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Retraction

Retracted: On-the-Spot Decision-Making System of Basketball Game Based on Data Mining Algorithm

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This article has been retracted by Hindawi following an investigation undertaken by the publisher [1]. This investigation has uncovered evidence of one or more of the following indicators of systematic manipulation of the publication process:

(1) Discrepancies in scope
(2) Discrepancies in the description of the research reported
(3) Discrepancies between the availability of data and the research described
(4) Inappropriate citations
(5) Incoherent, meaningless and/or irrelevant content included in the article
(6) Peer-review manipulation

The presence of these indicators undermines our confidence in the integrity of the article's content and we cannot, therefore, vouch for its reliability. Please note that this notice is intended solely to alert readers that the content of this article is unreliable. We have not investigated whether authors were aware of or involved in the systematic manipulation of the publication process.

Wiley and Hindawi regrets 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 own 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] D. Ma, "On-the-Spot Decision-Making System of Basketball Game Based on Data Mining Algorithm," *Security and Communication Networks*, vol. 2022, Article ID 6292221, 14 pages, 2022.

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Research Article

On-the-Spot Decision-Making System of Basketball Game Based on Data Mining Algorithm

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Modern competitive basketball has developed into a skilled international competitive sport. The situation in basketball is changing rapidly. At the same time, tactics are one of the main factors affecting game performance in athletic basketball. Whether the athletes successfully use the techniques and tactics in the game or not will often become the decisive factor for the outcome of the game. Therefore, it is essential to grasp the situation of basketball games, to study the technical and tactical rules of basketball competitive games, and to provide scientific support for the daily technical and tactical training of competitive basketball and technical and tactical decision-making during the game, which is an important way to improve the level of basketball competition in China. As a decision support technology, data mining plays an important role in decision support systems. This decision-making method is closely related to the amount of data, the way of organization, and the structure of the organization. Based on this, this study studies the improved Bayesian algorithm classification algorithm in data mining, and it also reorganizes and restructures the large, intricate, and unorganized data from the database of the system according to the decision-making demand. After a series of data processing processes are completed, the latest data organization mode is obtained, and new data correlation information is found from it, by finding the relevance of knowledge in the decision support system of the database-based relational database management system, and presenting the implicit structural information in the data to provide users with more accurate decision-making information. Finally, in the investigation and analysis of the on-site decision-making system of basketball games, it is found that 48% of sport coaches think it is very helpful, indicating that the system has merit.

1. Introduction

As the internet develops in the era of big data, its characteristics are vividly illustrated. Driven by contemporary technical data, computer technology, and database technology, the explosion of data is becoming prominent. Data mining and knowledge discovery technologies are proposed and developed under this requirement. Through the eigenvalues of explicit data and their arrangement rules, the unknown, hidden, and potential data organization rules and meanings between data or information can be found out to facilitate the processing of the same or similar information data types. By interpreting the implicit information data structure, the implicit meaning of the information data is revealed, and further decision-making, predictions, and corrections are carried out according to this law. This mechanism can promote the decision support system to form a virtuous circle from data analysis to decision-making.

Field control largely depends on the coach's experience and judgment. Therefore, if it is possible to directly introduce high-tech means such as computers in the competition, especially in some collective competitions that require group cooperation, such as basketball and volleyball competitions, and assisting coaches in on-site analysis and judgment will greatly improve the accuracy of analysis and judgment, thereby improving the performance of the game. In the 21st century, world basketball, as a global social culture and human landscape, will be further popularized and developed more rapidly in a wide range of the world. It can also assist the coach to carry out targeted training after the game. In basketball, which requires teamwork, if we can accurately and timely grasp the field information, make effective

judgments on the situation on the spot, and formulate corresponding strategies, people will definitely win the initiative.

In this study, the on-site decision-making system of basketball games was established by using data mining method and sports technique and tactic modeling research methods. Based on the structure of database, knowledge base, and model base, the system realizes the use of data mining technology to explore the implicit technical and tactical decision-making knowledge and laws under a large amount of data. In the functional analysis of the system, the relationship between the selection of the number of blocks and the size of the itemset is explored. It is found that the more the blocks are generated, the more the average local frequent itemsets are generated, and the greater the gap with the global maximum frequent itemsets is. That is, there will be many nonglobal frequent itemsets. This study also studies the gain value of the improved Bayesian algorithm on the physical attributes of athletes. The gain value of the height attribute obtained by the Bayesian algorithm is 0.25, which is the smallest among all attributes, and the improved algorithm obtains the gain value of 1, which is the smallest among all attributes. The simplified algorithm of the Bayesian algorithm and the improved Bayesian algorithm is consistent in selecting classification attributes, but the operation speed is greatly improved. In the feasibility analysis of the decision-making system, the decision-making system has the highest judgment accuracy rate for "foul" and "score," which are 96% and 97%, respectively. About 48% of sports coaches found it helpful, indicating that the system has merit.

2. Related Work

Tactical decisions on the field have an essential impact on the outcome of the game. A large body of literature exists to support the use of virtual modeling to improve the effectiveness of motor decision-making skills. Yet, it remains unclear whether these improvements are transferable (from laboratory to court/field) and widespread (from trained players to untrained players). Furthermore, it remains to be ascertained whether the use of virtual reality technology to demonstrate video simulations provides added value. To investigate these questions, Pagé C conducted four training sessions with varsity basketball players during which they observed video clips of basketball games displayed on a computer screen (CS group) or using a virtual reality headset (VR group). Both the VR and CS groups performed significantly better than the CTRL (a replay of the NCAA playoffs was viewed on a computer screen) group when faced with the trained items in the post-test. Conversely, when faced with an untrained match, the VR group performed better than both the CS and CTRL groups. The results show that CS training leads to transferable but nonuniversal decision-making gains, while VR training leads to transferable and generalized gains [1]. Understanding the demands of the basketball game can provide useful insights for creating concrete, personalized, group-based training programs. Ferioli identified and matched the playing event needs of basketball athletes at various positions: (i) strict ball control and (ii) overall activity during live games (independent of ball possession). The activity demands experienced by 44 adult professional men's basketball players were assessed during 10 official games. Time-motion analysis was used to determine the frequency and percentage (%) of recovery (REC), low-intensity (LIA), moderate-intensity (MIA), and high-intensity (HIA) activities. Defenders, forwards, and centers spent $11.9 \pm 5.9\%$, $3.5 \pm 1.3\%$, and $2.9 \pm 1.1\%$ of their field time holding the ball, respectively. Defenders are more active than forwards and centers at all intensities (total action, REC, LIA, MIA, and HIA) when in possession. In basketball, activities performed while holding the ball and during live play are affected by the position of the game. These data underscore the need to develop position-specific training, especially with the ball, but not very practical [2]. In this study, Nakashima pointed out that "ball of string" and "basketball with postman and edge zone" can improve the decision-making ability of sixth-grade students compared with the ordinary game of basketball. The results showed two findings. First, the students who played "line pitching" and "basketball with the postman and side zone" showed stronger decision-making skills compared to students who played regular basketball. Therefore, studies have shown that "basketball with postman and side zone" is effective because it improves decision-making and because it was developed to solve offensive strategy problems [3]. However, at present, the research on the on-site decision-making system of basketball games is not perfect.

With the rapid development of computer technology and the increasing application of information technology in basketball games, how to find useful information from a large amount of data to guide basketball games and help coaches make decisions is an urgent problem to be solved. Zi applied data mining technology to the technical and tactical analysis of basketball games. By performing correlation analysis and Markov (the Markov model is a statistical model widely used in speech recognition, automatic part-of-speech tagging, phonetic-to-word conversion, probabilistic grammar, and other natural language processing applications) process-based data mining analysis on the data collected in basketball games, basketball technical and tactical analysis system is developed, which has the functions of analyzing basketball technical and tactical characteristics, analyzing basketball technical and tactical direction, and analyzing key actions. The system solves the problem of technical and tactical associations in basketball games, studies the implementation process of key actions, provides a scientific basis for coaches' guidance and decision-making, and provides a scientific method for improving personal basketball skills. It has promoted the rapid and significant development of basketball players' careers [4]. Using computer technology to help athletes train and improve their competition has become the trend of modern sports development. Liu analyzed college basketball tactics based on data mining clustering technology. The analysis methods used in the basketball technique and tactic analysis system must extract data from the database and perform data transformation. The competition of modern competitive

basketball is fierce, and it is necessary to ensure the integrity, confrontation, and variability of tactical training. Combining individual tactics with collective tactics, offensive tactics, and defensive tactics can improve the effectiveness of tactical training [5]. Wen applies data mining technology to the technical analysis of basketball games to improve the efficiency and accuracy of data collection and analysis. Through database construction and data mining, it is possible to better understand each player on the court, obtain key information about each player's movements in a basketball game, and identify players' strengths and weaknesses. Coaches can use the information obtained to rationally allocate players' positions on the field and their responsibilities. Additionally, this information can help players understand themselves better. Therefore, applied data mining can provide useful information in training and competition, which in turn can provide important guidance to athletes and coaches [6]. To study the technical means of ball games in experimental sports, Wang used the basketball scene description language and scene description method to collect basketball game data and used the data mining method to analyze. This culminates in technical and tactical basketball positioning analysis and key action analysis. In the era of rapid development of computer technology, the number of basketball games has gradually increased. It is necessary to clarify with the help of data mining techniques whether there is other useful information hidden behind the massive data accumulated in the basketball database. Therefore, the application of data mining technology to the analysis of basketball tactics is of great significance to promote the rapid development of Chinese basketball [7]. In the related work section, a detailed analysis of data mining techniques and technical analysis of basketball games is carried out. It is undeniable that these studies have greatly promoted the development of the corresponding fields. We can learn a lot from methodology and data analysis. However, the research on the field decision-making system of basketball games by data mining is relatively few and not thorough enough, and it is necessary to fully apply these techniques to the research in this field.

3. On-Site Decision-Making System Method of Basketball Game Based on Data Mining Algorithm

The development of information technology has greatly improved people's ability to collect data in their daily activities, and a large amount of data from all walks of life has been stored to form a database. People are surrounded by these large amounts of data and often do not know how to deal with them. How to extract useful information from these large amounts of data is a problem worthy of study. Data mining is an interdisciplinary subject that emerges to discover new knowledge rules from a large amount of data. Data mining refers to the process of searching for information hidden in a large amount of data through algorithms [8].

The functions of data mining fall into two broad categories: description and prediction. Descriptive is to find potential patterns of connections in the data; prediction is to infer the value of a specific attribute based on current data [9]. The specific functions mainly include the following four aspects: (1) association and correlation analysis. According to the frequent pattern mining in the data, we determine the associations and related features in things [10]. (2) Cluster analysis: cluster analysis is the process of grouping a collection of samples so that the samples within each group are more closely related than the samples in other groups. (3) Anomaly detection: we identify observations in the database that are significantly different from other data [11]. (4) Prediction and modeling: we build a data feature model and implement predictions for future data features. The commonly used classification algorithms in data mining are shown in Figure 1 [6].

The application of the data mining algorithm in data analysis obtains experimental results with a shorter time, faster speed, and more obvious effect. The object of data mining can be any type of data source. It can be a relational database, such as a data source that contains structured data; it can also be a data warehouse, text, multimedia data, or such as a data source that contains semistructured data or even heterogeneous data. For data-based classification, it is necessary to study the relationship between them, usually using distance and similarity coefficients [12].

Bayesian classification is an advanced probability processing method, which models and analyzes the probability relationship between category attributes and other attributes. Naive Bayesian classification and Bayesian network methods are often used. If the conditions between attributes are assumed to be independent of each other, while ensuring the independence of noisy data and good classification accuracy for irrelevant attributes, then the naive Bayes method is used. The algorithm can be applied to large databases; the method is simple; the classification accuracy is high; and the speed is fast [13]. However, it is difficult to ensure the independence of attribute relationships in real data, and the Bayesian network method can be used in this case. Especially for those incomplete datasets, it has better applicability. The disadvantage is that it is more difficult to construct a reasonable network [14].

We consider n data as n points in the m-dimensional space; then, the similarity between the two data is measured by d_{ij}. $\mathrm{d}_{i,j}$ is the distance of sample A_i, A_j, which usually needs to meet: $\mathrm{d}_{ij} \geq 0$, for any $\forall i, j$: when $\mathrm{d}_{ij} = 0 \Leftrightarrow A_i = A_j$; $\mathrm{d}_{ij} = \mathrm{d}_{ji}$, for any $\forall i, j$; $\mathrm{d}_{ij} < \mathrm{d}_{ic} + \mathrm{d}_{cj}$, for any $\forall i, j$, then common distances are as follows.

(1) Mingshi distance (Mingshi distance is the shortest distance between two points based on space) as follows:

$$\mathrm{d}_{ij}(k) = \left[\sum_{i=1}^{p} \left|x_{it} - x_{jt}\right|^{c}\right]^{1/c} (i, j = 1, 2, \ldots, n). \quad (1)$$

The first-order Mingshi distance when $k = 1$ is as follows:

$$\mathrm{d}_{ij}(1) = \sum_{i=1}^{p} \left|x_{it} - x_{jt}\right| (i, j = 1, 2, \ldots, n), \quad (2)$$

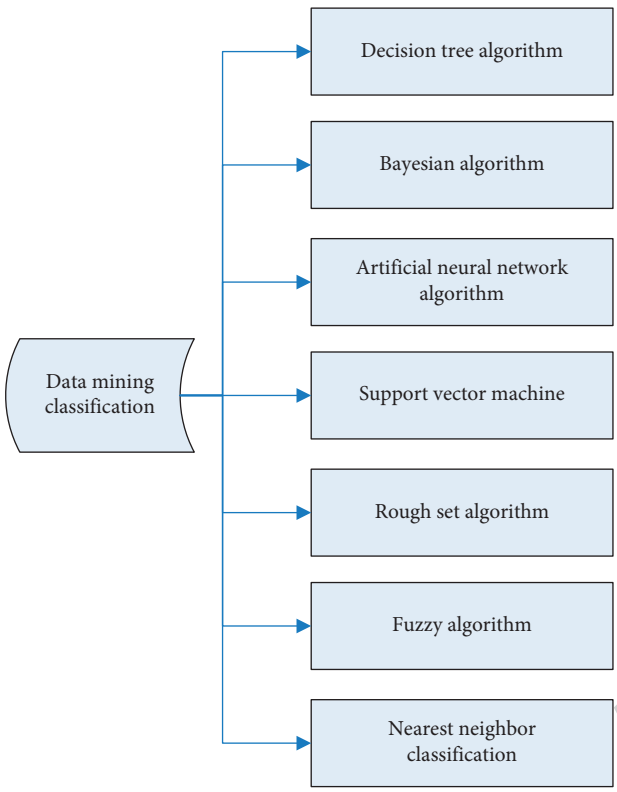

Figure 1: Classification diagram of data mining.

which is an absolute distance.

When $k = 2$,

$$d_{ij}(2) = \left[\sum_{i=1}^{p} \left|x_{it} - x_{jt}\right|^2\right]^{1/2} \quad (i, j = 1, 2, \ldots, n), \tag{3}$$

which is the Euclidean distance.

When $k \longrightarrow \infty$,

$$d_{ij}(\infty) = \max_{1 \le k \le p} \left|x_{ik} - x_{jt}\right| (i, j = 1, 2, \ldots, n), \tag{4}$$

which is the Chebyshev distance.

(2) Jay's distance is as follows:

$$d_{ij}(B) = \left[\sum_{c=2}^{q} \left(\sqrt{x_{ic}} - \sqrt{x_{jc}}\right)^2\right]^{1/2}. \tag{5}$$

(3) Mahalanobis distance is as follows:

The martingale distance indicates the variance-covariance separation of the data. It is an efficient way to determine the resemblance between two unidentified sample sets. $\sum$ is the covariance matrix of the index.

$$\sum = \left(\varphi_{ij}\right)_{p \times p}. \tag{6}$$

Among them,

$$\varphi_{ij} = \frac{1}{n-1} \sum_{\lambda=1}^{n} \left(x_{\lambda i} - \overline{x}_i\right)\left(x_{\lambda j} - \overline{x}_j\right) (i, j = 1, 2, \ldots, p),$$
$$\overline{x}_i = \frac{1}{n} \sum_{\lambda=1}^{n} x_{\lambda i},$$
$$\overline{x}_j = \frac{1}{n} \sum_{\lambda=1}^{n} x_{\lambda j}. \tag{7}$$

When $\sum^{-1}$ exists, then

$$d_{ij}^2(U) = \left(A_i - A_j\right)' \sum^{-1} \left(A_i - A_j\right). \tag{8}$$

That is the Mahalanobis distance.

The Mahalanobis distance from sample A to population H is defined as follows:

$$d^2(A, H) = (A - v)' \sum^{-1} (A - v). \tag{9}$$

Among them, v is the mean vector of the population.

(4) Level space distance is as follows:

Since there are often different degrees of correlation between variables, calculating the distance with Euclidean distance will bias the results. Therefore, the distance between samples i and j can be used as a classification scale in a more generalized oblique space distance.

$$d_{ij} = \left[\frac{1}{q^2} \sum_{n=1}^{q} \sum_{p=1}^{q} \left(x_{in} - x_{jn}\right)\left(x_{pi} - x_{pj}\right) r_{np}\right]^{1/2}. \tag{10}$$

That is the Rankine distance (also known as the Canberra metric).

$$d_{ij}(S) = \frac{1}{P} \sum_{a=1}^{p} \frac{\left|x_{ia} - x_{ja}\right|}{x_{ia} + x_{ja}} \quad i, j = 1, 2, \ldots, n. \tag{11}$$

This distance only applies to all $x_{ij} > 0$ cases, which is a self-normalizing quantity since it is insensitive to large singular values. This makes it particularly suitable for highly biased data.

We calculate the distance d_{ij} between any two samples A_i and A_j. The smaller the value of d_{ij}, the greater the proximity of the two data samples, the greater the value of d_{ij}, and the smaller the proximity of the two data samples [15]. When the distances of any two data samples are calculated, they can be arranged into a distance matrix G as follows:

$$G = \begin{bmatrix} d_{11} & d_{12} & \ldots & d_{1n} \\ d_{21} & d_{22} & \ldots & d_{2n} \\ \ldots & \ldots & \ldots & \ldots \\ d_{n1} & d_{n2} & \ldots & d_{nn} \end{bmatrix}. \tag{12}$$

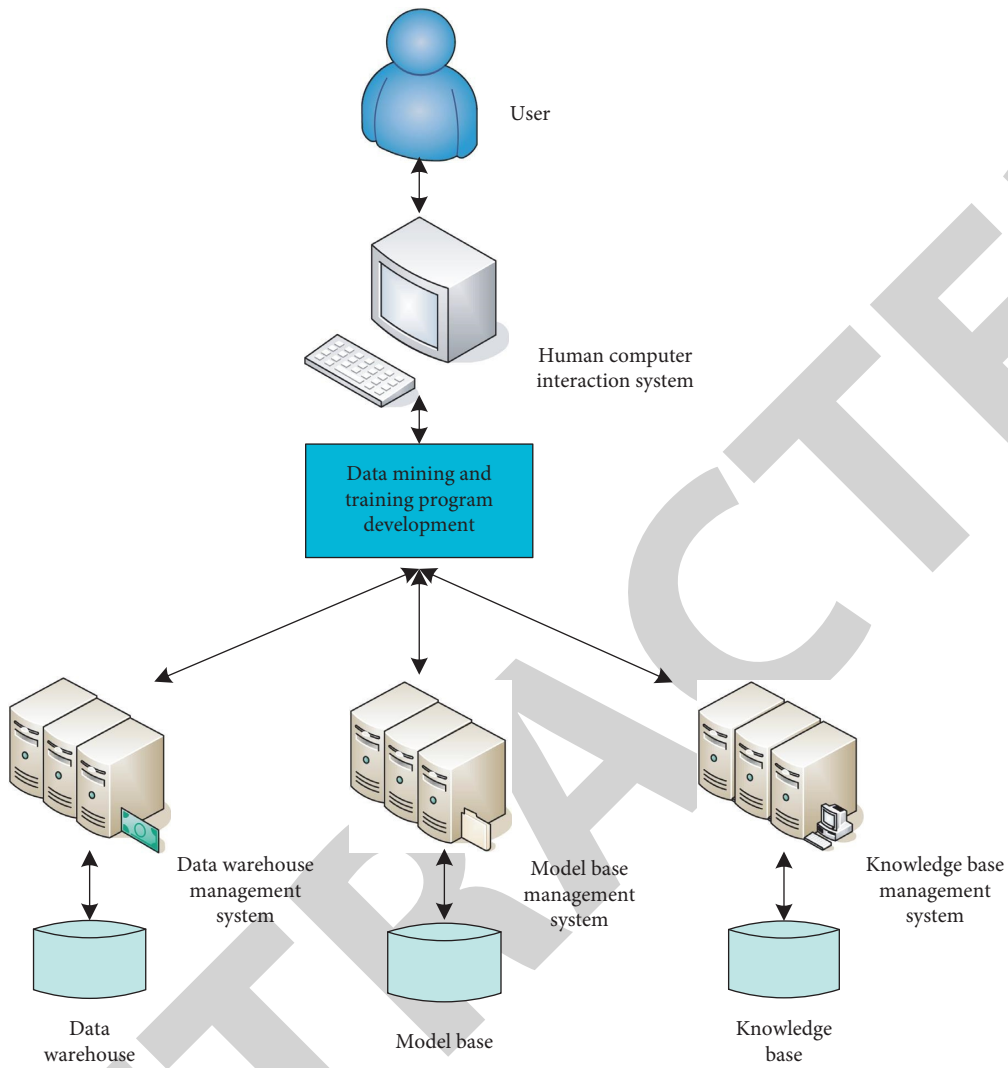

Figure 2: System functional architecture diagram.

Among them, $d_{11} = d_{22} = \ldots = d_{nn} = 0$. It can be seen that the matrix G is a real symmetric matrix, and only the upper triangular part or the lower triangular part needs to be calculated. Moreover, the n points can be clearly classified by the matrix G, and the points with a short distance can be classified into one category, and the points with a farther distance can be classified into different categories according to the actual situation [16].

Assuming that the imbalanced dataset is divided into two categories, the amount of data of the two types is very different, that is, $P(Ci)$ of the positive class is particularly small, which will cause the value of $P(A|Ci)P(Ci)$ to be very small corresponding to the positive class, and the generated classification data may be all classified into the negative class [17]. To solve this dilemma, this chapter multiplies the negative class $P(A|Ci)P(Ci)$ by a scaling factor R and guarantees $R < 1$. The improved formula is as follows:

$$P(Ci|A) = R * \frac{P(A|Ci)P(Ci)}{P(A)}. \quad (13)$$

The purpose of the improvement is to reduce the probability value of negative samples, relatively speaking, to increase the proportion of positive classes to a certain extent. However, this improvement also brings a corresponding disadvantage—reducing the accuracy of the naive Bayes algorithm for negative samples [18]. To improve the naive Bayesian algorithm, according to the principle that infinite probabilities less than 1 are multiplied to 0, multiple groups of base classifiers are trained. A complete classifier is formed in an ensemble manner to compensate for the loss caused by adding the scale coefficient R and further improve the classification performance of the positive class [19].

The process of combining the outputs of multiple classifiers to form a single value, resulting in a combined classifier, is called voting. How to combine the classification results of multiple classifiers? For the base classifier $\{g_1, g_2, \ldots, g_\tau\}$, the task of voting is to select the most likely class from $\{C_1, C_2, \ldots, C_l\}$ [20]. Commonly used voting methods include simple majority voting, majority voting,

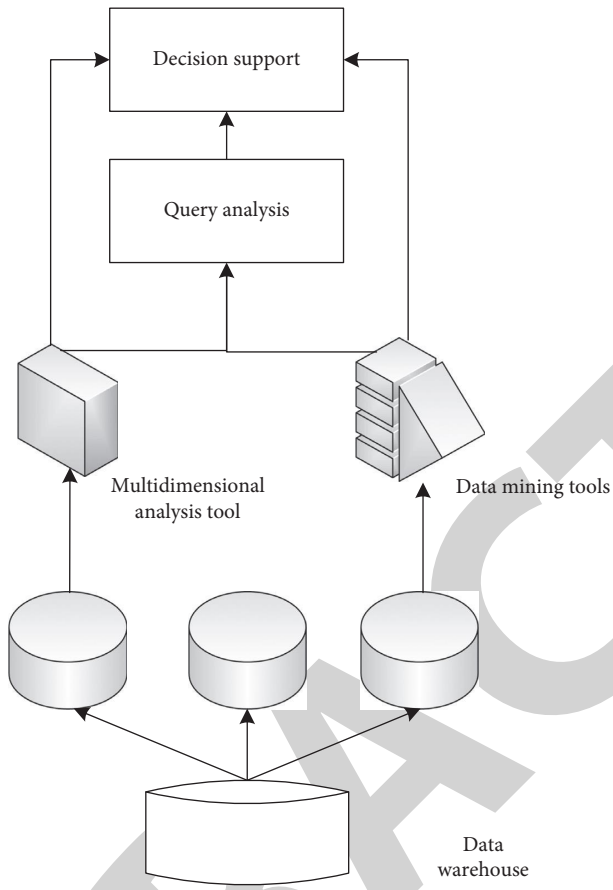

Figure 3: Application framework of data warehouse.

weighted voting, and average voting. In this chapter, we choose the average voting method as follows:

$$G(x) = \sum_{i=1}^{\tau} \beta g_i(x). \tag{14}$$

Among them, β is the weight of $g_i(x)$, which represents the contribution of the i-th collocation recognizer to the group class results ($\sum_{i=1}^{\tau} \beta = 1$). Two methods can be used to determine the weight of $g_i(x)$ to be β as follows:

(1) Voting method I (equal weight method): the weights of each collocation identifier are equal.

$$\beta = \frac{1}{T} (t = 1, 2, ..., T). \tag{15}$$

(2) Voting method II (priority optimization method): we assign larger weights to the base classifier with good effect, and the rest of the base classifiers have equal weights, namely,

$$\beta = \begin{cases} 1 + 0.2 * T/T + 0.2 * T \text{Optimal matching identifier} \\ 1/T + 0.2 * T \text{The rest of the matching identifiers} \end{cases} (t = 1, 2, ..., T). \tag{16}$$

If the classification results of the improved Bayesian algorithm are the same or similar, we use formula (17) to obtain the weight of the classifier. If the results are very different, formula (18) is used to give a relatively large weight to the classification algorithm with good results. Using formula (16) to integrate the base classification algorithm with the average voting method, it can be obtained as follows:

$$G(x) = \left\{ \sum_{i=1}^{T} 1 + 0.2 * T/T + 0.2 * T g_i(x) \sum_{i=1}^{T} 1/T + 0.2 * T_g(x). \right. \tag{17}$$

That is, the data classification results are obtained.

The development of information technology has made it possible to describe activities in an increasingly scientific and quantitative way, which makes quantitative decision-making possible. However, the increasing amount of quantitative

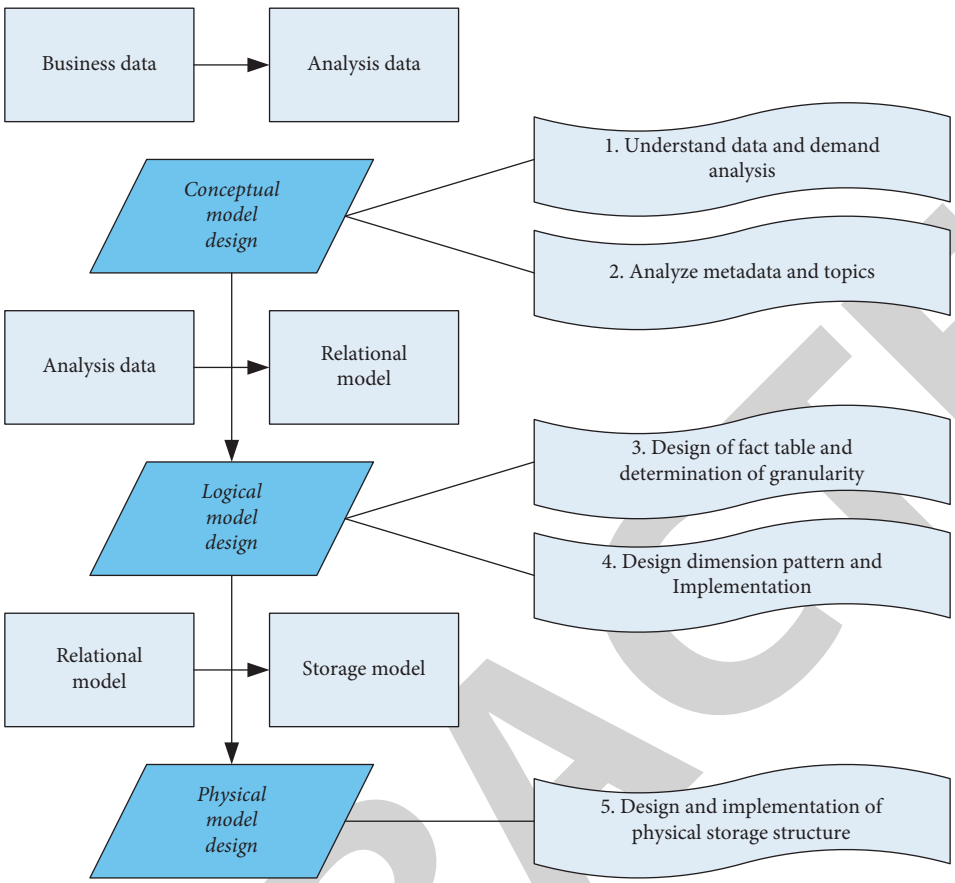

Figure 4: Design block diagram of the data warehouse.

information also increases the complexity of decision-making. It is difficult to discern patterns from these large amounts of data using a single statistical tool. Traditional statistical methods can only provide superficial information on these data but cannot discover the patterns hidden in the data, which is not conducive to making good decisions. It is imperative to find the right way to process large amounts of data and uncover hidden patterns. In this case, data mining plays a key role. As increasingly Chinese players participate in high-level international competitions, increasingly game videos are collected, and more technical and tactical data are collected from these games. Using data mining skills to study the technical and tactical characteristics of players' games makes up for the lack of knowledge captured by conventional statistical methods, thus identifying and discovering more unknown messages and patterns of value, and is an effective way to improve basketball technical and tactical decision-making. Thus, it is essential to use data mining to support basketball skills and taconic diagnosis.

Decision-making is the process by which people analyze and synthesize information to achieve specific goals, and then develop a systematic, theoretical, and specific action plan and prepare for its implementation. Epistemologically, decision-making is a process from practice to knowledge and from knowledge to practice. In terms of thinking, decision-making is a process of inputting, processing, and retrieving information.

Decision-making is a way of thinking that people often participate in, and people's lives are inseparable from different types of decisions. In basketball, techniques and tactics are complex and changeable, and previous technical and tactical decisions were mainly made based on personal knowledge and experience. Their correctness mainly depends on an individual's background knowledge, accumulated experience, knowledge, and judgment in synthesizing disparate information. With the improvement of the level of the game, the technical and tactical changes in the game become increasingly complicated, and it is often difficult to make accurate scientific judgments on these issues according to one's own ability. Therefore, it is necessary to develop a technical and tactical decision support system in basketball to help people learn the technical and tactical rules of basketball, assist people to make decisions, and improve the scientificity of the decision-making process.

The regularity and efficiency of decision-making behavior are an indispensable and important content in every field of data mining technology to achieve services. It is an effective way and method to solve the problem by extracting the decision-making knowledge and experience at the expert level and using it as a knowledge source of the knowledge base of the decision support system. The decision support system can absorb the knowledge and experience of most experts, simulate various complex and specific problems that can usually be solved by human experts through reasoning,

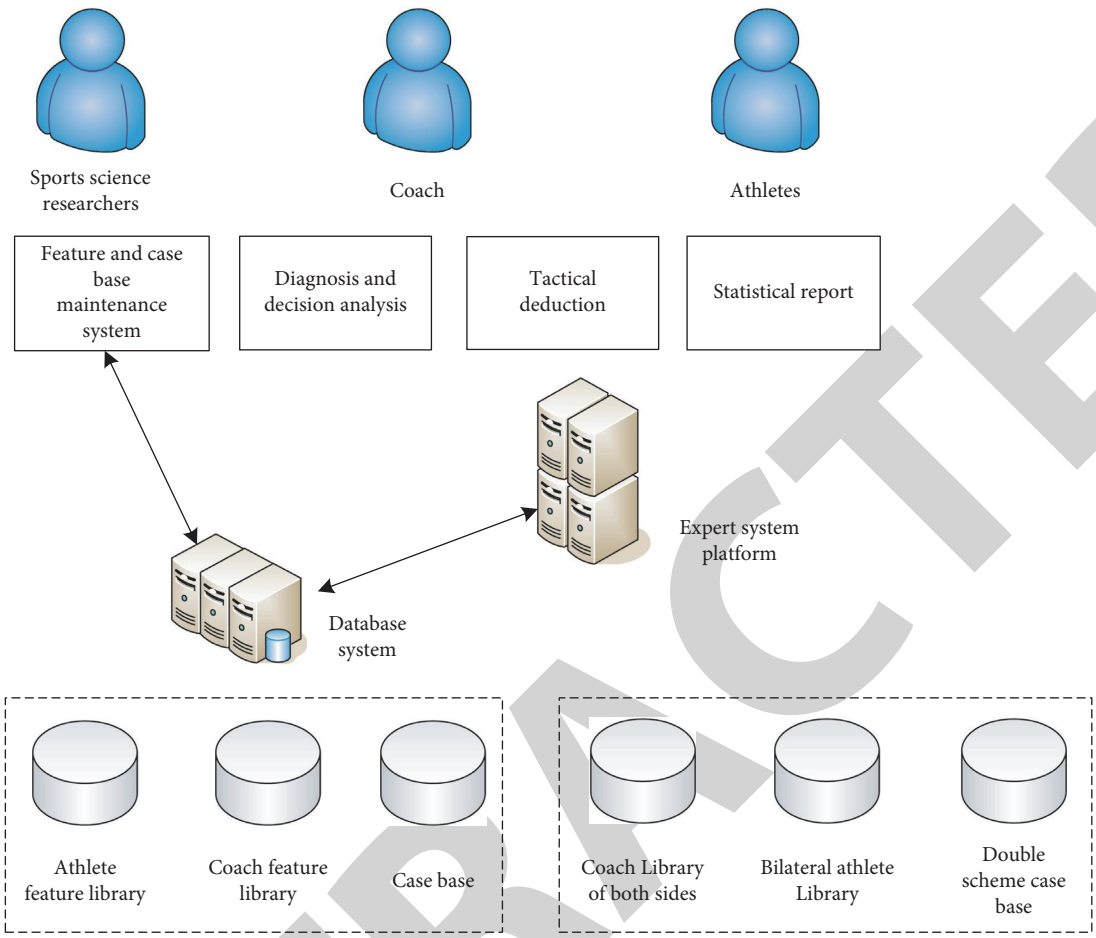

Figure 5: Legend of the basketball tactical analysis system.

and then make decisions equivalent to the expert decision-making level. By effectively extracting the knowledge and experience of domain expert decision-making, the knowledge base construction of the decision support system can be improved. On the one hand, more people can use the system to make decisions at the level of domain experts. At the same time, one-sided decision-making due to the limitations of a single expert's knowledge and experience can be avoided as much as possible, and the expert's knowledge has also been well inherited. This will ultimately allow more people to enjoy high-level decision support services.

Before making a decision, information must be obtained through a complete and systematic study and understanding of all details of the player and the team. Individuals must be familiar with their team, and this familiarity must be based on the amount of information they have. Information should be as complete and detailed as possible.

Based on the previous DSS with a dual library structure, when DSS is extended to the field of unstructured tasks, the introduction of AI tools and methods is inevitable. What followed was the addition of knowledge elements, that is, the integration of DSS and expert system (ES), which is the initial model of intelligent decision support system (IDSS) for basketball games in this field. IDSS should be integrated into decision support systems as an integrator for digital analysis and knowledge processing. IDSS combines the quantitative analysis techniques of traditional DSS and the advantages of symbolic ES processing to handle semi-structured and unstructured problems more effectively than DSS. The research of IDSS has been carried out in the field of combination of traditional DSS and ES, such as system structure, integration, model, interconnection technology, unified path, and so on. In this study, an intelligent decision model and additional modules are used for data mining and training pattern generation. Figure 2 shows a schematic diagram of the functional structure of the system.

Analytical data are different from business data. Analytical data are the data to be used for mining, while business data are some real data, the most primitive data, that is, the original database. To effectively use the original real data, it is necessary to carry out a reasonable data warehouse design. The purpose of building a data warehouse is to collect and summarize data from various databases, then connect multiple data tables with the star schema and snowflake models, and organize and manage them in the form of multidimensional data cubes, as shown in Figure 3. On this basis, various analysis, query, and reporting functions are provided to serve the high-level decision-making process. In

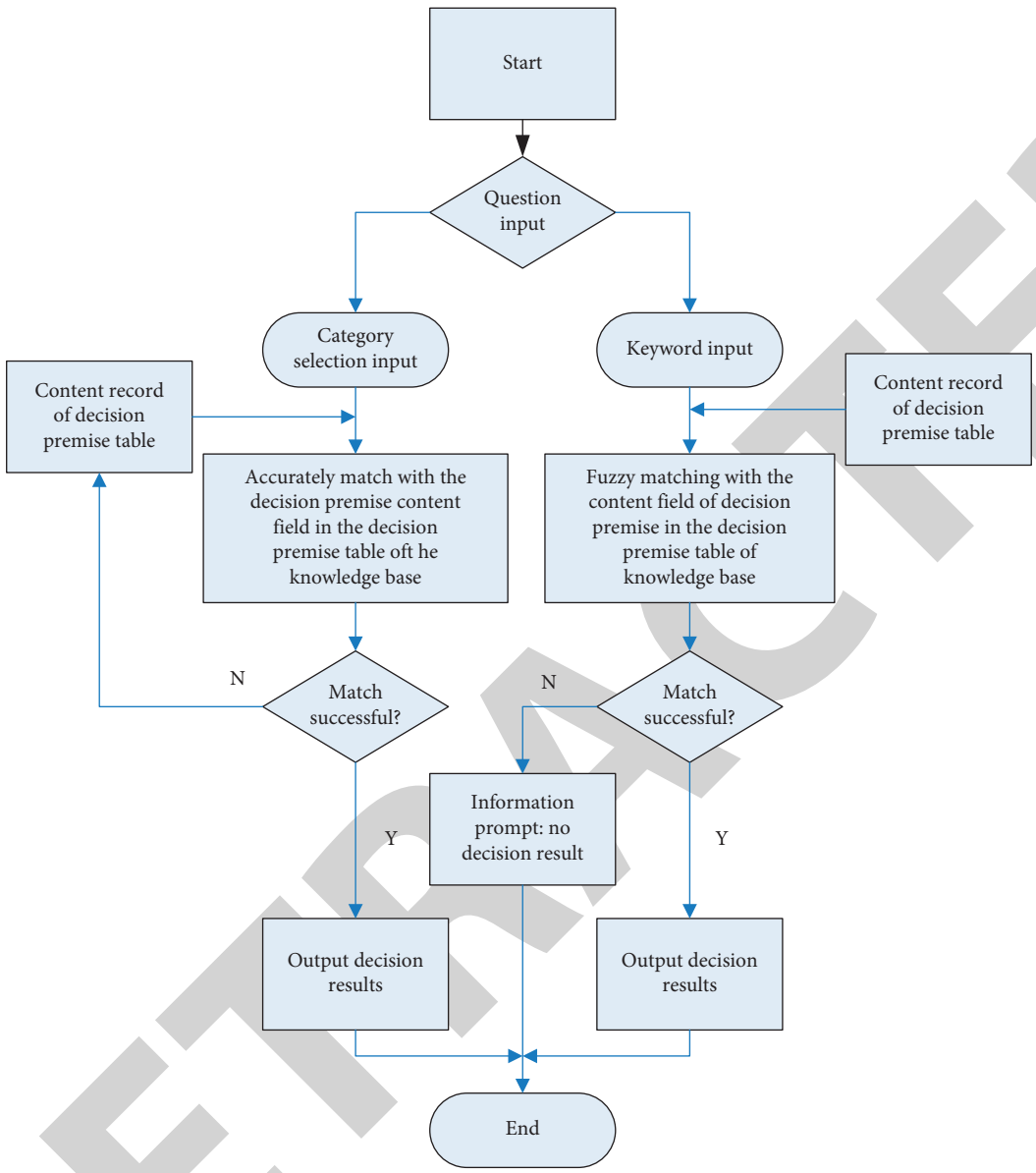

Figure 6: System's inference system.

addition, various data mining techniques must be developed on the basis of data warehouse, which penetrate into various fields of management decision-making.

4. Design of On-Site Decision-Making System for Basketball Games

The data warehouse is the data obtained after processing the data in the database. Analysis and mining of these processed data can extract decision-supporting information. A data warehouse has several characteristics: subject-oriented, integrated, stable, etc. The characteristics of data warehouse make it suitable for effective data mining and data analysis. Data warehouses are often used to create a decision support application environment. The design of the data warehouse mainly has five critical steps, and these five critical steps can be designed into a three-level mode, the structure of which is shown in Figure 4.

In basketball teaching and research, there is a large amount of specialist data, such as daily practice data, game data, training data, and empirical data from national and international peers. Using computer technology, these data are classified and efficiently organized to build a data warehouse and develop a system with artificial intelligence to make decisions at the basketball game site, as shown in Figure 5. The information of the data warehouse mainly comes from the basic database of the stadium. After data extraction, transformation, cleaning, loading, and other links, the required data are extracted from the basic database, the inconsistency of the data is eliminated, and then, the data are converted into the same structure and data type, and stored in the data warehouse. The artificial intelligence

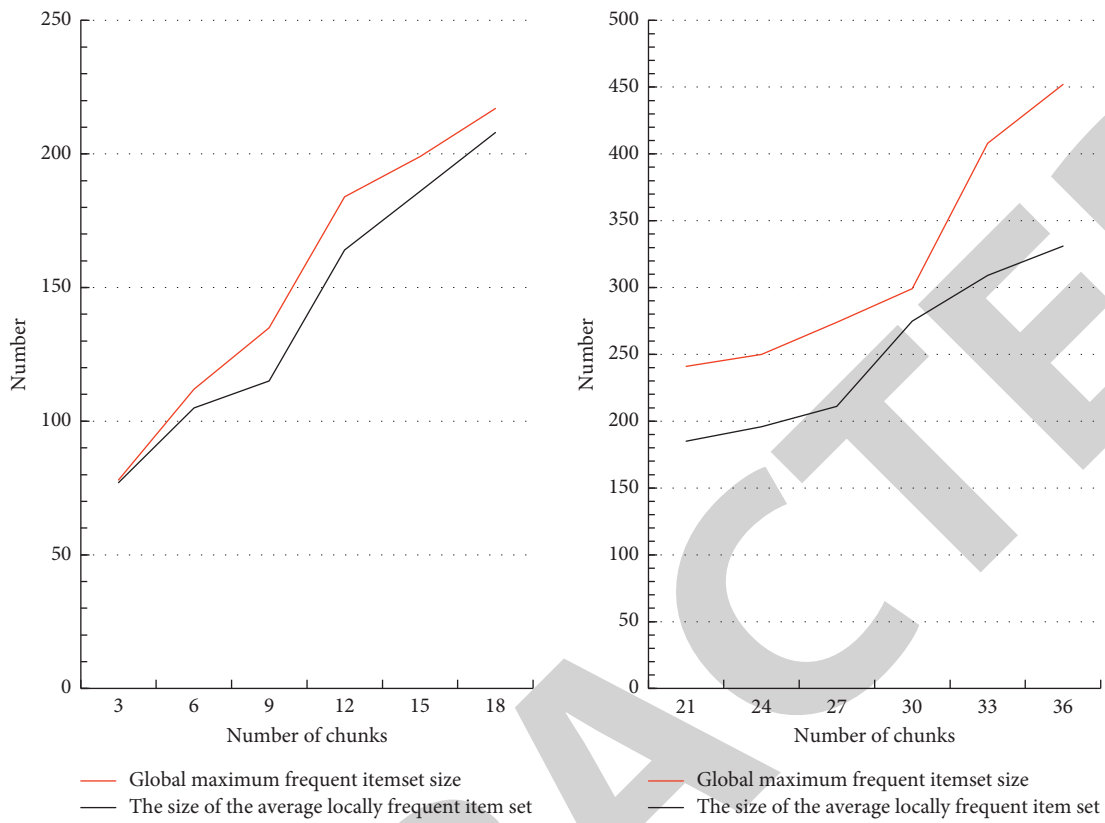

Figure 7: The relationship between the selection of the number of blocks and the size of the itemset.

Table 1: A collection of basketball training examples.

Serial number 1		1	2	3	4	5
Properties	Height	High	High	Short	High	Medium
	Flexibility	Good	General	Good	General	Poor
	Strength	Strong	Strong	Weak	Strong	Weak
	Speed	Quick	Quick	Slow	Slow	Slow
Category		*Y*	*N*	*N*	*Y*	*N*

system is divided into three layers: the database layer, the processing layer, and the visualization layer. The database layer is the basic support platform, which provides data support for the processing layer. The processing layer is the core actuator. The processing and representation layers are responsible for the logic between basketball tactics and visualizing the processed data to form decisions.

After the basketball skill and tactical knowledge base are established, the main task of constructing the decision support system is to construct the inference engine according to the structure of the knowledge base. The reasoning engine is another key component of the decision support system and its organizational control mechanism. The system adopts deterministic inference, and the control strategy adopts forward inference. The inference search process is shown in Figure 6. There are two ways to choose the input of the inference problem: classification selection input and keyword input. Classification selection input requires the user to select the belonging category according to the classification of knowledge by the system to deal with the decision-making problem, and then find the decision-making premise under this category to select and input the specific decision-making problem. The system will match the entered question with the decision premise field in the decision premise table of the knowledge base one by one. If the match is successful, the system will match the number of records with the decision premise number in the decision rule table of the knowledge base. We find the decision-making rule that meets the requirements, according to the decision-making conclusion number of the decision-making rule, go to the decision-making conclusion table to find the content of the decision-making conclusion of this number, and output it. Keyword input is based on the same reasoning and matching procedure, and the difference is that fuzzy matching is used to match the input problem with the content in the decision premise table. The system outputs decision rules that match the matching results in the form of a table for users to refer to and make decisions.

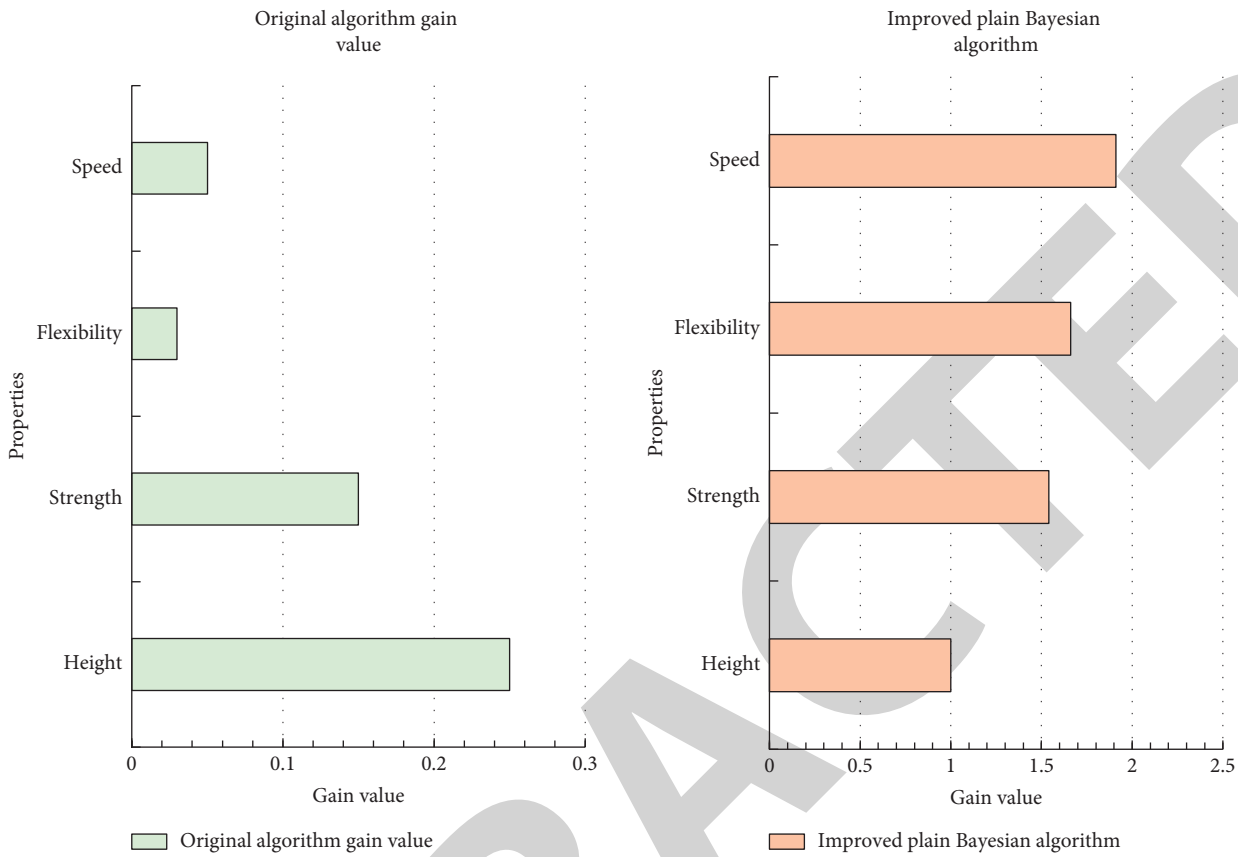

Figure 8: Comparison of gain values before and after algorithm improvement.

5. Experiment of On-Site Decision-Making System in Basketball Game

5.1. System Functionality. Data distortion is the fact that the data cannot produce the correct effect, an abnormal phenomenon occurs, and only partial or wrong results are produced. If the partition is too small, a large number of local frequent itemsets are generated, and a large part of these local frequent itemsets are not global frequent itemsets, which wastes a lot of space and time. For another example, if the database is divided in an order, some seasonal or seasonal items will sell a lot in a certain period of time. When sequential chunking, these types of items may be divided into a chunk so that such items in this chunk are frequent local itemsets. However, it hardly exists in other blocks so that the local frequent itemsets in different blocks rarely intersect. To solve this type of problem, we use random allocation to generate blocks, and people can experiment more with the size of the blocks. Using 5000 game records as the test dataset, when the number of blocks is 3 to 36, the measured values of the size of the global maximum frequent itemset and the size of the average local frequent itemsets are shown in Figure 7.

It can be seen that when there are more blocks, the more average local frequent itemsets are generated, and the greater the gap with the global maximum frequent itemsets, that is, many nonglobal frequent itemsets will be generated.

Table 1 is a basketball training sample set. To smoothly carry out the research, some assumptions should be made here, that is, assuming that the athletes' psychological, physical, and technical and tactical abilities in the game are in normal play, and the technical and tactical behavior characteristics of sports competitions will be studied from a systematic point of view. That is to say, this study does not consider the influence of psychological, physical, or other influencing factors on game behavior and results, but only considers the characteristics of technical and tactical behavior. Four attributes are given, namely, height, flexibility, strength, and speed. Here, according to the experience of sports experts, their weights are as follows: 0.25, 0.27, 0.3, and 0.32. Then, according to the improved Bayesian algorithm, the gain value of each attribute is calculated, and Figure 8 is obtained.

In terms of feature selection for classification, the simplified Bayesian algorithm has comparable classification performance to the improved Bayesian algorithm, but the computational speed is much higher. As can be seen from Figure 8, the gain of the original algorithm on the height feature is 0.25, which is the smallest among all features, while the gain of the improved algorithm is 1, which is also the smallest among all features.

5.2. Feasibility. The basis of a basketball game field decision support system is data, and the data and information collected during daily training and games form a solid foundation for the system. In a basketball decision support system, users are primarily concerned with the effectiveness

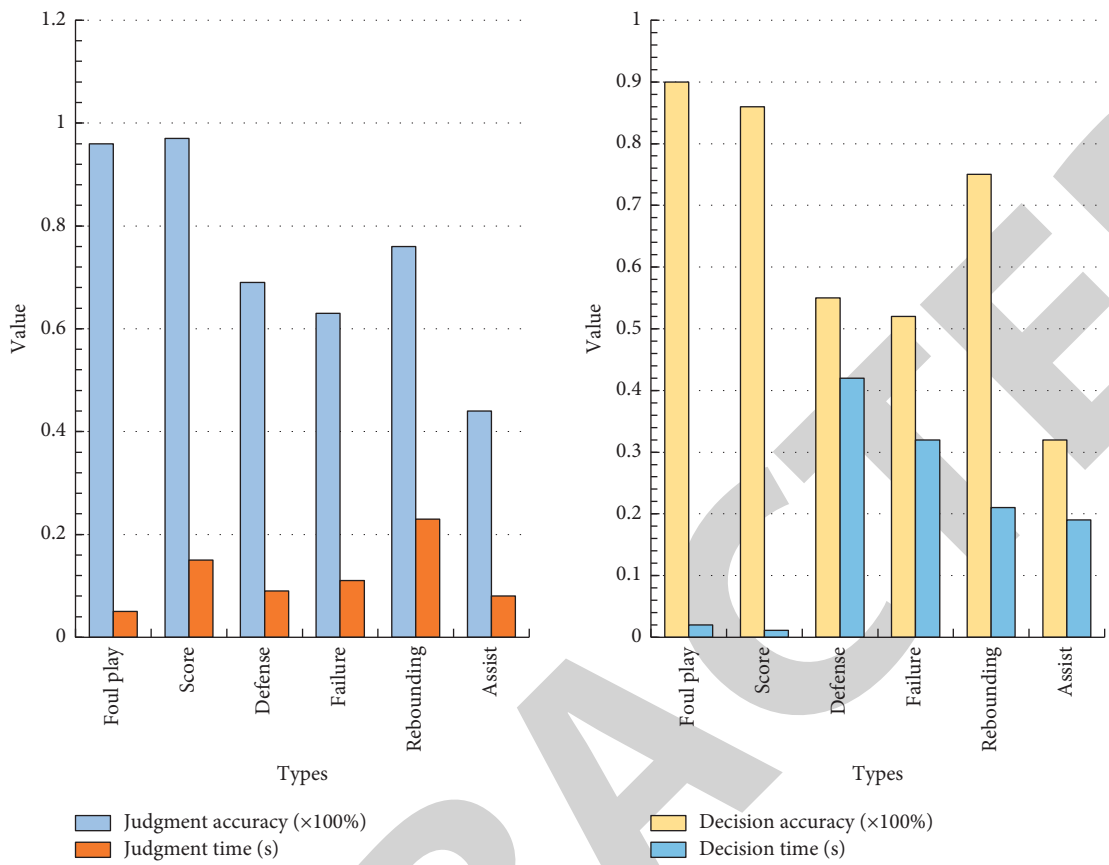

Figure 9: Judgment and decision-making of the decision-making system in a basketball game.

of their team's offense and defense, and predicting, analyzing, and processing game wins and losses. Key indicators for this purpose fall into the following categories: fouls, points, defense, turnovers, rebounds, and assists. Figure 9 is an analysis of these categories by the decision system in a basketball game.

Each type is a detailed description of the comprehensive indicators of the basketball arena. It can be seen from Figure 9 that the decision-making system has the highest judgment accuracy rates for "foul" and "score," which are 96% and 97%, respectively. The decision accuracy rate will decrease due to the decrease in the judgment accuracy rate.

5.3. Validity Test of the Questionnaire. According to the needs of the research, a questionnaire on "basketball on-site system decision-making" is designed, and a field survey is carried out on the relevant sports bureaus or relevant departments to conduct a questionnaire survey on the development environment, development mode, development content, and channels of the basketball event market. The logical validity of the questions in the questionnaire was checked by the method of logical analysis, and ten experts (see Table 2) were invited to check the validity of the structure and content of the questionnaire through expert review. The test results (see Table 3) show that the experts responded positively to the questionnaire and obtained high scores, indicating that the validity of the questionnaire is high.

Table 2: Statistics of the basic situation of experts.

Specialist technical positions	Number of people	Percentage (%)
Positively high	5	50
Deputy high	2	20
Intermediate	3	30

Table 3: Results of questionnaire validity evaluation.

	Number of people	Percentage (%)
Very reasonable	4	40
Reasonable	5	50
General	1	10
Unreasonable	0	0
Very unreasonable	0	0

When conducting a questionnaire survey on relevant events, to improve the recovery rate of the questionnaires, the method of on-site distribution and on-site recovery of questionnaires is mainly adopted. There are 50 respondents, including 30 men and 20 women. The occupations are mainly sports coaches, athletes, and spectators. The survey results are shown in Figure 10.

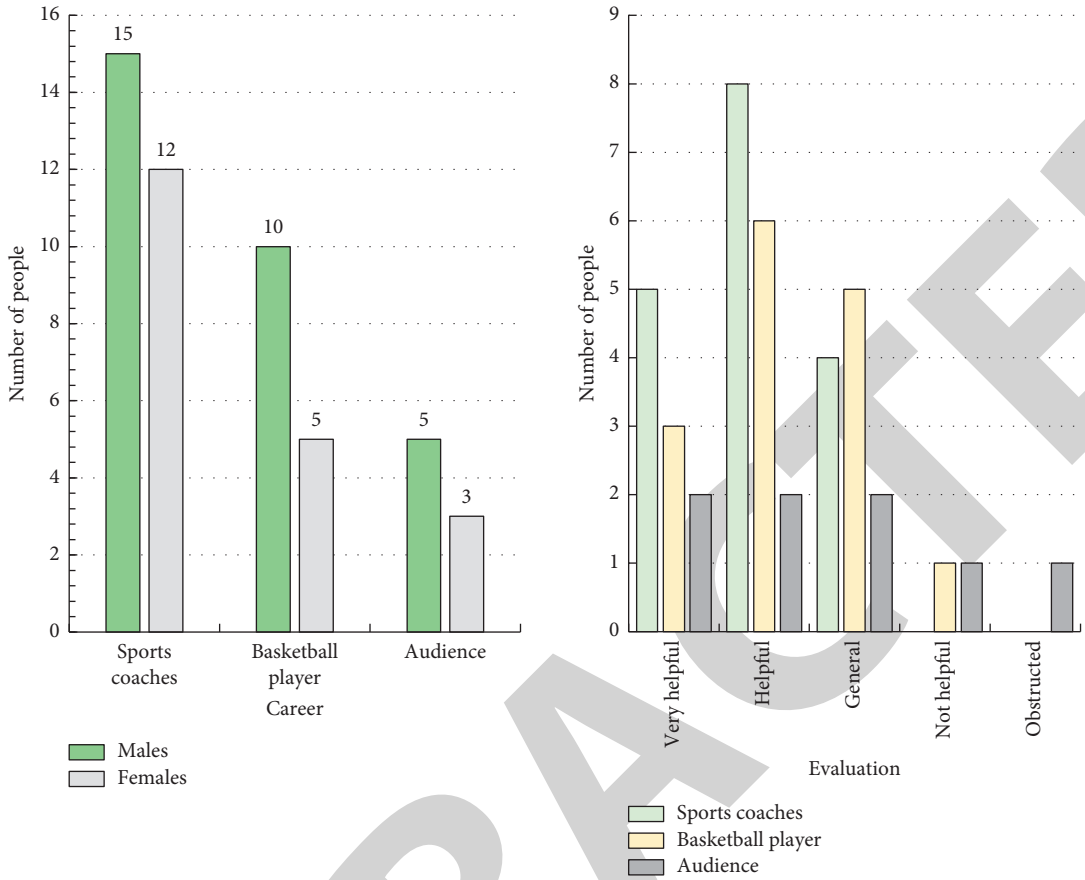

Figure 10: Survey results.

As can be seen from Figure 10, only 6% of the respondents believed that the on-site decision-making system was not helpful or even hindered. Sports coaches are important participants in the tactical analysis and decision-making of basketball games. About 48% of sports coaches found it helpful, indicating that the system has merit.

6. Conclusions

This study focuses on data mining techniques, discusses the effectiveness of improved Bayesian algorithm classification results, and develops a decision support system for a basketball court. It can accurately and timely provide real-time information and decision-making suggestions for the stadium, analyze technical and tactical indicators, or attribute values of various factors of athletes. Then, through the simulation model, we can see the impact of this change on the game results. This allows us to identify key metrics or technical and tactical factors that have the potential to influence an athlete's scoring rate in a game, and provide simulation support for technical and tactical decisions. In a survey of the practicality of a real-time decision support system, the system received high marks. The users of the stadium decision support system need to understand the events that have been carried out from a broad and comprehensive perspective and stand on the height of the overall situation. We comprehensively analyze the comprehensive data of the team members in all aspects and accordingly make reasonable decisions. By providing comprehensive data and various analysis tools, the system has high application value. Because it can visualize game data in real time, we support coaches in analysis and decision-making on the field, and achieve specific training goals. On this basis, more application systems can be established, various sports special research systems can be established, the experience and knowledge of sports experts and scientists can be accumulated, and the level of Chinese sports competition teaching and research can be improved.

Data Availability

No data were used to support this study.

Conflicts of Interest

The author declares that there are no conflicts of interest.

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