basketball position selection. Massive basketball game data will provide people with richer content. Analyzing massive basketball game data can provide a new method for position efficiency calculation. To solve this problem, we can combine edge computing and data mining technology classification technology to build a basketball game position efficiency calculation model. First of all, we build a basketball game position efficiency calculation architecture through edge computing technology. Secondly, we use random forest algorithm and fuzzy neural network algorithm to analyze relevant basketball game information. The experimental simulation test results verify the superior performance of the basketball game position efficiency calculation model established in this paper. This model can provide help to improve the information level of basketball games.



## 1. Introduction

With the continuous improvement of the competitive level of modern basketball, both sides of the game not only pay attention to the aspects of technology, tactics, style, consciousness, psychology, and physical fitness but also pay great attention to the control and mastery of the rhythm of the game [1, 2]. In a closely matched and fierce game, whoever can control and grasp the rhythm of the game can often firmly grasp the initiative of the game and win the final victory of the game. As we all know, the offensive and defensive confrontation of modern basketball games is fierce, and the situation on the court changes rapidly [3, 4]. In addition to technology, tactics, style, consciousness and psychology, sports, and control, both sides of the game have a large impact on the outcome of the game. Combined with the field rules of sports competitions, it is not difficult to find that the structure of sports competition videos is very strong [5]. Take a basketball game as an example. A basketball game is divided into four quarters, and each quarter consists of several defensive and offensive rounds of players from both sides of the game [6].

Each round usually includes events such as dribbling, passing, shooting, and scoring. Such a regular video content organization structure brings great convenience to sports video analysis. Facts have proved that improving the understanding of the rhythm of the basketball game, attaching importance to the study of various factors affecting the rhythm of the basketball game, grasping the timing of their use, and conducting targeted training are essential for giving full play to the players' technical capabilities and coordinating the overall effectiveness of the team [7, 8]. The best results of the game will play a positive role in promoting. Therefore, both at home and abroad, the relevant research on the game rhythm, which is both tangible and invisible, has been very extensive, and the definition of the game rhythm, the classification of the game rhythm, and the form of expression have also been deeply discussed. The number of cameras in sports videos is limited, and the shooting angle of each camera is relatively fixed [9]. The video frames shot at

different positions and different angles provide users with important semantic information and provide important content clues for video content analysis [10]. The traditional method of data cleaning by sensor nodes is not enough to deal with big data, but edge computing provides a good solution. Reference [11] proposed a new data cleaning method based on moving edge nodes in the process of data collection. The angular outlier detection method was used to obtain the training data of the cleaning model at the edge nodes and then the cleaning model was established by support vector machine. Because networks are deployed in remote, unattended areas, equipment is unreliable and vulnerable to multiple threats. Reference [12] discusses the challenges faced by the Industrial Internet of Things in data processing, secure data storage, efficient data retrieval, and dynamic data collection. We then designed a flexible and economic framework combining fog and cloud computing to solve the above problems.

By analyzing massive basketball game data, it can provide a new way for position efficiency calculation. To solve this problem, we can build a basketball game position efficiency calculation model by combining edge computing and data mining technology classification technology [13, 14]. First, we build a basketball game position efficiency calculation architecture through edge computing technology. Secondly, we use random forest algorithm and fuzzy neural network algorithm to analyze relevant basketball game information. Experimental simulation test results verify the superior performance of the basketball game position efficiency calculation model established in this paper [15, 16]. This model can provide help for the improvement of the information level of basketball games.

The remainder of this paper is organized as follows. Section 2 introduces the summary of related technologies. Section 3 discusses the calculation of basketball game position efficiency based on data mining and edge computing. Section 4 discusses experiment and analysis. Section 5 presents the conclusions of the study.

## 2. Summary of Related Technologies

*2.1. Basketball Game Position.* With the development of the basketball plan, basketball moves have shown a good momentum of development in recent years. But inevitably, there are many problems in the development of basketball [17, 18]. The core content of basketball is the basketball game, and the goal of basketball training is to achieve outstanding results in major games. Therefore, how to maximize the acquisition and analysis of the information reflected in the game is very important for coaches to improve the team's overall offense and defense [19].

As an important part of basketball games, basketball game technical statistics have played an active role in promoting the development of world basketball. Studying the technical statistics of the NBA is not difficult to find that the gap between the CBA and the world's high-level leagues is not only reflected in the level of competition, there is also a huge gap in the work of technical statistics [20].

Technical statistics are an important basis for objective analysis of basketball games. Much important actual combat information is implicit in technical statistics. Through objective analysis of technical statistics of the game, coaches can conduct training in a more targeted manner and fans can look at it objectively. In the competition, the media can also dig out more points to watch, and the enjoyment of the game will increase accordingly [21, 22]. Figure 1 shows the structure diagram of the influencing factors of basketball game position efficiency.

The emotions of athletes can be controlled, which has been confirmed by modern physiology. The experiments of American psychologists Shah and Singh proved that although people's emotions and psychological state are closely related to the external environment, they are still dominated by people's subjective conditions [22, 23]. However, the process of human cognition has the main reason that affects emotions, and it can control and regulate emotions. Arrow also pointed out that emotions and the individual's assessment of objective things are interrelated [24, 25]. According to the above research, we can give full play to our subjective initiative, consciously exercise, and control the psychological aspects in normal training and competitions and adapt to the complex competition situation with positive and full emotions [26].

*2.2. Edge Computing.* Mobile edge computing (MEC) and wireless power transmission are two promising technologies to solve the challenges. In recent years, MEC has received increasing attention from the industry and academia because it can significantly improve the computing power of mobile devices in a cost-saving and energy-saving manner [27–29]. It allows mobile devices to offload some or all their computationally intensive tasks to MEC servers located at the edge of the wireless network, such as cellular base stations and access points. Unlike traditional cloud computing, MEC servers are deployed near end users [29, 30]. Therefore, MEC has the potential to provide low-latency services, save energy for mobile users, and achieve high security. Figure 2 shows the schematic diagram of edge calculation of basketball game position efficiency.

Edge computing uses the storage and processing capabilities of many IoT devices to connect them to the Internet deployed at the edge, thereby providing an intermediate layer between terminal devices and the cloud [31–33]. With the existence of these "edge devices," some tasks can be processed to reduce the computing load of the data center. It reduces the delay in resolving requests and allows real-time tasks to be processed. Edge devices also support mobility because of the rich availability and the nature of geographic distribution. Edge computing theory is a commonly used intelligent computing method [34, 35]. The mobile edge computing (MEC) architecture can effectively enhance the capabilities of personal portable devices and can fully support advanced and personalized services such as augmented and virtual reality, voice recognition, and machine learning [36, 37]. In fact, compared to the traditional cloud architecture based on large data centers, there are fewer large data centers for mobile edge computing, and they seem to be

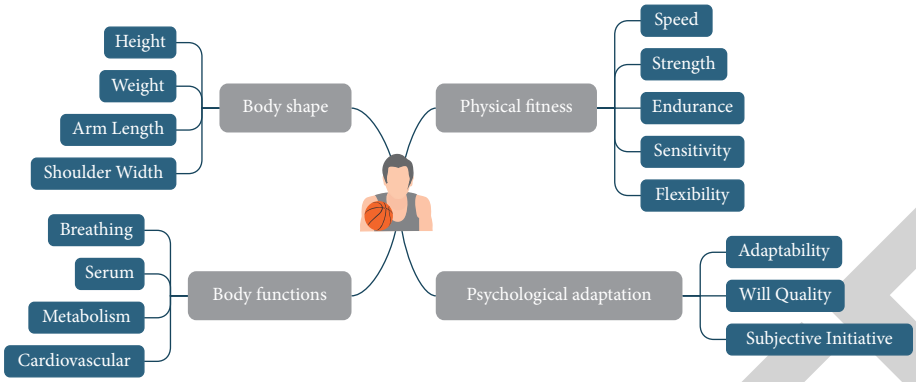


Figure 1: Structure diagram of factors affecting position efficiency of basketball games.

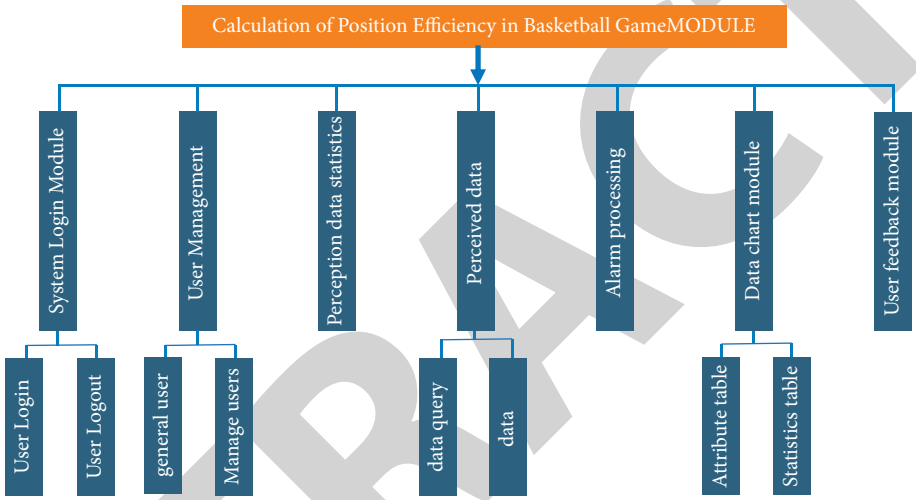


Figure 2: Schematic diagram of edge calculation of basketball game position efficiency.

more suitable to meet the latency, responsiveness, and privacy requirements of these advanced services [38].

## 3. Calculation of Basketball Game Position Efficiency Based on Data Mining and Edge Computing

The random forest (RF) algorithm has excellent performance and can process classification and numerical features at the same time. Even without hyperparameter adjustment, it will bring good results in most cases. Random forest can resist over-fitting. We know that when the entire set of data exists in the dataset, the decision tree will often produce over-fitting problems [39, 40]. Technical statistics are an important basis for objective analysis of basketball games. Much important actual combat information is implicit in technical statistics. Through objective analysis of technical statistics of the game, coaches can conduct training in a more targeted manner and fans can look at it objectively. In the competition, the media can also dig out more points to watch, and the enjoyment of the game will increase accordingly [41].

To some extent, the prediction of the decision tree is only shown in the memory data, but the random forest prevents for this kind of problem to occur; it is not just a decision tree, but a combination of multiple decision trees. Finally, the result is obtained by averaging decision trees [42]. The more the decision trees under the random forest algorithm, the better the generalization of the results and the lower the risk of fitting. At the same time, the stability of random forest is also extremely high, only when more than half of the errors occur will make an incorrect prediction. If only one new data point appears in the dataset, then it will only affect one decision tree and the entire algorithm. It will not be affected too much [43, 44].

$$U_{yz} = V_y + V_z + V_{yz} + \varepsilon_y + \varepsilon_z + \varepsilon_{(y,z)}. \tag{1}$$

Random forest randomly selects $n$ observations from $D$ and replaces them to form a leading sample.

$$\begin{aligned} V_y &= \theta_{10} + \theta_2 V y\text{Use} + \theta_3 B_Y, \\ V_z &= \theta_{20} + \theta_4 T_z + \theta_5 C_z. \end{aligned} \tag{2}$$

Use a subset of $m$ features from all $M$ features to form each tree. Then, randomly select $m$ features on each node and select the best performance among the $m$ features for segmentation according to the impurity measure [45].

$$V_{yz} = V_{zy} + \theta_6 d_{yz} + \theta_3 F_{yz},$$
$$P_y = \frac{\exp\left[\xi\left(V_y + V_y'\right)\right]}{\sum_{y_\prime \in Y} \exp\left[\xi\left(V_y + V_y'\right)\right]}. \tag{3}$$

Let each tree grow to its maximum depth. Not changing the tree and choosing the best function assigned at each node can make the random forest maintain the prediction strength [45].

$$V_y' = \frac{1}{\xi} \ln \sum_{z \in Z_y} \exp\left[\xi\left(V_z + V_{yz}''\right)\right],$$
$$P_{z/y} = \frac{\exp\left[\xi\left(V_z + V_{yz}'\right)\right]}{\sum_{z \in Z_y} \exp\left[\xi\left(V_{z_\prime} + V_{yz}'\right)\right]}. \tag{4}$$

In addition, the random selection of features reduces the correlation between trees. Unlike other tree-based methods, as more trees are added to the forest, random forests are not affected by over-fitting [46].

$$P_{yz} = P_y P_{z/y} = \frac{\exp\left[\xi\left(V_y + V_y'\right)\right]}{\sum_{y_\prime \in Y} \exp\left[\xi\left(V_y + V_y'\right)\right]}$$
$$\cdot \frac{\exp\left[\xi\left(V_z + V_{yz}\right)\right]}{\sum_{z \in Z_y} \exp\left[\xi\left(V_z + V_{yz}'\right)\right]}. \tag{5}$$

The overall forecast is based on the average forecast of individual trees in the forest. Random forest can not only summarize the predictions of trees in the entire sample but also use out-of-bag samples to provide variable importance metrics [47].

$$q_{z=A} = \frac{QP_{y=T} P_{z=A/y=T}}{C_A},$$
$$V_{yz} = V_{zy} + \theta_6 d_{yz} + \theta_3 F_{yz}. \tag{6}$$

The main idea is to eliminate the dependence of predictor variables on response variables by arranging their values on all trees [48].

$$q_{z=M} = \frac{QP_{y=F} P_{z=M/y=F}}{C_M},$$
$$q_{z=\text{Mix}} = \frac{QP_{y=T} P_{z=\text{Mix}/y=T} + P_{y=F} P_{z=\text{Mix}/y=F}}{C_{\text{Mix}}}. \tag{7}$$

Then, estimate the loss of forest prediction accuracy, high loss means the importance of predictors, and vice versa. Edge computing uses the storage and processing capabilities of many IoT devices to connect them to the Internet deployed at the edge, thereby providing an intermediate layer between terminal devices and the cloud [49]. With the existence of these "edge devices," some tasks can be processed to reduce the computing load of the data center. It reduces the delay in resolving requests and allows real-time tasks to be processed. Edge devices also support mobility because of the rich availability and the nature of geographic distribution. The theory of edge computing. The best results of the game will play a positive role in promoting [50]. Therefore, both at home and abroad, the relevant research on the game rhythm, which is both tangible and invisible, has been very extensive, and the definition of the game rhythm, the classification of the game rhythm, and the form of expression have also been deeply discussed. The number of cameras in sports videos is limited, and the shooting angle of each camera is relatively fixed [51]. The video frames shot at different positions and different angles provide users with important semantic information and provide important content clues for video content analysis [52].

## 4. Case Analysis of Position Efficiency Calculation in Basketball Game

*4.1. Basketball Game Data Source.* In the imbalanced dataset, most samples have an absolute advantage in number, which is the main reason that the prediction model cannot identify the minority samples. The solution to data imbalance is divided into two levels: data and algorithm. The simulation diagram of basketball court and location is shown in Figure 3.

The data imbalance method at the algorithm level can be dealt with by the integrated method, which mainly includes the two integrated methods of boosting and bagging. The Ad boost method is one of the representative methods of boosting. In the learning process, the weight of the training sample data is updated by increasing the weight of the wrongly classified sample and reducing the weight of the correctly classified sample. In this way, in the next learning process, the samples that were judged incorrectly in the previous learning will be focused on learning. The bagging method uses a certain integration strategy to combine multiple learning in parallel and improves the prediction effect by fusing the prediction advantages of learning. Therefore, compared to the learner, the strong classifier based on the parallel integration strategy has a better effect on the classification of data with unbalanced sample categories.

*4.2. Analysis of the Calculation Effect of Basketball Game Efficiency.* As shown in Figure 4, we have drawn the basketball trajectory diagrams under different schemes. The black broken line is the basketball trajectory diagram obtained by solving the traveling salesman problem (TSP). The pink broken line is the basketball trajectory diagram under the random unloading scheme.

The bit distribution coefficient of the random unloading scheme system is random, and the basketball trajectory diagram obtained by the solution scheme of the hovering flight communication protocol is used. The red broken line is based on the basketball trajectory diagram under the condition of optimizing the bit allocation coefficient of the system under the communication protocol scheme of basketball hovering. The blue dotted line is the basketball trajectory diagram based on the energy minimization design

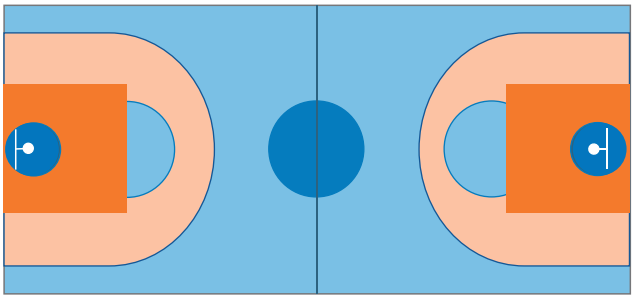

Figure 3: Schematic diagram of basketball game venue and location simulation.

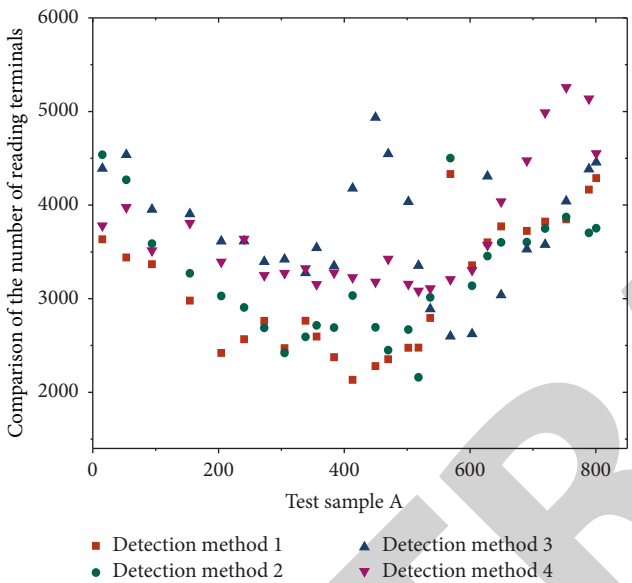


Figure 4: Basketball game efficiency resource mining response speed performance results.

of the continuous convex optimization algorithm under the path discrete scheme, and the green broken line is the basketball trajectory diagram based on the time minimization design of the continuous convex optimization algorithm under the path discrete scheme.

We found that the smaller the $L$, the more the basketball tends to find a shorter path to the next location. For this phenomenon, we understand that larger calculation data requires more communication energy and calculation energy. The best results of the game will play a positive role in promoting. Therefore, both at home and abroad, the relevant research on the game rhythm, which is both tangible and invisible, has been very extensive, and the definition of the game rhythm, the classification of the game rhythm, and the form of expression have also been deeply discussed. The number of cameras in sports videos is limited, and the shooting angle of each camera is relatively fixed. The video frames shot at different positions and different angles provide users with important semantic information and provide important content clues for video content analysis. The results of the concurrent endurance of the basketball game resource mining server are shown in Figure 5.

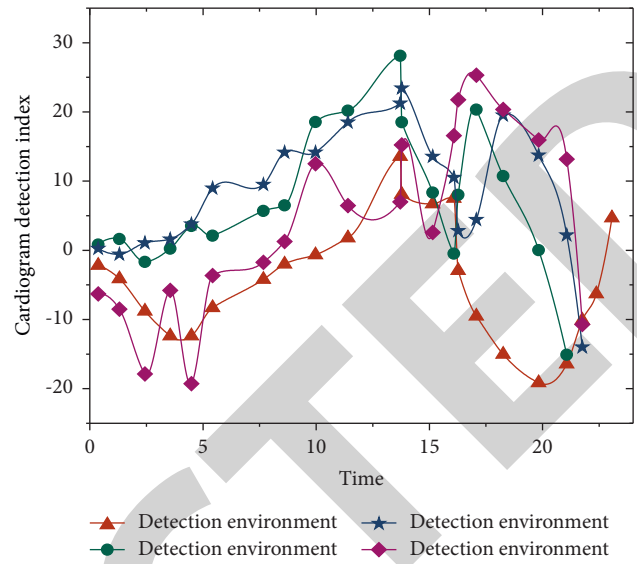


Figure 5: The results of the concurrent endurance of the basketball game resource mining server.

We observe that as $L$ becomes larger, the task completion time of the proposed side's basketball also increases. Compared with a single basketball, the task completion time of multiple basketballs is greatly reduced. This is because multiple basketballs can better achieve edge coverage and enhance channels. With the development of the basketball plan, basketball moves have shown a good momentum of development in recent years. But inevitably, there are many problems in the development of basketball. The core content of basketball is the basketball game, and the goal of basketball training is to achieve outstanding results in major games. Therefore, how to maximize the acquisition and analysis of the information reflected in the game is very important for coaches to improve the team's overall offense and defense.

Compared with the static basketball scheme, the task completion time of the proposed design scheme is also optimal. This is because in the proposed design, the basketball can fly back and forth between different positions in order to explore more effectively through time sharing. Figure 6 shows the comparison diagram of the reconstruction signal quality of the basketball game mining effect analysis.

Figure 6 lists the classification effects of the two models using the same features under the same test conditions. The results show that the random forest algorithm is slightly higher than the Bayesian classifier in recall and F1 score. Random forest can resist over-fitting. We know that when the entire set of data exists in the dataset, the decision tree will often produce over-fitting problems. Technical statistics are an important basis for objective analysis of basketball games. This is because the random forest integrates the decision results of multiple decision trees, with high stability, and the algorithm's identification effect is better. At the same time, compared with the original PQ feature, the accuracy rate and recall rate of the composite features screened by the algorithm using the mutual information method have increased by about 0.8. Figure 7 shows the comparison chart of

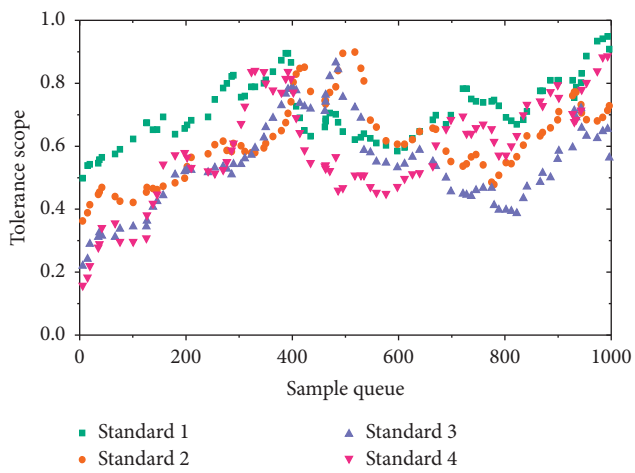


Figure 6: Comparison of the quality of the reconstructed signal from the analysis of the basketball game mining.

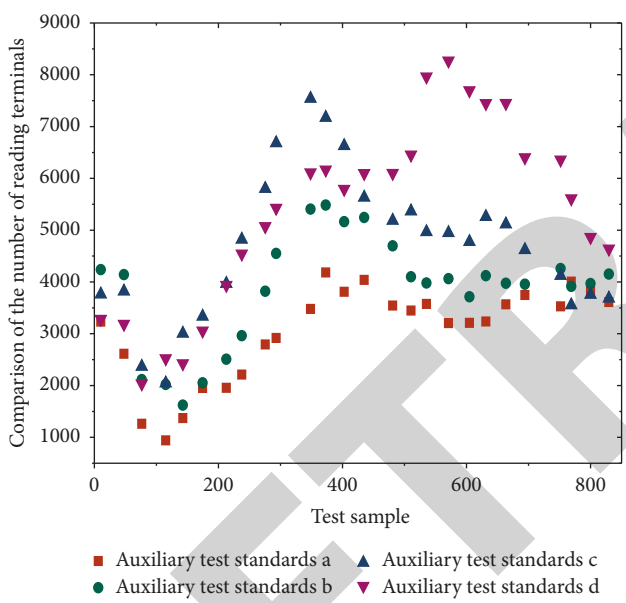


Figure 7: Comparison of data mining quality of basketball game resource mining and reconstruction.

data mining quality of basketball game resource mining reconstruction.

In order to characterize the importance of different features, the definition of accuracy loss is specifically expressed as the removal of different features from the training set. Under the same algorithm parameters, the calculation of the average accuracy rate is compared with the average accuracy rate of the original number of features. This result reflects the importance of the corresponding feature scene. This shows that the features of mutual information screening are effective for load identification under low-frequency sampling. In addition, since in the multiclass model, the number of positive samples for each electrical appliance is equal, the number of negative samples is higher than the positive sample for each electrical appliance, so the accuracy rate is generally higher.

## 5. Conclusion

Facts have proved that improving the understanding of the rhythm of the basketball game, attaching importance to the study of various factors affecting the rhythm of the basketball game, grasping the timing of their use, and conducting targeted training are essential for giving full play to the players' technical capabilities and coordinating the overall effectiveness of the team. Edge computing uses the storage and processing capabilities of many IoT devices to connect them to the Internet deployed at the edge, thereby providing an intermediate layer between terminal devices and the cloud. With the existence of these "edge devices," some tasks can be processed to reduce the computing load of the data center. It reduces the delay in resolving requests and allows real-time tasks to be processed. Edge devices also support mobility because of the rich availability and the nature of geographic distribution. The theory of edge computing. The best results of the game will play a positive role in promoting.

Therefore, both at home and abroad, the relevant research on the game rhythm, which is both tangible and invisible, has been very extensive, and the definition of the game rhythm, the classification of the game rhythm, and the form of expression have also been deeply discussed. Analyzing massive basketball game data can provide a new way for position efficiency calculation. To solve this problem, we can construct a basketball game position efficiency calculation model by combining edge computing and data mining technology classification technology. First, we built a basketball game position efficiency calculation architecture through edge computing technology. Secondly, we use random forest algorithm and fuzzy neural network algorithm to analyze relevant basketball game information. The experimental simulation test results verify the superior performance of the basketball game position efficiency calculation model established in this paper. This model can provide help to improve the information level of basketball games. In addition, there are extensive researches on tangible and intangible game rhythm at home and abroad, and the definition, classification, and forms of game rhythm have also been deeply discussed. Due to the limited number of cameras in sports videos, the shooting angle of each camera is relatively fixed, and video frames shot at different positions and angles provide users with different semantic information. Therefore, we need to make full use of these content clues in video analysis in future work.

## Data Availability

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

## Conflicts of Interest

The authors declare that they have no conflicts of interest.

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