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Evaluation of the value of basketball players based on wireless network and improved Bayesian algorithm

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Abstract

The selection of basketball players should highlight their specific characteristics and proceed according to the essential laws of basketball. When the acquired training level becomes closer and closer, and is more and more conducive to the control of the entire training and competition, the selection of the standard paradigm of basketball players plays a key role. At present, the existing evaluation methods of basketball players are limited to the human experience of coaches, and there is a lack of further information evaluation methods. This article discusses a new type of basketball player evaluation scheme that combines wireless network and machine learning methods. First, the wireless sensor network is used to perceive basketball players' performance on the court and record various evaluation indicators. Secondly, establish a player value evaluation model through improved Bayesian algorithm and fuzzy comprehensive evaluation methods. Finally, after relevant tests and comparisons with the coaches' results, the model showed better evaluation results and a fairer value distribution.

Keywords: Player value evaluation, Wireless network, Improved Bayesian algorithm, Fuzzy comprehensive evaluation

1 Introduction

Basketball game is a comprehensive process of competition and competition. The talents and hard work acquired by athletes are displayed through skills and tactics, physical fitness, and psychology [1]. Due to the project characteristics of basketball, the innate characteristics of athletes determine whether they are suitable for this sport or how much they can achieve in this project [2]. In addition, the scientific and technological achievements brought about by social and economic development have been continuously applied to training and competitions. The scientific research personnel's exploration of basketball game rules has made the context of the game process clearer and other factors have been deeply integrated into basketball training and competition [3].

When the external environment becomes more and more conducive to the control of the entire training and competition, the natural advantages of the athletes become more and more important, and even determine the outcome of the entire competition [4]. Talented star athletes, collective strength of the team, and distinctive technical and tactical

style play together constitute the basic elements of the development trend of today's basketball [5]. The key point of material selection. The concept of talent selection for excellent basketball players is closely related to the concept of basketball games. With the switching of basketball styles, there are also brand-new interpretations and standards for outstanding basketball players, and the basis for selecting basketball players has also changed [6]. At present, countries all over the world attach great importance to the scientific selection of basketball players while performing scientific training, in order to quickly and accurately select talents with basketball talents. Scientific selection of talents often has a multiplier effect on improving the overall competition level of basketball players [7]. The USA has become the center of all basketball elites in the world because of the NBA. The promotion of basketball has made basketball fans all over the world go crazy. Ryan R, Woo K conducted research on the applicable age of players and their court effectiveness. McCann MA and Rosen J studied the legality of players' age restrictions [8, 9].

At present, the evaluation method of the player value of basketball players is relatively single [10]. Generally, coaches make artificial evaluations through relevant standards. This model has the disadvantages of high subjectivity, fairness and transparency, and low transparency. Therefore, only relying on coaches for the selection and evaluation is not conducive to the further development of basketball players [11].

Aiming at the above shortcomings, how to design a player value evaluation method with excellent performance has important practical value for optimizing the evaluation of basketball players [12]. Aiming at the lack of existing player evaluation methods, this article explores a new type of evaluation method. Construct a new type of basketball player value evaluation technology by combining wireless network and Bayesian machine learning methods. This technology can effectively improve the functional rationality of the existing basketball training and evaluation mechanism, thereby improving the further development of basketball players.

2 Overview of related technologies

2.1 Evaluation of the value of basketball players

The evaluation goal of the basketball player's special physical fitness evaluation system is to establish a college student athlete's special physical fitness evaluation system. Through systematic methods and content, the current special physical fitness of college students can be evaluated accurately, comprehensively, systematically, and timely, and then the true level and status of the special physical fitness of Chinese college male basketball players can be grasped [13]. This program is conducive to us for effective training and adjustment of training concepts based on the specific physical fitness evaluation.

For physical fitness evaluation, the first step is to select evaluation objects and establish evaluation goals [14]. Then construct the evaluation index system, determine the index weight, design the evaluation scale, determine the index weight, design the evaluation standard, and finally get the evaluation result. Refer to Fig. 1 for the process of the evaluation index of basketball player value.

Factors are closely related to the quality of will and the external environment. According to research on competitive sports skills, physical fitness plays an important role in the composition of athletes' competitive ability [15]. It is a key factor for athletes to

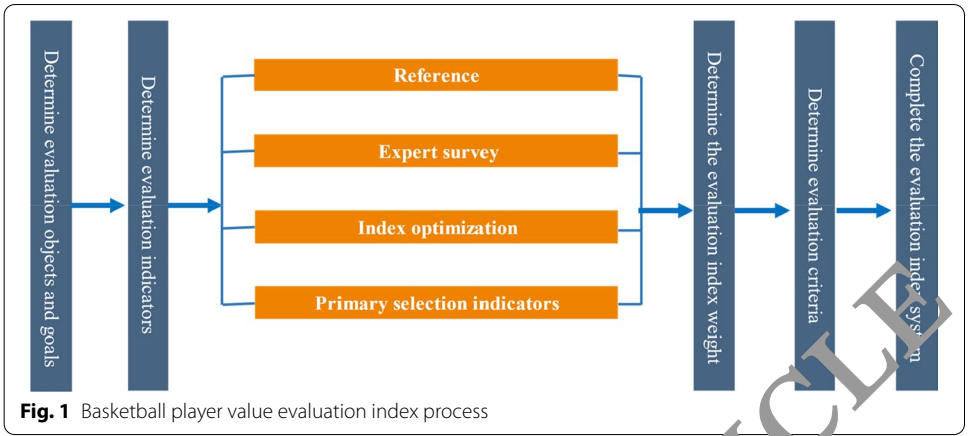

Fig. 1 Basketball player value evaluation index process

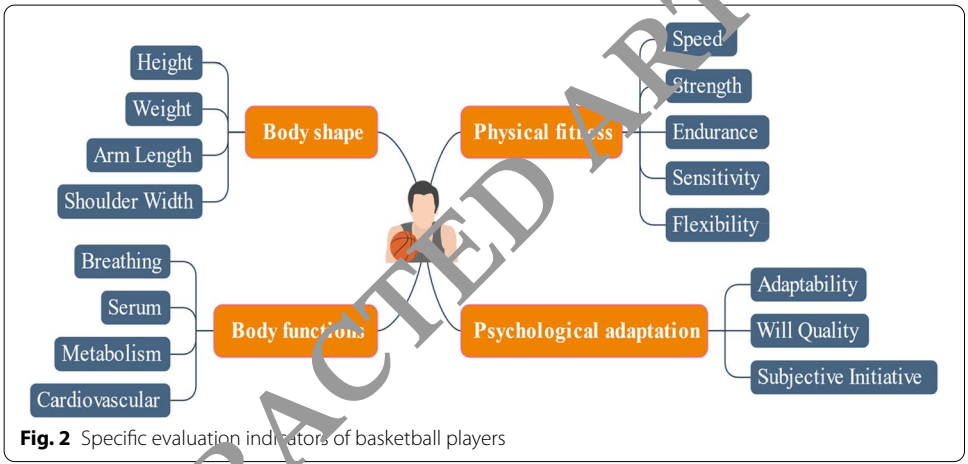

Fig. 2 Specific evaluation indicators of basketball players

achieve excellent sports performance in special sports competitions. Mainly manifested as physical function, body shape, physical fitness and psychological adaptability. The specific evaluation indicators of basketball players are shown in Fig. 2.

Based on the relevant results of expert consultation, basketball players' specific physical fitness refers to the ability of basketball players to withstand the load and adapt to environmental changes in basketball. It is a comprehensive manifestation of the specialization of athletes' physical shape, physical function, athletic quality, and health level [16]. In order of importance, the main factors affecting the effects of basketball specific physical training are: training factors, physiological factors, science and technology education factors, management factors, and psychological factors.

2.2 Wireless sensor network

With the progress and continuous development of science and technology, and the further development and maturity of wireless communication technology, embedded technology and perception technology, mankind has entered an unprecedented information technology era. As an important technology for humans to obtain information in the physical world, sensor technology has been widely used, and sensor devices have emerged [17]. The so-called sensor device refers to a device that integrates wireless

communication capabilities, embedded computing capabilities, perception capabilities, and storage capabilities. These devices can perform simple monitoring tasks and information processing tasks, and a large number of sensor nodes are combined to form a wireless sensor network [18]. At present, wireless Mesh networks have been widely used in the formation of Internet networks such as home networks and community networks, such as common WIFI mesh networks and campus wireless networks.

The wireless civilian market is dominated by two technologies, ZigBee and LoRa. LoRa wireless technology is a typical star network, and ZigBee technology has a shape, tree, and mesh network topology [19]. And Zigbee and LoRa wireless technologies both support wireless mesh network topology. The topological diagram of the wireless network structure is shown in Fig. 3.

Wireless sensor networks have been widely studied and applied at home and abroad, and are known as "the most promising technology in the twenty-first century". Wireless sensor networks have a very wide range of applications in the industrial, agricultural, and military fields. In the military field, in agriculture, wireless sensor networks can be used for crop growth environment monitoring, soil pH monitoring, soil moisture monitoring, and precipitation monitoring [20]. In people's lives, wireless sensor networks can also be applied to smart homes, transportation, physical health monitoring, etc. In ecological environment monitoring, wireless sensor networks can be used to monitor plant growth, such as the redwood tree monitoring in the USA. In industry, wireless sensor networks can be used for toxic gas monitoring and diffusion monitoring, product quality monitoring, etc. The structure of the player value evaluation system is shown in Fig. 4.

The indoor environment monitoring system based on wireless sensor network is designed for the environment, and its design mainly considers the user's experience, and convenience is the main goal [21]. In the evaluation of basketball players, we adopted the system structure shown in Fig. 4 above. The system can be divided into seven modules: system login module, user management module, perception data management, perception data statistics, alarm processing, data chart management and user feedback.

3 Basketball player value evaluation model

3.1 Index optimization based on Bayesian algorithm

Bayesian network (BN) is a directed acyclic graph model containing conditional probability tables, also known as reliability networks. Through Bayesian network, various

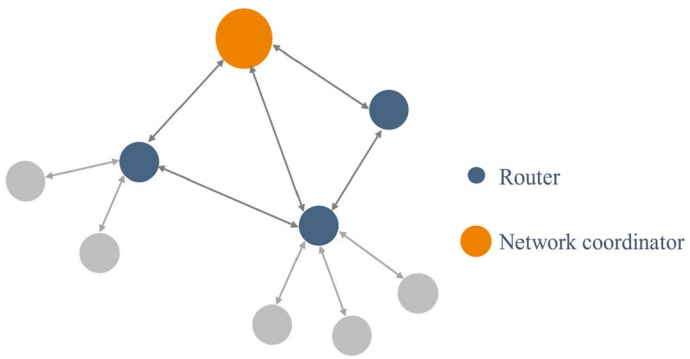

Fig. 3 Zigbee mesh network topology diagram

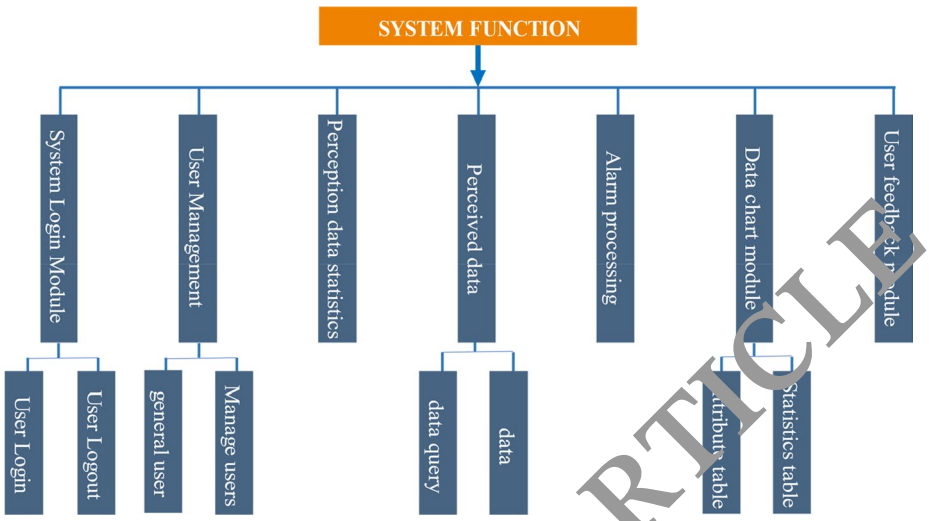

Fig. 4 Structure diagram of player value evaluation system

data can be summarized and comprehensive reasoning can be performed on these data. It is one of the most effective theoretical models for the expression and reasoning of uncertain knowledge [22]. Bayesian network is the product of the combination of artificial intelligence, graph theory, probability theory, and decision analysis. It is suitable for the expression and analysis of uncertain and probabilistic things.

Bayesian algorithm mainly refers to the joint probability distribution of input and output based on the assumption of the conditional independence of feature variables under the given conditions of the training data set [23]. Then based on this model, the input instance feature use Bayes' theorem to find the maximum posterior probability output. The joint probability distribution of X and Y is $P(X, Y)$, and $P(X, Y)$ is independent and identically distributed to generate the training data set [24].

$$T = \{(x_1, y_1), (x_2, y_2), \ldots (x_N, y_N)\} \tag{1}$$

Then, the Bayesian formula can be obtained:

$$P(Y = c_k/X = x) = \frac{P(X = x/Y = c_k)P(Y = c_k)}{\sum_{k=1}^{K} P(X = x/Y = c_k)P(Y = c_k)} \tag{2}$$

Bayes has built conditional independence for conditional probability, namely:

$$P(X = x/Y = c_k) = P\left(X^{(1)} = x^{(1)}, X^{(2)} = x^{(2)}, \ldots X^{(n)} = x^{(n)}\right)/Y = c_k) \tag{3}$$

The probability $p(y = 1|x, \theta)$ represents the probability that y belongs to 1 under the condition of a given characteristic variable x, and $h_\theta(x) = p(y = 1|x, \theta)$, then there is a model:

$$h_\theta(x) = [1 + \exp(-\theta^T x)]^{-1} \tag{4}$$

$$l(\theta) = \prod_{i=1}^{n} [h_\theta(x)]^{y_i} \cdot [1 - h_\theta(x)]^{1-y_i} \tag{5}$$

The basic formula of Bayesian algorithm is as Eq. 6, and its meaning is the probability of output category A under the condition of given instance Y [25].

$$y = f(x) = \arg\max \frac{\prod_{j=1}^{n} P(X^{(j)} = x^{(j)}/Y = c_k) P(Y = c_k)}{\sum_{k=1}^{K} (Y = c_k) \prod_{j=1}^{n} P(X^{(j)} = x^{(j)}/Y = c_k)} \tag{6}$$

In practical applications, when classifying feature instances, we choose the final category with the largest probability value, which can be formalized as Formula 6 [26].

This method is used in decision-making that conditionally relies on multiple control factors, and can make inferences from incomplete, inaccurate or uncertain knowledge or information. Bayesian network includes simple structure Bayesian network model and generalized Bayesian network model [27]. The simple structure Bayesian network is divided into series connection, divergent connection and convergent connection structure [28].

3.2 Value evaluation based on fuzzy comprehensive evaluation

The basic idea of the fuzzy statistical method is to make a clear judgment on whether a certain element of the evaluation index belongs to the set of evaluation levels. For different experimenters, the clear set can have different boundaries, but they all correspond to the same fuzzy set. Combining the definition of the fuzzy comprehensive evaluation method and the data content obtained from the relevant literature for statistics, the following evaluation matrices of the fuzzy comprehensive evaluation of each indicator layer can be obtained [29].

The first-level fuzzy evaluation matrix of the potential impact evaluation of basketball players is [30]:

$$P_1 = \begin{bmatrix} 0.2 & 0.5 & 0.3 \\ 0.4 & 0.3 & 0.3 \\ 0.5 & 0.3 & 0.2 \end{bmatrix} \quad P_2 = \begin{bmatrix} 0.4 & 0.3 & 0.3 \\ 0.6 & 0.3 & 0.1 \\ 0.7 & 0.2 & 0.1 \end{bmatrix} \quad P_3 = \begin{bmatrix} 0.6 & 0.3 & 0.1 \\ 0.4 & 0.3 & 0.3 \end{bmatrix}$$

(1) Calculate the first-level fuzzy evaluation of basketball player value

First, the first step is to make fuzzy comprehensive evaluation of various indicators. The first-level sub-indices are evaluated according to the formula. where represents the set of index weights of each layer, and the fuzzy evaluation is synthesized and calculated according to the product of the evaluation index weight and the evaluation matrix [31, 32].

First-level fuzzy comprehensive evaluation of "physical fitness" indicators:

$$Y_1 = W_1 \cdot P_1 = (0.0328, 0.0542, 0.0478) \cdot \begin{bmatrix} 0.2 & 0.5 & 0.3 \\ 0.4 & 0.3 & 0.3 \\ 0.5 & 0.3 & 0.2 \end{bmatrix}$$

$$= (0.052140.047\ 0.03566)$$

The first-level fuzzy comprehensive evaluation of "mental quality" indicators [33, 34]:

$$Y_2 = W_2 \cdot P_2 = (0.1465, 0.2142, 0.3071) \cdot \begin{bmatrix} 0.4 & 0.3 & 0.3 \\ 0.6 & 0.3 & 0.1 \\ 0.7 & 0.2 & 0.1 \end{bmatrix}$$

$$= (0.402090.16963\ 0.09608)$$

(2) Calculate the two-level fuzzy evaluation of the value of basketball players

Fuzzy comprehensive evaluation of various indicators to evaluate secondary sub-indices [35]:

$$L = W \cdot P = (0.1776, 0.5317, 0.2906) \cdot \begin{bmatrix} 0.05214 & 0.047 & 0.03566 \\ 0.40209 & 0.16963 & 0.09608 \\ 0.10062 & 0.05922 & 0.03756 \end{bmatrix}$$

$$= (\ 0.044613\ \ 0.044613\ \ 0.060272\ )$$

4 Case analysis of basketball player value evaluation

4.1 Data source and test environment

The experimental environment used in this chapter is a basketball training venue in a college. The schematic diagram of the venue is shown in Fig. 5. The test subjects are young male and female basketball players aged 18–20. The purpose of the test is to test the basketball player's ability to dribble quickly and the accuracy of shooting during the march.

During the test, the test was conducted on a standard basketball court (length: 28 m, width: 15 m), with the starting point at the intersection of the bottom line of the basketball court and the right side line of the restricted area. The distance from the starting point to the bottom line of the first obstacle and the fourth obstacle is both 6. 5 m, the distance from each obstacle to the sideline is 3 m, and the distance between them is 5 m. Basketball players participating in the test must dribble in accordance with the prescribed procedures and are not allowed to violate the law. If there is any violation during the test, the technical evaluation referee will whistle off the test athlete, and the athlete

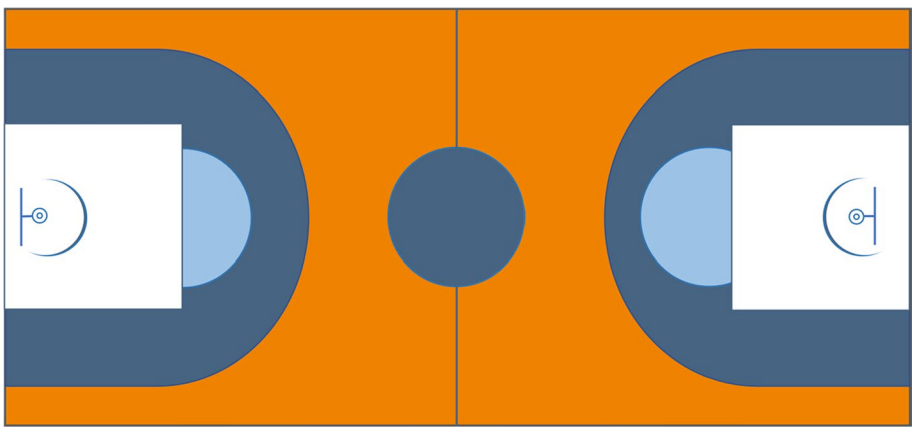

Fig. 5 Schematic diagram of the basketball player test site

Table 1 Statistics of normal distribution of basketball players' acceleration

Generation	18–19	20–21	22–23	24–25	26–27
N	62	77	99	123	131
Mean	4.23	4.15	4.45	4.67	4.12
Median	4.24	4.65	4.18	4.27	4.09
Variance	0.07	0.26	0.17	0.21	0.28
Full Range	2.34	2.57	2.76	2.45	2.68
Minimum	3.43	3.56	3.56	3.17	3.05
Maximum	5.48	5.48	5.27	5.78	5.13
Distribution	Normality	Normality	Normality	Normality	Normality

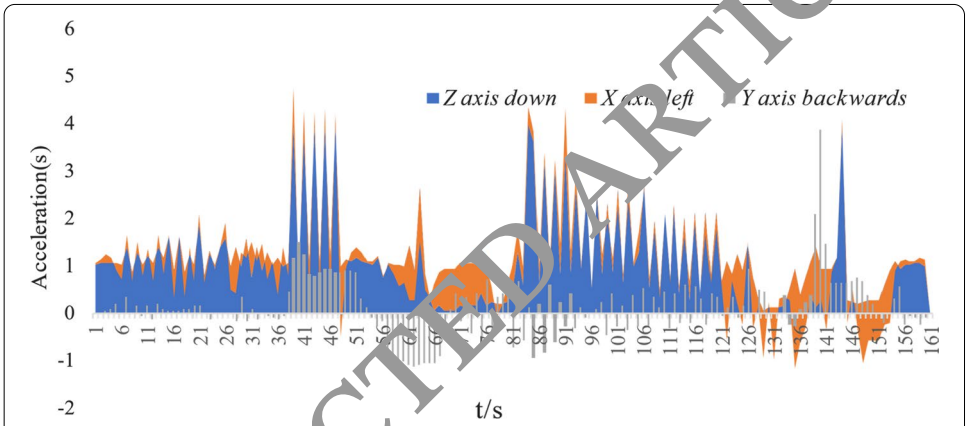

Fig. 6 Basketball player acceleration information obtained by sensors

will return to the starting point to retest. If there is another violation, the qualification for the test will be cancelled.

4.2 Player value evaluation test results

To some extent, age represents maturity and experience. Whether the age structure is reasonable reflects the maturity of a team and is also the basis for the sustainable development of basketball in my country. Therefore, the athlete's age status is used as an important parameter to judge whether a team is in the best age for sports. Table 1 shows the age distribution of the basketball players participating in the test and the corresponding normal distribution statistics for accelerated running.

The age of an athlete is closely related to the level of competition, and the physiological function and athletic ability of the human body are closely related to their age. The psychological quality of today's basketball players is becoming more and more important. To a large extent, psychological stability and mental maturity are closely related to age. Basketball is a team sport, and the players' experience is of great significance to understanding tactical intent and rational use of technology. Obtain high-quality cardiopulmonary and other physiological signal data of basketball players through wireless sensor networks. The human activity information captured by the three-axis acceleration sensor is shown in Fig. 6.

Figure 7 shows the applicability and test results of the wireless network in the basketball player evaluation model.

It can be seen from Fig. 7 that the basketball player value evaluation model established by this model can achieve a good degree of information transmission. The completeness of this information is related to the final evaluation result of the basketball player. From the above analysis, we can see that we need to broaden the athlete training system and selection system, and fully understand the development trend of world basketball. In the future selection and training of athletes, learn the scientific training system and selection system for scientific selection. Through scientific prediction of body shape, an excellent basketball player model is established, and practical measures are taken to solve it.

5 Conclusion

As part of the construction of social infrastructure, the sports industry is an important part of the modern service industry. The rapid development of the sports industry is a new economic growth point in the region and a new driving force for social employment. By studying the current status of evaluation of basketball players and analyzing their characteristics and shortcomings, this article proposes a new type of player value evaluation model. Aiming at the lack of existing player evaluation methods, this article explores a new type of evaluation method.

Construct a new type of basketball player value evaluation technology by combining wireless network and Bayesian machine learning methods. This technology can effectively improve the functional rationality of the existing basketball training and evaluation mechanism, thereby improving the further development of basketball players. The analysis done in this article is just a little bit of fur, and there are still many shortcomings in the evaluation of players' comprehensive capabilities. For example, the estimation of potential influencing factors is incomplete, and three factors are initially selected for evaluation. In this way, the evaluation of the players' comprehensive ability is relatively single, and the considerations are not comprehensive enough. There may be some potential interworthy factors that have not been noticed here. In the future, we will further

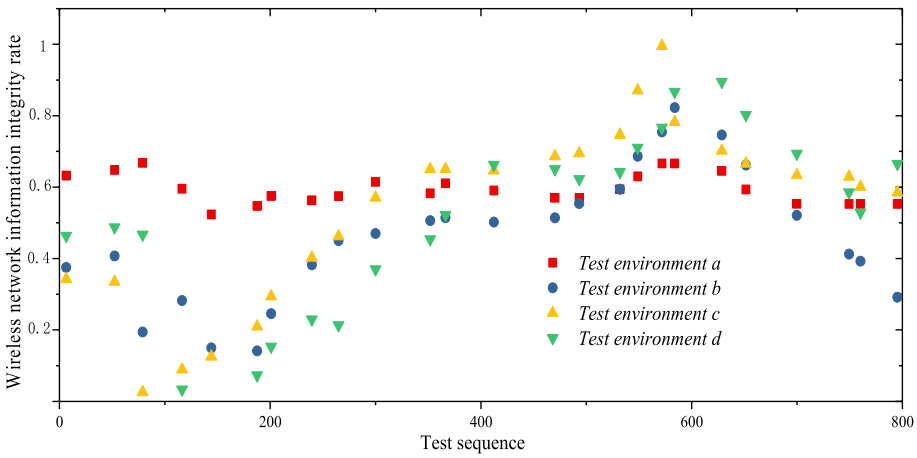

Fig. 7 The complete rate of information transmission on the wireless network during player evaluation

strengthen and in-depth exploration of research and application technologies in areas such as basketball player evaluation.

Abbreviation
BN: Bayesian network.

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Authors' contributions
DH is responsible for experimental simulation and the writing of thesis. The author read and approved the final manuscript.

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Ethics approval and consent to participate
This article does not contain any studies with human participants or animals performed by any of the authors.

Consent for publication
All authors agree to submit this version and claim that no part of this manuscript has been published or submitted elsewhere.

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