

Research on Physical Fitness Grading Model of Swimming Training Based on Real-Time Cloud Computing

Liqun Su^{1*}, Li Yang²

¹Zhuhai College of Jilin Llniversity, Zhuhai, China

²Landis+Gyr Meters & Systems (Zhuhai) Co.Ltd, Zhuhai, China

E-mail:level.83@163.com

Abstract—When the traditional physical fitness grading model was used to classify the swimming training physical fitness, there was a case where the classification accuracy was low and the stability was poor. Aiming at the above problems, a fitness training grading model based on real-time cloud computing was proposed. First, cloud computing was used to select the grading indicators constructed by the model and assign values to their weights, and then a comment set was created. At the same time, according to each index, the weight scale value was used to determine the rating scale of the index, and on this basis, the membership degree matrix was constructed to realize the fuzzy comprehensive evaluation of the physical fitness, and finally the rating level was determined according to the comment scale. The results showed that compared with the traditional physical fitness classification model, the classification accuracy was improved by 20%, and the accuracy of the model did not decrease with the increase of the number of classifications, and the stability was better.

Keywords—cloud computing, swimming training physical fitness, physical fitness grading, hierarchical model

I. INTRODUCTION

Swimming is an old and modern sport. According to historical records, China has carried out related swimming activities in the spring and autumn period, and the swimming project has become an important competition for the first Olympic Games. After more than 100 years of development, modern swimming has become one of the most entertaining sports. The characteristics of the swimming project not only require the athlete's technical exquisiteness, but also put forward higher requirements for the athlete's physical fitness. Swimming technology is the key to athletes' good performance and physical fitness is the basis for athletes to use their skills and tactics reasonably in competitions. It is the fundamental guarantee for completing technical and tactical cooperation and fully exerting the level of competition [1-2]. A fuzzy mathematics method was used to establish a fitness training grading model based on real-time cloud computing. The model construction is mainly divided into five steps: selecting the grading index, calculating the index weight, establishing the comment set, constructing the membership function and fuzzy comprehensive evaluation. Finally, in order to verify the accuracy of the model, a comparative experiment was carried out. The results show that compared with the traditional grading model, the grading accuracy of the model is improved by 20%, and the accuracy does not decrease greatly with the increase of the required quantity,

and the accuracy is better.

II. SWIMMING TRAINING PHYSICAL FITNESS CLASSIFICATION MODEL UNDER REAL-TIME CLOUD COMPUTING

For swimming training, scientific and reasonable training methods can improve the shape of the human body, transfer the material energy of the human body, and exert the potential ability of the human body. In sports, swimming is different from walking and running, and floating is the most prominent feature of swimming. When swimming, you must overcome the resistance of the water surface by consuming your own energy. The size of the resistance is related to the swimmer's body, speed, and water quality. Due to the floating force, the energy required for swimming is much greater than the energy consumption for running. During swimming, the aerobic metabolism is very obvious. If the distance is shorter, the greater the proportion of anaerobic metabolism in the human body. In addition, the athlete's physical fitness is related to factors such as body organ level, body structure, reserve psychology, external environment, and consciousness quality. Therefore, for swimmers, physical fitness is mainly a comprehensive manifestation of metabolic status, skill level and physical structure [3].

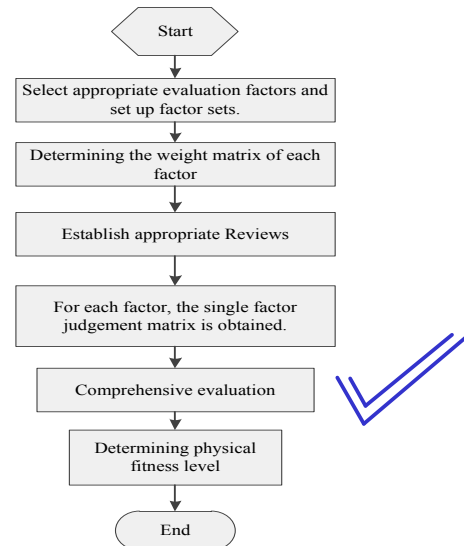


Fig.1 Model building process

Grading is the most common method of research that simplifies data and reveals the development of phenomena expressed by data. A swimming training physical fitness grading model based on real-time cloud computing is now established to classify swimmers' physical fitness. The model establishment process is shown in Fig.1.

A. Cloud Computing Selection of Physical Fitness Grading Indicators

The purpose of the comprehensive indicators is to establish a system motion analysis model to comprehensively assess and monitor the overall quality of athletes. The method of obtaining a systematic analysis of the sports entry should follow the following four simple steps: analyzing the needs of the sports entry, understanding the position of the sports and important events, analyzing the quality of the athletes, and understanding the common injuries in sports [4]. The establishment of this comprehensive model can guide each event in the sports training program and enable athletes to have the ability to engage in various sports.

After having a basic understanding of how the body produces the specific needs of sports with different motor functions, it is necessary to understand the physical fitness requirements of a particular sport. Test indicators are needed to evaluate the strengths and weaknesses of athletes in terms of speed, power, strength, flexibility and so on. Through such a process, specific sports, individual athletes, and personalized analysis can be realized.

For each sports program, the selection of physical fitness evaluation indicators should follow the following principles: the practicality and reliability of the evaluation indicators; the evaluation indicators should have the characteristics of the project, that is, they should be representative; Test indicators and test procedures should be continuous; test indicators should be more operable to ensure the validity of the data. For swimming, we must rely on the principle of selection of test indicators, according to the characteristics of its projects and the status quo of amateur training. The physical fitness grading indicators are screened by real-time cloud computing methods, and the grading indicators are tested for reliability and validity, and the grading indicators are finally determined [5].

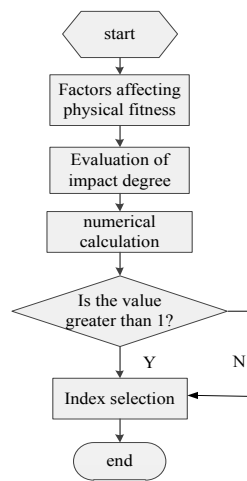


Fig.2 Real-time cloud computing grading index filtering process

The hierarchical index filtering process using real-time cloud computing is shown in Fig.2.

For physical grading, we divided them into three categories: morphological indicators, functional indicators and physical fitness. The test method of shape index and physical fitness index is relatively simple, and the requirement for equipment is relatively low, so the form index can be used flexibly according to the needs of coaches. As to the requirement of function index and the requirement of instrument, and the actual situation of amateur training, several routine indexes are chosen as function evaluation. The selection and classification of indicators are shown in Fig.3 below.

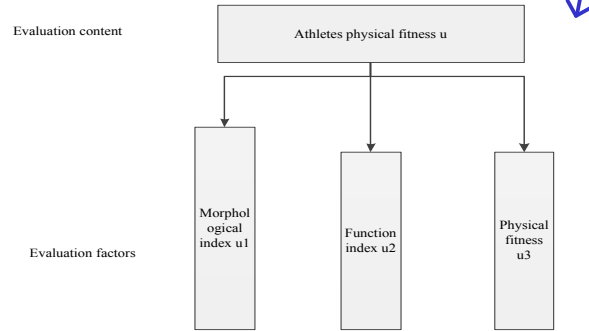


Fig.3 Selection and classification of indicators

The process of screening the grading indicators using real-time cloud computing methods is as follows:

```

<div id="m_logDiv" class="logPanel"
style="display:none"></div>
<div class="topshop">
  <div class="mainpart">
    <div class="tabs2">
      <ul class="tab">
        <li id="skins1" onclick="setTab('skins',1,2)"
class="current"> </li>
        <li id="skins2" onclick="setTab('skins',2,2)">
<div class="tabcont">
          <div id="skin_panel_1" class="skin-panel">
            <div id="con_skins_1">
              <ul class="skin-list" id="skin-list-img">
<div id="skin_panel_2" class="skin-panel">
              <div id="con_skins_2" class="hide">
                <ul class="skin-list" id="skin-list-color">
                  <div class="skinpaging">
<a href="javascript:void(0)" class="prevskin"></a>
<a href="javascript:void(0)" class="nextskin"></a>
              </div>
            <!--end tabcont-->
          </div>
        <!--end tabs2-->
      </ul>
    </div>
  </div>
</div>

```

For physical fitness grading indicators, we divide them into three categories: morphological indicators, functional indicators and physical fitness. The test methods of morphological indicators and physical fitness indicators are relatively simple, and the requirements for equipment are relatively low, so the morphological indicators can be flexibly applied according to the needs of the coaches. For the performance requirements of the performance indicators and the requirements of the instrument and the actual situation of amateur training, several conventional

indicators are selected as the functional evaluation. The selection and classification of indicators are shown in Table I below.

TABLE I TARGET SELECTION AND CLASSIFICATION

Evaluation content	Evaluation factors
Athletes physical fitness u	Morphological index u1
	Function index u2
	Physical fitness u3

Indicator factor set:

$$U = \{u_1, u_2, u_3\} \quad (1)$$

B. Cloud Computing Determines the Weight of Each Grading Indicator

Unlike traditional hierarchical models that use subjective judgments to determine weights, cloud computing uses a simple method to quantify such subjective judgments. The basis of this method is the comparison value of the relative importance of the target. The basic steps are: establishing a hierarchical structure; The judgment matrix is constructed by using the scale scale method of 1-9; the maximum eigenvalue of the judgment matrix and its corresponding normalized feature vector are solved. The components of the feature vector are the ranking weights of the factors of the same layer relative to the relative importance of a factor in the previous layer [6].

Establish a judgment matrix for the primary indicator and determine its weight.

Use cloud computing to build a judgment matrix.

$$\delta = (y_{ij})_{n \times n} = \begin{bmatrix} y_{11} & y_{12} & y_{13} \\ y_{21} & y_{22} & y_{23} \\ y_{31} & y_{32} & y_{33} \end{bmatrix} \quad (2)$$

In the formula, δ is the judgment matrix; y_{ij} is the ratio of the different importance degrees between the two events, and n is the evaluation index.

Weight calculation formula:

Judging that each row of indicators in the matrix is multiplied and opened n times:

$$w = \sqrt[n]{\prod_{i=1}^n y_{ij}} \quad (3)$$

Normalize the vector $w = (w_1, w_2, \dots, w_n)^T$ to get:

$$w_i = \frac{w}{\sum_{i=1}^n w}, i = 1, 2, 3, \dots, n \quad (4)$$

w_i is the weight value of each environmental performance evaluation indicator.

It can be seen that the set of index weights is:

Index weight:

$$W_n = \{w_1, w_2, w_3\} \quad (5)$$

Calculate the index weights by the above formula, and after a consistent test. When $CR < 0.10$, the matrix is considered to have passed the consistency test. Otherwise, the questionnaire should be fed back to the expert to reconstruct the judgment matrix until the consistency test is passed.

C. Create A Collection Of Reviews

Refer to the physical fitness test scoring standard, and determine the level range and the boundary value of each indicator of the athlete's physical fitness level (as shown in Table III and Table IV). Determine the set of judgment words as four levels of excellent, good, passing and failing, namely the comment set [7].

$$V = \{v_1, v_2, v_3, v_4\} = \{\text{Excellent, good, passing, failing}\} \quad (6)$$

TABLE II PHYSICAL FITNESS TEST LEVEL DIVISION

Grade	I	II	III	IV
Physical energy	excellent	good	pass	Fail

TABLE III PHYSICAL FITNESS TEST SCORES

Serial number	Grade	One-way score	Class limits indicate symbols.
1	excellent	90~100	c1
2	good	80~89	c2
3	pass	60~79	c3
4	fail	0~59	c4

D. Membership Function

According to the scoring standard of Table III, the membership function of physical fitness evaluation factor concentration morphological index u1, functional index u2, physical fitness u3 three grading index factors for physical fitness, good, good and failing is established.

The measured values are substituted into the membership functions of each grading index, and the membership degrees corresponding to the physical fitness of level 1, level 2, level 3 and level 4 are obtained, and the results of each individual indicator of the athletes are evaluated. The result is normalized, that is, the athlete's 3×3 single factor grading matrix R is obtained.

Normalized processing:

$$\bar{w}_i = \frac{w_i}{\sum_{i=1}^3 w_i} \quad (7)$$

Single factor ranking matrix R.

$$R = \begin{bmatrix} r_{11}, r_{12}, r_{13} \\ r_{21}, r_{22}, r_{23} \\ r_{31}, r_{32}, r_{33} \end{bmatrix} \quad (8)$$

E. Fuzzy Score

Fuzzy scoring of swimming training physical fitness

$$B = \delta \cdot R \quad (9)$$

Then, the score result is compared with the comment set, that is, the swimmer's physical training level is distinguished.

III. COMPARATIVE EXPERIMENT

An empirical analysis was carried out to verify the effectiveness of the model in environmental performance

assessment. Taking the physical fitness test data of swimming athletes in a sports academy as a sample, the test indicators were 9 items including height, weight, BMI index, vital capacity, pulse, blood pressure, 50m swimming, 100m, 200m swimming. According to the "Grading Standards", the test results are divided into four levels: excellent, good, pass, and fail. All data samples were screened by cloud computing, and data with incomplete test scores exceeding 3S were excluded, and training samples were randomly selected from the four levels of sample sets.

Assume that there are 10 swimmers waiting to be graded. The physical fitness classification of these 10 athletes is now carried out using the real-time cloud computing-based swimming training physical fitness classification model and the traditional physical fitness classification model. The classification results are shown in Table IV.

Grading accuracy (%) = correct rating number / total rating number

TABLE IV PHYSICAL FITNESS RESULTS WHEN THE NUMBER OF ATHLETES IS 10

Serial number	Physical level	Model of this paper	accuracy rate %	Traditional model	accuracy rate %
1	excellent	excellent	90 ✓	excellent	80 ✓
2	excellent	excellent		excellent	
3	excellent	good		good	
4	good	good		good	
5	good	good		good	
6	good	good		good	
7	good	good		pass	
8	pass	pass		pass	
9	pass	pass		pass	
10	fail	fail		fail	

It can be seen from Table IV that when using the new real-time cloud computing-based swimming training physical fitness grading model to classify 10 athletes, only one grade classification result is wrong, and the estimation accuracy is 90%. When using the traditional physical fitness classification model to classify 10 athletes, there are two kinds of classification results with errors, and the estimation accuracy is 80%. In comparison, the accuracy of the former is improved by 20%.

been greatly improved compared with the traditional model.

IV. CONCLUSIONS

In summary, physical fitness is a prerequisite for the development and performance of swimming athletics. Without a highly developed physical level, it is impossible to play superb skills and tactics in a fierce competition. Therefore, it is particularly important to strengthen the physical training of Chinese swimmers and improve the overall physical fitness of athletes. Physical training needs to be targeted. Athletes with different physical abilities should adopt different physical training programs. Based on this, it is important to grade the swimming training physical fitness. This study proposes a fitness training grading model based on real-time cloud computing. The model has been verified that the classification accuracy and stability have

REFERENCES

- [1] Zhao Wen. Research on Evaluating Indicator and Quantification Evaluation Model of Physical Ability Level of Outstanding Youth Women Basketball Team[J]. Journal of Guangzhou Sport University, 2016, 34 (4): 62-65.
- [2] Zhu Xueqiang. Classification and Analysis of the Model of Sports Colleges Physical Training[J]. Sports Science Research, 2015, 19 (6): 22-27.
- [3] Luo Zhi. Study on Physical Ability Model of Our Elite Weightlifters [J]. CHINA SPORT SCIENCE AND TECHNOLOGY, 2016, 42 (1): 130-134.
- [4] Li Zuai. Research on physical fitness models of elite weightlifters in China [J]. contemporary sports technology, 2017, 7 (6): 226-227.
- [5] Luo Lin, Cheng Hui, Liu Xudong, et al. A Multi-Granularity Stratification Method for the Elderly Physical Fitness[J]. Transactions of Beijing Institute of Technology, 2016, 36 (11): 1160-1165.
- [6] Wu Junying, Xinrui, Cao Xiufeng. Load Balancing and Efficient Scheduling Method for Diversity Resources in Cloud Computing Environment[J]. Bulletin of Science and Technology, 2017, 33 (12): 167-170.
- [7] Qin Hai. Establishment of Evaluating Model of Physical Fitness of the Athletes in Marine Skill Competitions and Its Application[J]. Journal of Zhejiang Institute of Communications, 2017, 18 (3): 36-39.