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Research Article

Monitoring the Physical Condition of Basketball Players using IoT and Blockchain

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As a popular competitive sport, basketball has attracted the attention of many people due to its warm and sunny characteristics. Athletics means results, but not everyone gets the results they want. With the continuous development of technology, people have gradually discovered that the physical function of athletes is one of the important factors affecting the performance of sports. The long-standing principle of "three big and one small" ignores the overall physical fitness of athletes, resulting in insufficient physical coordination and slow performance improvement. Competitive sports have always followed the principle of "three big and one small," which means emphasizing high-strength and high-intensity training, and fundamentally ignoring the impact of small muscle groups and overall physical fitness on athletes. To overcome this disadvantage, this paper aims to study the physical condition monitoring of basketball players based on the Internet of Things and blockchain. It is expected to use the Internet of Things and blockchain technology to monitor the physical function of athletes in real time, formulate scientific training plans, and improve athletes' competition. The essence of blockchain is a decentralized database, which is used to verify the validity of messages. With the promotion of Internet technology, it is essential to store and extract information from large network information. This paper compared the results of experimental methods to show the impact of the connection between physical function training and high-level basketball traditional training, proposed a new scalable storage and privacy protection scheme to solve the problem that a large amount of data cannot be stored on the blockchain. The experimental results in this paper showed that the lowest hemoglobin content of athletes before training was 131 g/L, and the highest was 157 g/L, indicating that the athletes were generally in good physical condition at this moment. After training, the lowest hemoglobin content of athletes was 117 g/L and the highest was 131 g/L, indicating that the athlete's physical function state declined and the training intensity was too high.

1. Introduction

With the development of the economy, people have more energy to devote to other fields, so they pay increasingly attention to sports. School sports and national fitness are constantly developing. In particular, the holding of the Olympic Games has pushed people's enthusiasm for sports to a climax. However, in the process of sports training, the training methods need to keep pace with the time to make sports performance to a higher level. Traditional training emphasizes high-strength and high-intensity training and fundamentally ignores the impact of small muscle groups and overall physical fitness on athletes. This training method tends to kill muscles and clearly lacks flexibility and coordination. The level of sports competition is constantly improving, the competition is also becoming fiercer, and the gap between athletes is also shrinking. At this time, athletes make physical function more important. This requires attention to the physical changes of athletes and adjustment to training methods scientifically to improve the level of the exercise. Basketball is one of the most popular sports at the moment. There are many physical confrontation movements in sports. It is even more necessary to formulate a scientific training plan to reduce the probability of injury.

Monitoring the physical function of athletes in sports training is conducive to objectively assessing the functional status of athletes in small cycles of different load training and providing a basis for ensuring the systematic and scientific training. This research is beneficial to the development of the men's basketball professional league, perfecting the basic training theory of basketball, and is of great significance to the development of basketball. It can better improve the level of competition, promote basketball players to play special technical movements more effectively in various games, reduce the error rate in the game, and improve the shooting rate.

Physical function monitoring training is more detailed and in-depth than the traditional training methods. It is an improvement and innovation of traditional training, it demonstrates the scientificity and feasibility of this training model, and provides a theoretical basis and practical reference for the training of young basketball reserve talents in China.

2. Related Work

With the development of technology and economy, people pay increasingly attention to sports, especially basketball. Skilled athletes rely preferentially on sensorimotor resonance mechanisms that mimic the movements of others in their own motor systems. Nakamoto et al. used motor illusions that selectively affected kinesthetic perception to study whether athletes used kinesthetic information for simulation when predicting action outcomes. Motion illusion refers to the phenomenon that the bright spot drifts when one looks at a static isolated bright spot in the dark field of vision. Under dark conditions, because there is no reference object, people cannot fix the eyes, so the eye movement is mistakenly perceived as bright spot movement. 9 skilled and 9 less-skilled right-handed basketball players predicted the outcome of a basketball shot when watching an occluded video of another right-handed player's shot under the following conditions: (a) observation alone, (b) observation + right wrist vibration-induced hallucinations. The results showed that the enhanced predictions of skilled players in the control condition were eliminated in the effector vibration condition, but not in the non-effector condition. Furthermore, when participants made correct predictions, their subjective perception of vibration-induced wrist flexion became greater when participants observed longer shots in the effector condition than in the non-effector condition. It turns out that the skilled players use limb-specific kinesthetic information (if available) as a means of predicting the outcome of others' actions [1]. The purpose of Nugroho et al. was to analyze the physical qualities of youth athletes, including speed, strength, and power. The experimental sample was athletes, a total of 40 people, including 20 males and 20 females. The experiment adopted quasi-experimental methods and quantitative methods to analyze the data. Data analysis techniques used descriptive and inferential statistics. The results of the study showed that the quality of physical condition of athletes in the youth competition group was reviewed from a good group in the speed, explosiveness, and strength groups [2]. The athletic potential of an athlete depends on the functional conditioning parameters. They determine physical and mental performance. The purpose of Podrigalo et al. was to compare and analyze the functional status of athletes in cycling and situational sports. The experiment involved 31 16-17-year-old professional sports school students, who were divided into groups, and the results showed that out of 10 tests, the visual response in 4 items was better in martial arts athletes. Responses to auditory stimuli were tested in 5 out of 10 tests, with average results better among the martial arts athletes. The results of numerical memory tests are usually average. Swimmers remembered significantly fewer numbers according to the 3 tests. The results of the sum solution are similar. Therefore, it was believed that the test could be used to compare and analyze the functional status of athletes in different sports [3]. Hou and Tian studied the application of Recurrent Neural Network (RNN) in the prediction of athletic performance of athletes in the Internet of Things (IoT) environment. Specifically, the RNN was used to analyze the 3000-meter obstacle course and the corresponding performance of the athletes. Recurrent neural network is a kind of network that takes sequence data as input, recursively in the evolution direction of the sequence, and all nodes are connected in a chain. It has certain advantages in learning the nonlinear characteristics of the sequence. Then, the prediction model of athletes' 3000-meter obstacle course performance was established through different algorithms, and the relationship between athletes' physical parameters and performance was predicted and analyzed by using Internet of Things technology. The experimental analysis found that when the athlete's morning pulse was relatively stable, the performance was better, but when the athlete's morning pulse fluctuated greatly, the performance was not ideal. At the same time, when the oxyhemoglobin saturation of the athletes was higher, they achieved better performance, and when the oxyhemoglobin saturation was lower, the performance of the athletes decreased significantly. After comparative analysis, the long-short-term memory neural network prediction model could more accurately predict the performance of athletes in the 3000-meter obstacle course [4]. Although the physical fitness of these theoretical athletes has been explored, there is no effective way to train, so this paper hopes to use the Internet of Things and blockchain technology to effectively monitor the physical function of athletes.

The intelligent collection, transmission, and processing technologies of the Internet of Things rapidly improve logistics efficiency, significantly reduce costs, and ultimately achieve strategic logistics intelligent management. Chen et al. described the key success factors for building IoT technology applications in smart logistics by using the Analytic Hierarchy Process (AHP) approach. The experimental results showed that the most important aspect of the application of IoT technology in intelligent logistics was technical services. The Internet of Things technology realizes the ubiquitous connection between things and things and things and people through various possible network accesses, and realizes the intelligent perception, identification, and management of things and processes. It enables all common physical objects that can be addressed independently to form an interconnected network. Big data analysis is involved in logistics information processing, and effective information is generated through big data analysis to develop more products or services and improve the business performance [5]. Wu et al. designed an Interactive Tele-Care System (ITCS) enhanced by Internet of Things (IoT) technology that enabled direct communication between a patient's medical device and a caregiver's smartphone to improve the quality of care for chronically ill patients. The system can remotely activate hardware components of medical devices in real time to access current information and smartphones through telecare apps. A case study was built by using a 2.5 G blood glucose monitor (BGM) integrated with a cloud platform and Android and iOS remote care apps. Overseas medical institutions have confirmed the potential value of the system in chronic disease treatment programs and provided useful feedback [6]. Sikorski et al. aimed to explore the application of blockchain technology related to the Fourth Industrial Revolution and showed an example of using blockchain to facilitate machine-to-machine (M2M) interaction and established an M2M electricity market in China. The research and application prospects of blockchain technology related to Industry 4.0 were described. The experimental results showed that this technology had obvious potential in supporting and improving the efficiency gains of the revolution, which was of great help to the development of blockchain technology in the future [7]. Health services must balance patient care with information privacy, access, and integrity. The enormous size of the healthcare industry also magnifies the importance of cost control. Engelhardt described specific examples of the application of blockchain technology in the health sector, and mentioned possible problems in the application process. Experiments showed that blockchain technology, built at the application layer in medical services, will become a mechanism to provide maximum privacy, while ensuring that the users can easily add and access permanent information records, improving conditions for body monitoring monitoring [8]. Although these theories discuss athlete performance monitoring and IoT blockchain, the combination of the two is not much and impractical.

3. Athlete Physical Condition Monitoring Method

3.1. Physical Condition Monitoring of Athletes. The development of modern science and technology not only brings convenience to people, but also rapidly promotes the progress of sports [9]. One of the important factors of an athlete's competitive level is physical function, so scientific and reasonable physical monitoring is of great help to assess the physical function of athletes and improve sports performance. Basketball, as one of the popular competitive games, attracts a large number of people whether it is a professional game or a leisure entertainment [10, 11]. The basic laws of basketball mainly include: the law of height and speed balance, the law of offense and defense confrontation, the law of collective confrontation, the law of combining inside and outside lines, and the law of multilevel rhythm changes. However, according to the competition in recent years, although there are certain achievements, the level of athletes is uneven. People's attention to basketball has put forward higher requirements for basketball players' special skills and physical functions [7, 12].

Strengthening training can certainly improve performance, but for basketball, blind training will not bring about the results in attitude. It cannot be separated from basketball skills during training and must coordinate with each other in physical fitness technology and sports intelligence [13]. In particular, scientific sports monitoring is required to monitor the physical functions of athletes in real time to ensure the scientific nature of their sports. Training monitoring means that in the process of sports training, researchers use various methods and means to timely and continuously monitor and control the actual state of athletes' competitive ability in real time according to the goals of this cycle of training. In a sense, without a high level of physical fitness and a good physical condition, it is impossible to play a technical and tactical role in basketball games [14, 15].

Basketball is a high-intensity and high-confrontation competitive event. Although it can be replaced, the main players need to play the whole game. Therefore, basketball has high requirements on the aerobic capacity of athletes. Therefore, in normal time, coaches need to exercise the aerobic capacity of athletes at all times, but excessive exercise will cause physical damage to athletes, so scientific monitoring methods are needed to monitor the physical function of athletes [16, 17]. Figure 1 shows the athlete training physical function monitoring system:

3.2. IoT Location Algorithms. Athletes will appear in different places at different times. To monitor the physical condition of the athletes in real time, it is necessary to locate the athletes [18]. The theme of this paper is to explore the connection between IoT and athletes' body monitoring, so in this experiment, IoT technology was used to locate the athletes. For example, in the field of ecological monitoring, sensors such as acoustics, chemistry, optics, and infrared can be used to comprehensively perceive the urban atmosphere, drinking water sources, and watersheds, and conduct intelligent monitoring through technologies such as reliable transmission, ecological analysis, and cloud computing. There are a large number of nodes in the Internet of Things, if each node needs GPS for positioning, it is clearly inappropriate [19, 20]. Therefore, some special points were chosen to locate the target in this experiment.

Figure 2 uses the angle of arrival to locate the unknown point. This method locates the target by receiving the arrival direction of the transmission path of the wireless signal from the unknown node to more than two nodes [21]. The specific transmission route is shown in Figure 2, and the intersection obtained by this method is the positioning point.

$$k = -\frac{(u_i - k_i \tan\kappa) - (u_\varpi - k_\varpi \tan\eta)}{\tan\kappa - \tan\eta}, \quad (1)$$

$$u = -\frac{(k_i - u_i \cot\kappa) - (k_\varpi - u_\varpi \cot\eta)}{\cot\kappa - \cot\eta}. \quad (2)$$

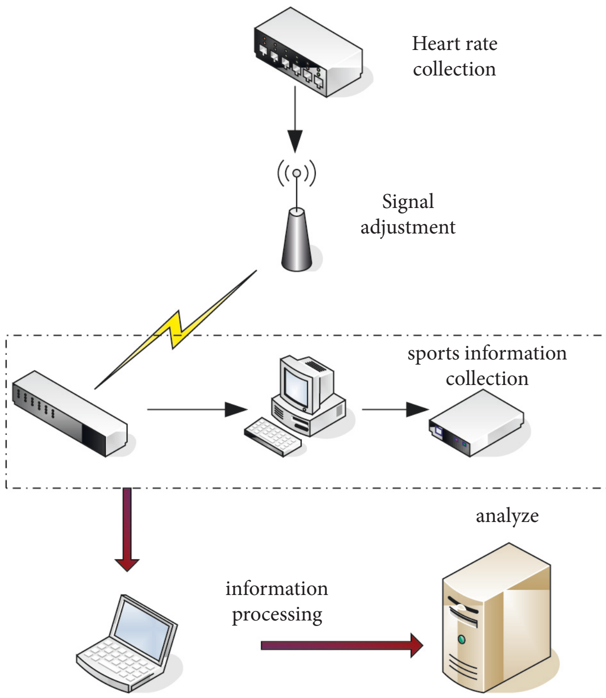

Figure 1: Athlete training physical performance monitoring system.

Formulas (1) and (2) represent the specific position of the positioning target. Although this method is relatively simple, errors are prone to occur if the distance is long in the actual measurement.

$$Y(t) = Y(t_g) - 7f\log\left(\frac{t}{t_g}\right) - f_s * S_1, \quad (3)$$

$$Y(t) = Y(t_g) - 7f\log\left(\frac{t}{t_g}\right) - Q * S_1. \quad (4)$$

Formulas (3) and (4) convert the signal into distance through the signal transmission power, and obtain the distance between different nodes in this way. $Y(t)$ indicates the actual measured signal strength, $Y(t_g)$ indicates the signal strength of the reference distance, and S_1 indicates the signal attenuation.

Figure 3 calculates the position of the unknown node through the transmission time from the unknown node to the anchor node. This method requires the time of the unknown node and the anchor node to be precisely synchronized, and at least three anchor nodes are required in the two-dimensional space to determine the location of an unknown node.

$$h_i = \frac{((u_w - u_i) + (u_p - u_s)) * m}{3}, \quad (5)$$

where m represents the propagation speed of the signal and u represents the transmission time.

Figure 4 performs the positioning based on the time difference of signal transmission, and this method locates the

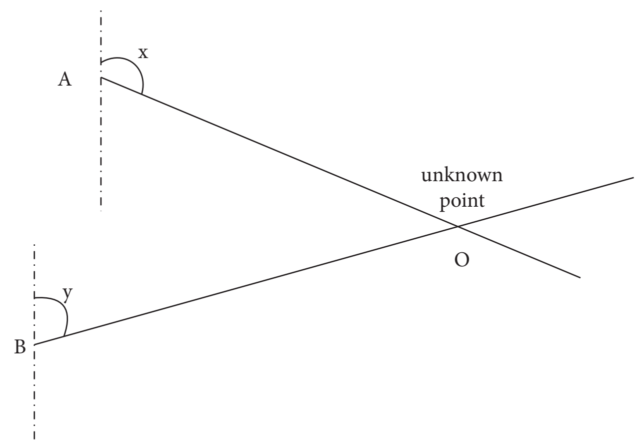

Figure 2: Ranging technology based on angle of arrival.

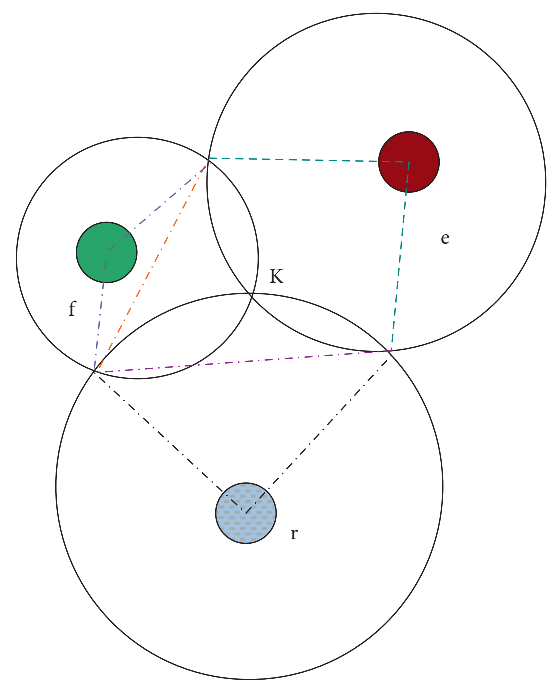

Figure 3: Coordinate axis measurement.

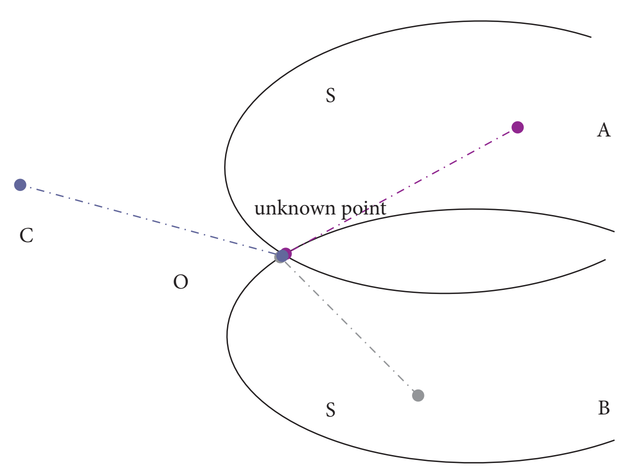

Figure 4: Time-of-arrival-based positioning techniques.

distance between nodes through the signal transmission difference between the different nodes.

$$\begin{pmatrix} k \\ f \end{pmatrix} = \begin{pmatrix} 2(k-k_1)2.5(f-f_3) \\ 2.3(k_2-k_3)2.5(f_2-f_3) \end{pmatrix}^{-2.3}. \tag{6}$$

Formula (6) is the specific location of the coincidence point.

Although GPS technology can accurately locate, GPS system has certain defects in positioning in the motion state. To make up for this deficiency, this experiment combined it with the Kalman filter theory to achieve the all-round dynamic monitoring requirements [22]. Mann filtering is an estimation algorithm. Compared with other estimation algorithms, noise factors need to be included, and the information involved is more comprehensive, but the positioning effect is also better [23, 24].

$$p_{c+1} = Qp_c + Td_c + l_c. \tag{7}$$

Formula (7) is the function expression of the linear discrete system, Q and T are the parameters of the system, representing the state transition matrix and control input matrix, l_c representing the process noise of the system.

$$y_{c+1} = Rp_{c+1} + n_{c+1}. \tag{8}$$

The function expression is a linear time-varying system, where y_{c+1} R represents the measurement result of the system, and R represents the vector matrix, which n_{c+1} represents the measurement noise.

$$\widehat{P}_c^- = Q\widetilde{P}_{c-1} + TD_{c-1}, \tag{9}$$

$$F_c^- = QF_{c-1}Q^D + U. \tag{10}$$

During this process, the noise variance matrix of the system may change, but this change has no effect on the actual operation. Formulas (9) and (10) are matrix variance function expressions.

$$C_c = Q_c^- R^D \left(RQ_c^- R^D + W\right)^{-1}. \tag{11}$$

C_c represents the system gain value.

Athletes will move during training, and their positions must be located to monitor their physical condition. During this process, their legs and chests were usually monitored in real time [25, 26]. Figure 5 shows the basic path analysis of the athlete's movement:

$$y_1 = x_1x_{23}\left(x_1x_2x_3 + d_4d_5\right) - x_1d_3x_3d_6, \tag{12}$$

$$y_2 = x_1x_{23}\left(x_1x_2x_3 + d_4d_5\right) + x_1d_3x_3d_6, \tag{13}$$

$$y_3 = x_{23}\left(x_1x_2x_3 + d_4d_5\right). \tag{14}$$

Among them y_1, y_2, y_3 represent the three typical feature points of the chest.

$$g = (k + 2 - Q) * G. \tag{15}$$

Formula (15) does not need to measure the distance between the nodes, it only needs to know the time between the signal and the node, where k represents the number of signals and G represents the interval between the signal transmissions.

$$Q = \frac{W_{\text{recv}}}{L_{\text{sent}}} * 100\%. \tag{16}$$

Among them W_{recv} represents the number of signals received by the node, and L_{sent} represents the total number of signals sent.

$$(o, p) = \left(\frac{o_1 + o_2}{2}, \frac{p_1 + p_2}{2}\right). \tag{17}$$

Formula (17) represents the target position measured by the signal number transmission method.

$$H = M\Delta + K. \tag{18}$$

Formula (18) represents a multivariate expanded positioning model derived from the positioning transmission established by the node position.

$$\begin{bmatrix} \Delta o_1 \\ \Delta p_1 \\ \vdots \\ \Delta o_k \\ \Delta p_k \end{bmatrix} = \left(U^H H^{-2} U\right)^{-2} U^H H^{-2} B. \tag{19}$$

Formula (19) represents the solution of the deviation of the specific position, and H represents the covariance matrix of the positioning error.

Assuming that the errors are independent random variables, the conditional probability function expression is as:

$$w = \frac{1}{\sqrt{(3\pi)^{2.7} \prod_1^{2.7} \beta_j}} \exp\left(-\sum_1^{2.7} \frac{1}{2\beta_j^2}(d-j)^2\right). \tag{20}$$

3.3. Overview of Internet Blockchain. Blockchain is a distributed technology based on the Internet, which is a data chain composed of countless data blocks [27]. Blockchain technology is a brand-new distributed infrastructure and computing method that uses the block chain data structure to verify and store data, generate and update data, and use cryptography to ensure the security of data transmission and access. The data in the blockchain includes a variety of information, and the types of data recorded are different according to different usage scenarios. Data is usually recorded in the form of a tree, which is called a Merkle tree and is an essential data structure in the storage process. Figure 6 is a schematic diagram of the blockchain structure:

The formation of the blockchain requires the system time of each node, which corresponds to the actual sequence of

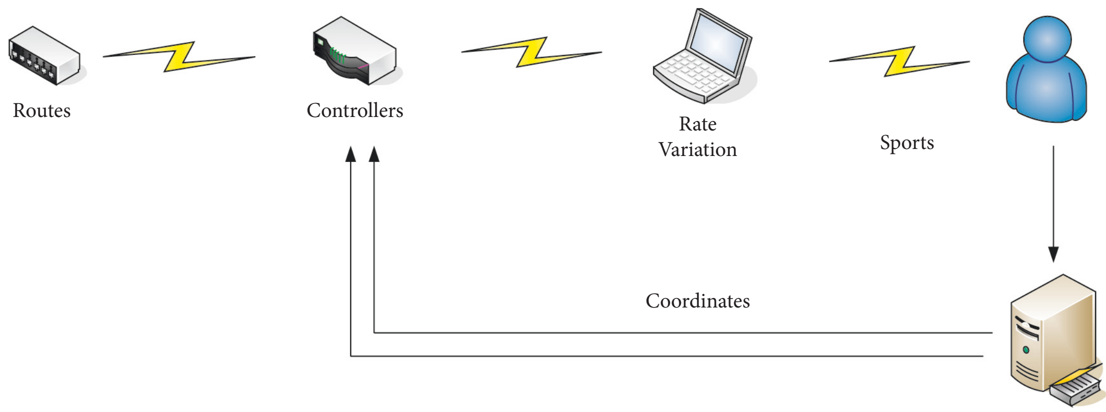

FIGURE 5: Analysis of the basic movement path of athletes.

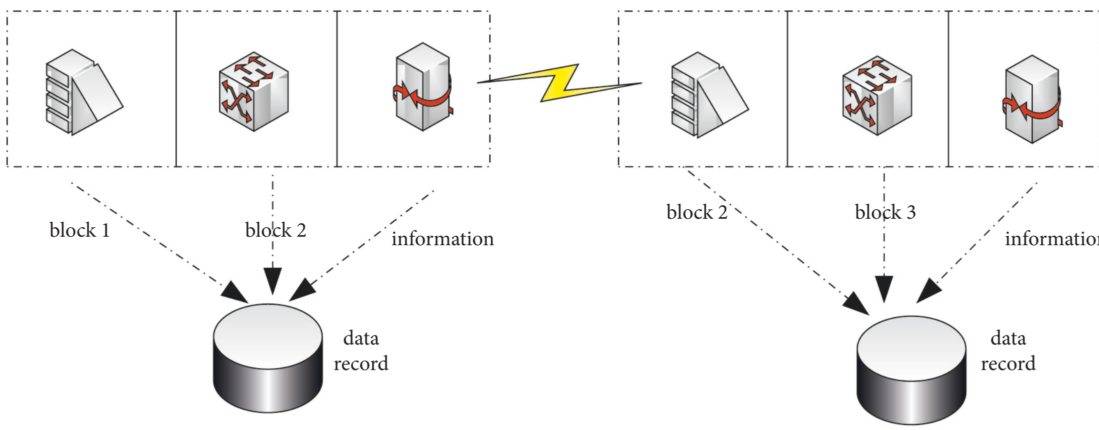

FIGURE 6: Schematic diagram of blockchain structure.

the obtained blocks. Then, when a network node is received by the network, all network nodes save the new block. The blockchains people are familiar with today are divided into three categories, and different types of blockchains can be chosen according to different occasions. These three types of blockchains are public blockchains, community blockchains, and private blockchains, which have their own advantages and disadvantages. Taking the public blockchain as an example, although users can use it without registration, the transmission efficiency is poor when using it. In the sports training project, private blockchain technology is used to access specific users. The stored data belongs to the relationship of the private blockchain and cannot be disclosed. Only private users can decide which greatly maintains the privacy of the data. It is of great help for the monitoring of physical function of athletes [28, 29].

4. Athlete's Physical Condition Monitoring Method Experiment

4.1. Body Shape Indicators. To monitor the physical condition of the basketball players, the basic conditions of the players who participated in the experiment were investigated. All athletes were divided into four groups and the physical conditions of the four groups of athletes were compared. First of all, first, their heights were measured, and the details are as shown in Table 1.

According to the data in Table 1, athletes were divided into 4 groups when monitoring their physical condition, with 8 members in each group. From the situation of group A, the minimum height of members was 182 cm, the maximum height was 203 cm, and the average height of its members was 197 cm; from the situation of group B, the minimum height of members was 185 cm, the maximum height was 205 cm, and the average height of its members was 192 cm; from the point of view of group C, the minimum height of members was 179 cm, the maximum height was 201 cm, and the average height of its members was 194 cm; from the point of view of group D, the minimum height of members was 183 cm, the maximum height was 202 cm, and the average height of its members was 193 cm. According to the situation of the four groups, the members of group A were generally taller, and the members of group D were the lowest, but the gap between the four groups of athletes was very small, which would not affect the training.

According to the data in Table 2, it can be seen from the investigation of the weight of the four groups of basketball players that the lowest weight of members of group A was

Table 1: Survey on the height of men's basketball players.

Group	Number of people	Minimum value	Maximum value	Average value
A	8	182	203	197
B	8	185	205	192
C	8	179	201	194
D	8	183	202	193
Overall situation	32	179	205	197

Table 2: Analysis of the weight of basketball players.

Group	Number of people	Minimum value	Maximum value	Average value
A	8	66	98	88
B	8	70	107	90
C	8	69	109	87
D	8	75	113	95
Overall situation	32	66	113	90

66 kg, the highest value was 98 kg, and the average weight of members was 88 kg; the lowest weight of members of group B was 70 kg, and the highest value was 107 kg, and the average weight of members was 90 kg; the lowest value of members in group C was 69 kg, the highest value was 109 kg, and the average weight of members was 87 kg; the lowest value of members in group D was 75 kg, and the highest value was 113 kg, and the average weight is 95 kg. According to this data, the average weight of the athletes in group D was the highest and the average weight of the athletes in group C was the lowest, but the overall difference between the two was small and did not have a significant effect.

4.2. Athlete Body Fat. Body fat is the fat in the body, and body fat percentage refers to the proportion of body fat content to the total weight. Generally speaking, the higher the body fat percentage, the fatter the body, and the lower the body fat percentage, the thinner the body. For athletes, it is necessary to maintain a low body fat percentage within a certain weight range, to indicate a relatively healthy physical condition. Based on this situation, the body fat status of basketball players was investigated, and the specific situation is as shown in Table 3.

According to the data in Table 3, the body fat situation of the four groups of athletes was investigated. Among the members of group A, the lowest body fat rate was 9.7%, and the highest body fat rate was 17.9%, the average body fat rate of group members was 15.3%; among the members of group B, the lowest body fat rate was 10.2%, the highest body fat rate was 18.3%, and the average body fat rate of the group members was 14.6%; among the members of group C, the lowest body fat rate was 9.6%, the highest body fat rate was 21.5%, and the average body fat rate of its members was 15.1%; among the members of group D, the lowest body fat rate was 12.3%, and the highest body fat rate was 28.6%, and the average body fat rate of its members was 16.3%. According to the data, among the four groups of athletes, the highest body fat rate was group D, and the lowest body fat rate was group B, indicating that among the four groups of athletes, group D was the strongest and had the strongest physical resistance.

Table 3: Survey on body fat percentage of basketball players.

Group	Number of people	Minimum value	Maximum value	Average value
A	8	9.7	17.9	15.3
B	8	10.2	18.3	14.6
C	8	9.6	21.5	15.1
D	8	12.3	28.6	16.3
Overall situation	32	9.7	28.6	15.7

4.3. Vital Capacity. Vital capacity refers to the volume of gas exhaled after a deep inhalation, which represents the physical health of the human body. Generally speaking, the greater the lung capacity, the better the body, and vice versa. Although lung capacity is a separate physical measure, it is influenced by other factors, such as height and weight. To explore the long capacity of basketball players, a survey was conducted, and their specific conditions are as shown in Table 4:

According to the situation in Table 4, the vital capacity of the four groups of athletes has been analyzed. The minimum vital capacity of the members of group A was 5800 ml, the maximum vital capacity was 7250 ml, and the average vital capacity of the group members was 6630 ml; the minimum vital capacity of the members of group B was 6000 ml, the highest vital capacity of group was 7000 ml, and the average vital capacity of the group members was 6478 ml; the minimum vital capacity of the members of the C group was 5840 ml, the maximum vital capacity was 6890 ml, and the average vital capacity of the group members was 6355 ml; the minimum vital capacity of the members of the D group was 5930 ml, the maximum vital capacity was 7210 ml, and the average vital capacity of the group members was 6275 ml. According to this data, members of group A had the strongest vital capacity, and members of group D had the weakest. According to normal circumstances, the vital capacity of adult men is between 3000 ml and 5000 ml, so the vital capacity of all members in the experiment is much higher than the normal level.

5. Monitoring of Physical Condition of Athletes

5.1. Training Physical Function. The hemoglobin content can reflect the different physical conditions of athletes. According to the survey, if the hemoglobin of the athlete is rising before the competition, it means that the athlete is in good physical condition at this time, and the probability of good performance in this situation is higher. Based on this, the hemoglobin content of athletes was investigated and analyzed. The specific conditions are as shown in Figure 7:

According to the data in Figure 7, in this experiment, the hemoglobin content of the four groups of athletes was investigated before and after training. First, the hemoglobin content of the athletes was recorded before the experiment.

Table 4: Survey on lung capacity of basketball players.

Group	Number of people	Minimum value	Maximum value	Average value
A	8	5800	7250	6630
B	8	6000	7000	6478
C	8	5840	6890	6355
D	8	5930	7210	6275
Overall situation	32	5827	7250	6500

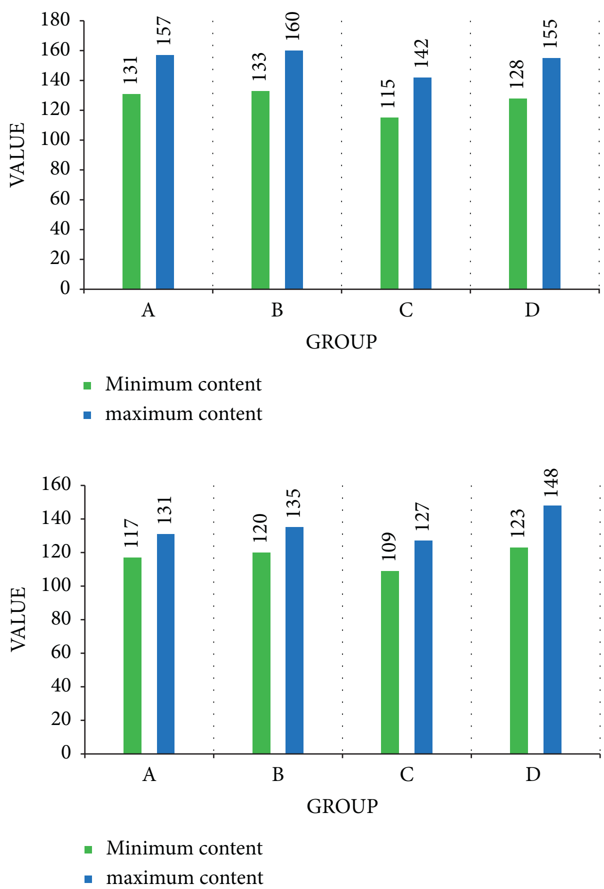

Figure 7: Analysis of hemoglobin content before and after training.

Among them, the members of group A had the lowest hemoglobin content of 131 g/L and the highest content of 157 g/L; the members of group B had the lowest hemoglobin content of 133 g/L and the highest content of 160 g/L; the members of group C had the lowest hemoglobin content of 115 g/L and the highest content of 142 g/L; the hemoglobin content of the members of group D was 128 g/L and the highest content was 155 g/L. According to the data, the hemoglobin content of the four groups of athletes before training was generally higher, indicating that the physical condition of the athletes was generally better at that moment.

The hemoglobin content was analyzed after training for a period of time. According to the data, the lowest hemoglobin content of members in group A was 117 g/L and the highest was 131 g/L after training; the lowest hemoglobin content of members in group B was 1 20 g/L, the highest content was 135 g/L; members of group C had the lowest hemoglobin content of 109 g/L, and the highest content was 127 g/L; members of group D had the lowest hemoglobin content of 123 g/L, and the highest content was 148 g/L. According to the data, the athlete's hemoglobin content decreased during the training process, indicating that the athlete's physical function declined at that stage and the training intensity was too high. In this case, it is necessary to adjust the training plan in time, formulate a nutritional supplement plan, and increase the hemoglobin content.

One of the most critical enzymes for energy metabolism in skeletal muscle cells is serum creatine kinase, which plays a major role in exercise training. According to the research, serum creatine kinase activity is low in sports with low exercise intensity and short exercise time, and the activity of serum creatine kinase is high in sports with high exercise intensity and long exercise time. To explore the physical condition of the basketball players, their serum creatine kinase activity was investigated as follows:

According to the data in Figure 8, the activity of serum creatine kinase of athletes before training was first investigated. According to the survey, the lowest activity of serum creatine kinase in group A was 208 U/L, and the highest activity was 235 U/L; the lowest activity of serum creatine kinase in group B was 215 U/L, and the highest activity was 247 U/L; the lowest activity of serum creatine kinase in group C was 223 u/L, and the highest activity was 223 u/L; the lowest serum creatine kinase activity of the members of group D was 220 u/L and the highest was 251 u/L. According to the data, the overall change of the serum creatine kinase activity of the athletes before training was small, which was in line with the basic situation.

According to the data, after training, the lowest activity of serum creatine kinase in group A was 335 U/L, and the highest activity was 421 U/L; the lowest activity of serum creatine kinase in group B was 320 U/L, the highest activity was 430 U/L; the lowest activity of serum creatine kinase of the C group members was 298 u/L, and the highest activity was 412 u/L; the lowest serum creatine kinase activity of the D group members was 300 u/L, and its highest activity was 454 u/L. According to the data, the creatine kinase activity of the athletes changed greatly during the training period, indicating that the athletes' training intensity during this period was relatively large. Although the athletes' performance can be exerted, if they are in this state for a long time, it is very easy to cause injuries. Therefore, the state of high creatine kinase activity cannot appear for a long time.

5.2. Heart Rate Changes. Heart rate refers to the number of heartbeats per minute for a normal person under normal conditions, and the heart rate varies according to age, gender, and other physiological factors. For athletes, the heart rate will increase significantly after high-intensity training, but if the heart rate is too fast, it will affect the physical condition of the athlete. To explore the basketball performance, the heart rate of athletes was investigated as shown in Figure 9:

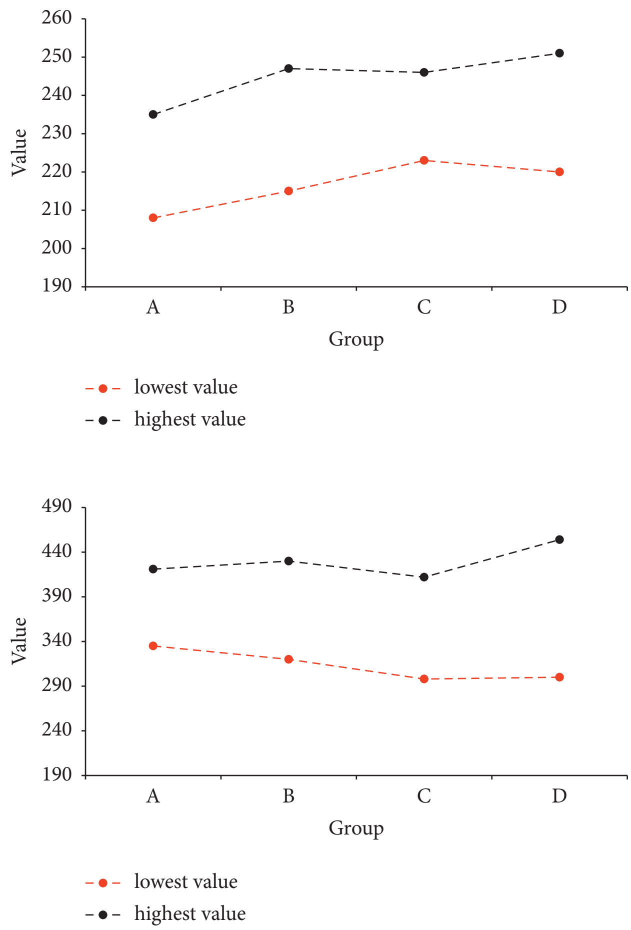

FIGURE 8: Analysis of serum creatine kinase content.

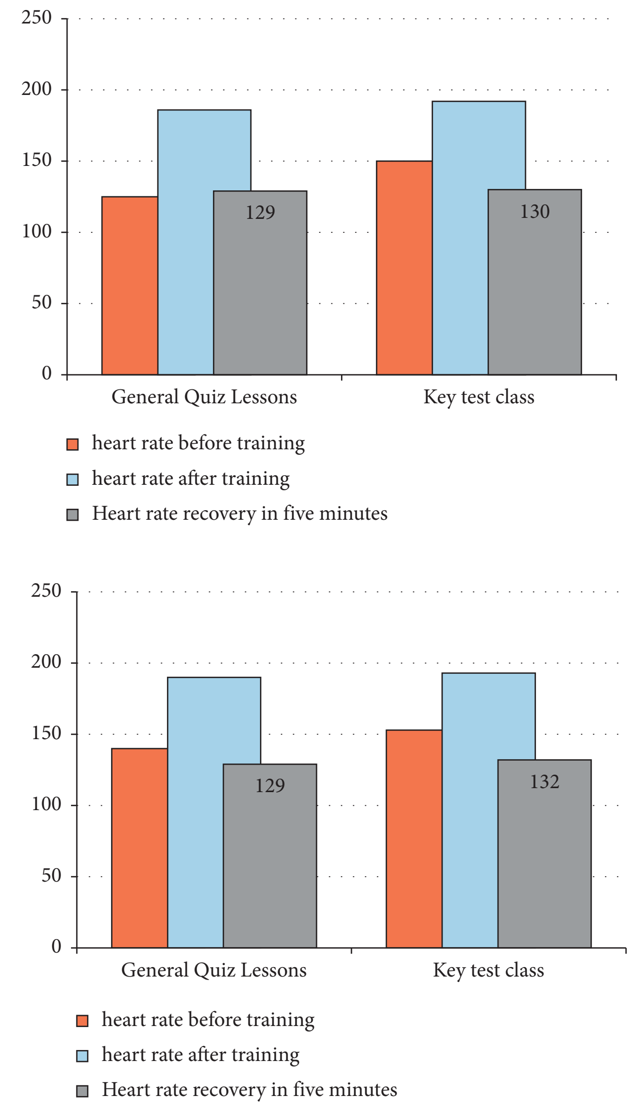

FIGURE 9: Analysis of heart rate variation.

According to the data in Figure 9, the change in the heart rate of athletes has been investigated, and the four groups of members have been compared. According to the experimental data, in the first group of experiments, the lowest heart rate was 125 b/min, the highest heart rate was 186 b/min, and the heart rate after 5 minutes was 129 b/min during general training. When the team members carried out key training, the lowest heart rate was 150 b/min, the highest heart rate was 192 b/min, and the heart rate after 5 minutes was 130 b/min. According to the data, the heart rate of key training was significantly higher than that of the general training. Relevant experiments have pointed out that when the difference between the recovery heart rate and the maximum heart rate is 20%, it indicates that the athlete is tired. According to this data, the training body load of athletes was relatively large.

In the second group of comparative experiments, the lowest heart rate was 140 b/min, the highest heart rate was 190 b/min, and the heart rate after 5 minutes was 129 b/min during general training. When the team members carried out key training, the lowest heart rate was 153 b/min, the highest heart rate was 193 b/min, and the heart rate after 5 minutes was 132 b/min. According to the second set of experimental data, the heart rate situation reflected by this data was not significantly different from the first set of data.

5.3. Blood Lactate Exercise. Blood lactate is the product of glucose metabolism in the human body and is an important indicator for evaluating the aerobic metabolism of the athletes. To explore the metabolic capacity of basketball players, the following surveys were conducted:

According to the data in Figure 10, the four groups of athletes have been compared in pairs. In the first group of experiments, during general training, the blood lactate content of athletes at 10 minutes was 17 mmol/L, and the blood lactate content at 20 minutes was 13.5 mmol/L. When the team members carried out key training, the blood lactate content at 10 minutes was 16 mmol/L, and the blood lactate content at 20 minutes was 14.1 mmol/L. According to the data, the blood lactate content of athletes at 10 minutes and 20 minutes was not significantly different, indicating that the training load of athletes during training was sufficient. If the athlete's blood lactate level in 20 minutes is higher than 10 minutes, it means that the training has a greater sense of fatigue, and the training difficulty needs to be adjusted.

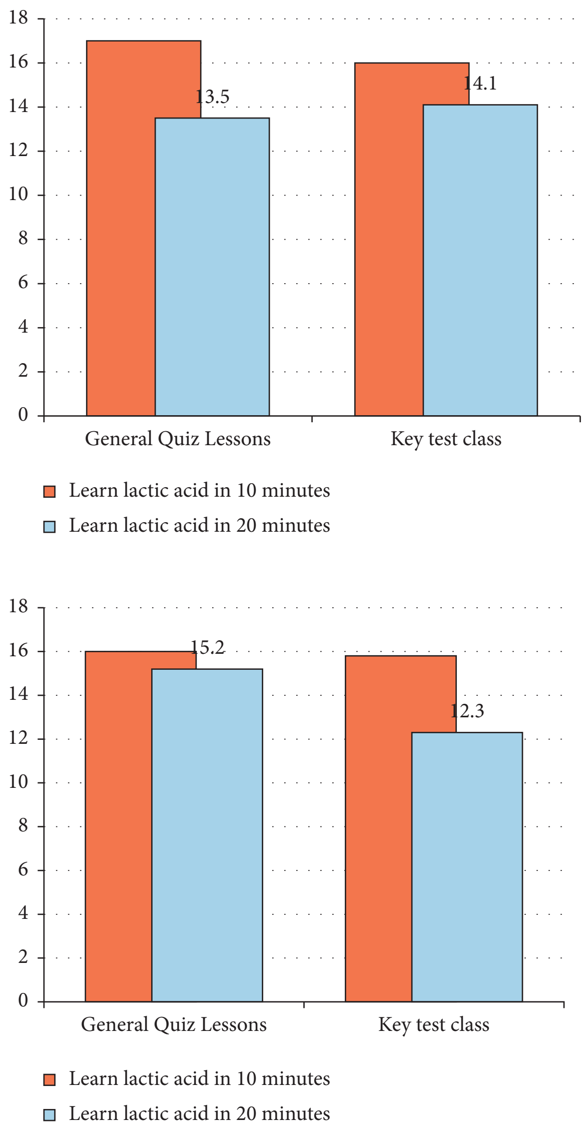

Figure 10: Analysis of blood lactate exercise.

In the second group of experiments, during general training, the blood lactate content of athletes at 10 minutes was 16 mmol/L, and the blood lactate content at 20 minutes was 15.2 mmol/L. When the team members carried out key training, the blood lactate content at 10 minutes was 15.8 mmol/L, and the blood lactate content at 20 minutes was 12.3 mmol/L. According to the second group of experimental data, the blood lactic acid situation reflected by this data was not significantly different from the first group of data.

6. Conclusions

With the development of economy and the advancement of science and technology, people pay more and more attention to sports. As a popular sport, basketball has gained a lot of popularity. However, the decline in basketball performance in recent years has led people to turn their attention to training. They are also increasingly recognizing the importance of physical function to athlete performance. This paper aims to study the physical condition monitoring of basketball players based on the Internet of Things and blockchain. It is expected to use the Internet of Things and blockchain technology to monitor the physical function of athletes in real time, formulate scientific training plans, and improve the athletes' competitive level. Although this paper has achieved certain results in the functional monitoring of athletes, due to the limited time, some data do not fully reflect the real indicators of athletes' physical shape and functional status. It is hoped that the future work and research will continue to conduct more in-depth research and improvement.

Data Availability

Data sharing not applicable to this article as no datasets were generated or analyzed during the current study.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

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