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Enhancing Students' Physical Fitness Through Optimized Training based on Genetic Algorithm

Abstract: - With good physical fitness, people can put more energy into their daily life, study and work. Enhancing people's physical fitness is an important foundation in the modernization of our country's socialism. The physical fitness of students has always been the primary concern of colleges and universities. To improve the basic physical ability of students, students can get a significant improvement in their own physical level to ensure the successful completion of their academic career. The data collection terminal is installed around the campus road, the campus card is carried by the students, and the wireless module with small suction cup antenna is installed on the base station and each collection terminal to form a wireless communication between the base station and the collection terminal and between the collection terminal and the campus card. The base station is connected to the Web server through a wired network. In this paper, from the current realistic needs of students' preparation for physical education tests, the physical fitness training methods and means with more obvious effects in competitive training are introduced into physical education, the methods and means of physical fitness training are preferably selected, and the training load is reasonably arranged, and the experimental results prove that the optimized physical fitness training methods and means of genetic algorithm have novel equipment, practice methods The experimental results proved that the optimized genetic algorithm physical training method and means have novel equipment, diverse and interesting exercises, focus on developing coordination quality and mobilizing more muscle fibers and muscle groups to participate in sports, which can stimulate students' interest and emphasize the reasonable use of technical movements, and enhance students' physical fitness by controlling the training intensity and interval time.

Keywords: Machine learning; Internet of things; physical fitness training; genetic algorithm optimization

I . INTRODUCTION

The quality of life of Chinese residents has improved significantly, however, the physical fitness of Chinese school students has been declining, and terms such as myopia, obesity, depression, "Internet addiction" and "cell phone control" have been constantly appearing in Myopia, obesity, depression, "Internet addiction", "cell phone control" and other terms are constantly appearing in students. Our higher education institutions are responsible for the important task of training and exporting talents to the society, and the model secondary schools in various cities have a huge responsibility, so secondary education has become the focus of the country's attention. School physical education curriculum is not only an important part of secondary education, but also the foundation and guarantee of secondary education and even lifelong education [1]. "As the future and hope of the motherland, the physical fitness of young people [2]. Therefore, it is especially important to cultivate good physical exercise habits and improve their physical health for the current situation of students' physical health in China, which is an important issue facing secondary school physical education.

Especially the results of student tests in China over the years are very unpromising, and some physical fitness test indicators have shown a downward trend in recent years, this reality has caused the whole society and the country to pay high attention [3]. Modern physical training is a relatively new form of physical exercise and training that is widely used in competitive sports. Currently, all sports teams recognise and cherish modern physical training due to the numerous studies that demonstrate how learning modern physical training will enhance each athlete's physical function and development as well as their unique attribute. Training is important and should not be disregarded [4]. I had the opportunity to visit schools and speak with physical education teachers, and during our conversations, I discovered that many of them were ignorant of the current state of physical education, most physical education teachers have not studied modern physical training methods and means, let alone using them to teach. This is likely because modern physical training is a relatively new form of physical exercise. Given this, in order to enable physical education teachers to fully utilise certain methods and means of physical training, we must first explain to them the theoretical knowledge of contemporary physical training and demonstrate some basic and elementary methods of modern physical training. Today, the "Internet of Things" will become another new form of technology that will

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change the face of the world after the Internet, which will break the traditional way of fitness and become the symbol of the new "fitness" era [5].

This paper clarifies the connotation of urban community sports, including the concept, characteristics, and functions of urban community sports, explores the current situation of the development of community sports in Beijing, and examines the Internet of Things fitness system's organisational structure, the links it contains and their relationships, as well as a summary of the issues this process raises [6]. This will enable the public to understand the new fitness model of IoT fitness system, experience the benefits of this model, and support raising people's standard of living; as a result, it has significant application.

This paper focuses on the key technologies of the perception layer. The traditional method of predicting students' physical fitness test scores is for physical education teachers to give scores to students' individual measurement scores against the National Student Physical Fitness Standards, and add or subtract as appropriate according to students' usual performance, and get the comprehensive score of physical fitness test after weighting all scores together [7]. Since college students' physical performance is influenced by many factors, the calculation process of the comprehensive score is extremely complicated, which leads to the low efficiency of physical performance prediction. The overall calculation process is all manual, so the criteria for calculating comprehensive scores have not been strictly uniform over the years. It is difficult to observe whether a student's physical fitness has improved when comparing the measurements of the same student over the years. Using the model to predict the test scores can effectively reduce manual calculation, save a lot of time and unify the prediction standards of physical fitness test scores in previous years.

In summary, this study attempts to integrate machine learning and physical fitness training in the Internet of Things into physical education, and to improve students' physical fitness through preferred physical fitness training methods and approaches, thus improving their physical fitness test scores. This study can enrich the theoretical research system in physical education testing, provide reference for future physical education teaching reform, and explore an effective way to improve physical fitness, which can provide direction and theoretical support for secondary schools to prepare for physical education testing.

Ⅱ. RELATED WORKS

In order to fully replace the process of human learning, the literature [8] simulates human learning behaviours for computer analysis. It does this by continuously acquiring new knowledge and skills and rearranging them. as civilization keeps developing. The literature [9] demonstrates how practical problems can be effectively solved by selecting the best machine learning algorithm for the given data and model requirements. According to the literature [10], as people's awareness of their own health grows, human health has emerged as a major global concern, and the idea of staying fit and healthy through exercise is progressively gaining traction and acceptance among a growing number of people. In order to make people's lives and jobs more convenient, machine learning is also progressively being used in the fitness industry [11]. Compared with technologically advanced countries, China's research in the field of IoT is not lagging behind. Since 1999, China has started research on wireless sensor networks in theory and practical applications, and two joint EPC and IoT conferences and the first China International EPC and IoT High Level Forum were held in Beijing in 2003 and 2004 [12]. The literature [13] suggests that these three conferences opened a new era of IoT in China, where hot issues on related technologies, standard specifications, government policies and related laws were discussed and early theoretical results were formed. The State Council's 2006 publication of the National Medium- and Long-term Science and Technology Development Plan (2006-2020) noted that sensor networks were included in the new generation mobile wireless communication plan and elevated to the status of a critical research area [14].

The literature [15] argues that various local governments have introduced a large number of preferential policies to support the industry, and have rapidly launched the construction of pilot projects for the IoT industry. In the context of national efforts to promote industrial informatization, IoT is a very realistic breakthrough [16]. Physical fitness, physical training, and methods and means are the prerequisite concepts for the conduct of this study, and it is necessary to define these three core concepts throughout the study before it begins [17]. The definition of the basic categories of the concepts will vary depending on the discipline and research perspective, and it is these differences in definition that may have an impact on the depth of the study and necessitate a redefinition of these concepts [18]. The central idea of this research is physical fitness, but there isn't a single, accepted definition of this term, and various academics

and experts have defined it in different ways. This completely demonstrates the complexity of the term "physical fitness." The literature [19–21] makes the case that physical fitness training is actually exercise done to increase an organism's level of physical fitness, and scholars both domestically and internationally have differing interpretations of what physical fitness training actually entails.

As per scholarly research [22], "Physical training is a training approach that integrates the athlete's real-world circumstances and unique requirements, employing scientific load to encourage movement exercises that enhance body form," the overall improvement of physical attributes, bodily functions, and sports performance. Its primary goal is to enable athletes' organs and physiological systems to function as intended through movement exercises with a suitable load,and the physiological performance of the athlete's organs and systems through the application of a suitable load to progressively induce adaptive modifications and enhance the body's capacity to adjust to the demands of sports." literature [23] holds that the ultimate goal of physical training, as the name suggests, is the development of human physical training, which aims to improve physical condition, create the ideal physical training programme by improving physical fitness and the body's ability to adapt to the demands of sports. The literature [24] describes physical training from the viewpoint of popular sports, emphasising that "physical training is a systematic, fixed form, safe, effective, and targeted physical exercises." According to the literature [25], there are clear parallels and notable differences between the definitions of physical training in popular sports and competitive sports. Physical training is essentially a collection of physical training tools, while the differences are in the goals of the two types of training.

In summary, this study combines machine learning with the definition of physical training in the Internet of Things, and defines the concept of physical training as an exercise process that uses various effective means and methods to exert a positive influence on the body through reasonable load stimulation to enhance physical health, improve physical form, improve physical function and develop specific sports ability. Among them, the development of special sports ability is the main content of physical training, and the development of sports quality as the main way to achieve the purpose of promoting physical health, improving physical form and improving physical function.

III. GENETIC ALGORITHM OPTIMIZATION

First, a random initial population is created. Next, the population's individual fitness F is determined. Then, the good individuals X and Y are chosen based on F. Finally, X and Y are crossed and mutated. Lastly, it is determined if they match the termination condition; if they do, the process is complete; if not, the second step is carried out. Figure 1 displays the particular implementation process diagram.
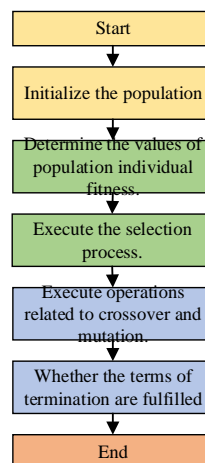

Figure 1 Flowchart of genetic algorithm optimization of sports physical training target system

A set of ordinary convolution with a convolution kernel of K is shown in Figure 2.
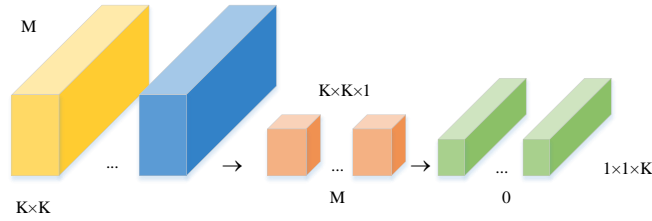
Figure 2 Depth-separable convolution for physical training

Computational and parametric quantities of depth-separable convolution versus normal convolution.

$$\frac{\text{Cost}_{\text{Depth separable}}}{\text{Cost}_{\text{Standard}}} = \frac{S_k \times S_k \times C_i \times S_i \times S_i + S_i \times S_i \times C_i \times C_o}{S_k \times S_k \times C_i \times S_i \times S_i \times C_o} = \frac{1}{C_o} + \frac{1}{S_k^2} \quad (1)$$

$$\frac{\text{Num}_{\text{Depth separable}}}{\text{Num}_{\text{Standard}}} = \frac{S_k \times S_k \times C_i + C_i \times C_o}{S_k \times S_k \times C_i \times C_o} = \frac{1}{C_o} + \frac{1}{S_k^2} \quad (2)$$

These two bottleneck structures are formed by stacking two Ghost Bottle Nets, as shown in Figure 3.
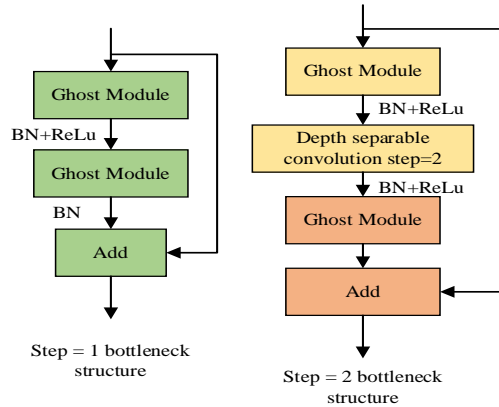

Figure 3 Optimization of the Ghost Net bottleneck module for the physical fitness training target system

IV. METHODS

Physical fitness training is actually training for the development of the body's physical fitness level, and scholars have differing interpretations of what physical fitness training entails. Through the exercise of reasonable loads to stimulate the movement exercises, the main goal of the training process is to improve the body's adaptation to the demands of sports and help the athletes' organs and systems gradually adapt to morphological, functional, and physiological changes. Figure 4 displays the Ghost Module's structure.
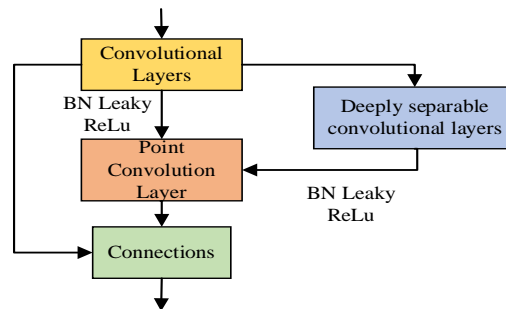

Figure 4 Optimization of Ghost Module structure for physical fitness training target system

The sum of the losses of the five stages is the total loss, the purpose is to purify the prediction results with multiple stages and to add intermediate supervision to prevent the gradient from disappearing. Loss is calculated as follows:

$$f_L^{t1,t2,+13,t4} = \sum_{c=1}^{c} \sum_p W(p) \cdot L_c^t(p) - L_c^*(p)_2^2 \ (3)$$

$$f_S^{t5} = \sum_{j=1}^{J} \sum_p W(p) \cdot S_j^t(p) - S_j^*(p)_2^2 \ (4)$$

$$\text{Loss} = f_L^t + f_S^t \ (5)$$

As the name suggests, physical fitness training focuses on improving a person's physical fitness. It is a methodical process of building physical fitness in a deliberate and intentional way with the ultimate goal of enhancing physical condition, enhancing one's own physical fitness and body's capacity to adjust to sports demands, creating the ideal physical fitness training plan and carrying it out methodically, and employing a variety of exercises in a reasonable and scientific manner. Figure 5 illustrates the steps involved in the data mining process, which is contingent upon the nature of the data and the business requirements. The process typically consists of a number of stages, including identification of the analysis target, pre-processing of the data, data mining, pattern evaluation, and knowledge expression.
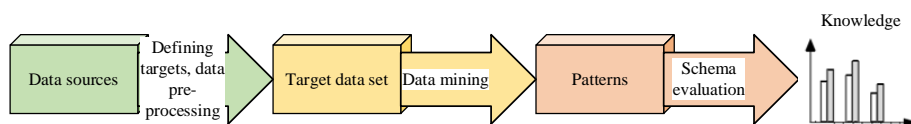

Figure 5 IoT sports physical training data mining process

Through observation, questioning and testing of physiological indexes of students in the pre-experimental process of physical fitness training, the training load of the preferred physical fitness training methods and means was appropriately adjusted by changing the intensity of the exercise content, changing the sequence and combination of exercises, changing the restrictions of exercises, changing the number of repetitions of exercises, etc. The training load that most students could bear was used as the training load of the preferred physical fitness training methods and means. After the above operation, the load arrangement of physical training methods and means was determined, as shown in Table 1.

Table 1 List of physical fitness training load arrangement in the experimental class teaching

Exercise content	Exercise requirements	Exercise intensity
Obstacle jumping exercises	5 jumps/group×8~10 groups	Medium
Standing long jump	10 times / group × 3 groups	High
Rope ladder jumping exercises	Continuous bipedal jumping rope ladder: 6 times × 2 groups	High
Abdominal wheel exercises	Continuous single-leg jumping rope ladder: 4 times each leg exchange × 2 groups	High
Resistance band exercises	20 times/group×3 groups+	Medium
Small fence running exercises	In-situ leg swing exercises: 15 times each leg / exchange × 3 sets	High
Variable speed line running	In-situ lunge resistance exercise: 15 times per leg / exchange × 3 sets	High
Small bar frame running practice	3Om bar frame run/5 times×3 groups (bar spacing 1.8~2m)	Medium
Variable speed folding line running	6 round trips (16m) × 3 groups (3 minutes rest between groups)	Low-Medium-High

Explanatory demonstration method, complete exercise method and decomposition exercise method, which are often used in traditional physical education, are also the three most commonly used methods in physical fitness training

experiments. Through these training methods can help students further understand the main points, purpose and significance of the preferred physical training methods and means, scientific and standardized action demonstration can not only help students understand the key points of the correct physical training methods and means, and can enhance the students' learning enthusiasm and initiative. The lecture should grasp the key points, and strive to be concise, with the most concise language to help students understand the main points and techniques of physical training methods; questions should be carefully designed in advance, the difficulty of the questions should be appropriate, not too high and not too low, and to have the meaning and value of the discussion. The system is shown in Figure 6, which incorporates the key point information of human skeleton, locates and classifies the video action sequences, finally extracts the action key frames, conducts action comparison analysis, gets the evaluation results and displays them in the system interface.
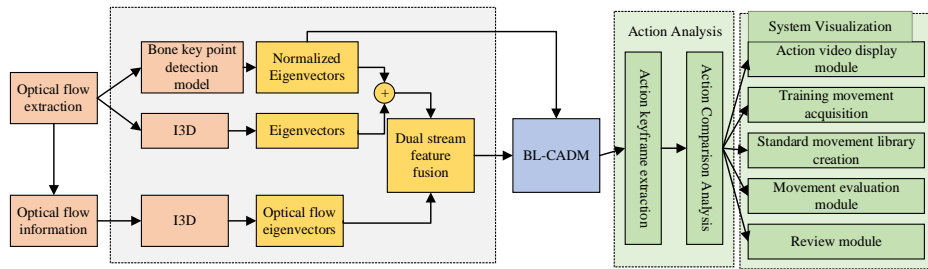

Figure 6 Optimization of processing process of physical training evaluation system

Behavioral performance, and give timely evaluation and targeted improvement suggestions to help students grasp their actual situation. Teachers should fully respect students' individual differences, give them targeted guidance according to their actual situations, and give them appropriate encouragement to improve their self-confidence and make them enthusiastic about training, allowing the global evaluation module to make predictions using multiple resolution feature maps, as in Figure 7.
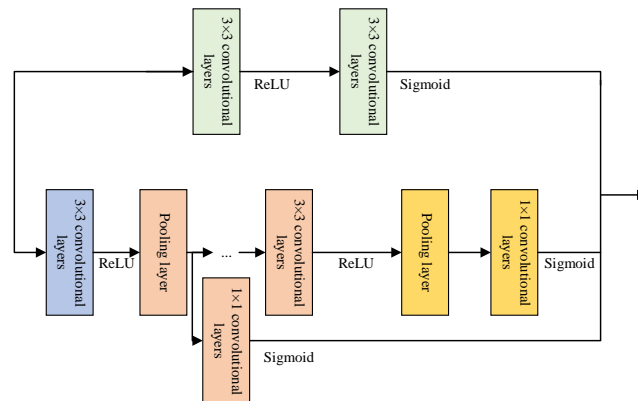

Figure 7 Optimization of the structure of the module for the nomination of temporal movements for physical education training

Safety is a big issue in physical education classes. In order to ensure absolute safety in students' physical training, schools as well as teachers should cooperate with parents to grasp the health condition of each student in detail, and for those students who cannot participate in physical exercise due to physical reasons, they can be arranged to participate in some physical exercise with small amount of exercise that is not harmful to their health. During the period when this experiment is conducted, the school as well as relevant personnel should do a good job of daily attendance of students and strict classroom discipline. During the physical training, the intensity of the exercises should be appropriate and the pulse index of the students should be tested regularly. Before training, safety education is provided to students and strict testing of field equipment, is carried out in an effort to create a safe and secure environment for students' physical activities. The operation process is shown in Figure 8.
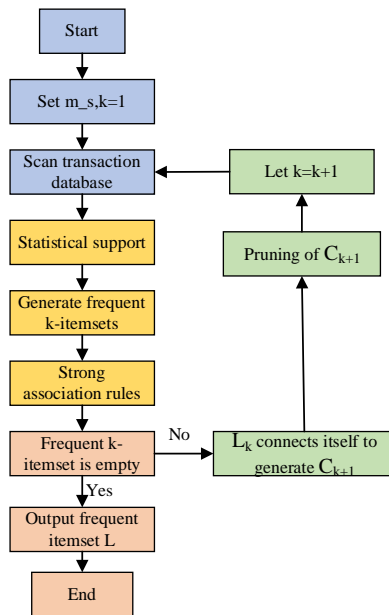
Figure 8 Optimization of the process of mining the frequent item set of physical fitness training by genetic algorithm

In order to rapidly ascertain the relationship between physical fitness indicators and the major factors influencing physical fitness, this section concentrates on the physical fitness test scenario of college students and builds an association rule optimisation model based on the enhanced genetic algorithm, as illustrated in Figure 9. First, taking physical test data out of a school and preprocessing it to create a format that can be processed with an association rule algorithm; second, utilising hash and transaction-based compression.The enhanced genetic O algorithm mines the correlation of sports data to extract meaningful association rules, which are then filtered out based on the support-confidence framework to predict the physical fitness indicators that influence students' physical fitness and their significance as well as to evaluate their general state of physical health.
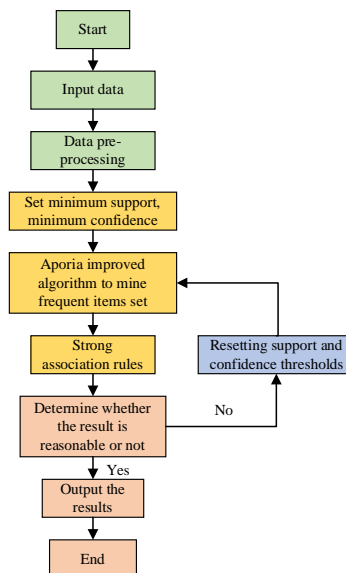

Figure 9 The process of constructing an efficiency optimization model of physical training association rules based on improved genetic algorithm

In this experimental work demonstration and explanation method is the most direct method throughout the experiment, demonstration and explanation of the purpose of physical training and action essentials, demonstration of action is the most direct way of teaching this experiment, correct and beautiful action demonstration so that students in the first time to establish the concept of correct action, so that students are interested in willing to learn the enthusiasm [26,27]. Explanation is the basic skill of physical education teachers, with the demonstration of

movements and exercise requirements, explanation should be concise, highlight the key points, using the simplest words so that students can understand. This section focuses on the structure of the physical fitness training assessment system, as shown in Figure 10.
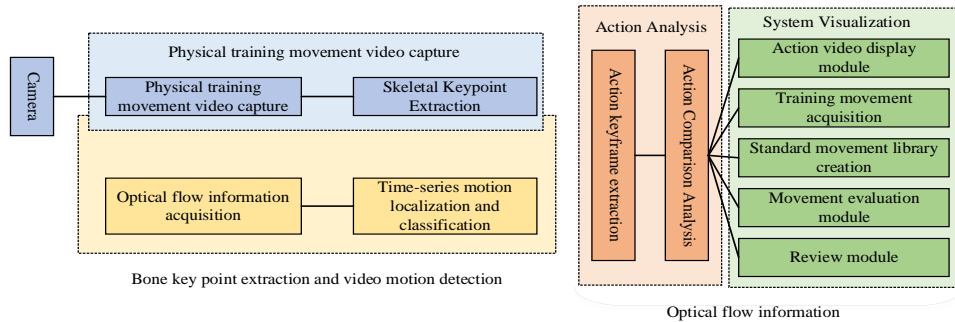

Figure 10 Structure diagram of physical training assessment system

It is critical to recognise the unique characteristics of each student, and the assessment process should be focused and supportive, so that students can understand and teachers know the progress of students, giving them confidence, making them feel valued and trusted, and improving their self-confidence. The evaluation scale should be fair, based on the students' sports test results, combined with the corresponding evaluation indicators for a comprehensive evaluation, so that each student can feel the progress and successful experience gained through their efforts. Teachers should fully motivate and guide students to evaluate themselves and each other to improve their participation, and teachers can also understand students' mastery of physical education knowledge and skills from their self- and mutual evaluations. The physical education course data is first organised into chromosomes using a real number coding system. Next, the initial population is considered, the individual fitness F is calculated, the best parent individuals are chosen, the chaotic crossover and chaotic mutation operations are carried out, and lastly the end conditions are assessed. In Figure 11, the implementation process is displayed.
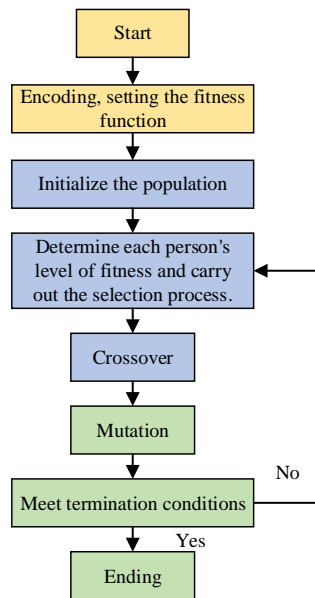

Figure 11 Diagram illustrating the chaotic genetic algorithm optimisation process for training in physical fitness

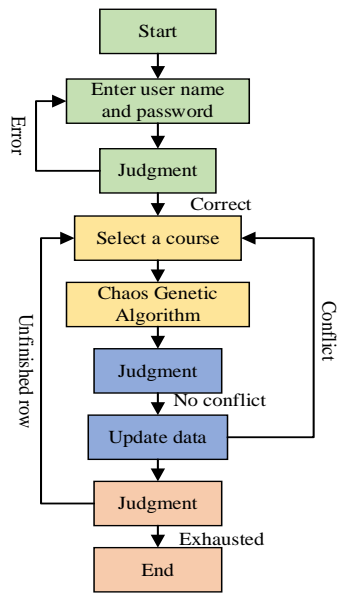The flowchart of the course scheduling module is shown in Figure 12.

Figure 12 Flowchart of physical fitness training curriculum layout module

In summary, the selection of training methods and means in physical fitness training can stimulate students' interest and increase their enthusiasm in training, while emphasizing the reasonable use of technical movements and enhancing students' strength, speed, flexibility, agility and coordination by controlling the training intensity and interval time, so as to improve physical fitness and sports test scores.

V. CASE STUDY

The means of strengthening physical training put more emphasis on the rational use of technical movements; and strictly controlling the intensity of exercise and the interval between groups. Enhance students' strength, endurance, speed and other qualities, and improve sports performance. Figure 13 illustrates the process of genetic algorithm optimization.
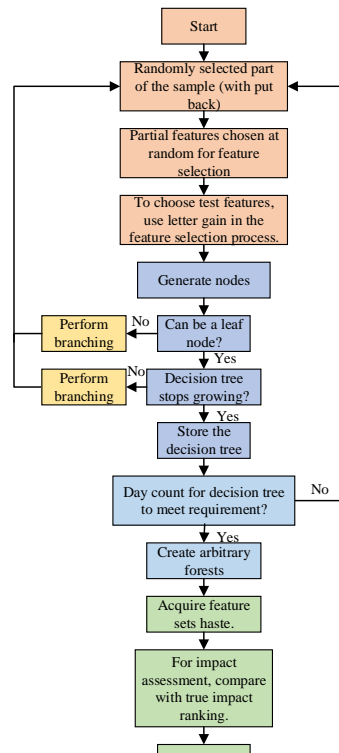

Figure 13 Optimization diagram of genetic algorithm for physical fitness training

Two scheduling schemes based on genetic algorithms and chaotic genetic algorithms were employed in accordance with the scheduling requirements. A test programme was then created for testing in accordance with the algorithmic concepts discussed in Chapters 2 and 3. The test outcomes are displayed in Figures 14 and 15.
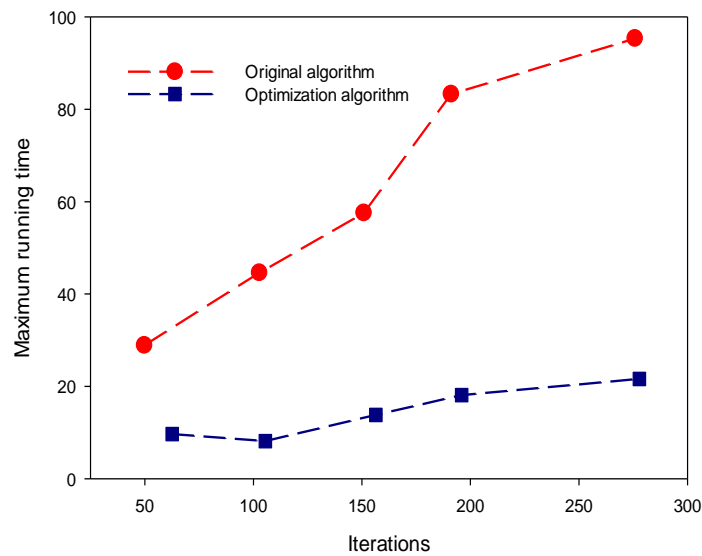

Figure 14 Number of iterations and maximum computing time for physical fitness training in sports
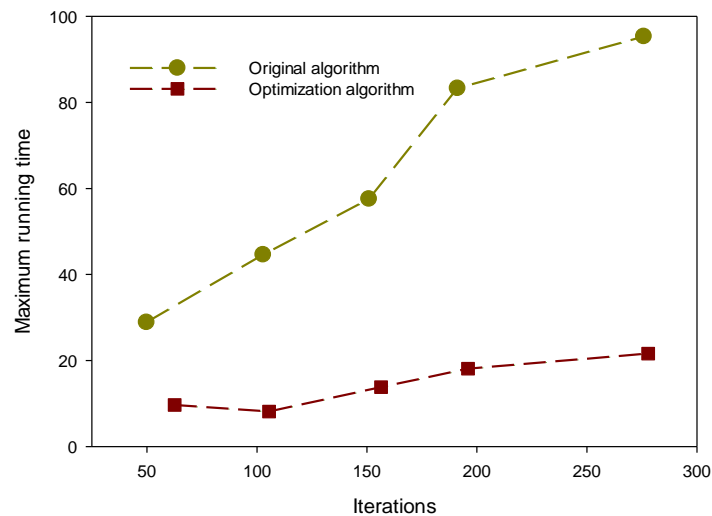

Figure 15 The quantity of repetitions and the minimal duration of operation for sports physical training

Over the decades, there have been many different approaches to machine learning, and different classifications can be made with different emphasis on the side. For example, we take a test when the standard answer already exists, and we give an answer of our own based on our own judgment, whether it matches the standard answer is our prediction of accuracy or not. The chaotic genetic algorithm performs better than the genetic algorithm, as demonstrated in Figure 16, reaching equilibrium at 150 compared to the genetic algorithm's 200, with the chaotic genetic algorithm having a higher fitness value and a faster rate of convergence.
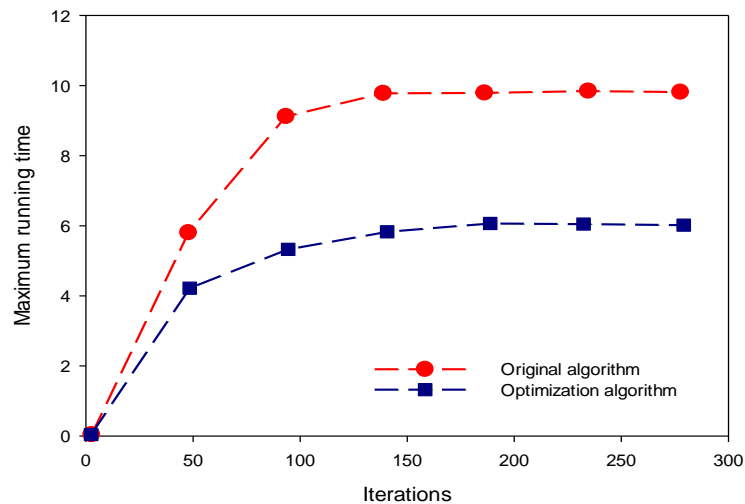
Figure 16 The adaptation function and number of iterations of physical fitness training

At the end of the 3-month teaching experiment, the control classes were tested on physical education test items using the same test contents and according to the same test procedures and test standards, as shown in Table 2.

Table 2 Results of male students' physical education exams in the experimental and control groups following the experiment are compared

	Trial session	Class Control	T	P
1000 Run(s)	255.12 $\pm$ 27.60	254.21 $\pm$ 25.45	-1.162	0.250
Standing long jump (cm)	207.50 $\pm$ 9.19	195.33 $\pm$ 2.66	0.643	0.022*
1 minute jump rope (times)	113.55 $\pm$ 13.23	93.36 $\pm$ 9.88	-2.908	0.005**
Solid ball throwing(m)	7.45 $\pm$ 0.55	6.28 $\pm$ 0.55	0.516	0.008**
Sitting forward bend(cm)	10.55 $\pm$ 0.82	8.80 $\pm$ 0.47	5.678	0.000**
Sit-ups (times/min)	41.37 $\pm$ 3.99	29.55 $\pm$ 4.10	0.168	0.025*

It can be seen that traditional physical education long-distance running, middle-distance running training and variable speed folding running in physical training have good effects on improving students' endurance quality, but variable speed folding running has more obvious effects on improving secondary school girls' endurance quality. This study adopts variable speed folding running to develop students' endurance quality, from small intensity to medium intensity and then to large intensity training, strictly controlling the interval between groups and using the interval between groups to practice technical movements to help students recover quickly, this physical training method is more reasonable than the previous medium and long distance running training in terms of load control, especially for secondary school girls can significantly improve their endurance quality. Boys' one-minute jump rope test scores differ significantly from one another, as Table 3 illustrates.

Table 3 Comparison of the experimental and control classes' one-minute jump rope test results following the experiment

	Trial session	Class Control	T	P
Male	113.55 $\pm$ 13.21	93.36 $\pm$ 9.88	-2.908	0.005**
Female	119.45 $\pm$ 13.59	95.58 $\pm$ 11.77	-3.911	0.000**

As shown in Table 4, indicating that traditional physical education was not significant in developing students' waist and abdominal strength quality, while physical training had a more significant effect on students' waist and abdominal quality.

Table 4 Comparison of the experimental and control classes' pre- and post-experiment sit-up test results

	Trial session	Class Control	T	P
Male in the experimental class	26.12 ± 3.24	41.37 ± 3.99	-3.579	0.000**
Male students in the control class	25.99 ± 3.48	29.55 ± 4.10	1.358	0.588
Female in the experimental class	19.22 ± 4.11	35.48 ± 4.69	1.698	0.000
Female students in the control class	19.35 ± 4.05	23.39 ± 4.15	1.699	0.782**

It is very complicated to calculate the comprehensive score of physical fitness test in colleges and universities, and because of the complicated process of the traditional calculation method with too much human involvement, the scoring standard is not uniform in the past years.

In this paper, we use R language combined to establish a prediction model for physical fitness test to calculate the overall score, which can improve the prediction efficiency on the one hand, and remove the human influence factors on the other hand, and keep the unified scoring standard every year, so that we can understand the change of students' physical fitness more clearly. After the unified scoring standard, the comprehensive score will be used as a standard to measure a student's physical fitness and record the changes of students' physical fitness during the school years, thus helping teachers to change and optimize their teaching programs at any time. Although the IoT fitness system has unique advantages as a new type of fitness system, there are still many problems to be solved as it is still in the initial stage of application. It is connected to the wireless network through the electronic tags (, sensors, two-dimensional codes, installed on the kinds of objects through the interface. IoT fitness system as the application research of IoT within the field of national fitness, it is inevitably subject to the constraints of the relevant IoT-related technologies.

The methods and means of physical fitness training should be selected with the fundamental purpose of promoting the overall development of students' physical fitness, taking into account the current practical conditions of physical education and the special "sensitive periods" for the development of different physical fitness. The priority of physical training methods and means for students should be to develop students' flexibility and agility, followed by speed, balance and endurance, and strength at the end.

VI. CONCLUSION

According to the application and reflection of the school for more than one year, the long-distance running performance of students' physical fitness test has improved significantly and achieved a good application effect. The training means in the current physical education test teaching focus on developing students' strength quality and endurance quality, and the training means are mainly frog jump, push-up, sit-up, squat and endurance running, etc. The practice intensity is mainly in the middle and high load intensity, and the lack of training for the sensitivity quality, flexibility quality, waist and abdominal endurance and whole body coordination force, etc. The training effect is poor. And can promote students' physical fitness training in the preferred training methods and means to improve physical education test scores is more significant, and its effect on the improvement of physical education test scores. The physical fitness training methods and means selected in this study have the characteristics of novel equipment, various and interesting exercise methods and means, and focus on developing coordination quality and mobilizing more muscle fibers and muscle groups to participate in exercise, which can stimulate students' interest and increase their enthusiasm to participate in training, while emphasizing the reasonable use of technical movements and enhancing students' physical fitness by controlling the intensity and interval time of training. The selection of physical fitness training methods and means is a novel subject, and there are still many problems to be explored, especially how to control the training load of different training methods, which still needs further research in future studies, to further improve the effect of physical fitness training by enriching physical fitness training methods and improving the rationality of training load.

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