Investigation and Analysis of the Status Quo of Competitive Aerobics Based on the Big Data of the Internet of Things

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Big data refers to a large amount of diverse digital information that requires new processing modes to have higher decision-making power. Big data is known for its large capacity, complex types, and high application value. At present, big data is also considered as a modern service technology. The Internet of Things technology originated from the third scientific and technological revolution, which refers to the connection of objects and networks through information sensor devices according to agreed protocols. Competitive aerobics is a sport that can perform continuous, complex, and high-intensity complete sets of movements under the accompaniment of music. The complete set of competitive aerobics combines four sets of difficulty to demonstrate the strength, balance, and flexibility of the athletes, and through the continuous combination of movements, it shows the diversity of the seven steps of competitive aerobics and the coherence of the calisthenic movements. The purpose of this paper is to investigate the current situation of competitive aerobics based on the big data of the Internet of Things. It is expected that, through the IoT and big data technology, the current situation of aerobics competition will be investigated and analyzed, the current industry situation will be analyzed, and the scientific and reasonable training methods of competitive aerobics will be explored. This paper uses a questionnaire to investigate the competitive aerobics, analyzes the problems and deficiencies reflected in the questionnaire, and proposes feasible countermeasures. The experimental results of this paper show that there are 20 coaches with undergraduate education, accounting for 49%. Therefore, in the recruitment of coaches, education and experience must be combined; it is normal for athletes to train 2–3 times a day, and the training frequency can be adjusted according to individual circumstances.

1. Introduction

As the pace of reform and opening up continues to deepen, it not only brings a take-off to China’s economy, but also provides a foundation for the development of technology. The technology that has the greatest impact on life today is the Internet of Things. In the era of big data, the development of all walks of life cannot be separated from big data. Intelligent house is the organic combination of various subsystems of furniture life by using state-of-the-art computer technology to make home life more comfortable through overall management. The purpose of this paper is to study the investigation and analysis of the current situation of competitive aerobics based on the big data of the Internet of Things and to explore the current development of aerobics by using the big data technology of the Internet of Things. With the continuous development of the world economy, people’s living standards have also been greatly improved, people’s pursuit of material life has begun to decline, and more energy has been invested in their own health. In this context, many fitness methods have emerged. Competitive aerobics is one of the many fitness methods. It combines gymnastics and dance, which can play a role in sculpting and strengthening the body, and is loved by people. By participating in aerobics, bodybuilders can make muscle fibers thicker, increase the content of protein and glycogen reserves, and develop muscles and joints in a symmetrical and coordinated manner. With the continuous development of
active aerobics, more and more people participate in this exercise, and many people are injured due to unscientific exercise methods. In order to explore the current development of competitive aerobics, we combine IoT big data with competitive aerobics, hoping to find a scientific training method and reduce the probability of injury.

With the continuous development of competitive aerobics, high-intensity and superconformity have appeared in the process of participating in training, which has caused a certain degree of harm to the body of the trainers, which will not only reduce the performance of the competition, but may also lead to lifelong disability in severe cases. Through the exploration of this paper, we can analyze the current situation of the current competitive aerobics guidance, provide certain data support for the formulation of a scientific training system, and make the development of the aerobics market more scientific and standardized. Using the big data of the IoT to investigate the overall development of the aerobics industry can make the obtained information more comprehensive and the analysis results more scientific.

Aiming at the data fusion in the IoT, the real-time nature of the data is studied, and a new method is proposed, so that the time obtained during data transmission depends on its own timeliness level. The data fusion in the Internet of Things is analyzed, the workload of data fusion is reduced, and the data fusion method is improved.

2. Related Work

The Internet of Things technology is becoming more and more popular, and people need the Internet of Things in more and more places in their lives. How to use the big data technology of the Internet of Things to integrate the information around them is a major difficulty at present. Antunes M discloses the shortcomings of current storage schemes, indicates the strengths of semantic approaches, and extends the nonsupervised model to automatically pick up classes of characters. The scheme was implemented and evaluated against the Miller-Charles dataset and an IoT semantic dataset extracted from a popular IoT platform with a correlation of 0.63 [1]. While IoT may create data that contains a lot of useful information, finding meaningful patterns in the vast amount of IoT data is a challenge. Ismail W N proposes a novel behavioral pattern called Production Cycle-Frequency Sensor Pattern (PPFSP). PPFSP can find correlations between a set of temporally frequent sensor patterns that can reveal interesting knowledge from monitoring data. The results show that this method is more time and memory efficient in finding PPFSP compared to existing algorithms [2]. To effectively utilize the 3C resources of nearby fog devices, Luo S proposed F3C, a 3C resource sharing framework that supports fog, by addressing the issue of power generation cost under 3C constraints. He proposes an elegant F3C algorithm that treats 3C resource sharing per task as a problem. Extensive performance evaluation shows that the F3C algorithm can achieve excellent performance in terms of energy savings compared to various benchmarks [3]. Todorova V examines the areas in which there is a need to improve choreographic training in athletic calisthenics. He hopes to improve the effectiveness of choreography training in sports aerobics in the professional basic training stage. In his research, he used the literature to analyze and summarize and perfected the dance training content of athletes in the basic training stage of sports aerobics. According to the requirements of modern sports, the tools and methods for improving the dance training of athletes aged 15–17 were selected; the means of expressive education and the technology of perfecting competitive works were introduced, and the means and methods for controlling the preparation of athletes’ choreography were developed [4]. Since the data is generated from a variety of devices in a short period of time, these data are characterized by different storage formats and fast generation speed, which can be regarded as a big data problem to a large extent. Zhang Yi proposes a patient-centric system based on cloud and big data analytics technologies. The system consists of a standard data collection layer and a data management layer for parallel computing. The results of this study show that cloud and big data technologies can be used to improve the performance of healthcare systems [5]. Zhou L introduced the big data machine learning framework, providing direction for identifying related opportunities and challenges, and providing direction in many unexplored research areas [6]. IoT associated usage has become an essential area for investigators, particularly in cloud based computing. Cai H has proposed a feature based library framework that identifies areas for acquiring and mining big data for IoT and describes several technical modules according to their key characteristics and capability definitions. He then analyzes current IoT application research and identifies challenges and opportunities associated with IoT big data research. He has also conducted research based on relevant academic and industry publications [7]. Although these theories have expounded the Internet of Things technology and competitive aerobics to a certain extent, the connection between the two is less, and the practical effect cannot be obtained.

3. Current Situation Investigation and Analysis Methods

3.1. Discussion on Big Data. With the continuous development of computer technology, the concept of big data has gradually emerged [8]. Although big data has been used in many fields, there is currently no internationally recognized concept, and big data has its own unique understanding in various fields. For example, some scholars believe that big data refers to the idea that the scale of data sets involved has exceeded the ability of traditional database software to acquire, store, manage, and analyze. Regardless of the definition of big data in various fields, we cannot deny that now we are in the era of big data, and surroundings are closely related to big data [9, 10]. Big data is a brand-new way of thinking. The transformation of information in the production process into data forms promotes the development of social economy and culture [11]. Big data is scalable, diverse, fast, and valuable. Figure 1 is a big data structure diagram.
The development trend of information analysis in the current big data environment is mainly (1) strengthening information and data sharing; (2) carrying out collaborative analysis.

Big data brings many challenges to data processing. Taking traffic security data as an example, after years of informatization construction, public security and government departments have collected massive data resources related to traffic security, whose scale and complexity have exceeded the management and processing capabilities of traditional databases and software technologies. Since the promotion of the Internet of Things technology, big data is everywhere in daily life, and the scope of application has been expanding [12, 13]. The emergence of the scale of big data urgently requires us to classify and process big data. In this context, big data systems emerge as the times require, and big data can analyze information from multiple dimensions [14, 15]. Big data is shown in Figure 2.

Big data is mainly analyzed in four dimensions. (1) The amount of data. Quantity is perhaps the most relevant characteristic of big data, referring to the large amount of data that businesses attempt to leverage in order to improve decision-making in the enterprise. (2) Diversity. Diversity refers to the complexity of managing multiple data types. (3) Speed. The acceleration is due to the immediacy of data generation and the necessity of integrating in-stream data into operational workflows and policy initiatives. (4) Accuracy. Accuracy is defined as the degree of reliability relative to some data forms.

3.2. Data Mining Algorithms. The decision tree is essentially the process of classifying and analyzing data. Its analysis process appears in the form of a tree, and each node represents a different type of data [16]. The specific structure is shown in Figure 3.

The main algorithm of decision tree algorithm is to establish the root node and then find the optimal solution from the obtained results [17]. The ID3 algorithm is a common optimal solution algorithm.

$$\text{Info}(S) = -\sum_{i=1}^{u} U_{i} \log_{3} (U_{i}),$$  \hspace{1cm} (1)

where $U_{i}$ represents the proportion of the sample to the population.

$$\text{Info}_x(S) = \sum_{i=1}^{u} \frac{|S_i|}{|S|} \text{Info}(S).$$  \hspace{1cm} (2)

X represents the sample attribute characteristics, and Info$_x(S)$ represents the expected information.
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\[ G \text{aint}(S) = \text{Info}(S) - \text{Info}_x(S). \]  

(3)

Formula (3) represents the difference between the old and new information needs.

\[ W_a = \alpha + \beta W_{a-1} + \delta_a, \]  

(4)

where \( W_a \) is the demand, \( \beta \) is the change in the demand, and \( \alpha \) is a constant.

\[ R(W_a) = \frac{\alpha}{1 - \beta} \]  

(5)

\[ \text{Var}(W_a) = \frac{\phi^3}{1 - \beta^3}, \]  

(6)

and it can be seen from the above function expression that the customer’s demand changes with time, and the final demand is different.

\[ k_a = QW_a + \eta \sqrt{QF_a}, \]  

(7)

where \( Q \) is the expected demand, \( W_a \) is the estimated value, and \( \eta \) is the standard deviation.

\[ W_a = \frac{\sum_{j=1}^{n-1} W_j}{s}, \]  

(8)

\[ F_a' = \frac{\sum_{j=1}^{n-1} (W_j - W_a)^3}{j - 2}. \]  

(9)

Formula (8) and formula (9) represent projected estimates.

The traditional information representation has uncertainty; we express the uncertainty as

\[ W(A) = f(a_1)j(a_1) + f(a_2)j(a_2) + \cdots + f(a_i)j(a_i), \]  

(10)

and when \( f(a_1) = f(a_2) \), \( W(A) = 1 \).

\[ j(f, k) = -\frac{f}{f + k} \log_2 \left( \frac{f}{f + k} \right) - k \log_2 \left( \frac{k}{f + k} \right). \]  

(11)

Formula (12) represents the amount of information required for a decision tree to correctly classify.

\[ Y(B) = \sum_{k} \frac{f_k + l_k j(f_k, l_k)}{f + f l_k}, \]  

(12)

where \( B \) represents a subset of the functional decision tree, \( j \) represents the information expectation, and \( Y(B) \) represents the average information expectation.

\[ \text{New}_R(U, C_i) = \sum_{U| \atop C_i} |U| \text{R}(U_i). \]  

(13)

Formula (13) represents the functional expression of subtree information entropy, and \( U_i \) represents the sample attribute feature.

\[ \text{gain}(B) = J(f, I) - Y(B), \]  

(14)

where \( \text{gain}(B) \) represents the information gain of attribute \( B \).

\[ J(c_s) = -\sum_k f_k \log_2(f_k), \]  

(15)

where \( c_s \) represents the subset, and \( J \) represents the amount of information in the subset.

\[ Y(B) = \sum_h \frac{|c_s|}{|g|} J(c_s). \]  

(16)

\[ Y(B) \] represents the desired information expectation when \( B \) is the attribute.

\[ g(a_1, a_2) = a_1 + 0.5(a_2^2 - a_1^2). \]  

(17)

\( a_1 \) and \( a_2 \) represent random independent variables, and \( g(a_1, a_2) \) represents the sample decision attribute.

\[ W = \sum_k \frac{g_k \log_2 g_k}{G_k}, \]  

(18)

where \( G \) represents the sample data, and \( g \) represents the quantity.

\[ W_1 = \frac{G_1}{G} \left( -\sum_k \frac{G_k \log_2 G_k}{G_1} \right). \]  

(19)

Formula (19) represents the information entropy when the sample data is 1.

\[ W_2 = \frac{G_2}{G} \left( -\sum_k \frac{G_k \log_2 G_k}{G_2} \right), \]  

(20)

and among them, \( 3i \) represents the number of classifications, and the values obtained at this time are all approximate information gain values.

3.3. IoT System. The Internet of Things is a comprehensive information processing technology based on the network and for the purpose of services. It not only made a leap in the way of communication between people, but also made the communication between people and things and things and things possible [18, 19]. All in all, IoT technology has transformed the world into a whole [20]. Networking, Internet of Things, Internet, automation, perception, and intelligence are the basic characteristics of the Internet of Things. From the current research progress, IoT can be divided into perception layer, application layer, and network layer, as shown in Figure 4.
The transport layer is the control center of the Internet of Things, which is primarily in charge of data preparation and distribution. The more common types are the Internet and radio and television networks.

The application layer consists of data acquisition monitoring and energy management. The data acquisition monitoring system is to monitor and control the equipment with the computer as the core in order to understand the various data in the system; the management system involves statistics and management functions. All in all, the application layer is the technology that combines IoT technology with other fields to obtain new intelligent solutions. Figure 5 shows the three-tier architecture of the Internet of Things.

IoT security is closely related to the three-tier architecture of the IoT. The research on the security of the Internet of Things is a hot topic at present. Although the research angles are different, everyone has a consensus that the biggest security challenge of the IoT is data security and privacy protection. The IoT security is a combination of physical security and information security, and it is more difficult to protect privacy. Physical security refers to ensuring the security of IoT physical layer devices, ensuring their security and integrity, and preventing malicious control and deliberate destruction. Information perception layer security refers to ensuring the confidentiality and integrity of collected or perceived information, as well as other forgery and replay attacks. Figure 6 is a structural diagram of information security protection.

4. Status Survey and Analysis Experiment

4.1. Experimental Subjects. In order to explore the current status of the competitive aerobics industry, we conducted a survey on the field of aerobics in city A. The details are as follows.

According to the data in Table 1, a total of 119 athletes participated in the experiment. Among them, there are 3 athletes under the age of 20, accounting for 2.5%; there are 25 athletes between the ages of 21 and 30, accounting for 21%. There are 43 athletes aged 31–40, accounting for 36%; there are 33 athletes aged 41–50, accounting for 27.8%; there are 15 athletes over 50 years old, accounting for 12.7%. According to the survey data, athletes under the age of 20 accounted for the least proportion, and athletes between the ages of 31 and 40 accounted for the largest proportion.

According to the data in Table 2, 42 of the 119 athletes who participated in this experiment had a training period of 1–2 years, accounting for 35%; 31 athletes had a training period of 2–3 years, accounting for 26%. There are 19 athletes who have been training for 3–4 years, accounting for 16%. There are 11 athletes with 4–5 years of training, accounting for 9%; there are 12 athletes with 5–6 years of training, accounting for 11%. There are 4 athletes who have been training for more than 6 years, accounting for 3%. According to the data, aerobics athletes with training years of 1–2 years accounted for the highest proportion, and athletes with more than 6 years of training accounted for the least. Among the athletes of 1–2 years, quite a lot of people joined the industry because of curiosity or hobbies, and they may later find that they are not suitable for opting out. Therefore, there are very few athletes who can persist for 3–4 years. In the later period, due to the decline of physical fitness, they may be unable to complete professional movements and withdraw from the training team. From the perspective of the overall training scale, the number of trainees and age are inversely proportional.
4.2. Athlete Training Situation. Although athletes all train together, each individual will train differently due to individual physical differences. In order to analyze the current training status of competitive aerobics, we surveyed the training situation of 119 athletes; the details are as follows:

According to the data in Table 3, 37 of the 119 athletes who participated in this experiment trained once a day, accounting for 31%, and 34 trained twice a day, accounting for 29%. There are 31 people who train 3 times a day, accounting for 26%, 14 people who train 4 times a day, accounting for 12%, and only 3 people who train more than 4 times a day, accounting for 2%. According to the data, the number of trainings 1, 2 and 3 times a day is equivalent, and it is also the largest proportion of the trainers. Training more than 4 times a day is because there is a recent competition event and precompetition training is required. From this data, it can be seen that it is normal to train 2–3 times a day. The training frequency can be adjusted according to personal circumstances, and the training plan should be arranged reasonably.

According to the data in Table 4, among the 119 athletes participating in this experiment, 12 of them trained for 1 hour each time, accounting for 10%; 23 people trained for 2 hours each time, accounting for 19%. There are 41 people who train for 2.5 hours each time, accounting for 35%; 32 people who train for 3.5 hours each time, accounting for 27%; 11 people who train each time for more than 4.5 hours, accounting for 9%. According to the data, in the training population, the proportion of each training time of 2.5 h is the highest, and the proportion of more than 4.5 h is the least. In general, athletes who train more frequently have shorter training sessions.

4.3. Investigation of Sports Injuries. Competitive aerobics belongs to sports. In order to achieve certain results, it is necessary to participate in training. Long-term physical training will cause sports injuries. Aerobics events are fast, short time, high risk factor and require high physical fitness of athletes. Long-term aerobics training will cause harm to athletes’ bodies.
According to the data in Table 5, there are 3 athletes under the age of 20, with 3 injuries, and the injury rate is 100%; there are 25 athletes between the ages of 21 and 30, with 25 injuries, and the injury rate is 100%. There were 43 athletes aged 31–40, with 43 injuries, and the injury rate was 100%; there were 33 athletes aged 41–50, with 33 injuries, and the injury rate was 100%. The survey data shows that the injury rate of competitive aerobics athletes is 100%. This phenomenon is very surprising. Although it is a sports event, injuries are inevitable, but the training load must be reasonably arranged according to the physical fitness of the athletes.

5. Investigation and Analysis of the Status Quo of Competitive Aerobics Based on the Big Data of the Internet of Things

5.1. Sports Injury Analysis. According to the sports survey, the injuries of competitive aerobics athletes are very serious. We used the big data technology of the IoT to analyze the injury data of the athletes.

According to the data in Figure 7, among the injuries in this survey, 82 people suffered from muscle strain, accounting for 69%. There were 54 people with joint sprain, accounting for 45%; there were 118 people with joint contusion, accounting for 99%. There were 2 patients with joint dislocation, accounting for 2%; there were 4 patients with fracture, accounting for 3%. According to the data, the number of joint contusions is the largest, which is related to competitive aerobics. During training, the joints bear a lot of load, which leads to joint damage.

Injuries caused in the course of competitive aerobics training are very common, and we have made a brief analysis of the degree of each type of injury. There were 83 people with minor abrasions during training, accounting for 70%, and 42 people with slight injuries during training, accounting for 35%. There were 22 people with minor injuries during the training process, accounting for 18%, 15 people with heavier injuries during the training process, accounting for 13%, and 10 people with serious injuries during the training process, accounting for 8%. According to the data, there are many cases of scratches and minor injuries during the training process. This situation can be trained with simple treatment, but other injuries need to be repaired according to the severity.

According to the data in Figure 8, it can be seen that sports injuries are very common, and the injuries that occur at different training times are also different. There were 18 people injured during preparation activities, accounting for 15%; 50 people suffered injury during quality training, accounting for 42%. There were 101 people who were injured during the training of difficult movements, accounting for 85%; 75 people were injured during the training before the game, accounting for 63%; 15 people were injured during the competition, accounting for 13%. According to the data, the probability of injury during difficult exercise training is very high. Therefore, during the difficult training process, special attention should be paid to the training method and scientific training. The training load should also be reasonably arranged before the competition to reduce the probability of injury.

Injuries are different in different training levels. The first group is dynamic strength group, the second group is static strength group, the third group is jumping, and the fourth group is balance group. According to the survey data, the number of injured in the first group was 42, accounting for 35%; the number of injured in the second group was 7, accounting for 6%. The number of injured in the third group was 69, accounting for 58%; the number of injured in the fourth group was 17, accounting for 14%. According to the
data, the third group accounted for the largest proportion of the injured, indicating that the training of the third group was the most difficult. Jumping required the cooperation of various parts of the body, which had a greater impact on the body and it was prone to injury.

5.2. Survey on the Situation of Aerobics Coaches. The role of coaches in the training process is very important, and they are the planners of the entire sport. Most of the coaches are retired or active personnel in the bodybuilding industry. The specific investigation is as follows.

According to the data in Figure 9, among the 40 coaches surveyed, 2 are under the age of 30, accounting for 5%; 11 are under the age of 40, accounting for 27%. There are 16 people under the age of 50, accounting for 40%; there are 13 people over the age of 50, accounting for 33%. According to the data, the proportion of coaches over 40 years old is relatively large, which is also consistent with the fact that most of the coaches mentioned before are retired players. In the coaching industry, the more the experience, the better the teaching.

In addition to the survey of coaches’ age structure, we also analyzed coaches’ educational levels. According to the survey data, among the 40 coaches surveyed in this survey, one has a secondary school education or below, accounting for 4%. There are 9 people with college education, accounting for 22%; 20 people with undergraduate education, accounting for 49%; 10 people with postgraduate education, accounting for 25%. According to the data, the education of coaches is generally undergraduate, followed by graduate and college. Although the experience of coaches is very important, education is an important symbol of personal scientific culture. A low level of education may lead to a situation of single knowledge and lack of innovation in training, which will affect the training of athletes. Therefore, in the recruitment of coaches, it is necessary to combine education and experience to find suitable coaches.

5.3. Competition of Aerobics Athletes. The training results are displayed through the competition results, and the competition has a certain guiding effect on the training. The following is the competition situation of aerobics.

According to the data in Figure 10, the frequency of participating in aerobics competitions is still relatively low.
There are 30 people who participate in the competition once a year, accounting for 25%; 71 people participate in the competition twice a year, accounting for 60%. There are 11 people who participate in the competition three times a year, accounting for 9%; there are 7 people who participate in the competition four times a year, accounting for 6%. According to this data, most aerobics athletes compete in 1–2 games per year.

In competitive competitions, the referee’s ruling is very important. Coupled with the small number of aerobics competitions, it is even more important to improve the referee’s law enforcement process. According to the data survey, 44 people, accounting for 37%, were dissatisfied with the judgment of the referee in the verdict of the aerobics competition; 35 people were not very satisfied with the judgment of the referee, accounting for 30%. There are 24 people who held a general attitude towards the referee’s decision, accounting for 20%; 15 people were very satisfied with the referee’s decision, accounting for 13%. According to the data, more than half of the people are dissatisfied with the referee’s ruling, which shows that the referee has some problems in the law enforcement process, and the law enforcement process needs to be continuously improved.

6. Conclusions

Health is the first element of quality of life. With the improvement of living standards and the increase of leisure time, people pay more and more attention to health, and sports consumption has also become a fashion. However, physical exercise requires professional guidance and training; otherwise, it will not only fail to achieve the function of strengthening the body, but also damage one’s own body. The main conclusions of this paper are as follows: (1) The injury rate of competitive aerobics athletes is as high as 100%. (2) The injury occurrence time ranks first in the difficult movement training stage, which is related to the difficult movement arrangement of competitive aerobics. The higher the difficulty factor is, the more likely the training and competition will lead to the occurrence of injury. Although this article explores the aerobics industry, there are still deficiencies: (1) The selection of experimental data in this paper is not representative. The data can only represent the current situation of the aerobics industry in a certain city and cannot represent the entire industry. (2) In the process of experimental analysis, there is no scientific monitoring of the training in the aerobics industry, nor is the issue of training funds explained.

Data Availability

Data sharing is 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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