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Applications of Methods of Information Technologies in Engineering and Social Sciences

Li Dinghai ^{1,*}, Sheng Jiaqiao ²

* lidinghai@home.swjtu.edu.cn

¹ Southwest Jiaotong University, Chengdu, China

² Information Center for OPPEI Communication Technology Co.Ltd., Hong Kong

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It is well known that, the development and application of information technologies is a considerable driving force behind economic growth, citizen engagement and job creation etc., information technologies, in particular, are reshaping many aspects of the world's economies, governments and societies.

So we are pleased to release Vol. 2016, No. 18B of the RISTI - Revista Iberica de Sistemas e Tecnologias de Informacao, to report the current status of the application of information technologies as tools in engineering and social sciences, sharing the latest research findings from China with the readers of the journal.

In the past years, the Journal has grown significantly in terms of content quality. The academic impact of the publications has been improving remarkably. The present 30 extended papers in the journal, which are selected from the panel discussion on Hybrid Information Technology and Multi-media Tool held in May 2015 in Changchun China, are blind reviewed to ensure objectivity and scholarly content. We gratefully appreciate the authors for their scholarly contributions, referees for their highly objective and systemic comments within the short stipulated time and readers for supporting in terms of access and usage. We do hope that the new issue would serve the readers in terms of enhanced access.

Índice / Index

EDITORIAL

Applications of Methods of Information Technologies in Engineering and Social Sciences.....vii
Li Dinghaim, Sheng Jiaqiao

ARTIGOS / ARTICLES

Construction of Emergency Logistics System Based on Internet of Things 1
Zhao Lianming

Research on Artificial Intelligence Evaluation Model Based on BP Neural Network.... 11
Huang Fan, Lin Guoyong

Application of Multimedia System in the Training of Basketball Tactics 24
Wu Bing

Research on English Language Teaching Mode Based on Computer Network Education.....37
Guojun Han

Research on the Intelligent Teaching System of College Basketball Based on Artificial Intelligence 49
Li Tingting

Design and Practice of the Schedule Arrangement System of Track and Field Sports Competition Based on Artificial Intelligence61
Sun Yu

Research on Intelligent Control Strategy of Urban Parking Guidance System Based on Artificial Intelligence.....72
Ge Yinglong

Research on the Establishment of Intelligent Cognitive Student Model 84
Zhang Jing, Zhou Ning

The Construction of English Teachers’ Classroom Teaching Ability System Based on Artificial Intelligence..... 94
Yu Cuiye

A Study of English Intelligent Classroom Model Based on Artificial Intelligence and Emotion Judgment.....105
Wang Ning

Research on Digital Art Creation Based on Artificial Intelligence 116
Yu Yu

Research on Innovation Design of Chinese Paper Cutting Pattern Based on Evolutionary Algorithm.....	127
<i>Guo Chenyuan</i>	
Research on the Architecture of Sports Decision Making System Based on AI Technology Expert System	139
<i>Chen Jun</i>	
Research on the Application of Artificial Intelligence Computer Assisted Instruction System in College Physical Education	151
<i>Chen Ying</i>	
Research on Curriculum Inquiry Teaching Based on Artificial Intelligence	164
<i>Wang Fu, Ma Chao</i>	
Video Face Tracking and Recognition Method Based on Adaptive Feature Subspace	175
<i>Liu Zhi</i>	
Research and Analysis of Computer Aided of Table Tennis Training.....	190
<i>Li Shuaixu</i>	
Research on the Application of Computer Technology in the Center Community Construction of the Experimentation Area of the Two-oriented Society in Hunan Province	203
<i>Yi Chun, Yi Qingqing</i>	
Research on EOT Filter of Abnormal Transmission of Terahertz Sub Wavelength Hole	214
<i>Liu Xiang, Yang Dongxiao, Yu Chunyan</i>	
Research on Data Processing Technology in Table Tennis Match.....	226
<i>Li Peng</i>	
Application of GPS Based Intelligent Dispatching System in Public Transportation.....	237
<i>Luo Tian, Zhang Yunjiao, Zhao Jianyou</i>	
Application of Biological Chip Technology in Sports Field	249
<i>Shi Ming</i>	
Research on the Dynamic Simulation Model of the New-Energy Power System Based on Grey-Correlation Analysis	259
<i>Tao Yubo, Chen Hongkun, Wan Jie, Liu Xin</i>	
Research on the Design of Computer measurement and Evaluation System of Sports Competitive Psychology.....	270
<i>Hou Yingfeng</i>	
Multiphase-Interacting Equations and Their Solutions in Simulation of Coalbed Gas Migration	284
<i>Junguo Chen, Weiqun Liu, Qiang Li, Zhengfeng Yi, xiaoji Shang</i>	

Wireless Sensor Network Node Scheduling Algorithm Based on Energy
Saving Strategy297
Zhihu Wang

An Empirical Study on Spatial Heterogeneity of Manufacturing OFDI Reverse
Technology Spillover and Dynamic Threshold of Absorption Capacity 304
Shen Fei

Logistics Forecasting Method Based on A Hybrid Quantum Particle Swarm
Optimization and RBF Neural Network Model 317
Syed Abdul Rehman Khan CSCP, Zhang Yu

Qualitative Analysis of a Rumor Transmission Model with Multiple Transmission
Pathways 326
Chen Hua

Research on Damage Mechanics of Modified Soil Sub-grade in Cold Regions under
Coupling Effect of Freeze-Thaw Cycle and Load 339
Zhang Li-qun, Cui Hong-huan

Construction of Emergency Logistics System Based on Internet of Things

Zhao Lianming^{1,2}

849360877@qq.com

¹ School of Transportation and Logistics, Southwest Jiaotong University, 610031, Chengdu, Sichuan, China

² Department of Business Management, Chongqing Business Vocational College, 401331, Chongqing, China

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Abstract: Due to the disaster location in the mountains, the implementation of disaster relief work is relatively large, in the whole process of disaster relief, computer information technology can help the emergency logistics information system to play a greater role. Under such background, this paper mainly discusses how to construct the emergency logistics information system based on the Internet of things, and the overall evaluation of the information system. First of all, this paper summarizes the results of previous studies, analysis of the Internet of things technology and application properties of the logistics network, emergency logistics system analysis framework is proposed, according to the system requirement and the business flow, the function module of the emergency logistics system were divided, finally, through scientific and reasonable evaluation method and index selection, the information system were overall evaluation and gives the evaluation results. Evaluation results show that the Internet technology has important reference value for emergency logistics system and its guiding significance.

Keywords: Internet of things; emergency logistics; system network construction.

1. Introduction

Internet of things (of Things Internet (IOT), also known as of Things Web), is regarded as an extension of the application of the internet (Khan, T. H., Mohammed, S. K., Imtiaz, M. S., & Wahid, K. A., 2016). 2005, in the World Summit on the information society held in Tunisia, the International Telecommunications Union released the ITU Internet Report 2005: Internet of things, the official proposed the concept of Internet of things (Utkucu, M., Küyük, H. S., & Demir, İ. H., 2015). The Internet of things is the radio frequency identification (RFID), infrared sensors, global positioning system GPS, laser scanners and other information sensing equipment, according to the agreement, the anything connected with the Internet, information exchange and communication, in order to realize the intelligent recognition, positioning, tracking and monitoring and management of a network (MEMON, M., MAHOTO, N., KHUHAWAR, F., & TANAKA, J., 2015).

The emergency logistics information system based on the Internet of things is the development of emergency logistics information system on the basis of the existing Internet of things technology to meet the requirements of disaster relief (Nan, L.,

Chunlong, Z., Ziwen, C., Zenghong, M., Zhe, S., Ting, Y., ... & Junxiong, Z., 2015). Including emergency material demand statistics analysis, emergency procurement, warehousing, transportation, distribution, distribution and emergency logistics monitoring, scheduling optimization, optimization of different aspects of emergency logistics information real-time transmission, the information sharing and auxiliary decision-making, and optimize the scheduling etc (Jiangtao, Q., Honglei, J., Yang, L., Haibo, Y., Xinhui, L., Yubin, L., ... & Yongxi, Y., 2015). provided high emergency relief of the scientific level and efficiency, reduce the losses caused by disasters (Derafshi Beigvand, S., & Abdi, H., 2015). Emergency logistics operation must be in the shortest period of time, to ensure the emergency material demand; emergency relief logistics information can improve efficiency and standardize management (Shivhare, N., & Gupta, P., 2015). Build a complete emergency logistics information system model as a whole and should have the basic components and for each subsystem construction mode and function mode were investigate (Xiong Wei, Luo Fang et al.2009). Based on data warehouse technology, the emergency logistics information system can realize the sharing of government emergency management information, enhance the ability of emergency warning, and improve the efficiency of emergency decision-making and command (Jiang Changbing et al.2010). Put forward a kind of based on GIS of emergency material dispatching management information system, and the system overall structure, work flow and basic function module are analyzed, GIS is adopted to optimize path (Lotung et. 2011). This study discusses the application of the Internet of things in the logistics information system. It is believed that the construction of smart city will use all kinds of advanced technology in the era of Internet of things (Xing Zhiyi et.2012).

The remainder of this paper is organized as follows. Section 2 describes the Internet of things technology and emergency logistics network planning. Section 3 studies and designs the framework of emergency logistics system based on the Internet of things. Section 4 presents a real experiment to evaluate the performance of the emergency logistics network system. Conclusions are summarized in Section 5.

2. Analysis on the Technology of Internet of Things

2.1. Internet of Things Impact on Existing Business

The emergency logistics information system based on the Internet of things should be able to collect the information from the affected people and the disaster stricken areas in a timely manner, and to transfer the information to the emergency management department in time (Hemmatpour, M. H., Mohammadian, M., & Gharaveisi, A. A., 2016). In addition, it also relates to the management of departments, relevant units and relief supplies, equipment, equipment, and for the distribution of all relief goods, transport, allocation and supply (Astashev, M. G., Novikov, M. A., Panfilov, D. I., Rashitov, P. A., Remizevich, T. V., & Fedorova, M. I., 2015). Information system should be timely for the relief units, departments to provide information on the supply and demand of disaster relief supplies, to remind the management and business personnel in a timely manner, please collar, procurement, transportation, distribution of disaster relief items (Sutana, S. R., Krishan, P. B., Gouthami, K., & Kim, T. H., 2015). In a certain extent, the system should also be able to formulate emergency procurement plan, supplement disaster

relief supplies and transportation and distribution plan, and according to the needs of the emergency relief. Analysis emergency relief materials requirements planning and distribution of completion, to realize the control and supervision of planning for disaster response and relief goods transportation and distribution implementation (Goel, A., Agarwal, J., Mehta, S., & Kumar, K., 2015).

Should give full consideration to the impact of the existing networking technology of emergency logistics operation business, so as to be both better combined together (Abreu, A., Rocha, Á., Cota, M. P., & Carvalho, J. V., 2015), to play the maximum effect in the information system business process analysis stage, the specific effects is shown below.

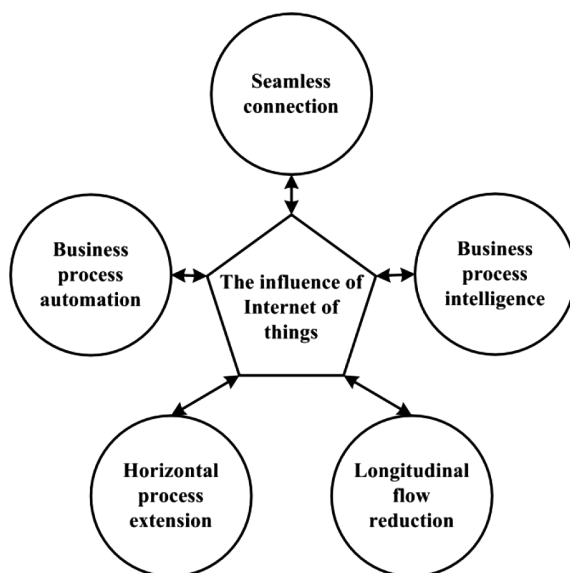


Figure 1 – The Influence of Internet of Things on Emergency Logistics System

By means of in network technology, the traditional emergency logistics business process is more automation, information and intelligent, and further optimize the structure of the business process, reduce unnecessary manual operation and simplify the steps of the logistics business process. Therefore, from the viewpoint of longitudinal emergency logistics, which can further reduce the relief time and improve the response speed of the relief; the business process of the longitudinal compression, for the time is the life of the emergency relief. This is very important improvements.

2.2. Characteristics of Emergency Logistics Network

Emergency logistics network has the characteristics of general logistics service network, openness and scale effect, and to properly solve the problem of public emergencies material support, also has the reverse, complex structure and high degree of participation, information guide and other characteristics of the operation (Allameh, S. M., Ghazinour, S., Aghaei, M., & Khodaei, S. A., 2015).

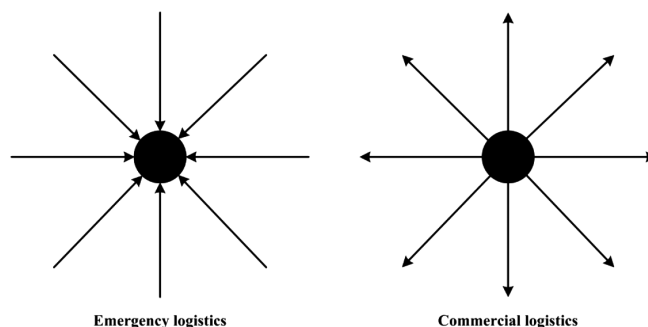


Figure 2 – Difference Between Emergency Logistics and Commercial Logistics

1. the operation of reverse. The operation mode of emergency logistics network is similar to the reverse logistics in a certain degree, and the material flows from the point to a fixed point. Business logistics structure and radial direction instead, network operation shows a gathering normalization form, as shown in figure 2.2.
2. structural complexity. Emergency logistics network to achieve the goal of the Rescue Decision of the complexity of its structure. Prompt rescue and relief and security requirements of the comprehensive makes the network node must reach a certain number; activities orderly, continuous and network have certain depth, reduce the cost and increase the path selection of difficulty.
3. high degree of participation. Commercial logistics demand in a longer period of linear growth, emergency supplies are often in a short period of explosive demand, there may continue to surge.
4. information lead. The information flow plays the role of guiding and integrating in the operation of emergency logistics network, through the construction of logistics information network, to realize the information transmission and communication between nodes, so as to ensure the orderly connection between entities.

3. Construction of Logistics System Based on Internet of Things

3.1. Emergency Logistics Process

Compared with general enterprise logistics activities, the biggest characteristic of emergency logistics is in the “urgent”, the emergency logistics emphasizes to time benefit maximization and the disaster loss is minimized. This is the basic starting point and foothold of emergency logistics. The principle of weak economy of emergency logistics will be considered as the goal of the whole emergency logistics activities (Tijani, O. M., Sanni, M., & Ishola, K. A., 2015). It can be said that emergency logistics activities must be efficient delivery of relief supplies, in order to meet the need of the lives of people in the disaster areas, disaster relief organizations at all levels, the unit’s mission and objectives, implementation of natural disasters and emergencies a fast to be, in the shortest possible time disaster on the desired materials and equipment sent to the site in the event of an emergency (Iwu, H. N., 2015). Under this premise can try to reduce the operation cost of the emergency logistics. In addition, because in the process of emergency logistics, there is little time for delivery and delivery time buffer, we must go all out to meet the

fastest speed of emergency needs, the disaster loss to minimize. Compared with general logistics system, emergency logistics system in the target system requirements, system units, the characteristics of system operation and system distribution and so on have greater difference, compared the similarities and differences such as table 1 shows.

Project	General logistics system	Emergency logistics system
<i>System target Requirements</i>	The loss is the smallest, the biggest benefit	Time, efficiency, life
<i>System use unit</i>	Supplier and manufacturer	Relief materials reserve procurement point
	Wholesalers, retailers	Material transfer point
	Customer	Disaster demand point
<i>System operation characteristics</i>	Daily	Temporary, urgency, sudden
<i>System Distribution mode</i>	Circuit type	One way

Table 1 – Comparison of General Logistics System and Emergency Logistics System

Due to the emergency logistics is different from the general logistics enterprise and the whole logistics process almost no time gap. Therefore, in order to of emergency logistics the whole operation process of system analysis, detailed design, for constructing an efficient emergency logistics information system to pave the way for the work. Only in this way can the natural disasters and unexpected events occur, the implementation of rapid emergency relief, not only to ensure the safety of people's lives and property, but also to minimize the logistics costs. According to one of the top of emergency logistics system characteristics analysis, logistics supply chain management thought and can be the emergency logistics activities of the entire process is divided as the following four aspects: affected the demand side data statistics, emergency logistics coordination command center, storage goods and materials purchasing and supply side, and emergency logistics distribution center; in each stage of emergency logistics, the relevant units and departments to realize the information real-time transfer and sharing, dynamic feedback disaster information, classification processing treatment of the purchase and collection of relief materials and funds, according to corresponding relief distribution to each affected locations (Raji, S., 2015).

3.2. Emergency Logistics System Function Module Division

The functional modules of the system are divided into three major aspects, which are the prevention, the first aid, and the management and maintenance of the system itself. In this paper, according to the function of the information system and the user of the system classification, the system is divided into the following 10 subsystems.

Based on GIS and satellite remote sensing technology, can be the first time to master the loss due to disasters caused by the roads and houses, combined with relevant departments prediction can be achieved from the overall grasp of the disaster caused by the loss of the degree and level, to facilitate the implementation of rescue plan as soon as possible. Rely on modern computer assistant decision technology, according to

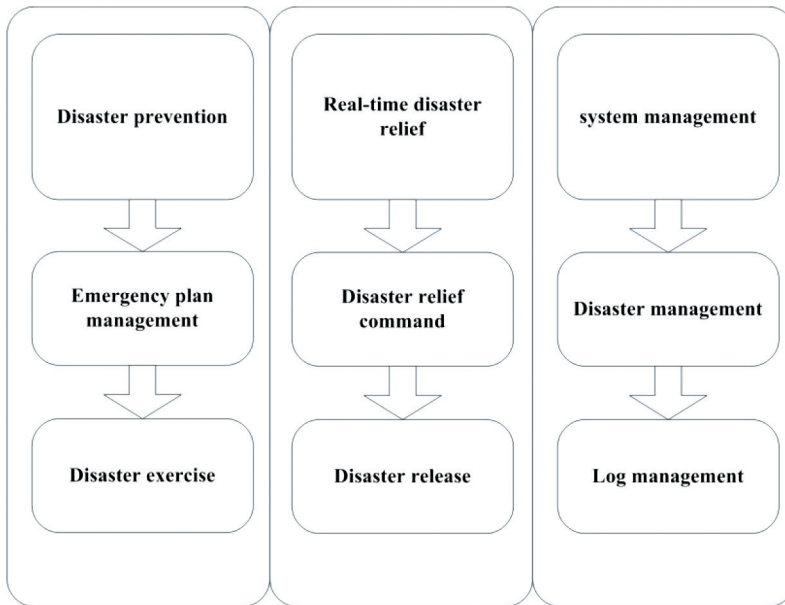


Figure 3 – System Function Module Division

the disaster information can make a rapid decision on disaster relief, easy to determine the relief plan and carry out command, deployment, the corresponding department can quickly implement the rescue to efficient disaster relief. Application of RFID and GSM / WLAN technology can realize high-speed wireless data acquisition and transmission, in goods warehousing, inventory and distribution process can be relief supplies to achieve full visual management, eliminating the need for traditional by hand counting method, can save precious rescue time. Fit with GPS, GIS function device can real-time control of vehicle location and the corresponding road conditions, the corresponding path optimization function, can in the shortest possible time, the relief supplies to the affected people in the hands of the transportation of relief supplies to the team. The issue of supervision subsystem is mainly to realize the supervision and payment of funds and materials. In the disaster, due to the order at the scene than usual some confusion, the emotion of the crowd excited, so in the use of materials and funds issued process, to achieve a fair and open to ensure everyone can timely brought disaster relief funds and materials. To realize the prevention and control of the combination of disaster relief, the implementation of effective prevention of disaster, and pay attention to the emergency plan, to achieve the scientific management of contingency plans. Mainly to achieve the overall management of disaster relief medical rescue and the sick and wounded, timely treatment, to protect life and diet safety of the people in the disaster areas. The main realization of the government, relief agencies and other command departments to carry out the situation of disaster relief, and the masses, relief personnel to make reasonable arrangements. After disaster, we should make a summary of the losses caused by disasters, disaster relief, a good way to sum up the shortcomings of the existing to be corrected, improved, and enhance the ability of the whole country's disaster relief. Mainly to solve the system's own maintenance, upgrade and the use of the

use of personnel rights, access to a record, database and other implementation tracking management. In addition, to improve the utilization of the information system itself, the system is divided into two kinds of state of “peacetime” and “disaster”.

4. System Implementation Evaluation Results Analysis

Due to the combination weighting method can make up for the subjective weighting method and the objective weighting method for their lack of, can more objectively and accurately evaluate a given object, has the very strong persuasive power, so in this paper by entropy method and GL method combining the combination weighting method to carry out the overall evaluation of the information system. To illustrate the application of this method, we choose X, Y and Z three emergency logistics information system for the comprehensive evaluation of the actual indicators, and the evaluation results are compared.

$$A_k = 1 / (1 + \sum_{k=2}^{k=n} \prod_{l=k}^n r_l) \quad (1)$$

$$M = (M_{ij})_{m \times n} \quad (2)$$

$$Q_{ij} = x_{ij} / \sum_{i=1}^m Q_{ij} \quad (3)$$

$$B_j = k * \sum_{i=1}^m Q_{ij} \ln Q_{ij} \quad (4)$$

$$X_j = 1 - B_j / \sum_{i=1}^m (1 - B_j) \quad (5)$$

$$F_j = A_j X_j / \sum_{j=1}^{j=n} A_j X_j \quad (6)$$

A_k -Subjective weight coefficient of evaluation index.

Q_{ij} -The index value of normalized quantization without processing.

B_j -entropy.

X_j -Objective weight.

F_j -Combined weight.

$$V_{ij} = (k_{ij} - \min k_{ij}) / (\max k_{ij} - \min k_{ij}) \quad (7)$$

$$V_{ij} = (\max k_{ij} - k_{ij}) / (\max k_{ij} - \min k_{ij}) \tag{8}$$

V_{ij} -Non dimensional treatment.

Two level index and number	Combined weight	X score	Y score	Z score
A1. User satisfaction	0.06	0.06	0.03	0.01
A2 System objective science	0.04	0.02	0.04	0.01
A3 Coverage of the Internet of things	0.05	0.05	0.03	0.01
A4 Emergency response speed	0.07	0.05	0.07	0.02
A5 Accuracy of Internet of things	0.06	0.02	0.06	0.03
A6 system stability	0.06	0.02	0.06	0.05
A7 Security and confidentiality	0.03	0.02	0.03	0.02
A8 Human computer interaction	0.03	0.01	0.03	0.02
A9 Expected social achievement	0.06	0.01	0.06	0.05
System total score		0.26	0.41	0.22

Table 2 – Initial Value of Evaluation Index

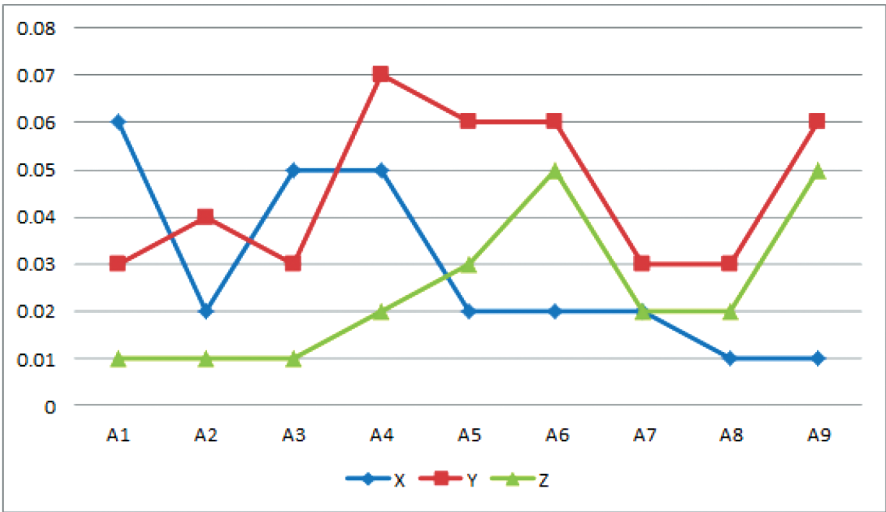


Figure 4 – Two Level Indicators Scoring Line Chart

In the system constructed on the basis of information system evaluation index, first of all through the expert scoring method gives the target the evaluation scores is of value evaluation index system in each of the secondary indices were scoring is the initial value assigned, x, y and Z corresponds to no dimension processing refers to the scalar value respectively and secondary indicators of the weight combination corresponds to multiplication, each information system evaluation index combined score, as shown in table 24. From the table can be found that the highest score of Y information system is 0.41, indicating that

the overall quality of Y information system, performance is relatively high, and the other two systems of quality, performance is poor. In based on the evaluation of emergency logistics information system of Internet of things, the experts on the information system of emergency logistics system goal of science, emergency response speed of the, the new data processing technique, the auxiliary support systems, and other aspects of comprehensive weight and score higher, these aspects of the system requirements is relatively high; of course, only such emergency logistics information system to meet the requirements in case of emergency relief, which also from the side illustrates the based on the selection of evaluation indicators and evaluation methods of emergency logistics information system of Internet of things has certain is scientific, representative and rationality.

5. Conclusions

The conclusion of this paper is that the main disaster prone is the special situation of the country. When the disaster occurs, emergency logistics information system of Internet of things based on can play a huge role, as supplies of food, water, medicines and tents and emergency query and transfer; quickly identify the disaster situation; the scheduling of emergency vehicles, to advance for optimum path planning etc., more emergency logistics work in the aftermath of the disaster, to development, to reduce disaster, disaster relief and post disaster reconstruction work to an important role in safeguarding. The on the basis of previous studies, first of all construction and development of emergency logistics in China are summarized, and analysis of the development trend of Internet of things, it is pointed out that the Internet of things can be well applied in emergency logistics information system and improve the scientific and efficiency of emergency relief. Of things of emergency logistics information system based on the construction and evaluation of, mainly from based on Internet network of emergency logistics information system planning, analysis, design, build, safeguard and evaluation aspects of information system were elaborated. It is concluded that the Internet technology has certain guiding significance to the construction of emergency logistics system.

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Research on Artificial Intelligence Evaluation Model Based on BP Neural Network

Huang Fan^{1,*}, Lin Guoyong¹

* gxhuangfan@126.com

¹ Department of Computer Science and Engineering, Xiangsihu College of Guangxi University for Nationalities, 53000, Nanning, Guangxi, China

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Abstract: This paper mainly studies the artificial intelligence evaluation model based on BP neural network. To determine the effectiveness of artificial intelligence evaluation model based on BP neural network for help individuals control their life. This article proposed and validated an original and automatic method based on artificial intelligence evaluation model based on BP neural network. The methods section of our paper describes how work was performed. A widely accepted benchmark for an adequate methods section is that another research familiar with the area of research in question should be able to duplicate the work based on the methods section of paper. We hope that this method would be successfully applied in the case of dealing with special things. First of all the traditional structure of BP network is studied. Then this paper improves the traditional BP learning algorithm, and designs an intelligent evaluation model of seismic potential. Finally, the model is tested. The accuracy rate of the BP network test model is 92%, and the evaluation results are in agreement with the standard values. It tends to make full use of neural network, which is great to individuals. BP neural network application in the field of artificial intelligence will become increasingly significant. And it would serve individuals in the future. We should analyze it carefully. And we must attach much importance to it.

Keywords: Artificial intelligence; BP neural; model; research.

1. Introduction

Artificial intelligence (AI) is the intelligence exhibited by machines or software. It is also the name of the academic field of study which studies how to create computers and computer software that are capable of intelligent behavior. Major AI researchers and textbooks define this field as “the study and design of intelligent agents”, which provides the version that is used in this article. Note that they use the term “computational intelligence” as a synonym for artificial intelligence.] in which an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. John McCarthy, who coined the term in 1955, defines it as “the science and engineering of making intelligent machines”. AI research is highly technical and specialized, and is deeply divided into subfields that often fail to communicate with each other. Some of the division is due to social and cultural factors: subfields have grown

up around particular institutions and the work of individual researchers. AI research is also divided by several technical issues. Some subfields focus on the solution of specific problems. Others focus on one of several possible approaches or on the use of a particular tool or towards the accomplishment of particular applications.

The central problems (or goals) of AI research include reasoning, knowledge, planning, learning, natural language processing (communication), perception and the ability to move and manipulate objects. General intelligence is still among the field's long-term goals. Currently popular approaches include statistical methods, computational intelligence and traditional symbolic AI. There are a large number of tools used in AI, including versions of search and mathematical optimization, logic, methods based on probability and economics, and many others. The AI field is interdisciplinary, in which a number of sciences and professions converge, including computer science, mathematics, psychology, linguistics, philosophy and neuroscience, as well as other specialized fields such as artificial psychology.

The field was founded on the claim that a central property of humans, human intelligence, the sapience of *Homo sapiens* can be so precisely described that a machine can be made to simulate it.” This raises philosophical issues about the nature of the mind and the ethics of creating artificial beings endowed with human-like intelligence, issues which have been addressed by myth, fiction and philosophy since antiquity. Artificial intelligence has been the subject of tremendous optimism (Wu, Q., & Peng, C., 2015) but has also suffered stunning setbacks. Today it has become an essential part of the technology industry, providing the heavy lifting for many of the most challenging problems in computer science (Abreu, A., Rocha, A., Cota, M. P., & Carvalho, J. V., 2015).

In machine learning and cognitive science, artificial neural networks (ANNs) are a family of models inspired by biological neural networks (the central nervous systems of animals, in particular the brain) and are used to estimate or approximate functions that can depend on a large number of inputs and are generally unknown. Artificial neural networks are generally presented as systems of interconnected “neurons” which exchange messages between each other. The connections have numeric weights that can be tuned based on experience, making neural nets adaptive to inputs and capable of learning.

For example, a neural network for handwriting recognition is defined by a set of input neurons which may be activated by the pixels of an input image. After being weighted and transformed by a function (determined by the network's designer), the activations of these neurons are then passed on to other neurons. This process is repeated until finally, an output neuron is activated. This determines which character was read.

Like other machine learning methods - systems that learn from data - neural networks have been used to solve a wide variety of tasks that are hard to solve using ordinary rule-based programming, including computer vision and speech recognition.

The remainder of this paper is organized as follows. Section 2 describes the BP neural network and its structure. Section 3 give a explaining of BP neural network learning algorithm. Section 4 presented a principle that artificial intelligence evaluation model based on BP neural network. Section 5 presented Application and testing of artificial intelligence evaluation model based on BP neural network.

2. BP Neural Network and its Structure

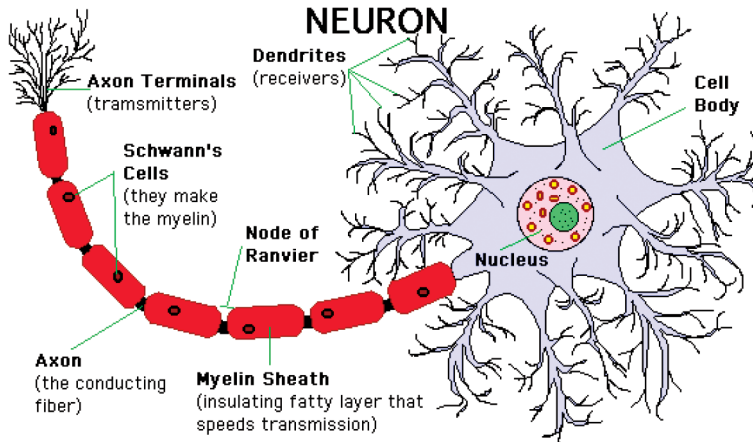


Figure 1 – BP Neural Network

BP network is a kind of Multi-layer Feedforward Network, which uses Error Back Propagation to train the network (Hooze, E., 2015). BP network has input layer, output layer and hidden layer. The hidden layer can be one layer, and it can be a multi-layer. Structure is shown in Figure 2.

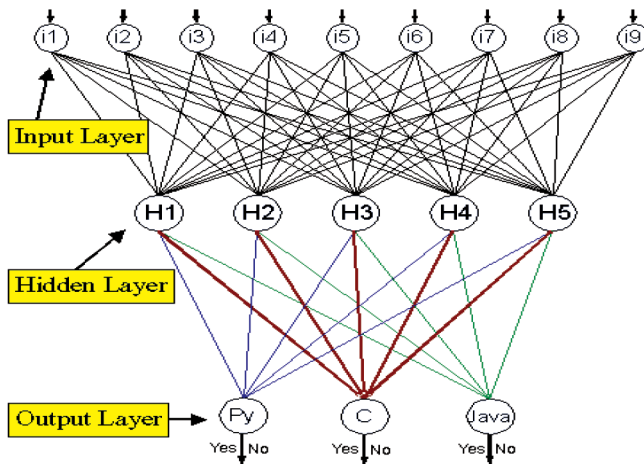


Figure 2 – The Structure of BP Neural Network

As shown in the graph, the BP neural network is generally referred to the three layer feedforward network or the three layer perceptron. It is characterized by that the neurons are only connected to the adjacent layer, and there is no connection between the neurons in the same layer (Arda, B., 2015). The single layer feedforward neural network can only solve the linear separable problem, and the network must be a multi-layer neural network with hidden layer.

3. BP Neural Network Learning Algorithm

3.1. The Traditional BP Neural Network Learning Algorithm

The BP learning algorithm is designed to adjust the weights of the network, so that the adjusted network can get the desired output (Akpinar, Y., Ardac, D., & Amuce, N. E., 2015). The learning process is composed of forward and backward propagation. Forward propagation is used to calculate the forward network, which is calculated by the network. Its traditional BP algorithm specific steps are as follows.

1. In the random initialization, it gives the weight w , v and threshold θ_i , RT .
2. By the given input and output mode, the output layer and the hidden layer are calculated.

$$bj = f(wij \bullet ai - \theta j) \quad (1)$$

$$ct = f(vjt \bullet bj - rt) \quad (2)$$

The formula is the actual output of the hidden layer J neurons; is the actual output of the output layer t neurons; is the connection between the input layer and the hidden layer; is the connection between the hidden layer and the output layer.

$$dtk = (ytk - ct) \bullet ct(1 - ct) \quad (3)$$

$$ejk = (dtv \bullet jt) \bullet bj(1 - bj) \quad (4)$$

3. It selects the next input mode to return to the second step and repeat until the network set the output error to reach the end of the training.

The main drawback of the traditional BP learning algorithm is that convergence speed is slow, there is no theoretical guidance in selecting the number of nodes in network, and it may appear the local minima problem (Jian, J. I., Xiao, L. I., Shuang-Xing, X. U., Huan, L. I. U., & HUANG, J. J., 2015). So people have to work together with the new learning model and the new learning model. For this purpose, the author has conducted extensive research on the learning algorithm of BP network, and introduced the new improved algorithm.

3.2. The New Improved Algorithm

In this paper, we introduce the momentum term (Biasutti, M., 2015). The standard BP algorithm is essentially a simple steepest descent static optimization algorithm, in which the negative gradient direction of the K moment is corrected, and the former is not considered. To this end, it is proposed that the following improved algorithm.

$$w(k+1) = w(k) + \eta(1-a)D(k) + aD(k+1) \quad (5)$$

In the formula: w_k can express a single connection weight coefficient and also can indicate the connection weight vector; $D(k)$ is the negative gradient of K moment; $D(k-1)$ is the negative gradient of $k-1$ moment; η is the learning rate; a is the momentum factor, $0 \leq a < 1$.

This method reduces the oscillation of the learning process and improves the convergence, and it is a widely used method to improve the learning process.

Back-propagation algorithm or BP algorithm, one of the most widely used algorithms in artificial 4. Model Construction.

This paper uses the dataset of an automotive parts company to train the improved BP neural network. As we know, nowadays automobiles are comprised of lots of parts. These parts are produced on the demand of automobile manufacturers and then are sent to assembly factories to form a complete product. In this way, the whole production process of an automobile exists in the form of a supply chain. To realize the highest overall efficiency, it needs cooperation of all the suppliers, manufacturers, wholesalers, and retailers. Inventory control is an important aspect which reflects such kind of cooperation. In the following part, this paper will use the improved BP neural network to forecast the inventory level of bearings—one of the components for an automobile.

3.3. Evaluating Product Model Design

the method of using BP neural network is given to evaluate product model design after analysis theory of artificial neural network. Based on discussing on the self-learning, self-organizing, adaptive and nonlinear dynamic handling characteristics of the BP neural network, product model design evaluating model of BP neural network is set up. 13 samples, from 13 product model designs, are used for network training and testing by Matlab. The results of simulation test show that BP neural network is the efficient and accurate method to evaluate product model design.

4. Empirical Process and its Results Analysis

4.1. Factors Influencing Inventory Control and Selection of Sample

Usually accurate inventory level is the precondition for good inventory management. For inventory management, inventory controlling cost and customers' service levels as well as inventory controlling quality are the main factors to estimate the inventory level. Therefore, in the design of inventory control system, we mainly use these factors to predict. They are described as follows (Javaheri Fard, H., Eliasi, H., & Najafi, H. R., 2015).

1. Various Costs. They are one of the main indicators to evaluate inventory control strategy. The costs mainly include all the expenses in product purchase and production as well as sales. For enterprises, analyzing inventory controlling cost can effectively reduce the overall cost of enterprises. However, inventory controlling costs include many aspects and these aspects can influence each other. Therefore, dividing inventory controlling cost in details and analyzing the accumulated data of business systems to find the main factors will be helpful for enterprises to make corresponding decisions and control all kinds of costs.

The costs mainly include ordering cost, storage cost, transportation cost, and shortage cost.

2. Demand Level. The purpose of inventory control is to best satisfy the demands. Therefore, demand is another important factor influencing inventory control. However, demand may be certain but also may be stochastic or seasonal. Demand level is positively proportional to inventory level.
3. Supply Level. It refers to supply level of finished products of producers. It is positively proportional to inventory level.
4. Quantity of Substitutes. It refers to the types of other parts which can substitute for the parts used. It is negatively proportional to inventory level.
5. Lead Time. It refers to the period of time from sending the order to being ready for production. It includes the time for ordering, waiting time, preparatory time for suppliers to deliver goods, time on transportation, time for check and acceptance for warehouse entry, and time for preparation for use. It is positively proportional to inventory level.
6. Customer Service Level. It refers to the possibility for enterprises to satisfy customers' needs after customers propose the ordering requirements. It is negatively proportional to inventory level. The higher the customer service level goes, the lower the inventory level will be. In this case, we use 2 (very good), 1 (general), and 0 (poor) to represent the extent of the customer service level.

This paper chooses the historical data of factors which influence the safety inventory level and inventory data of bearing of an automotive parts production company in one of the middle provinces of China from March 2012 to March 2013 as a sample to train the improved BP neural network. We mainly choose 100 groups of the data to train the network and then check its prediction ability. The number of training samples cannot be too small; otherwise, the network cannot learn enough which may result in low prediction ability. However, too large samples will lead to redundancy. At this time, the network will be overfitted. Therefore, this paper chooses 100 groups of data as input to train and predict and chooses inventory level as output to establish the BP neural network model. In this case, because the system is nonlinear, the initial value plays very important role in achieving local minimum. Therefore, the input sample needs to be normalized and the purpose is to make the big input values also fall in the range with large gradients of activation function.

4.2. Sample Data Collection

The data come from such authoritative websites as a commercial bank's credit management system.

(CMIS), the Securities website of Shanghai Stock Exchange (www.sse.com.cn) and the Shenzhen.

Stock Exchange (www.szse.cn), etc. The samples come from 161 loans listed companies from Bank A.

in 2006. The evaluation and non-financial indices are incomparable in different sectors of the business.

environment and business scope. As different industries have different evaluation index, the model data.

are selected from the same industry. Data retrieval conditions are as follows: sample industrial.

coverage: industrial enterprises; types of loans: one year and within three years; loan date:

January 1, 2004; loan balance deadline: December 31, 2006; the amount of loans: the amount of.

loans actually paid; loans balance: loss of loan balances up to December 31, 2006; loan forms:

the form of loans currently enjoying; corporate full name and code: the unique code of enterprise.

identification; report date and reports: the corporate balance sheet and income statement on.

December 31, 2006: Involving a total loan amount of more than 13,000 billion RMB.

4.2. Network Variables.

Any continuous function can be realized by a three-layer artificial neural network. Therefore, this paper adopts the three-layer BP neural network structure. When all information is input into the network, the information starts by being transmitted from input layer to hidden layer. With the work of activation function, the information is then transmitted to output layer. There are 9 input factors and the output is inventory level. The selection of variables of the network is as follows.

1. Input Layer. The input layer includes 9 factors: storage cost (X1), ordering cost (X2), shortage cost (X3), transportation cost (X4), demand level (X5), supply level (X6), quantity of substitutes (X7), waiting time (X8), and service level (X9).
2. Hidden Layer. Usually when there are one or two hidden layers, it has the best convergent attributes. If there is no hidden layer or there are too many hidden layers, the convergent effect is not so good. Theories have proved that networks which have deviations and at least one S-type hidden layer and one linear output layer can approach any nonlinear function. That is, a three-layer BP network with a hidden layer can approach any nonlinear function. According to empirical formula, it is the number of nodes of hidden layer and is the number of nodes of input layer.
3. Output Layer. The number of nodes of output layer is the number of system objects. We choose one node as the inventory level of March 2013 to be measured.
4. Selection of Initial Value and Threshold Value. Because both of them are two random groups of value, we choose a random value.
5. Selection of Expected Error and Number of Iterations. We choose 10000 as the number of iterations and the expected error is 0.1. neural network, is a kind of supervised learning algorithm. Its main purpose is to adjust weight matrix according to the squared error between the actual output and target output. The squared error is expressed as follow:

4.3. Evaluation System of BP Neural Network

BP Neural Network.

BP (Back Propagation) neural network, which was done by a group of scientists.

headed by Rumelhart and McClelland, is the multilayer feedforward network with error.

back propagation algorithm training and is one of neural network models applied widely.

BP neural network can learn and store a large number of input and output model mapping,

without disclosure and description of mathematical equation on the mapping relations.

beforehand (Nikitas, G., Vimalan, N. J., & Bhattacharya, S., 2016). The topology structure of BP neural network model is input layer,

hidden layer and output layer, as shown in Figure 2.

Figure 2. BP Neural Network.

5. Artificial Intelligence Evaluation Model Based on BP Neural Network

5.1. Seismic Potential Liquefaction

In this paper, a model of artificial intelligence for seismic potential liquefaction is studied in this paper based on BP neural network.

We assume that the effective stress is covered above in seismic potential. Earthquake magnitude is M . The peak acceleration of the ground level is only SPT (Liu, K., Zhang, Y., & Qin, L., 2016). Viscosity content is F . Average particle size is D_{50} . The ratio of equivalent dynamic stress and effective stress is τ_{av} / σ_v . These are used as evaluation indicators (Heinermann, J., & Kramer, O., 2016). The sample index vector is (1,0), (0,1), respectively, for liquefaction and non-liquefaction. The input layer of the BP network structure is 7 neurons, which correspond to two kinds of output model. The hidden units can be used for 6 hours, and the network learning time is up to the required accuracy. The intelligent evaluation model of seismic liquefaction neural network is shown in figure 3.

5.2. Artificial Neural Network

With the advent of the digital computer, stock market prediction has since moved into the technological realm. The most prominent technique involves the use of artificial neural networks (ANNs) and Genetic Algorithms. Scholars found bacterial chemotaxis optimization method may perform better than GA. (Pan, X., Niu, X., Yang, X., Jacquet, B., & Zheng, D., 2015) ANNs can be thought of as mathematical function approximators. The use of ANN simulates how human brain functions, by feeding computers with massive data to mimic human thinking. The most common form of ANN in use for stock market prediction is the feed forward network utilising the backward propagation of errors algorithm to update the network weights. These networks are commonly referred to as Backpropagation networks. Another form of ANN that is more appropriate for stock

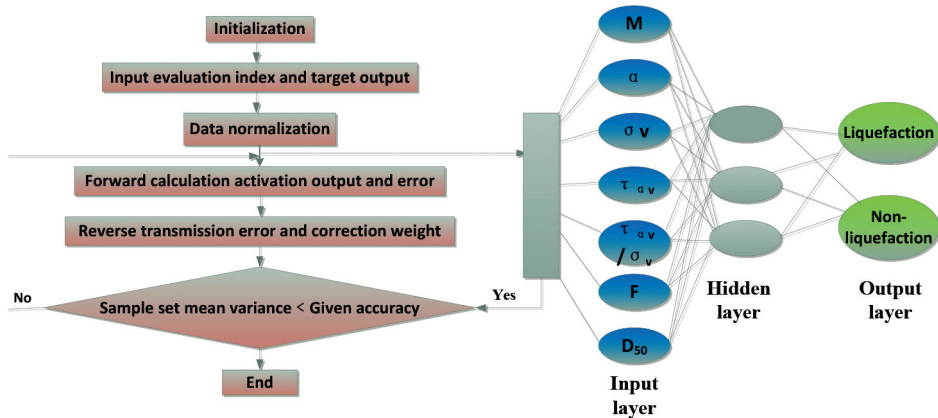


Figure 3 – The Intelligent Evaluation Model of Seismic Liquefaction Neural Network

prediction is the time recurrent neural network (RNN) or time delay neural network (TDNN). Examples of RNN and TDNN are the Elman, Jordan, and Elman-Jordan networks. (See the Elman And Jordan Networks).

For stock prediction with ANNs, there are usually two approaches taken for forecasting different time horizons: independent and joint. The independent approach employs a single ANN for each time horizon, for example, 1-day, 2-day, or 5-day. The advantage of this approach is that network forecasting error for one horizon won't impact the error for another horizon—since each time horizon is typically a unique problem. The joint approach, however, incorporates multiple time horizons together so that they are determined simultaneously. In this approach, forecasting error for one time horizon may share its error with that of another horizon, which can decrease performance. There are also more parameters required for a joint model, which increases the risk of overfitting.

Of late, the majority of academic research groups studying ANNs for stock forecasting seem to be using an ensemble of independent ANNs methods more frequently, with greater success. An ensemble of ANNs would use low price and time lags to predict future lows, while another network would use lagged highs to predict future highs. The predicted low and high predictions are then used to form stop prices for buying or selling. Outputs from the individual “low” and “high” networks can also be input into a final network that would also incorporate volume, intermarket data or statistical summaries of prices, leading to a final ensemble output that would trigger buying, selling, or market directional change. A major finding with ANNs and stock prediction is that a classification approach (vs. function approximation) using outputs in the form of buy($y=+1$) and sell($y=-1$) results in better predictive reliability than a quantitative output such as low or high price. (Coelho, V. N., Coelho, I. M., Coelho, B. N., Cohen, M. W., Reis, A. J., Silva, S. M., ... & Guimarães, F. G., 2016) This is explained by the fact that an ANN can predict class better than a quantitative value as in function approximation—since ANNs occasionally learn more about the noise in the input data.

Since NNs require training and can have a large parameter space, it is useful to modify the network structure for optimal predictive ability.

Internet-based data sources for stock market prediction [edit].

Tobias Preis et al. introduced a method to identify online precursors for stock market moves, using trading strategies based on search volume data provided by Google Trends. (Atlas, R., Bucci, L., Annane, B., Hoffman, R., & Murillo, S., 2015) Their analysis of Google search volume for 98 terms of varying financial relevance, published in Scientific Reports, (Jiaran, Y., Xingcheng, W., Xiaofen, L., & Cheng, J., 2015) suggests that increases in search volume for financially relevant search terms tend to precede large losses in financial markets. (Shi, W., Tan, X., Gao, Z., & Moan, T., 2016) Out of these terms, three were significant at the 5% level ($|z| > 1.96$). The best term in the negative direction was “debt”, followed by “color”.

In a study published in Scientific Reports in 2013, Helen Susannah Moat, Tobias Preis and colleagues demonstrated a link between changes in the number of views of Wikipedia articles relating to financial topics and subsequent large stock market moves.

The collective mood of Twitter messages has been linked to stock market performance. The study, however, has been criticized for its methodology.

Applications of Complexity Science for stock market prediction [edit].

Using new statistical analysis tools of complexity theory, researchers at the New England Complex Systems Institute (NECSI) performed research on predicting stock market crashes. It has long been thought that market crashes are triggered by panics that may or may not be justified by external news. This research indicates that it is the internal structure of the market, not external crises, which is primarily responsible for crashes. The number of different stocks that move up or down together were shown to be an indicator of the mimicry within the market, how much investors look to one another for cues. When the mimicry is high, many stocks follow each other's movements - a prime reason for panic to take hold. It was shown that a dramatic increase in market mimicry occurred during the entire year before each market crash of the past 25 years, including the financial crisis of 2007–08.

6. Application and Testing

In this paper, the total number of samples is 59, of which 28 are non-liquefaction, and 31 are liquefaction. There are 25 test data, liquefaction for 14 and not liquefaction for 11. Network learning factor A is taken as 0.44, momentum factor B is taken as 0.276, variance 0.000050, training 11900 times. Examples of the ground liquefaction index values are shown in Table 1, BP network intelligence evaluation model and comparison results are shown in Table 2.

From table 1 and table 2 can be seen that the accuracy rate of BP network test model is 92%, the evaluation results are in agreement with the standard value, and the customer service has the subjectivity of the evaluation process.

Serial number	Buried depth	M	α	N	σ_v	τ_{av}/σ_v	F/%	D_{50}
<i>ZN4</i>	17.32	6.0	0.1122	6	201.7	0.08	4.4	0.05
<i>ZN5</i>	9.94	6.0	0.1122	8	113.2	0.10	4.7	0.07
<i>ZN7-1</i>	5.36	6.0	0.1122	6	77.6	0.09	4.5	0.07
<i>ZN7-2</i>	17.86	6.0	0.0880	15	208.7	0.08	4.8	0.17
<i>ZN7-3</i>	19.92	6.0	0.0880	6	231.2	0.08	4.5	0.18
<i>ZN12</i>	15.85	6.0	0.0880	11	186.2	0.10	2.3	0.18
<i>ZN13-1</i>	10.43	6.0	0.1122	6	125.6	0.09	1.5	0.16
<i>ZN13-2</i>	11.84	6.0	0.0880	4	175.4	0.07	5.6	0.12
<i>ZN14</i>	16.65	6.0	0.1122	5	135.2	0.10	6.2	0.07
<i>ZN15</i>	10.43	6.0	0.1122	19	189.6	0.08	5.8	0.02

Table 1 – Examples of the Ground Liquefaction Index Values

Serial number	ANN forecast results			JTJ004-89	GB50011-2010
<i>ZN4</i>	0.235	0.765	Non-liquefaction	Liquefaction	Liquefaction
<i>ZN5</i>	0.888	0.001	Liquefaction	Liquefaction	Liquefaction
<i>ZN7-1</i>	1.002	0.000	Liquefaction	Liquefaction	Liquefaction
<i>ZN7-2</i>	0.000	0.936	Non-liquefaction	Non-liquefaction	Non-liquefaction
<i>ZN7-3</i>	0.064	0.002	Non-liquefaction	Non-liquefaction	Liquefaction
<i>ZN12</i>	0.888	1.000	Liquefaction	Liquefaction	Liquefaction
<i>ZN13-1</i>	1.002	0.002	Non-liquefaction	Non-liquefaction	Non-liquefaction
<i>ZN13-2</i>	0.000	1.000	Liquefaction	Liquefaction	Liquefaction
<i>ZN14</i>	0.888	0.001	Liquefaction	Liquefaction	Liquefaction
<i>ZN15</i>	0.988	0.003	Non-liquefaction	Non-liquefaction	Non-liquefaction

Table 2 – BP Network Intelligence Evaluation Model and Comparison Results

7. Conclusion

This study evaluates the level of sustainable development for railway transportation based on back-propagation (BP) neural network. Four aspects, which cover the conception of economy, society, environment and resource, are considered when constructing the index system, which is optimized through Principle Component Analysis. An evaluation model based on BP neural network is constructed and the railway enterprise in China is taken as the study case, the results show that the evaluation model based on BP neural network is creditable and effective. The results reveal that the trend of sustainable development of railway transportation is gradually upward despite a low overall level, holding that it has massive potential to improve.

We conclude the following with the practical importance of our findings. First, this paper proposes a new, fast convergent BP algorithm and deduces new chain propagation rules of neural network by introducing an error offset. Secondly, this paper applies it to the prediction of inventory level of an automotive parts company and achieves good effect. From the experimental results, we can see that using neural network to predict inventory is effective. The improved BP algorithm not only significantly exceeds the standard algorithm both on convergence time and prediction effect but also outperforms some other improved BP algorithms on these two main indicators. In this sense, this paper provides a valuable reference for inventory control of supply chain. At this point, we spare no efforts to.

Run Research on artificial intelligence evaluation model based on BP neural network. However, this paper also has limitations. There are still some problems that need to be solved such as how to decide the number of nodes of hidden layer and the optimization of whole structure of network. Apart from that, the introduction of the error offset is based on experiences. The theoretical explanation for it still needs to be further discussed. All these problems wait to be further explored in future research.

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Application of Multimedia System in the Training of Basketball Tactics

Wu Bing¹

Wubing64322@126.com

¹ School of Social sports, Lanzhou University of Arts and Science, 730000, Lanzhou, Gansu, China

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Abstract: With the continuous development of science and technology and the wide application of multimedia technology, the multimedia system based on the computer platform is gradually introduced into the field of education. In the process of basketball training and teaching, the application of computer multimedia system makes the teaching process more rich and innovative, has achieved good practical results. This paper mainly introduces the combination the multimedia system based on the computer platform and training process of basketball tactics, and introduces the related method with introducing the actual effect of the system. The application of multimedia system in the training of basketball tactics can carry out the teaching of tactics better, to cultivate students' tactics consciousness, and vail the development of the cause of basketball education, and to provide a reference for other sports education and training, let physical education to be enough to play a more significant efficiency.

Keywords: Multimedia system; basketball; tactical training.

1. Introduction

The continuous development of basketball technology, the technology of athletes from single to comprehensive. skills of center is not only attacking and defensive skills, but also to have good assists technology and outside shooting technology. basketball athletics competition fierce competition, the athletes to want to come to the fore, must have a comprehensive technology. development of competitive basketball tactical requirements showing a new form, for example, efficient time of attack and defense technology in relationship; the use of technology can not be separated from the combination of athletes' intelligence. there is a high positive correlation between the number of effective participation and the success rate of basketball tactics. (figure 1) (Nageshwar V., Noronha J A., Nileshtar A., et al., 2015).

The training of basketball tactics directly affects the basketball competition results. With the advent of the information age, the traditional training mode can't meet the needs of competition at this stage, the application of multimedia system in the training of basketball tactics has become an inevitable historical development. How to effectively combine the multimedia system and China Basketball Tactical training has become the focus of the study. (Prata, P., Fazendeiro, P., Augusto, C., Azevedo, S., & Machado, V. C.,

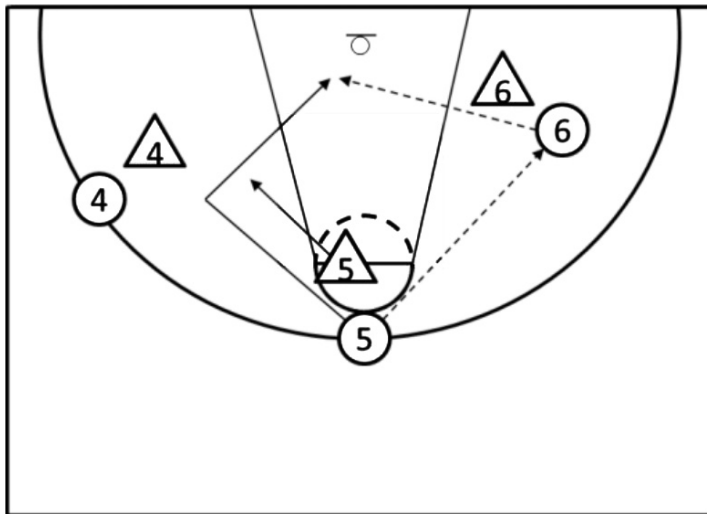


Figure 1 –Analysis of Basketball Tactics

2013) A study is a breakthrough for the training of basketball tactics, in the application process, can promote the effect of the training of basketball tactics to improve. At present, the world basketball movement will continue to high skills, develop in the direction of high speed, high resistance, and athletic skill, intelligence, refining continues to increase. Keen observation ability, thinking the decision ability, strain capacity combined with rational tactics in the game play is conducive to athletes. It cannot do without the usual tactics, the multimedia system based on the computer platform by providing text, image, sound, video, animation and so on, the teaching method is more intuitive, accurate, clear and, image, and ensure the information transfer of scientific and effective. Figure 2 (Angeli C., Tsaggari A., 2016).

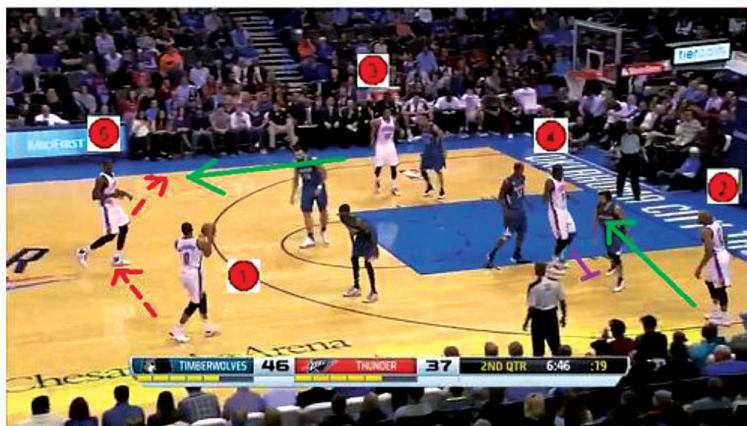


Figure 2 – Analysis And Display of Basketball Tactics Based on Multimedia System

2. Analysis of the Reasons for the Application of Multimedia System in Basketball Tactical Training

2.1. Feasibility Analysis

In theory, the three principles of cognitive psychology research results of the main representative Meyer (multimedia principle, image principle, excess principle) pointed out the direction for the design of computer multimedia system for the training of basketball tactics, from here you can grasp the basic characteristics of a good basketball tactical training multimedia system should have, to prepare for the next step. In technology, the paper mainly uses Flash software programming, making basketball tactical computer multimedia training system. It also uses the Photoshop interface design, screen video capture video footage. In device, the software operating environment requirements is not high, now the most low-end computer configuration can be run, so this dissertation has equipment on the feasibility (Cheng T S., Lu Y C., Yang C S., 2015).

2.2. Advantage Analysis

First of all, the multimedia system based on computer platform can improve the traditional teaching mode solve the traditional teaching difficulties. System through sounds, pictures, video, animation and computer aided software of slow, replay, tagging, suggesting that language, intuitive, image, dynamic demonstration. It can not only help to make up for lack of body language and verbal instruction, help students to fully understand the tactical principle, to make up for the shortcomings of traditional teaching methods, but also can gradually improve the tactical consciousness of students, through the form of video image demonstrates the mobile route, guiding each position players by observing the moving route perception game scene, analyze and judge the tactics cooperate select the appropriate time to make the action choice. In the consolidation of the tactical thought, through some virtual reality scene, guide the students to make the analysis judgment, so as to cultivate the students' ability of analysis, judgment. Finally, the multimedia system based on computer platform can effectively improve the basketball teaching schedule. This kind of teaching method broke the monotonous explanation to realize the combination of dynamic and static characteristics of teaching, simplifies the rapid and complicated technical movements, lets the student in the study can easily understand and master the theory of basketball skills, improve the learning environment, but also improve the learning efficiency of basketball (Hong L., Xiaodong L., Ganchen T., et al., 2015).

3. The Design of Multimedia Basketball Tactical Training System Based on Computer

3.1. System Design Idea

The core idea of the system is referenced to the information processing model of the consciousness form process. It provides a moving scene and ask questions by the computer, encourage students to think and generate decisions, and by the system of decision-making evaluation, provide feedback, so as to achieve the purpose of strengthening decision-making. System model as shown in Figure 3 (Yang Y., Chen M., Zeng X., et al., 2015).

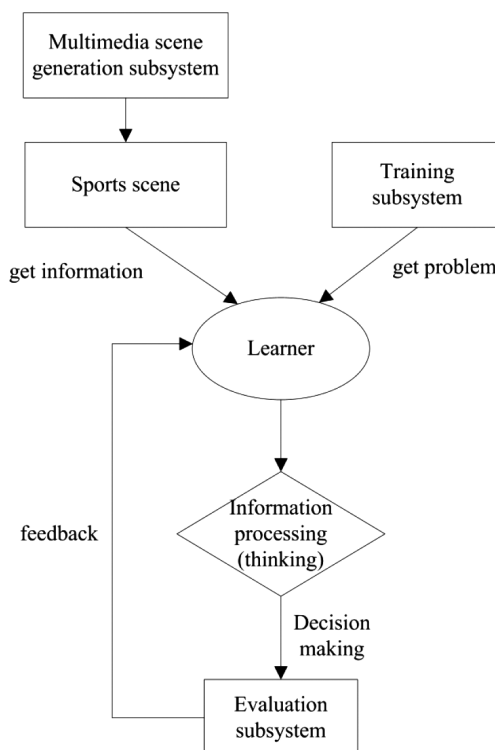


Figure 3 – System Model

The whole system consists of three subsystems: multimedia scene generation subsystem, training subsystem, evaluation subsystem.

1. the main function of scene generation system is to provide sport scene, scene here exists mainly in the form of video, so the main function of scene generation system is processing video: including video capture, format conversion, metadata(video length, content, size, etc.) injection, video file management.
2. training subsystem put forward corresponding problems and decision options according to the scene. the problem and decision options are setted good in advance by the teachers, therefore the main function of training subsystem is to support the teacher on settings the problem and decision options.
3. the main functions of evaluation subsystem is to obtain training data and analyze, it consists of expert grading library and analysis procedures. experts score standard library is a scoring criteria given different scores by experts and coach according to the reasonable of simulation tactical situation, and enter it into the database, the analysis procedure draws the result through the comparison between the training data and the score standard (Космеда Т А., Kosmeda T., Осіпова Т Ф., et al., 2015).

3.2. Function of System Realization

There are two main purpose of the system: the first is the effective auxiliary function to improve students’ tactics consciousness; the second is convenient for teachers to effectively intervene. So this system mainly realizes several functions, first function is the learning of basic tactics, the system can enhance students’ understanding of some basic tactics; second functions is to strengthen the training function. The student can acquire or strengthen some tactical thinking through the interaction and feedback with the system, so as to promote awareness; third functions is the evaluation function, the students interact with the system, the system records the data and analyzes it, and feedback the result of the student’s operation, which can be used as a summary evaluation, of course the results could not reflect the level of students’ consciousness, because consciousness psychologically related with many factors, and the evaluation to it is also more complicated, can not be determined by a single indicator of its good or bad. If the results feededback by verification system can become one of the indicators to measure the level of consciousness, then the feedback will be meaningful; fourth functions is management function, the teacher can set up the system through the background management module, including the exercise scenarios and test question classification, modify, add, delete. System function module such as Figure 4 (Bell J M., 2016).

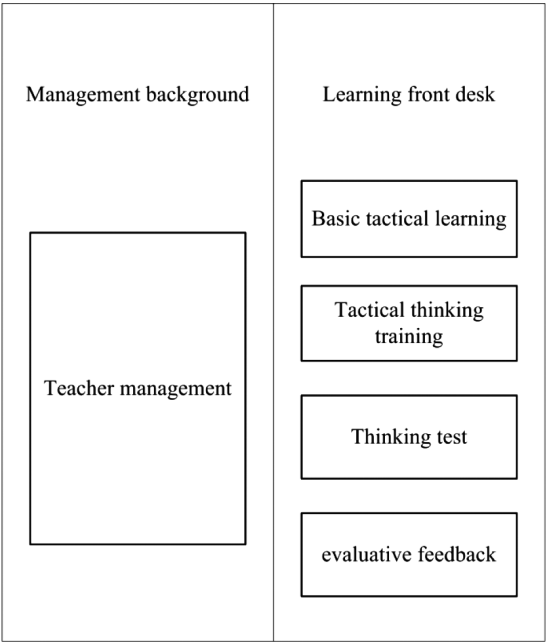


Figure 4 – System Function Module

3.3. System Design and Development and System Function Module

Module one: tactical knowledge.

The information represented is main in this module, it explain mainly some basic tactics by text, in this process, teachers explain the process complemented with animation, video

to enhance students' understanding of tactical. Should pay attention to the correlation between video, text and animation, and the presentation method of information. It is worth mentioning that, with video assisted teaching, teachers can use system of painting tools painting directly on video, greatly improve the teaching effect.

Module two: thinking training.

Students enter personal information into the module, providing sports scene in the basketball game video in the form of a large number of in this module, the NBA matches, training in such a way that the students to watch the game, video playback to a picture frame, a screen system for athletes next action ask questions, and the corresponding information and options in the picture, let the students make a choice, choose to continue to play the video, the next question, until the video is completed. After the training system will be the choice of students and make a choice for each time (reaction time) stored in the database, comparative analysis the results by an expert with the standard score, students will finally choose their own feedback results were compared with the results in the video or system, so as to strengthen the training of thinking, thinking to them. In the process of training, video frames, picture information, content and options are set in advance by the teacher.

Module three: thinking test.

This part of the principle and module two similar, they differ in that, training module, students choose, video continues, athletes step action will verify their choice is correct, students can get a timely feedback. And in the test module, students make a choice after directly transferred to a video and enter the next question test, students can not get timely feedback. Test data is still by the system saved for analysis (Berry J., Blanchette J., 2015).

3.4.System Experimental Verification Analysis

Test preparation: collection season video of the NBA2007-2008, and screen out the tactical teaching value fragment (here only choose offensive tactics), further screened 60 segments for testing (two tests, each 30 section), 100 for training. The establishment of expert database, integrated video content and basketball teachers, expert opinion that is reasonable, the rationality of the evaluation to test all options, option rationality is the most rational, reasonable, is not reasonable four grades, the corresponding score 3,2,1, video screening only the player's behavior is the most reasonable as training video, to strengthen the role of learning. Then give each option value training. When directly to give students feedback, to strengthen the role of learning (Butler L., 2015).

Experimental implementation: the experiment mainly use their spare time, the first independent tests on 30 major groups of students in the author's control, to eliminate the interference of irrelevant factor to ensure the validity of the test. Then the software system is copied to the stand-alone version of the computer for autonomous learning and training, a week after the second test three. Then let the experts responsible for professional training group (two teachers and a teaching assistant) experience qualitative evaluation on students. Grade 30 volunteers selected way: every day in the room of multimedia educational technology extraction about 5 basketball fans were tested, one week after the test is completed. Finally, the experimental data were compared analysis and experiment results.

Experimental data collection: statistical data by software automatically records, descriptive data through questionnaire, interview records (Weiss E., 2015).

Experimental data statistics:

Group test score compared such as Figure 5.

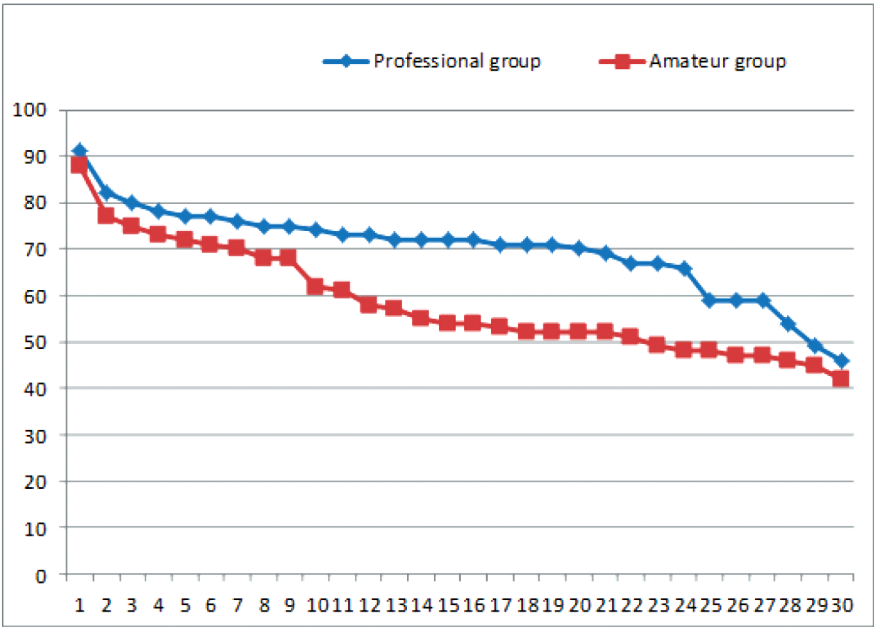


Figure 5 – Group Test Score Comparison

Compared with the amateur group and professional group test scores, the results of the independent sample T test are as follows:

Grouping	Average	Standard value	Standard error
Amateur group	58.0	11.53	2.10
Professional group	68.9	10.55	1.92

T Value	Freedom	P Value
-3.797	58	<0.001

Table 1 – Results of Test Results By Independent Samples T

Mean reaction time compared such as Figure 6.

The results of independent sample T test are as follows when comparing the reaction between the amateur and professional groups are as follows:

Grouping	Average	Standard value	Standard error
Amateur group	3.99	2.23	0.41
Professional group	2.85	0.86	0.06

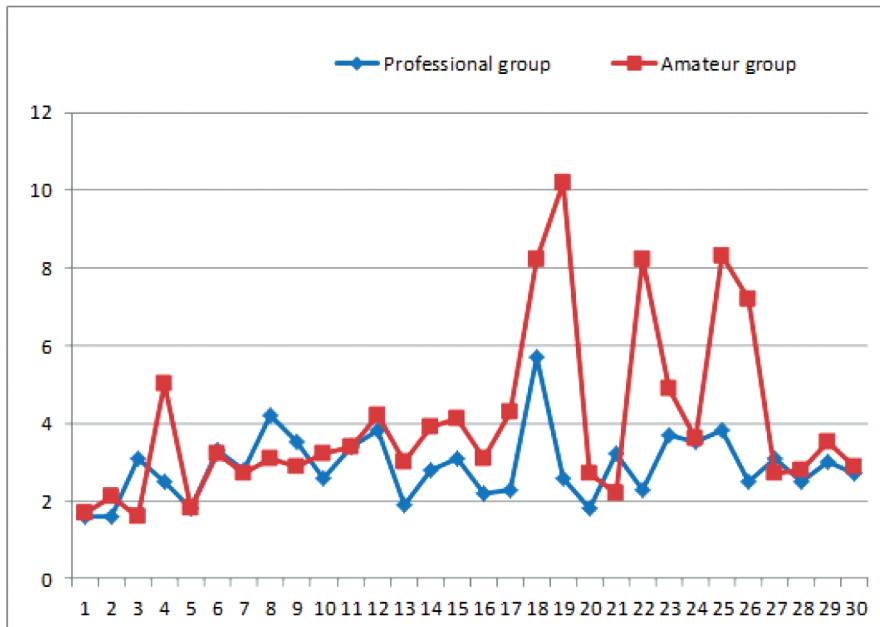


Figure 6 – Average Reaction Time Comparison Fig

Homoscedasticity	T Value	Freedom	P Value
0.001<0.05	2.612	37.5	=0.013

Table 2 – Results of Average Reaction Time By Independent Samples T

By two t test shows, scores of a group of professional and amateur group very significantly ($P < 0.001$), the reaction time difference reached significant level ($P=0.013<0.05$) and variance homogeneity test for homogeneity of variance ($P < 0.05$). This showed that between students in the amateur group reaction time difference is bigger, the reason may and amateur groups of students level uneven. From the experimental results, the hypotheses. Professional groups have a strong sense in the amateur group. Founded, the hypothesis is accepted that there was correlation between the test results and the tactical consciousness (Loy J W., 2015).

Professional group test scores and expert score correlation such as Figure 7.

4. Effect Analysis of Basketball Tactical Training Based on Multimedia System

According to the literatures, consulting the views of experts and basketball teaching and research room teacher, in the evaluation and comparison of different teaching methods of teaching effect, mainly focus on and basketball tactics is closely related to several aspects, and formulate the corresponding grading standards, '1-2-1-1' a full court press and '2-1-2' zone was selected as the experimental teaching tactics teaching contents.

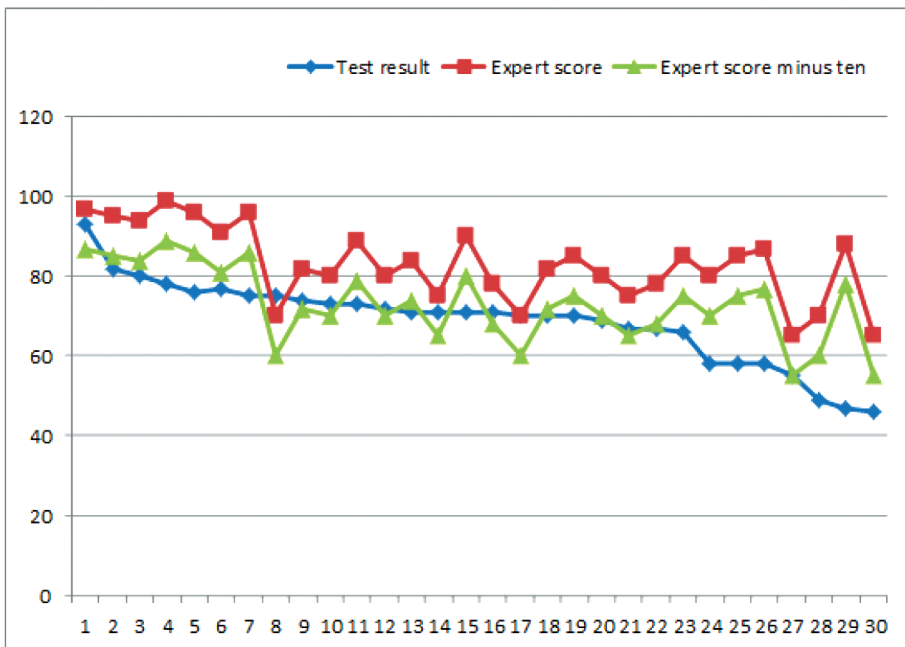


Figure 7 – Correlation Between Evaluation Results and Expert Score

The following table to table three is regional press tactics paired samples t test results. Statistics for each table contains a number, standard deviation, average number of standard error, the value of T, degrees of freedom and significant level (519. Value, two tailed test), and then according to the table in 519. Value to determine the size of the significant differences between the two groups (Liebenberg I., 2015).

Ordinary group and experimental group	Mean deviation	Standard deviation	Average standard error	t	df	Sig. (2-tailed)
Defense morale	0.245	0.7316	0.1636	1.498	19	0.151
Defensea ction	0.275	0.447	0.100	2.751	19	0.013*
Defense effect	0.710	0.6488	0.1451	-4.894	19	0.0001**
Run path	-0.615	1.245	0.2776	-2.215	19	0.039*
Defense move	-0.755	0.7824	0.1749	-4.316	19	0.000373**
Location selection	-1.375	1.1456	0.2562	-5.367	19	0.000**
destination task	-3.825	1.6958	0.3792	-10.087	19	0.000**
Coordination	-0.685	0.9449	0.2113	-3.242	19	0.004**

Table 3 – ‘1-2-1-1’Area Press Tactics Front Area Pair Sample T Test

The statistical results have certain reasons: Although multimedia animation method cannot directly stimulate students in tactical exercises the enthusiasm, but its advantage

is dynamic presentation and expression of basketball tactics, with the defensive player, defensive purposes and moving route is clear, position overall feeling better.

Ordinary group and experimental group	Mean deviation	Standard deviation	Average standard error	t	df	Sig. (2-tailed)
<i>Defense morale</i>	-0.650	0.6692	0.1496	-4.344	19	0.000**
<i>Defense action</i>	-0.420	0.4384	0.0980	-4.284	19	0.000**
<i>Defense effect</i>	-0.660	0.8660	0.1936	-3.408	19	0.003**
<i>Run path</i>	-0.795	0.7957	0.1779	-4.468	19	0.000**
<i>Defense move</i>	-0.600	0.7671	0.1715	-3.498	19	0.002**
<i>Location selection</i>	-0.600	1.1309	0.2529	-2.373	19	0.028*
<i>destination task</i>	-2.500	1.7014	0.3804	-6.571	19	0.000**
<i>Coordination</i>	-1.060	0.6770	0.1514	-7.002	19	0.000**

Table 4 – ‘1-2-1-1’The Whole Area Press Tactics Middle Area Pair Sample T Test

‘1-2-1-1’fit part of a full court press tactics of the central region is relatively simple, mainly midfield attack. In paired samples t-test (Table 2), the defensive position selected a difference is significant, the remaining seven statistical difference is very significant; the differences between the two groups of tests of statistical results is significantly greater than that in the test statistics results of.

The statistical results reflect a problem: in theory, the tactical coordination is relatively simple, traditional teaching methods and multimedia methods can easily express, there should be no such a significant difference in teaching effect. A lot of research also believes that the auxiliary teaching content is more simple than for the necessity of using multimedia means think, if the selected content is too simple, it can not reflect the advantages of multimedia animation means. There are two reasons for table two statistic: 1, as a simple teaching content independent, indeed is not suitable for the use of multimedia assisted teaching, however, tactical coordination is the overall tactics with a central part, and other parts of the tactical coordination is inseparable from the overall; 2, with relatively simple teaching tactics can also reflect the multimedia Advantage. In the experimental teaching, the cooperation of all is an inseparable whole, but in actual practice, multimedia assisted teaching by and integrated and decomposing training method used in combination so produced the reason should be the results of interaction of the two factors. (SHAN W., PING X., 2015).

The statistical results, statistics is closely related with the advantages of Multimedia: running routes, mobile location, defense, defense and task coordination of t test statistics of five items were significantly different, in addition to selecting a defensive position difference is significant, the remaining four differences are very significant for multimedia. The animation has the advantage of clear expression means of tactical routes and tactical content, easy to express the tactical contents and requirements, this advantage in the evaluation results in the analysis of central tactics reflected. On defense morale statistics, in the teaching experiment, two groups of enthusiasm in practice are not really very good mobilized, however, results in the difference of a defensive morale is

very significant. There are two main reasons: 1, the students' interest in multimedia aided teaching means in a The extent of interest into tactical exercises, this transformation reflects less on more complex tactical exercises, and in the relatively simple tactical exercises in 2, reflected more content; in the multimedia assisted, relatively simple tactics content of the experimental group students have a good grasp, defensive movement more active in place, the effect is obviously, the subjective feeling of evaluating students' morale is high, great enthusiasm. Students in all evaluation items are good conditions, good tactical defensive effect compared to normal. Significant position selection of a difference of no other statistical significant, reflecting a defect assisted multimedia animation methods: to a certain extent from the field position it is difficult to express the form of students' real precise location on the field. The teacher questionnaire survey also showed that: teachers generally think CAI Courseware of multimedia animation field Position expression accuracy is insufficient, the location must be more accurate. To solve this problem, teachers in the use of multimedia were aided teaching should take necessary measures to prevent or remedy the defects, after all, between the virtual environment and the real environment and a certain distance, students feelings about different teaching assistance method is also not the same. (O'Brien J., 2015).

Ordinary group and experimental group	Mean deviation	Standard deviation	Average standard error	t	df	Sig. (2-tailed)
<i>Defense morale</i>	-0.415	0.6459	0.1444	-2.874	19	0.010*
<i>Defense action</i>	-0.480	0.5297	0.1185	-4.052	19	0.001**
<i>Defense effect</i>	-0.025	0.6423	0.1436	-0.174	19	0.864
<i>Run path</i>	-1.270	0.9852	0.2203	-5.765	19	0.000**
<i>Defense move</i>	-0.775	0.4447	0.0994	-7.794	19	0.000**
<i>Location selection</i>	-0.225	0.6973	0.1559	-1.443	19	0.165
<i>destination task</i>	-1.050	1.2555	0.2807	-3.740	19	0.001**
<i>Coordination</i>	-1.105	0.7977	0.1784	-6.195	19	0.000**

Table 5 – '1-2-1-1' The Whole Area Press Tactics Pair Sample T Test

Table 3 is a regional press tactics full range of overall test, evaluation of students' overall tactical performance in the process from the backcourt to promote the frontcourt. Statistical results show that, defensive and defensive choose two difference was not statistically significant, the defensive morale a difference is significant, the remaining five differences are very significant.

The subjective factors of the evaluation is large proportion for the evaluation of defensive morale. In order to reflect the objectivity of the teaching experiment, in the premise to eliminate irrelevant factors, student play fully their true tactical skills on the tactical evaluation process, the enthusiasm of the students demonstrated is different for each tactical evaluation. the difference was not significant in the selection of defensive position, there is still a lack of expression of multimedia animation for a very clear location relationship, teachers need to make up by other methods in the practical teaching. Individual performance has a great influence on the tactics effect in any basketball tactics that needs the whole coordination. In the process of tactical evaluation, any individual

tactical performance will affect the tactical implementation effect. Therefore, the statistical results of a defensive effect relatively large changes in the multimedia animation. Advantages mainly lies in reduce students' tactical difficulty of understanding, clear and coherent expression of tactical coordination route, defensive purposes and cooperative with the methods and steps of etc., so from table to table three evaluation results of the statistical analysis are broadly the same conclusion and to animation, multimedia aided teaching advantage a embodied. Statistical results show that multimedia animation auxiliary means in the basketball tactics teaching has good effect.

For the characteristics of multimedia systems in the statistical results showed, teachers should be pay attention to exert the advantages of the multimedia means in the practice of basketball tactics teaching, and use the auxiliary teaching means reduce the students' understanding difficulty of tactical, to help students establish the tactical concept and coordination method, shorten the time to explain, increase effectively the tactical exercise time, in order to improve the effect of tactics teaching. (Batchelor B., 2015).

5. Conclusions

The multimedia system based on computer platform is strong superiority and applicability in the training of basketball tactics, so multimedia systems are used more and more widely in the training of basketball tactics, is the majorization of the traditional teaching mode, to solve the shortcomings and difficulties of traditional basketball tactics in the training process. The multimedia system can be more targeted to improve tactical consciousness of training for each students, enhance students' memory, speed up the progress of the training of basketball tactics, thereby achieving more ideal training effect. Of course, for the training of basketball tactics using multimedia system will also appear some new problems, for different coaches and students, different quality of courseware will have great impact on them. Moreover, coaches' mastery of information technology is also related to the teaching progress, which relate to the students understanding of the tactics. However, with the continuous improvement of science and technology and the continuous development of computer multimedia technology, the role of the multimedia system in the filed of basketball tactics training will become more and more important.

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Research on English Language Teaching Mode Based on Computer Network Education

Guojun Han¹

hgj@aynu.edu.cn

¹ School of Foreign Languages, Anyang Normal University, 455000, Anyang, Henan Province, P.R. China

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Abstract: Since the 1990s, with the rapid development of modern information technology, the computer network has rapidly entered the various fields of the society. However, in practice, the model hasn't been effectively implemented because the function of the computer has been limited. In order to effectively implement the model, method: this paper takes college English teaching as an example, mainly aims at the research of the integration of computer network and foreign language teaching in college English teaching reform, explores the effective means, method and mode of the integration. Especially in the reform of current college English teaching, these studies are very important and urgent. Process: This thesis analyzes the present situation of foreign language teaching reform based on the new model, expounds the relationship between computer and foreign language teaching, and puts forward the advantages of the integration of computer and foreign language teaching. Conclusion: The content that this paper explores will undoubtedly have a positive impact on the foreign language teaching in our country, especially for the current college English teaching reform. The views expressed in this paper are also valuable for academic innovation.

Keywords: Computer network; integration; English class; teaching mode; teaching structure.

1. Introduction

With the increasing update and popularity of computer and global network technology, most colleges and universities have been gradually transformed the traditional teaching mode into the multimedia courseware teaching mode in the English teaching. (Lawley, J., 2015) It is easy to enable students to have a strong interest in learning with the teaching methods of the graph, text, sound, and video, but which doesn't yet fully establish the teaching environment with the students as the center. Based on the analysis and understanding of curriculum contents, the teachers have a comprehensive plan and arrangement to the students' English learning and development through the field translation and classroom questioning and other methods. They control the whole class, and the students are always in a passive and accepting position, which causes the students excessively depending on the teacher's guidance, and lacking of independent learning ability. The college English teaching based on the network aims at combining the traditional classroom teaching with the modern information technology, implementing

the complementary advantages of network curriculum and traditional classroom teaching, strengthening the cultivation of autonomous learning ability of the students, focusing on individual differences, carrying on diversity and personalized teaching. In the process of learning, (Chamberlin, J., 2015) the students can make use of huge network resources library to find the information that they need, and be able to use online media to discuss with the teachers and students to deepen the understanding of the knowledge. (Chauhan, R., 2015) At the same time, the teachers can release information, assign tasks, participate in the discussion, answer questions, receive homework, feedback information and so on, so as to give the students the guidance. (Galloway, A. C., 2016) The new teaching mode should be based on modern information technology, especially network technology, so that the English teaching and learning can't be limited by time and place in a certain extent, and can develop towards the direction of individual and autonomous learning. (Zhang, L., Li, J., Zhou, D. B., & Zhu, T. N., 2015) At the same time, it is pointed out that the important sign of the success of the reform of teaching mode is the formation of students' individualized learning method and the development of students' autonomous learning ability. From this can be seen, the university English teaching in our country will gradually transit to the college English teaching model based on the network (Cheeran, M. T., & Saji, K. S., 2015).

2. Situation of English Teaching Under the Network Environment

Lack of necessary hardware security.

Network teaching is a kind of interactive teaching method based on computer and network, (Haddix, M. M., 2016; Trimbur, J., 2016) which is an important part of teaching terminal. The achievement of English learning platform through the network center is often limited by the time and environment and other objective factors, which can't really meet the requirements of students' autonomous learning (Lele, A., 2015).

Most of the network courseware can't adapt to the needs of network learning (Reynares, E., Caliusco, M. L., & Galli, M. R., 2014).

Most of the network courseware is only a copy of the contents of the textbook. Survey shows that 95% of the students mainly use the language materials to complete the task of learning in the way of reading. Students generally think the reasons for this phenomenon is that electronic platform content is not rich and flexible, which is very difficult to realize the interaction, especially in the speech communication, and broadcasting effect is poor; Network resources are just the tasks of the text, the reading and practice provided from Internet are not enough; The content of some courseware is very rich, and have good text materials and examples, but which can't be changed according to the needs because of the sake of intellectual property protection (Tsuda, A., & Hwang, K. K., 2016).

Traditional teaching mode hasn't been changed.

In the process of teaching, the teachers emphasize the study of the basic knowledge of language and neglect the training of language ability.

The supervision and management of teacher are not in place in the Network learning of students (Inoue-Smith, Y., 2016; Bawarshi, A., 2016).

In the network environment, students can carry on fully autonomous learning, the time and progress of the network test are controlled by students themselves. Teachers often mistakenly think that students' autonomous learning don't need supervision. (Choi, H., Kim, J., Bang, K. S., Park, Y. H., Lee, N. J., & Kim, C., 2015) The lack of necessary inspection and management to student online learning leads to the attitude of students to network learning is increasingly indifferent, until the antipathy, conflict.

3. New English Teaching Mode

3.1. English Teaching

<<College English course teaching rules>> (The course) is the programmatic document of the university English teaching reform. The construction of <<The course>> is on the basis of the study theory, which stipulates the objectives, methods, assessment and other systems of university English teaching, and elaborates teaching requirements of current college English teaching for a full range, which mainly includes: a target, three levels, two concepts and a teaching mode and so on. (Shipka, J., 2016) Teaching mode is the core of the teaching reform of this college English teaching. The English teaching mode based on computer and classroom (New model), as shown in Figure 1:

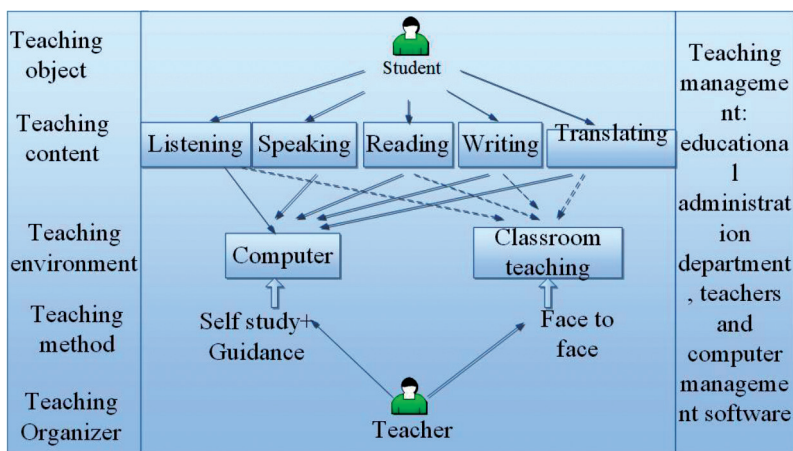


Figure 1 – English Teaching Model Based on Computer and Classroom

3.2. The Theoretical Connotation of the New Mode

The new model has the characteristics of information technology application and integration, it is precisely because of this feature, the new model and the traditional teaching mode have a different nature: The traditional model focuses on the teacher's teaching, that is, the teacher as the center, which emphasizes receiving the best effect by the best teaching of the teacher; But the new model is a super text of the overall teaching, which emphasizes the combination of classroom teaching and learning, the stereoscopic teaching of sound, images, text, animation that spread through the modern information

technology makes the teaching and learning become vivid. The combination of the teacher's teaching process and students learning process promotes the idea of teaching and the fundamental changes in the teaching process, thus forms a new combination of teachers, students, content and media so as to promote learning and improve the teaching effect. Therefore, the use of information technology makes the new model have more distinct characteristics, namely "individuation", "independent learning" and "hypertext". To sum up, the teaching mode has its own characteristics in theory and practice. Therefore, the implementation of the new model will inevitably lead to the adjustment and change in foreign language teaching. To do this, we have made a special investigation (Cegielski, C. G., & Jones-Farmer, L. A., 2016).

3.3. The Implementation Survey of the New Model

Classroom observation is one of the main methods for us to investigate.

During the field research, we have carried out a survey on the Southeast University in Nanjing and Shanghai University of Engineering Science. The questionnaire mainly involves the following several aspects: (1) The view of the application computer network in the teaching; (2) The role of the computer network.

We have designed one question about the students' perception of computer networks:

Option	Southeast University(%)	Engineering University(%)
<i>Vivid,explain the text more interesting</i>	55%	53.33%
<i>Large amount of information,improve the classroom efficiency</i>	50%	51.66%
<i>Make classroom activities more diverse</i>	43.33%	31.66%
<i>There is no difference between the traditional teaching and teaching,but the computer network instead of the blackboard chalk</i>	10%	6.67%
<i>Other</i>	0	0

Table 1 – View of the Application Computer Network in the Teaching

About the computer network's function and the independent study, we have designed one question:

Option	Southeast University(%)	Engineering University(%)
<i>Have significantly improved</i>	10%	10%
<i>Improved, but not obvious</i>	65%	56.67%
<i>No change</i>	21.67%	25%
<i>Drop</i>	3.33%	8.33%
<i>Greatly reduced</i>	0	0

Table 2 – Role of the Computer Network

4. Integration of Computer Network and the Foreign Language Curriculum

4.1. New Concept of Computer Application to Foreign Language Teaching

According to the traditional view, CALL, computer aided language learning, the outstanding of which is its auxiliary function. Of course, this idea in the first few years of the introduction of CALL can be accepted and understood, after all, the computer's performance, technology and applications are very limited. But after nearly 30 years of development, the development of the performance of computer hardware and software technical support and network communication technology can be said to be far beyond people's imagination, the role of computer in teaching has already not only a dispensable "tool".

4.1.1. Computer Teaching

The first view is that with the rapid development of computer science, the role of computer in foreign language teaching has been far beyond its auxiliary function, the computer has gradually changed from the auxiliary role to the front desk teaching, that is, the leading position of teaching. This view is mainly based on three aspects: (1) the computer aided foreign language teaching is teachers adopt some functions (or computer sharing part of teaching) of computer to change the teaching method and improve the teaching effect. (2) Three key technologies of computer, namely, artificial intelligence technology, digital technology, information network technology have been rapid development. (3) In the field of foreign language learning, the learners and the computer have already formed a personal computer society.

In fact, learners can have a number of micro-computers, anyone can get obtain the required learning content from any place and any time through the wireless network. Each learner can learn according to their needs. The formation of foreign language teaching has been initially formed, as shown in Figure 2:

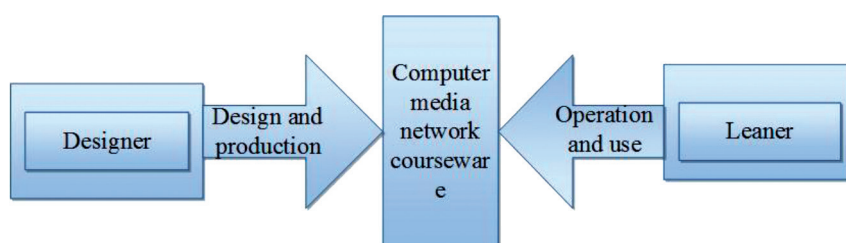


Figure 2 – Computer Dominant Mode

In the computer dominant mode, the relationship between the computer and the learner becomes a multiple relationship. The computer not only can be used as a teacher, but a learner. In addition, the dominant mode can allow the computer to act as a teacher and a partner, or let the computer act as a learner, and interact with the learners. In short, the computer in dominant mode can play a variety of roles in foreign language teaching, so that foreign language teaching can really do a virtual, personalized, wide, cooperation and natural.

4.1.2. “Normalization” of Computer Using

The second view is that the use of computer in foreign language teaching should reach “normalization”. Normalization is one kind of state, namely computer has completely integrated into people’s daily life, the teacher and the student are no longer regard the computer as the special technology, but is only a part of daily teaching activities. Like the pen and books that we use now, it is a natural thing, it will not cause special attention, and it will not exaggerate its role. The “normalization” of computer application can’t be achieved overnight, the general need to go through the following seven stages:

The early using: Minority teachers and schools adopt computer teaching because of curiosity;

Suspect/ Hesitate: Most people still keep the attitude of suspecting/ hesitating;

Try: Some people tried a not because of too many problems, and there is no value and did not seem to be increased any “comparative advantage”.

Try again: Others tell them that the computer teaching is really useful, so they try again, and find that there is a relative advantage;

Worry / Psychological fear: More people begin to use, but there are still some worries;

Start normalization: Computer teaching is as the daily needs;

Normalization: Computer teaching is completely into our life, people are accustomed to normalization.

To achieve normalization, logistics support is the most basic, which needs to ensure the preparation time from the engine room, on the computer, classroom layout.

These two perspectives are explained, we can’t look computer functions at the traditional concept, and should re-examine the relationship between computer and foreign language teaching with the vision of dynamic development. In particular, the classroom English teaching mode based on computer emphasizes the organic integration of computer network and foreign language teaching, which is essential to computer assisted instruction. Of course, the view of computer dominant teaching seems to be more radical, because “dominant” means the full control of teaching and guidance, but the computer is not human, it is impossible to have a unique inherent emotion and the full control of things changes like human. Therefore, in order to achieve normalization of foreign language teaching, three matters are needed, namely hardware, software and humanware.

4.1.3. Hardware, Software and Humanware

The first is hardware construction. General the main equipment in multimedia classroom is: desktop computers, video display, LCD projector, electric screen, DVD players, audio power amplifier, microphone and speakers and so on. Multimedia classrooms with advanced facilities may be equipped with digital interactive whiteboard. Thus the teaching equipment system in the classroom teaching is formed.

The followed is software construction. From the current situation of college English teaching reform, the success of English teaching depends on the teaching software on a

large extent. At present, there are many problems and defects in the development of the English software that produced by the publishers in China. The design of multimedia English teaching software should emphasize 5 principles:

Adaptability. The use of the English multimedia teaching software must be intuitive and easy to use.

Interest. The abstract, boring learning content is presented to the students by the way of illustrations and dynamic and static combination, so that the students can construct their own knowledge system in the visual image of the scene.

Inspiration. The interactivity and intelligence of the multimedia computer can help students overcome the shortcomings of shyness, so as to increase the enthusiasm of learning.

Inspiration. The interactivity and intelligence of the multimedia computer can help students overcome the shortcomings of shyness, so as to increase the enthusiasm of learning.

Interactivity. The multimedia computer is used to help students correct their error of pronunciation, morphology, syntax and even used language so as to give full play to the computer and human interaction.

Progressiveness. The teaching difficulty that designed by teaching software should be continuously improved, and can automatically track the progress of students learning, which also need to find that the students' learning difficulties and automatically give help.

Compared with the hardware and software construction, humanware construction (mainly refers to the training for teachers) is one of the most important thing in these three factors. Due to the promotion and application of the educational technology, the participation degree of teacher is actually the decisive factor of the success. From the point of view of the current situation of Chinese CALL teaching, human factor has become the bottleneck to restrict the development of the computer multimedia teaching, popularization and achieve "normalization". Therefore, the humanware construction is imperative.

At this point, we should have a new understanding of the relationship between computer and foreign language teaching. It can be said that under the computer network environment of foreign language teaching, we should pay more attention to the use of computer super function, the emphasis is on the use of computer networks "normalization" as well as the organic integration of teaching.

4.2. Integration of Computer Network and Foreign Language Curriculum

The integration of computer network and foreign language curriculum is different from computer assisted instruction: Computer assisted instruction is just a prominent feature, which is used to help teachers improve the teaching effect, and the integration of computer and curriculum can become an organic part of the whole course system. Therefore, the integration of computer network and curriculum changes the course in the nature, which mainly in three aspects: breaking the "classroom + textbook", creating

an ideal environment and the way of teaching and learning, fundamentally changing teaching structure.

1. Breaking the limitations of “classroom + textbook”. The computer assisted instruction is actually based on classroom and textbooks, that is, the textbook is the only source of knowledge to the students. Teachers, textbooks, students, the relationship among the three factors is teachers dominate the classroom, the essence of this model is the teachers dominate the classroom, students are completely in a passive position, and become the object, even if the teachers use the computer as a teaching aid. Computer network and curriculum integration can change this situation, because the framework of the teaching has a fundamental change, as shown in Figure 3:

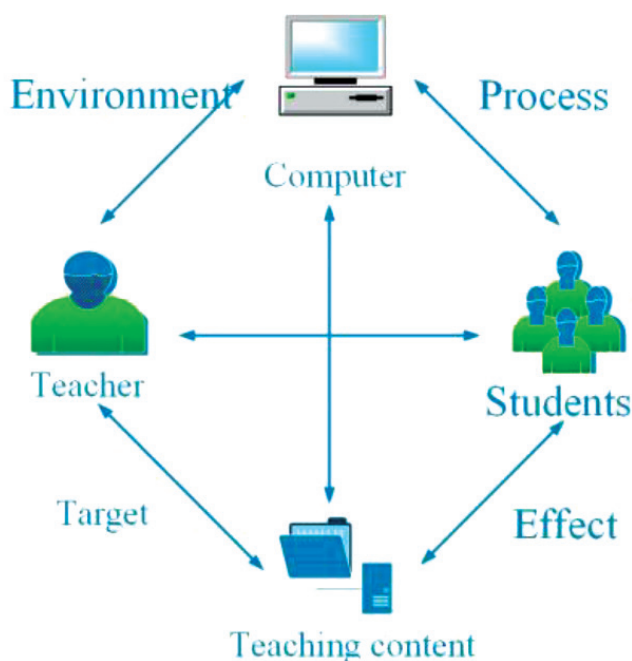


Figure 3 – Integrated Framework of Computer and Foreign Language Curriculum

In terms of teaching elements, the relationship among teachers, students, computers and teaching contents is not a one-way, but a two-way interaction, interdependence, mutual conversion. As shown in Figure 4:

Thus, in the whole learning process, students can contact the knowledge that far beyond the scope of the textbook, they can carry out meaningful, active knowledge construction through many ways.

2. Creation of ideal environment and way of teaching and learning.

The integration of computer network and foreign language teaching is good for creating an ideal environment and way of teaching and learning. The creation of this ideal

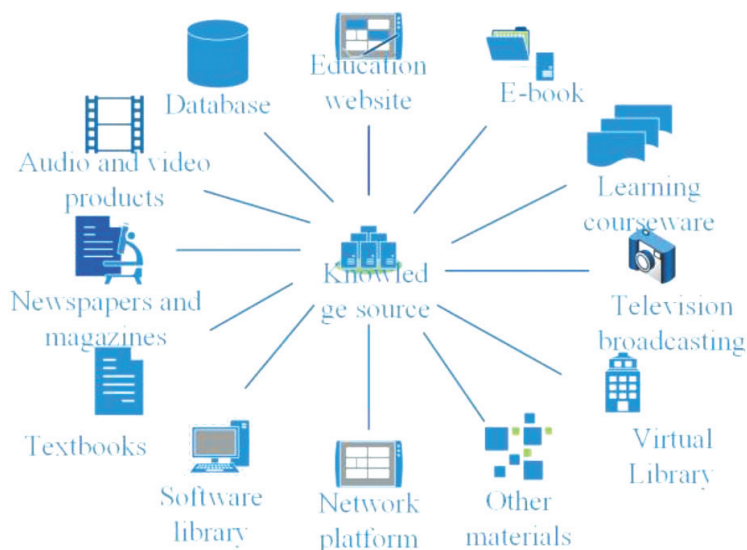


Figure 4 – Knowledge source

environment benefits from the rapid development of computer network technology, which creates the conditions for the students to study as the center. From the view of theoretical point, ideal communicative language teaching environment is a student-centered learning environment, which should include situational learning, cooperative learning and open learning three elements:

Situational learning. The traditional textbooks and teaching will be separated from the situation.

Cooperative learning. In a student centered teaching environment, teachers and students need to cooperate more than ever before. After the integration, the teaching structure no longer accepts the concept of teachers as an isolated decision maker. It is very important to distinguish the teaching characteristics of the development of the cooperation and social skills and the characteristics of the traditional group learning.

Open learning. This learning environment usually requires students to solve problems by means of contacting, transforming, and changing new information. This open learning environment is mainly based on two methods: Inquiry learning and task learning.

4.3. The Fundamental Changes in the Structure of Teaching

The integration of computer network and foreign language teaching not only can create an ideal teaching environment, but also make the teaching structure system have a fundamental change. The traditional teaching structure that “teaching” as the center of teaching changes to the teaching structure that “teaching” and “learning”. As shown in Figure 5:

1. The teacher’s leading role is mainly reflected in the function. In this kind of teaching structure, the teacher wants to change its traditional role, must have a

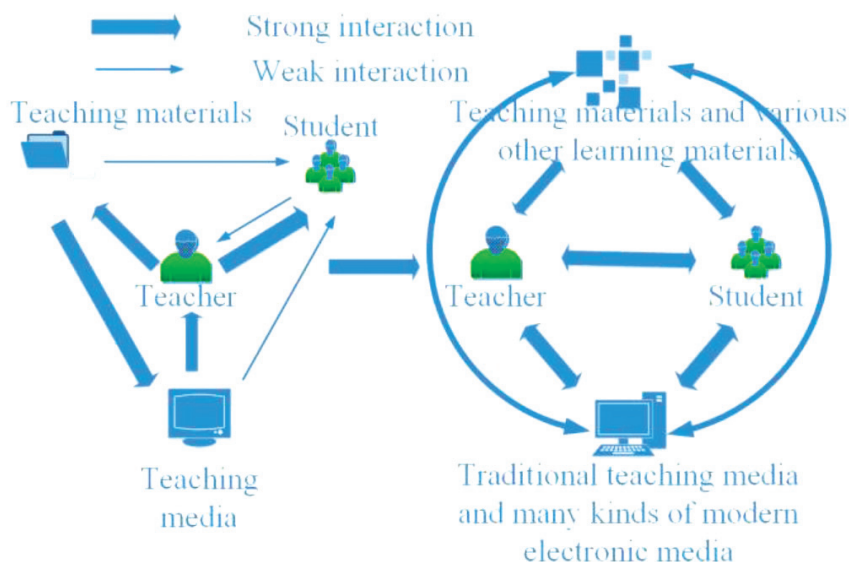


Figure 5 – Teaching Structure of the Teachers Centered and the Teaching Structure of the Main Body

new understanding to the change of teaching structure.(2) The students' main role is mainly reflected in the learning method of "student centered". In the dominant teaching structure, the image of the students as the "be infused" is changed, and the students become more and more active in the learning activities.

5. Conclusions

The purpose of the current college English teaching reform is to solve the problems of students' application ability and the shortage of educational resources. Therefore, a new teaching mode of foreign language is put forward by the Ministry of education. However, as for the current teaching situation, the implementation of the new model in most colleges and universities is still a kind of traditional computer assisted instruction with the teacher as the center. In order to truly achieve the goal of teaching reform, the computers is just regarded as a supplementary tool is not enough. Therefore, we should change the idea, and integrate the computer network with the foreign language curriculum. Through the analysis and discussion of this paper, we should have a more profound and clear understanding of the relationship between computer and foreign language teaching: Firstly, the computer can effectively improve the teaching and learning effect and efficiency; Secondly, with the development of computer technology, it is very low to take the computer as an auxiliary tool to improve the teaching efficiency, which also doesn't meet the needs of the development of the times and the requirements of current college English teaching reform; Thirdly, in order to apply the computer to the foreign language teaching effectively, it is necessary to integrate the computer with the course to make the computer become the organic part of the curriculum, so

as to implement the mode of English teaching based on computer and classroom more effectively. The foreign language courses after integrating will break the limitations of the traditional education model, which can use the developed computer technology to create an ideal foreign language teaching environment, and thus fundamentally change the existing teaching structure. Only in this way, the reform of college English teaching is likely to reach the target of solving the problem of the students' language application ability and the serious shortage of foreign language education resources.

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Research on the Intelligent Teaching System of College Basketball Based on Artificial Intelligence

Li Tingting^{1,*}

313444301@qq.com

¹ Basketball Department, Jilin Sport University, 130033, Changchun, Jilin, China

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Abstract: As education measures to promote college basketball skills and health exercise habit of college basketball teaching, basketball teaching effectiveness of need based on the development of students intelligence, based on the premise of physical and mental health of college students and the development of intelligent, the increase of college basketball teaching mode innovation and application. Artificial intelligence theory in intelligent space and body movement intelligence put forward has positive effect on basketball teaching. Based on the practice of college basketball teaching, this paper analyzes the application strategy of basketball teaching in colleges and universities with the point of the artificial intelligence teaching as the breakthrough point. To the intelligent teaching system of college basketball. The design and test of the model of the intelligent teaching system. Firstly, the intelligent teaching model is designed based on the Agent technology and the adaptive selection algorithm. Secondly, the model is tested by teaching experimental method. Finally, the results are come out, and the results are compared and analyzed. The experimental results of the model group are significantly better than the control group. And $P < 0.05$, it has statistical significance. Intelligent teaching system for college basketball teaching has unique advantages. Through this study, it is to provide theoretical and practical reference for the improvement of basketball teaching in colleges and universities, and it deserves to be promoted.

Keywords: Basketball; artificial intelligence; intelligent teaching system.

1. Introduction

At present, there exist some problems in commercial bank experiment teaching such as the single experiment instrument, the deficiency of integration between theory and practice and the lack of logical connections between experiments. In accordance with the modern cultivation goal of financial majors, this paper introduces comprehensive experimental method into commercial bank experiment teaching, which takes theoretic knowledge as the basis, adopts proper and multiple experiment methods, forms logical connections between experiments, and assembles modules to construct a synthetically experiment teaching system of dividing levels, multiplying modules, combining compulsory with elective and classroom with out-classroom. The paper aims to describe ideas and implementation of the computer tool for computer-aided and recycling-oriented design. Currently, there is a strong tendency to take into account the impact of a product on the

natural environment. The authors concentrated on the issue of the recycling process of the product, taking into account the phase of its design. The purpose, structure, technology and example results are presented in this paper. At the same time, we develop the interactive information platform to provide the consultation and promotion service of goods. The overall framework will help enhance the performance of the sales outlets and improve the customer service, while addressing the time effect issue of the popular commodity. Molecular biology technique is the essential skill for biological technic talents. Combined working with studying, the special course system was established by converting the scientific research to integrated experiment items in teaching. Teaching with task-driven teaching method and simulating working environment, it pays great attention to cultivate the students' professional quality and the accomplishment. It takes ability as the core inspection appraisal system. Multi-agent based simulation has been looked as an efficient tool for large-scale system, like urban intelligent transport system. However, the main problem is how to build a multi-agent based model to simulating it. This research presents a multi-agent based demand responsive transport (DRT) services model, which adopts a multi-agents planning approach for metropolis traffic services control.

2. Agent Technology

With the development of computer aided education and artificial intelligence, a new comprehensive educational technology based on Computer Assisted Instruction, the artificial intelligence teaching system is booming. Intelligent teaching system is based on the students as the center, the computer as a medium, the use of computer simulation teaching experts thinking process, the formation of an open type of human-computer interaction system.

Artificial intelligence is a branch of computer science (Hazell, P., Sprague, T., & Sharpe, J., 2016). It is a comprehensive subject that studies the use of computer simulation and extends the human brain function. In many areas of computer science, artificial intelligence is one of the most challenging and creative fields. Artificial intelligence technology has many kinds, including neural network technology, genetic algorithm, expert network technology, Agent technology, etc. With the birth and development of artificial intelligence, people began to use computers for teaching (Gamburd, M. R., 2015). Among them, Agent technology is very important in the design of intelligent teaching system (Gaitán, H., 2015). This paper is based on the research of Agent technology in intelligent teaching system of the sports college basketball. The purpose of this paper is to promote the application on new teaching technology in basketball teaching practice, and to explore new ways to improve the quality of basketball teaching in colleges and universities (Reynares, E., Caliusco, M. L., & Galli, M. R., 2014).

With the development of computer aided education and artificial intelligence, a new comprehensive educational technology based on Computer Assisted Instruction, the artificial intelligence teaching system is booming. Intelligent teaching system is a student centered, computer mediated, the use of computer simulation of the thinking process of teaching experts, the formation of an open system of human-computer interaction (Teixeira, F. R., Mayr, L. R., Paisana, A. V., & Vieira, F. D., 2014).

Research on agent theory and technology is originated from the Distributed Artificial Intelligence (DAI) and it is a software entity that can independently learn and adapt

to the environment (Polishetty, A., Littlefair, G., Goldberg, M., & Nomani, J., 2016). Distributed Artificial Intelligence (DAI) is an approach to solving complex learning, planning, and decision making problems. It is embarrassingly parallel, thus able to exploit large scale computation and spatial distribution of computing resources. These properties allow it to solve problems that require the processing of very large data sets. DAI systems consist of autonomous learning processing nodes (agents) that are distributed, often at a very large scale. DAI nodes can act independently and partial solutions are integrated by communication between nodes, often asynchronously. By virtue of their scale, DAI systems are robust and elastic, and by necessity, loosely coupled. Furthermore, DAI systems are built to be adaptive to changes in the problem definition or underlying data sets due to the scale and difficulty in redeployment. It is able to achieve a set of pre - set goals or tasks by using the information in the environment. Multi Agent system is composed of multiple independent Agents, and each Agent has its own responsibilities. And it obtains information with other Agent communication and work together to complete the entire problem solving. Compared with a single Agent, multi Agent system can complete more complex and more complex functions (Schmidt, J., 2016). And multi-agent intelligent teaching system can support individual learning guidance according to the current level of domain knowledge and learners, and enable students to truly become the main body of learning, to teach students in accordance with their aptitude (Peirano, M. P., 2016). It is a read from the adaptive teaching process, and there are broad prospects for application, which also makes studies on Intelligent Tutoring System in the recent few years have become very necessary and very active. How to use the method of pure technology to improve the existing teaching methods that facilitates students to learn become more and more important.

3. Adaptive Selection Algorithm for the Model of Intelligent Tutoring System Based on Agent Technology

The intelligent tutoring system is widely used by the system to provide many kinds of teaching mode, there are two kinds of design, by the students in the study of the second option is for the advance has been made a main teaching pattern, but some teaching mode is by the learners according to their own need to choose their own. These two forms are not able to truly reflect the intelligence of teaching mode selection. Intelligent teaching mode selection should be according to the students' cognitive styles and teaching contents of information, through the search and reasoning of the intelligent system, and automatically generate the most suitable learning teaching mode, and according to the different stages of learning according to certain strategy adjustment, dynamic automatically learning and teaching mode of adaptation. The adaptive strategy is the choice of a kind of teaching mode, through the teaching resources and student learning characteristics of the teaching mode is the modest computational, first determine the a phase moderate the largest teaching model preliminary teaching, according to the stage of test results of dynamic adjustment is moderate, and according to the adjusted phase appropriate to choose teaching mode, so as to realize the adaptive selection of teaching mode. Adaptive intelligent tutoring system is a cross field of artificial intelligence, cognitive science and educational science. It is the integration of intelligent teaching system and adaptive system in the network environment. Adaptive intelligent tutoring system of preschool diagnostic tests and in the learning process updates the learning

model of information, the purpose is to real-time grasp learning the basic experience, cognitive structure, cognitive style, hobbies and other aspects of the information, thus providing learners in the current state of learning new information is most suitable teaching mode, learning content, learning strategies, learning support and the best of the knowledge base. Here we discuss a multi-mode teaching model adaptation algorithm.

In a variety of teaching mode, to determine the appropriate teaching mode for different characteristics of students is a key to the system can be intelligent personality teaching. The appropriate teaching model has two meanings: one is to determine the teaching mode, the teaching resources can meet the teaching requirements. Two is under the premise of teaching resources, the teaching mode should be as far as possible to meet the specific situation of student learning. The teaching resources of the teaching mode phase moderate algorithm and the student model of teaching mode phase moderate algorithm proposed this paper in the two phase moderate based, and then through the teaching mode selection algorithm is a kind of teaching model to determine

According to the suggestion of educational theory and subject, the teaching model can be regarded as the basic structure and activity program of various types of teaching activities and its implementation methods (Garcia-Bernabeu, A., Mayor-Vitoria, F., & Mas-Verdu, F., 2015). So the formal definition of teaching mode is as follows.

$$S = (\text{Pattern Name}; \text{Resource Feature}; \text{Student Feature}) \quad (1)$$

Student model is a record of the basic information of learners and the representation of cognitive state. Can accurately and objectively reflect the students' current knowledge level and cognitive ability of the month 'dial. It is the basis for the realization of adaptive teaching and the guidance of true intelligence. Establishing a suitable model of students can diagnose the misunderstanding of the students' knowledge, and take appropriate methods to correct the students' mistakes in the appropriate time to achieve a good learning effect. The student model plays a very important role in the individual teaching. It provides the basis for the system to realize individualized teaching. Therefore, the establishment of a good cognitive model is the foundation of the intelligent teaching system. Student model and teaching model is closely related to the selection and under the presupposition of teaching resources, teaching mode to conform as much as possible to students' personality characteristics. Therefore, in this paper, the design of the use vector space model to calculate the student model of teaching mode phase moderate algorithm, vector space model by. Model of document representation. It takes the feature item as the basic unit of the document, and the feature item can be composed of the word, word or phrase. All feature item set. Each document can be represented as a vector, and the dimension of the vector is the number of the feature item set.

Its calculation method is as follows.

We extract features (t_i), the value of the feature item (a_i) and the corresponding weight (w_i) from the Student Feature from the teaching model P_K . Among them, $\sum_{i=1}^n w_i = 1$ the results of a_i and w_i are assigned to u_i . $u_i = a_i \times w$ Is a compound weight of the feature term, which forms the feature vector space U.?

$$\{(t_1, u_1), (t_2, u_2), (t_3, u_3), \dots, (t_n, u_n)\} \quad (2)$$

Through the students' learning style test and analysis of the students' learning history, it obtains the actual information of the students' learning characteristics in the form of feature vector with the weight of R.

$$\{(t_1, r_1), (t_2, r_2), (t_3, r_3), \dots, (t_n, r_n)\} \quad (3)$$

For vector space model, the degree of the similarity is usually expressed between the two vectors by the angle between the vectors (Kishk, T. F., Al-Barah, A. M., El-Sheikh, Y. M., El-Khouly, W. B., & Omran, A. F., 2015). $\text{Cos}(R, U)$ Is the angle between the vectors, which is the P_k teaching mode of the appropriate $\beta(P_k)$ for the student model?

$$\beta(p_k) = \text{Cos}(R, U) = \frac{\sum_{i=1}^n u_i \times r_i}{\sqrt{\sum_{i=1}^n r_i^2} \times \sqrt{\sum_{i=1}^n u_i^2}} \quad (4)$$

4. Intelligent Tutoring System Model

In this paper, we first design a personalized intelligent tutoring system model, which is composed of several components. By using the cooperative mechanism, the knowledge exchange and sharing are realized, and a multi hierarchy system is formed. In the system of individualized instruction proposed a teaching mode selection of adaptive selection strategy by using vector similarity calculation for a study of which adapt to the learning style, and track students learning records and case, to make adaptive adjustment strategy of teaching mode, to the students for the purpose of strengthening the teaching of personalized teaching process, is designed according to the progress of learning, difficulty level and learning interest of intelligent estimation of personalized recommendation algorithms such as.

The model of the intelligent teaching model mainly includes the knowledge base, the student model, the teacher model and the man-machine interface (Masunaga, M., Ueda, H., Shibaguchi, T., & Tanne, K., 2016). The basic structure block diagram is shown in figure 1.

An intelligent tutoring system (ITS) is a computer system that aims to provide immediate and customized instruction or feedback to learners, (Dabrovolskas, A., 2016) usually without intervention from a human teacher. ITSs have the common goal of enabling learning in a meaningful and effective manner by using a variety of computing technologies. There are many examples of ITSs being used in both formal education and professional settings in which they have demonstrated their capabilities and limitations. There is a close relationship between intelligent tutoring, cognitive learning theories and design; and there is ongoing research to improve the effectiveness of ITS. An ITS

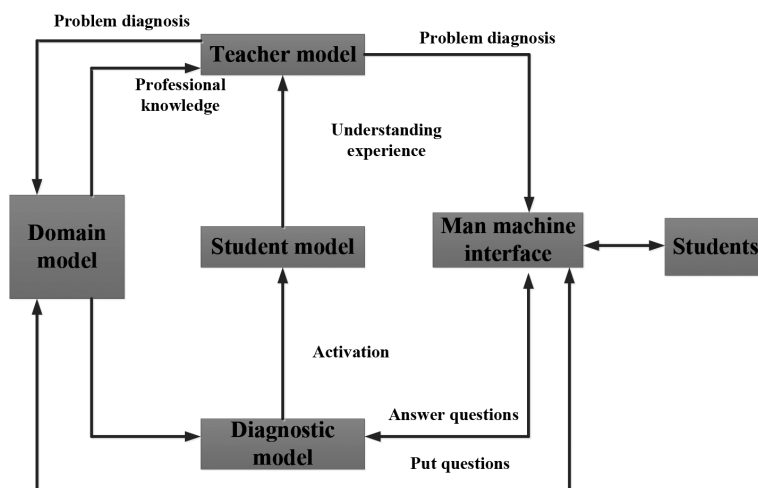


Figure 1 – Intelligent Tutoring System Model

aims to solve the problem of over-dependency of students over teachers for quality education. It aims to provide access to high quality education to each and every student, thus reforming the entire education system.

Our model has focus on three main points: (1) the distributed negotiation model for coalition formation, (2) fuzzy-based evaluation model and (3) best set of effective coalition(s). Based on the best successful deals from negotiation, effective coalitions obtained. The performance of proposed fuzzy-based negotiation model for coalition formation is evaluated and compared with other conventional models. The results obtained from this work have proven that using fuzzy-based decision maker negotiation model is not only more practical and increased the efficiency and effectiveness for forming a best set of coalition(s) among agents but also increase the accuracy of the system in case of agent's utility and social welfare.

Based on this model, a simplified multi-agent based demand responsive transportation services system can be developed that is effective for reducing traffic congestion and air pollution. By computational experiments, we examine an effectiveness of the proposed method.

Students' cognitive level estimation is analysis of the most important functions, but also to achieve the personalized teaching is an important method, no cognitive level estimate would be unable to analyses the learning effect of students, it is impossible to realize the personalized teaching control.

Student model (Figure 2): it can accurately reflect the level of knowledge, learning ability, etc., and provide the basis for the system to achieve the individual teaching.

Teacher model (Figure 3): it can be combined with the teaching strategy and the structure of knowledge, and choose the problem for them to answer (Singh, M. S., & Peer, D., 2016), monitor and evaluate their behavior for students, when students need to choose appropriate remedial materials for them.

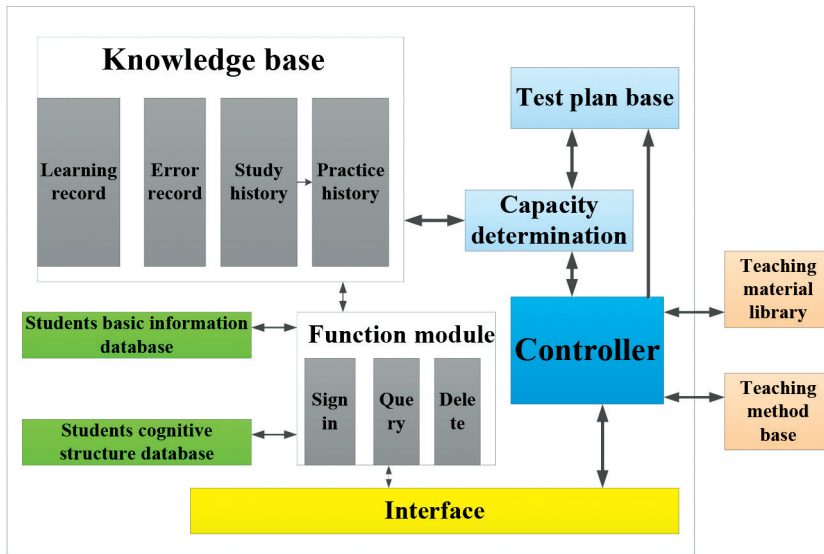


Figure 2 – Student Agent Model

Through the above algorithm to determine the teaching mode is static, according to determine the learning content and learning environment is a kind of teaching mode and did not after the students practice, ideal of intelligent teaching system teaching mode should according to the students' learning content change and students learning interest, preferences and the transfer of dynamic adjustment, and previously calculated phase moderation should be after the practice of students according to the stage of evaluating the results of dynamic adjustment, the above - mentioned reasons will cause the change of teaching mode. Therefore intelligent teaching system must have a teaching mode selection of adaptive strategies to deal with due to change the environment characteristics of learning, teaching mode adjustment, and the strategies to ensure the adjusting of real-time and dynamic.

5. Model Testing

5.1. Teaching Experiment Method

In a variety of teaching mode, to determine the appropriate teaching mode for different characteristics of students is a key to the system can be intelligent personality teaching. The appropriate teaching model has two meanings: one is to determine the teaching mode, the teaching resources can meet the teaching requirements. Two is under the premise of teaching resources, the teaching mode should be as far as possible to meet the specific situation of student learning. The teaching resources of the teaching mode phase moderate algorithm and the student model of teaching mode phase moderate algorithm proposed this paper in the two phase moderate based, and then through the teaching mode selection algorithm is a kind of teaching model to determine.

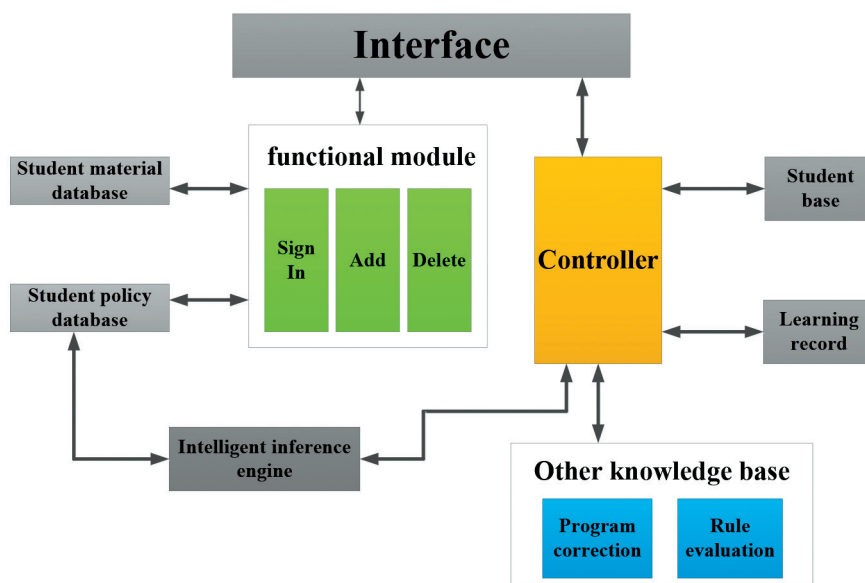


Figure 3 – Teacher Agent Model

In the proposed model, there are three layers: transport-admin agent layer, node-station agent layer and taxi agent layer. The agent for station and each vehicle have a planning domain, and select a route by a cooperation of agents in its planning domain. Based on this model, a simplified multi-agent based demand responsive transportation services system can be developed that is effective for reducing traffic congestion and air pollution. By computational experiments, we examine an effectiveness of the proposed method.

This article mainly uses the teaching experiment method (Manimaran, D., Khan, D. M., Bharathi, K., Raman, T. R., & Anuradha, S., 2016). Experiment is conducted in two teaching methods to compare the teaching experiment (see Table 1). It explores the differences of the teaching effect of the two teaching methods by testing the differences between groups (Reader, A. T., 2016). In the experimental group (A2, B2), the teaching method was based on the model of the intelligent system, and the control group (A1, B1) were used in the traditional teaching method. The corresponding experimental groups are in agreement with the experimental group (Uytun, M. Ç., & Demirci, E. Ö., 2015). Except for the teaching methods, other conditions such as teachers, teaching progress, teaching content, teaching hours, the main test personnel and standards, and the standards are maintained.

5.2. Research Results and Analysis

Student model is a record of the basic information of learners and the representation of cognitive state. Can accurately and objectively reflect the students' current knowledge level and cognitive ability of the month' dial. It is the basis for the realization of adaptive teaching and the guidance of true intelligence. Establishing a suitable model of students

Group	A1	A2	B1	B2
Time	2014.10-2015.1		2014.10-2015.1	
Object	Basketball class 2013 grade in Southwest Jiao Tong University		Basketball class 2012 grade in Southwest Jiao Tong University	
Number	25	25	25	25

Table 1 – Teaching Experiment Arrangement

can diagnose the misunderstanding of the students' knowledge, and take appropriate methods to correct the students' mistakes in the appropriate time to achieve a good learning effect. The student model plays a very important role in the individual teaching. It provides the basis for the system to realize individualized teaching. Therefore, the establishment of a good cognitive model is the foundation of the intelligent teaching system. Student model and teaching model is closely related to the selection and under the presupposition of teaching resources, teaching mode to conform as much as possible to students' personality characteristics. Therefore, in this paper, the design of the use vector space model to calculate the student model of teaching mode phase moderate algorithm, vector space model by. Model of document representation. It takes the feature item as the basic unit of the document, and the feature item can be composed of the word, word or phrase. All feature item set. Each document can be represented as a vector, and the dimension of the vector is the number of the feature item set.

The experimental group compared with the students of the experimental group is based on Table 2.

Project	A1	A2	Pa	B1	B1	Pb
Vertical jump (m)	0.75±0.078	0.78±0.054	>0.05	0.71±0.088	0.74±0.045	>0.05
30m	4.17±0.145	4.13±0.112	>0.05	4.13±0.167	4.16±0.108	>0.05
Pull ups (n)	9.18±0.41	9.15±0.56	>0.05	9.11±0.79	9.12±0.55	>0.05
Reentry run (s)	13.61±1.78	13.41±1.31	>0.05	13.71±1.66	13.72±1.41	>0.05

Table 2 – Comparison of Students' Special Qualities

The results of the experiment are shown in Table 3.

Project	A1	A2	Pa	B1	B1	Pb
Technology	70.66±7.10	74.71±7.78	<0.05	71.23±7.19	72.65±7.71	<0.05
Theory	70.23±7.45	74.87±7.09	<0.01	69.17±7.99	72.43±7.69	<0.01
Total score	70.37±7.01	72.99±6.98	<0.05	71.11±7.33	73.23±7.19	<0.05

Table 3 – Comparison of Experiment Result

The results showed that the experimental group was better than the control group, the difference was significant difference; the experimental group was better than the control group, and the degree of the difference was very significant. The total score of

the experimental group was better than that of the control group, and the degree of the experimental group was significantly different. Compared with the technical achievement, the difference of theory course is more significant. Intelligent teaching methods on theoretical achievement effect more obvious, which is due mainly to motor skill learning of Basketball Teaching in theory teaching will be technical and tactical structure, key points of visually demonstrate, promotes the student to understand the concept of action and form a dynamic setting, with very important significance. (Duggirala, S. X., Saharan, S., Raghunathan, P., & Mandal, P. K., 2016) From the point of view of the current teaching situation, teaching theory with teaching mode of the traditional media, such as the instruction, slide shows, videos and other, in expressive force exists some deficiencies, so that it is difficult to complete the task, basketball theory teaching and skill teaching disjointed phenomenon exists. Such as through the method of video teaching theory course, due to the lack of the characteristics of man-machine dialogue recording, teachers on the teaching process is difficult to control, students' attention to much to appreciate technical movement, thus ignoring the study of the action concept and structure. Intelligent teaching system can provide many kinds of media integration of intelligent interactive environment, theory teaching and skill practice can in this environment achieve the organic integration, teachers can guide the learners according to the need for selective and efficient learning, so as to improve the teaching effect.

6. Conclusion

Basketball artificial intelligence teaching system of sports colleges basically achieved the expected design goals and requirements, the practical test proves that it can improve the effect of basketball teaching in physical education colleges and universities, and has certain promotion value.

Basketball artificial intelligence teaching system is a multi-level dynamic interactive multimedia presentation system, which has good interaction and intelligence. Through the establishment of a logical link between the multimedia information, teachers and students can be based on the needs of teaching and learning, the selection of efficient learning.

Basketball teaching material of integral ware base has been established in the sports college basketball teaching of artificial intelligence system, the rich teaching resources library and intelligent interactive control, for teachers and students to the system to make full use of and continue to develop and improve the utilization efficiency of the system.

Intelligent tutoring system can provide a variety of media integration of intelligent interactive environment, theoretical teaching and technical practice can achieve the organic integration in this environment, and the teacher can guide the learners according to the need that can carry out selective efficient learning, so as to improve the teaching effect.

The remainder of this paper is organized as follows. Section 2 describes the agent technology and the development intelligent of agent technology. Section 3 gave adaptive selection algorithm for the model of intelligent tutoring system based on agent technology. Section 4 presented intelligent tutoring system model. Section5 gives the Model testing of teaching experiment method and the research results and analysis. Conclusions are summarized in Section 5.

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Design and Practice of the Schedule Arrangement System of Track and Field Sports Competition Based on Artificial Intelligence

Sun Yu¹

460001870@qq.com

¹Dept. of PE Teaching, North China Electric Power University, 071000, Baoding, Hebei, China

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Abstract: Sports industry has become the most promising emerging industries in the 21st century. The industrialization of sports competition is an important part of sports industry, it is the product of the combination of sports and market, and has great developing potency. The traditional manual schedule arrangement of track and field meeting is a very complicated work, which is very easy to make mistakes by manual processing. Therefore, in order to solve the existing problems in the traditional manual schedule management, the schedule arrangement system of track and field sports competition based on artificial intelligence is designed in this paper. The design scheme, the realization method of the system, the development tools and related technologies are expounded, and how to use artificial intelligence technology to develop the schedule management system of track and field sports meeting is described, then based on the genetic algorithm in artificial intelligence, the schedule arrangement algorithm is researched, thus a schedule arrangement system of track and field sports competition is designed on the basis of the artificial intelligence. The experiment proved its effectiveness. This system can solve the existing problems in the traditional manual schedule management, improve management level, management quality and work efficiency of the sports meeting, and save a lot of manpower, material resources and time for event managers.

Keywords: Artificial intelligence; track and field competition; genetic algorithm; schedule management.

1. Introduction

With the rapid development of artificial intelligence technology, the schedule arrangement work of modern track and field sports meeting also entered into the era of artificial intelligence. Traditional management methods of track and field sports meeting have been greatly challenged, and there are many complicated affairs in the management. At present, the schedule arrangement of the track and field sports meeting still uses manual operation, the traditional manual arrangement of track and field sports meeting is a very complicated and complex work, which is time-consuming and easy to error by manual operation. Therefore, the design and implementation of the intelligent management system of track and field sports meeting, can solve the existing problems in the traditional manual schedule management, and save a lot of manpower, material

resources and time for event managers, overcome the unnecessary errors caused by manual processing. (Ibrahim, I. B. M., Aghasafari, P., & Pidaparti, R. M., 2016) The early small systems mainly to use VF6.0 and Microsoft SQL Server 2000 to build software system, it is mainly to achieve the management of track and field games on a single machine, the registration form is imported in the form of a floppy disk. If the floppy disk is damaged, the data will be easily lost, this is easy to happen, and the workload is very large. In recent years, with the continuous deepening of informationization in our country, the units have built the internal LAN or even Iniet network in different degrees, so as to make the track and field sports information management system based on LAN and the Internet more and more attention. The information management system mainly uses Delphi, VB, VC and other powerful database and network communication programming ability, as well as ASP, JSP software database, web programming ability to make the final information system interface beautiful, convenient operation, powerful. Therefore, this paper focuses on researching the genetic algorithm in artificial intelligence. Through the genetic algorithm, the schedule arrangement algorithm is researched, then, a schedule arrangement system of track and field sports competition based on artificial intelligence is designed. The experiment proves that this system can improve management level, management quality and work efficiency of the sports meeting, and provide better service levels for the event organizers and participants (Raei, F., & Ahmadi, G. R., 2015).

2. Research Status

As the foundation of all kinds of sports, track and field has broad masses. It is an effective way to improve the physical fitness of the whole people and carry out the national fitness campaign. Sports management scheduling system development history can be traced back to the end of the 60's. (Boudia, M. A., Rahmani, A., Rahmani, M. E., Djebbar, A., Bouarara, H. A., Kabli, F., & Guandouz, M., 2016) At that time, due to the computer technology has entered the practical stage, and the large movements that processed by hand calculation have cost a lot of time, in order to solve this contradiction, the games scheduling management system has come into being. Due to the restrictions of the technical conditions and demand, the users were very few, and this kind of system was only an automatic calculation tool, (Saadat, A., & Tabatabaei, M., 2015) almost had no report generation function and data layout analysis. However, its appearance shows a bright future for the the sports management, the computer's high speed and automation are used to replace the manual to deal with a huge amount of industry and trade, the high accuracy of computer avoids manual errors. (Santos, A. C., Duhamel, C., & Belisário, L. S., 2016) In the more developed countries in foreign economic, whatever the large track and field games, or small and medium sized games, as well as the basic level of track and field games have used the basic computer management. Such as Japan, South Korea, Singapore and other countries, the track and field games at all levels basically have achieved the standardization of management automation management. In China, in recent years, the research on the automatic management of the track and field sports meeting has been some achievements, (Rahmani, M. E., Bouarara, H. A., Amine, A., & Hamou, R. M., 2016) many companies have published a lot of research results in sports automatically scheduling management. Which generally can be divided into two aspects, on the one hand, the arrangement management of all kinds of sports events is researched. It mainly studies the purpose, significance, structure of the athletics events and so on. On

the other hand, the automatic management of the track and field games is studied, which is based on the previous research to design and implement the automatic scheduling and management of the games. Through the study of the contents of the above two aspects, there are many sports will automatically manage the software system. Now commonly used software are: The Haojie track and field sports scheduling information management system was designed to realize the information management of each stage during the games, and provide the motion parameter setting and a custom function, which could support all-round sports project and the excel bulk conductivity and manual entry (Liu, B., & Qian, J. M., 2015). Management integrated system of track and field sports meeting was developed to realize the functions of the site, layout and the setting of competition parameters and so on (Liu, X. F., Fang, Y., Cao, Z. H., Li, G. F., & Yang, G. Q., 2015). Jingba sports meeting management system had the main functions of parameter setting, registration management, pre competition arrangement, competition management, post match inquiry and so on (Sun, L., Wu, B., Tian, M., & Luo, Y. Z., 2016). YiQi track and field sports meeting arrangement management system was organized by the collaborative processing of the Microsoft Acces card method and Word, Excel, which supported for registration data import and export competition data (Parry, A., & Higginson, R., 2016). All of the above software basically can meet the automatic scheduling management needs of the sports meeting. However, due to the specific situation of the operation of various small and medium-sized track and field is not the same, the units of the project are also not the same, in addition, (Ferrari, P., 2015) the various software prices are not cheap. Therefore, in view of the specific situation of the small scale of the sports meeting, it is very necessary to research and develop the management system for the small and medium-sized sports meeting. The remainder of this paper is organized as follows. Section 3 describes the relate algorithms used in this paper. Section 4 gives the design and realization of the schedule arrangement system. (Li, Y. X., Ming, Z., & Chunjie, S., 2016) Section 5 presents a real experiment to evaluate the performance of the system. Conclusions are summarized in Section 6 (Velásquez, E., Cardona, A., & Peña, A., 2014).

3. Relate Algorithms

3.1. Genetic Algorithm

Genetic algorithm is a kind of optimization algorithm of the abstract biological evolution process, using the basic ideas of GA. (Firdhous, M. F. M., 2016) First we need to encode the result set of the problems that will be solved, then randomly select part of codes from the result set codes, regard it as the initial result sets of the solving of genetic algorithm, through calculating the adaptive value of each kind of codes in the initial result sets, using random selection mechanism, according to the adaptive value of each kind of codes to pick out the appropriate codes for reproduction, and using mutation and crossover to produce the next generation codes. Repeat the above steps until get the final result (Venkateswarrao, S., & Bhaskar, K., 2016).

According to the basic process of genetic algorithm in Figure 1, the basic process of the traditional genetic algorithm is found:

Encoding result sets of pending problems;

Species initialization work;

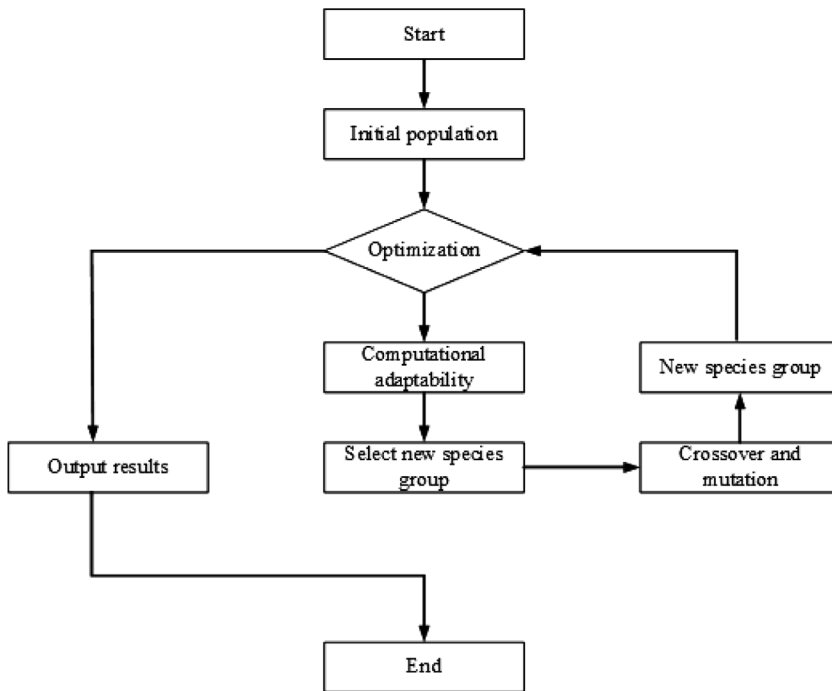


Figure 1 – Basic Flow Chart of Genetic Algorithm

Designing species fitness algorithm;

Species screening strategy;

Crossover and mutation genetic operation;

Optimizing termination conditions.

3.2. Schedule Arrangement Algorithm

To get the division (Y_1, Y_2, \dots, Y_K) of Y , first we can get vertex ordering in a Y , then, according to the time limit of each time unit, the well-ordered sequence of vertex is divided into K sets of vertex, that is the division (Y_1, Y_2, \dots, Y_K) . Thus not only can get the division, but ensure the result to satisfy the constraint conditions. To get the vertex ordering of a Y that the total number of entries is minimal in the same time unit, is similar to the traveling salesman problem (TSP). The traveling salesman problem can be solved by genetic algorithm, so the schedule arrangement also can adopt the similar genetic algorithm. The genetic algorithm is based on the model of the natural evolution of the biological chromosome, follows the genes of chromosome to selection, crossover, mutation in the process of evolution, and generates the next generation. At the beginning of the calculation, initializing the species, calculating the fitness function of each individual, and generating the first generation. If the generated species doesn't satisfy the optimum conditions, choosing individual on the basis of the fitness of each individual to crossover, mutation and generate the offspring. The offspring replaces

the father generation, and then generating the next generation. Executing this process circularly until satisfying the optimum conditions.

3.3. Encoding and Fitness

With the serial sequence number of m track and field events as codes, a chromosome represents the sequence number of each track and field event. Calculation of fitness of individual: In the case of satisfying the constraint conditions, the sequence of events in the field is divided into k parts; calculating the total number of track and field events in each time unit; adding the number of track and field events in each time unit; the fitness of individual adopting the reciprocal of the total number of track and field events in each time unit, the following formula:

$$f = 1 / \sum_{l=1}^k \sum_{x_i \in X_l, y \in Y_l} d(X_i, Y_j) \quad (1)$$

The greater the fitness, the better the individual.

3.4. Genetic Operators

Crossover: adopting the partially matched crossover (PMX) method to generate two intersection points randomly, the area between two points is called the matching area. (Hatam Siahkal Mahalle, A. R., Rezaei, S., Yousefzadeh Chabok, S. H., & Reyhaniyan, A., 2016) Exchanging two matching areas of the parent string. Then exchanging the duplicated genes outside the parent strings one by one on the basis of the mapping relations of position in the matching area, in order to ensure that the two parent strings is still the no repeated order after crossover. Variation: adopting the exchange variation method, that is, choosing two points in the strings randomly, and exchanging their value. Selection: retaining one of the best parent strings, replacing the rest of the parent strings, and retaining the species size constant.

4. The Design and Realization of the Schedule Arrangement System

4.1. General Principles of System Design

Any design is carried out around the established goals, the process of designing is the process of achieving the intended targets. The goal of the competition schedule arrangement system of track and field sports is to design a schedule arrangement system that complies with the rules of track and field, and in accordance with the actual situation. In the design and development of the system, we should follow the general principles:

Openness: The system should be applied to a variety of operating systems, supporting a variety of protocols, supporting for the majority of the database background, and adapting the future development of technology.

Reliability: The product that lacks of stability has large harm to the users. We must ensure that the design of the management system with high reliability. In particular, the system must ensure the stability and reliability of the system, such as timing, score, score processing, and information release in the sports meetings; timely backup data.

Choosing high reliability network products, fully considering the redundancy and fault tolerance ability of the equipment.

Practicality: The construction of the system provides reliable, efficient service for track and field sports competition, at the same time, it needs to have a good cost performance to avoiding waste.

Security: Adopting good security strategy, fully considering the security of the platform, preventing data from being attacked and destroyed; with fault tolerance function, and the system runs reliably.

时间	性别	项目	轮次	时间	性别	项目	轮次	时间	性别	项目	轮次
18:45	女子	400米栏	决赛	18:25	女子	100米栏	半决赛	18:10	男子	110米栏	半决赛
18:55	女子	3000米障碍	决赛	18:30	女子	跳高	及格赛A&B	18:40	女子	3000米	决赛
19:10	女子	三級跳远	决赛	18:45	男子	800米	决赛	18:45	女子	跳远	决赛
19:15	女子	400米	决赛	18:55	女子	800米	决赛	19:10	男子	3000米障碍	决赛
19:15	男子	十项全能-标枪	B组	19:05	男子	200米	决赛	19:20	男子	铅球 (6kg)	决赛
19:25	男子	400米	决赛	19:15	女子	200米	决赛	19:40	女子	4×400米接力	预赛
19:45	男子	400米栏	半决赛	19:30	男子	链球 (6kg)	决赛	19:50	男子	标枪	决赛
20:15	男子	1500米	决赛	19:50	男子	400米栏	决赛	20:20	女子	七项全能-800米	决赛
20:40	男子	十项全能-1500米		20:15	女子	100米栏	决赛	20:50	男子	4×400米接力	预赛
▶8月18日				20:25	女子	七项全能-200米		▶8月20日			
				▶8月19日							
09:00	女子	七项全能-100米栏		09:00	女子	七项全能-跳远	A&B组	18:00	女子	跳高	决赛
09:05	女子	铁饼	及格赛A	09:05	女子	10000米竞走	决赛	18:10	男子	110米栏	决赛
09:30	男子	三級跳远	及格赛A&B	09:05	女子	10000米竞走	决赛	18:35	男子	1500米	决赛
09:40	男子	110米栏	预赛	10:10	男子	10000米竞走	决赛	18:40	男子	三級跳远	决赛
09:55	女子	七项全能-跳高	A&B	10:15	女子	七项全能-标枪	A组	18:45	女子	铁饼	决赛
10:00	男子	铅球 (6kg)	及格赛A&B	11:10	女子	4×100米接力	预赛	19:05	男子	5000米	决赛
10:15	女子	1500米	预赛	11:30	女子	七项全能-标枪	B组	19:40	女子	4×100米接力	决赛
10:30	女子	铁饼	及格赛B	11:45	男子	4×100米接力	预赛	19:55	男子	4×100米接力	决赛
18:00	女子	撑杆跳高	决赛	18:00	女子	标枪	决赛	20:20	女子	4×400米接力	决赛
18:15	女子	七项全能-铅球	A&B组	18:05	男子	撑杆跳高	决赛	20:50	男子	4×400米接力	决赛

Figure 2 – Track and Field Competition Schedule

4.2.Logical Relationship Among the Parts of the Game

The logical relations among the 3 parts of the previous preparation, the arrangement processing and the order book module. As shown in Figure 3:

Previous preparation includes: Group setting, each group limited numbered off set, generate each group registration form, runway setting, time setting, race time settings, packet traffic settings, and complete the registration.

Arrangement processing includes: The statistics of number of participants in each group, the principle of the grouping, the schedule of each group competition, the principle of competition schedule arrangement.

The order book module includes: Team list, competition schedule, competition grouping list, the check tablelist of competition, record registration form.

4.3.Data Flow Diagram

The data exchange between the users and the system, within the modules of the system, we use the graph to intuitively and vividly describe that, which is called the data flow diagram of system, abbreviate DFD. DFD can concisely express the trend of data and

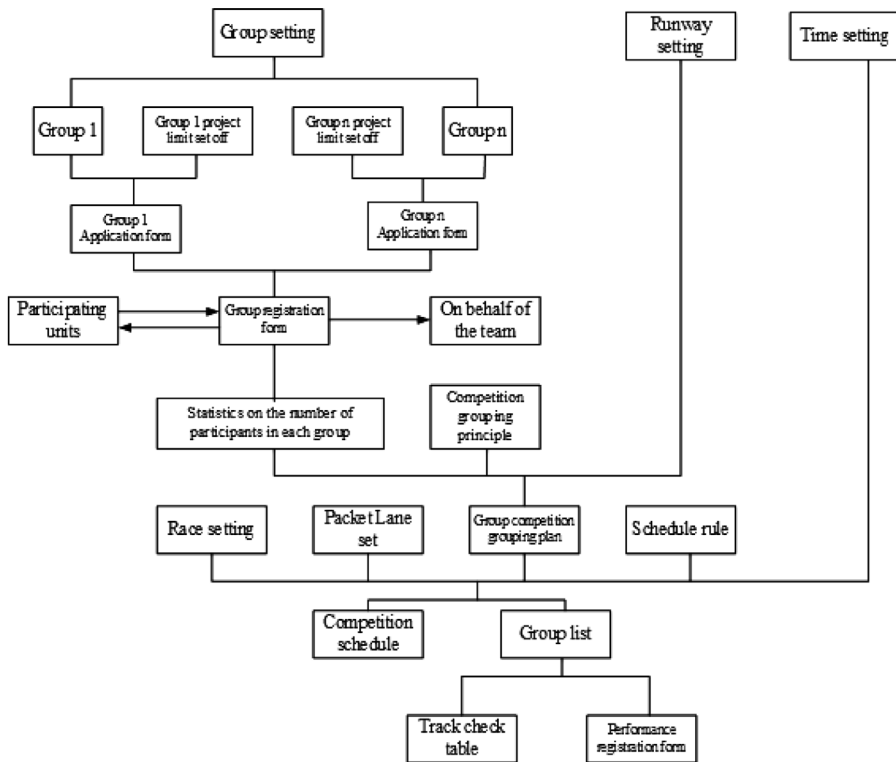


Figure 3 – Logic Relationship Before Game

processing procedure of data in the system. DFD is a guide to the design staff, and provides the function of software specification for the users.

5. Optimization Example and Experimental Evaluation

Based on the global data of genetic algorithm, the implementation process model is an example, the optimization algorithm is used to optimize the model. In the experimental process, the experimental data is distributed in a number of grid nodes. As shown in following Figures.

Simulation data is used to carry out the experiments to the model, the response time and CPU usage records of the model are analyzed and compared, the computational cost and data transmission cost are also compared, which verifies the response time and resource use balance is better than the centralized approach.

6. Conclusion

The traditional manual arrangement of track and field sports meeting is a very complicated and complex work, which is time-consuming and easy to error by manual operation. This article is under the guidance of theory, combines with practice,

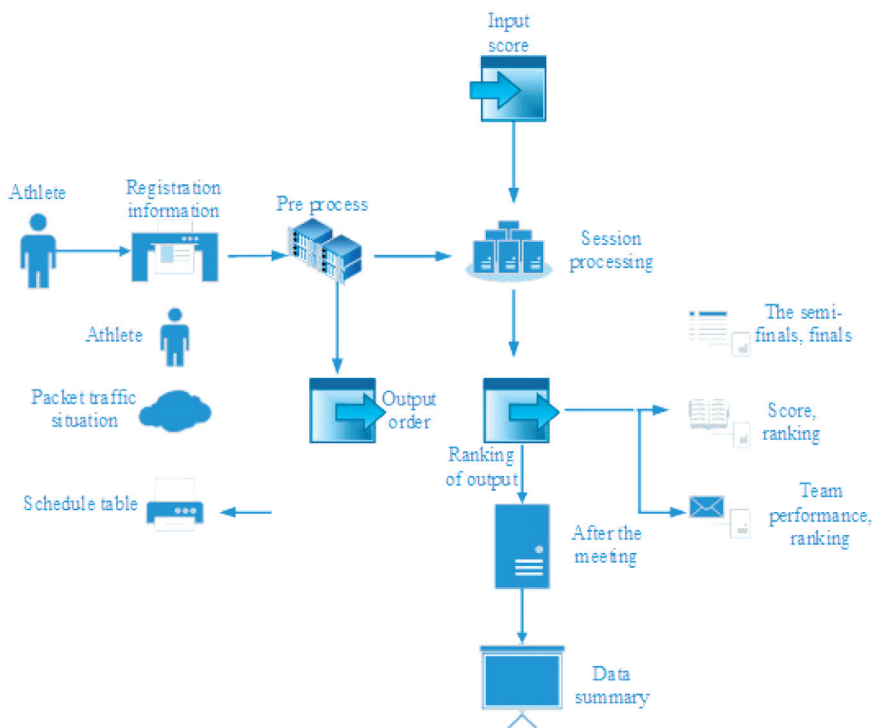


Figure 4 – DFD of the Sports Meeting Management System

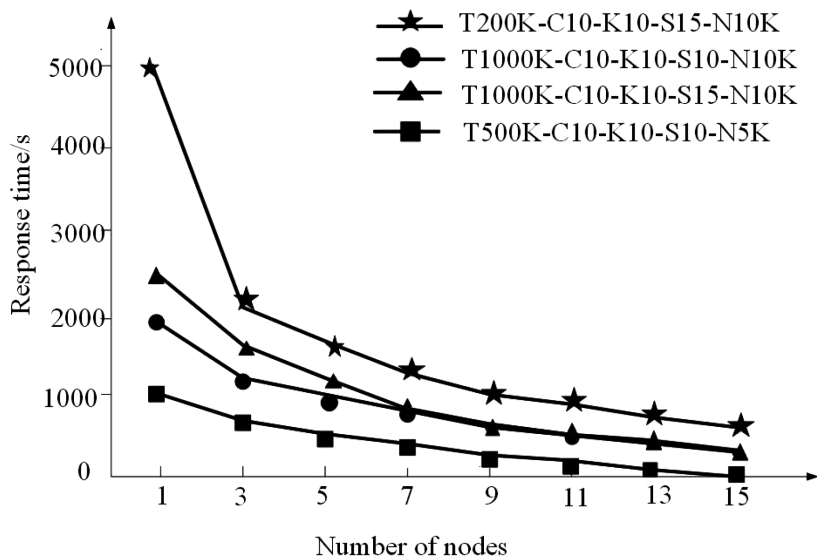


Figure 5 – Response Time of the Model in $k(k=1,2,3,\dots,15)$ Nodes

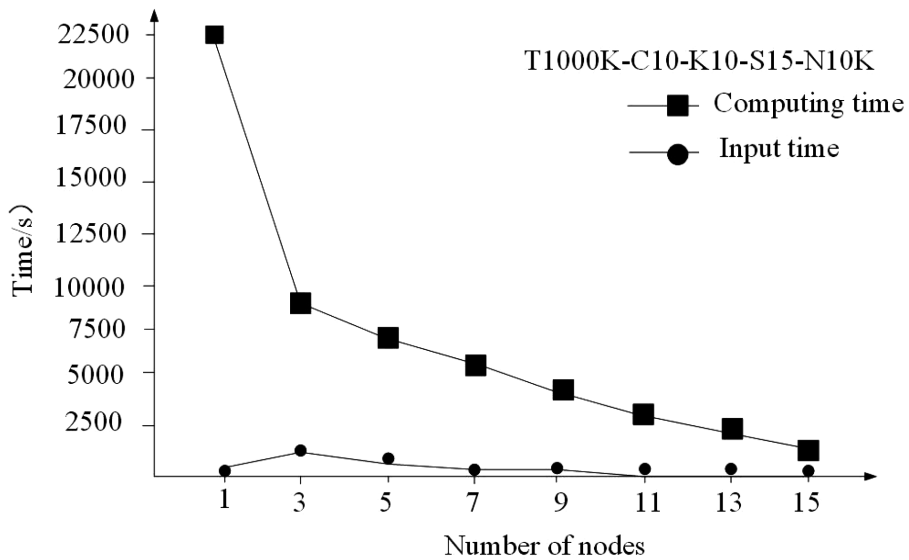


Figure 6 – Computation Time and Data Transmission Time of the model in $k(k=1, 2, \dots, 15)$ Nodes

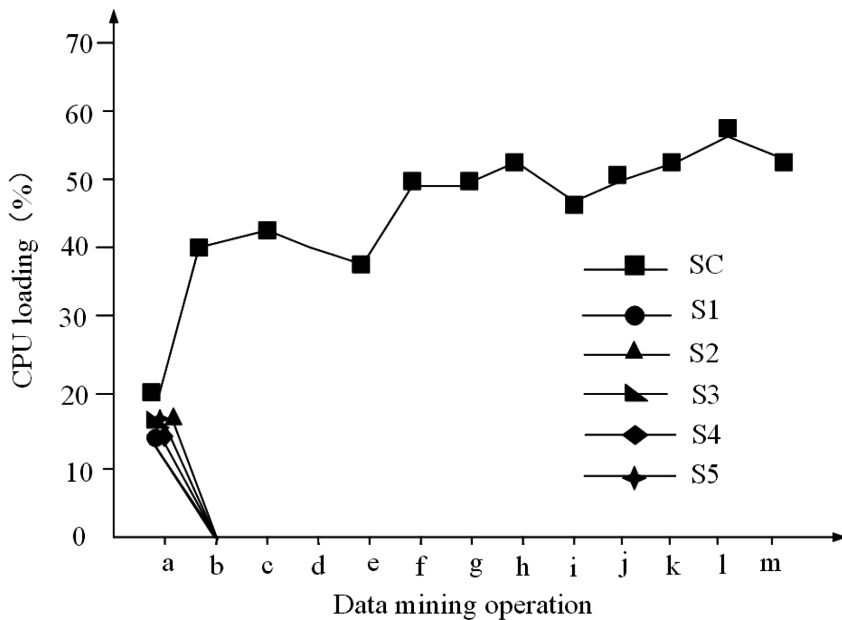


Figure 7 – CPU Usage Record When the Model is Executed in a Centralized Environment

develops a schedule arrangement system of track and field sports competition based on artificial intelligence, integrates the advanced artificial intelligence technology into the sports industry, describes how to use artificial intelligence technology to develop the

arrangement system of track and field sports meeting, the design and the realization process of schedule management system of track and field sports competition, and the composition and structure of the automatic schedule management system of the track and field sports meeting. This paper expounds the design scheme, the realization method of the system, the development tools and related technologies, focuses on the analysis of the realization process of the schedule management system of the track and field sports competition. Finally researches and develops a set of schedule management system for track and field sports meeting. The experiment proved its effectiveness. The intelligent management system of track and field sports meeting can solve the existing problems in the traditional manual schedule management, improve management level, management quality and work efficiency of the sports meeting, and save a lot of manpower, material resources and time for event managers, overcome the unnecessary errors caused by manual processing, provide better service levels for the event organizers and participants.

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Research on Intelligent Control Strategy of Urban Parking Guidance System Based on Artificial Intelligence

Ge Yinglong¹

geyl@hdu.edu.cn

¹ School of Information Engineering, Hangzhou Dianzi University, 310018, Hangzhou, Zhejiang, China

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Abstract: With the rapid urbanization and fast increase of car ownership, parking problem has increasingly turned to be a bottleneck for the sustainable development of urban transportation system. In order to improve the parking management level, a urban parking guidance system based on artificial intelligence is proposed. In this paper, the composition and structure of the urban parking guidance system is analyzed, the parking place control terminal hardware design and implementation methods based on the microcontroller SX52 are supplied, and the principles and processes of the control terminal software are introduced, then the principles and methods of protocol dispose in the control terminal are described based on the analysis of the TCP/IP protocol, the principles of work of guidance server are explained. The characteristics of urban parking guidance system based on artificial intelligence are as follows: the design idea is novel, the cost is low, the utility is strong, and it is easy to spread. Therefore, it can be used as an auxiliary system of urban intelligent transportation system, which plays an active role in relieving the traffic congestion and improving the traffic environment.

Keywords: Intelligent parking management system; parking guidance; roadside parking; system architecture.

1. Introduction

Urban intelligent parking management system is an important part of intelligent transportation system, which is an effective method to solve the problem of urban parking. With the rapid urbanization and fast increase of car ownership, parking problem has increasingly turned to be a bottleneck for the sustainable development of urban transportation system, which is not only reflected in the road congestion, but also reflected in the low efficiency of parking management and illegal parking and other aspects. (Cats, O., Zhang, C., & Nissan, A., 2016) Parking problem has become a common problem in the economic development of large and medium cities in the country, which is manifested in the following 5 aspects. Parking information is not transparent. Due to lack of dedicated parking information resources platform to query the real-time parking information, which leads to the owners who are not familiar with the situation wasting a lot of time in the process of parking, (Abreu, A., Rocha, Á., Cota, M. P., &

Carvalho, J. V., 2015) producing invalid traffic, and making the road more crowded. The construction degree of intelligent parking lot is relatively low. Compared with the developed countries, the development of intelligent transportation in China is still very backward, especially in the construction of the intelligent parking lot, which is still in the initial stage. The management efficiency of roadside parking is low. The current domestic roadside parking management is still in the manual management level, the management efficiency of which is low, and there are many management loopholes, so as to lead to the occurrence of various parking problems. The phenomenon of illegal parking is serious. Roadside illegal parking is very common in every city, which causes serious disturbances to the efficient operation of urban traffic. System management for urban parking problems is lack. Uniform management of all kinds of parking information is lack, such as parking resources, illegal parking and other information. Therefore, this paper analysis the composition and structure of the urban parking guidance system, and proposes a scheme of urban parking guidance based on Internet. This system plays an active role in relieving the traffic congestion and improving the traffic environment (Dewen, S., Xinhong, C., Jing, C., & Xujian, F., 2015).

2. Research Status

On the premise of shortage of land resources and rapid expansion of the amount of motor vehicles in current urban. How to use scientific and technological means to improve the management level of parking, research and construct the intelligent parking management system, and promote the effective use of existing parking facilities, has become one of the effective methods to solve the problem of urban parking. Research and application of the intelligent parking management system in some foreign countries and regions starts earlier, the technology of which is relatively mature, and the function is relatively perfect. The first parking guidance system was established in the world (Mahmudah, N., & Tubagus, A., 2016). The earliest Japanese parking guidance system was established to provide the guidance information for the parking users, including the location of the parking lot, the vehicle number, the use situation and so on (Fishman, E., 2016). In theoretical research, the theories and methods of parking search model and the optimization and information display configuration of parking guidance system were researched (Asante, L. A., Sasu, A., Ayitey, J. Z., & Boakye-Agyeman, N. A., 2015). A parking reservation system based on integer programming and fuzzy logic method was proposed (Xydis, G., & Nanaki, E., 2015). A kind of intelligent parking management system based on the low cost wireless network was researched to realize data sharing between the systems, this system was a part of the more advanced intelligent transportation system (Ji, S., Cao, G., Zhang, J., Yu, F., Li, D., & Yu, J., 2016). Compared with the developed regions, the intelligent parking management system of our country starts late. In the aspect of theoretical research, the urban parking guidance information system was carried on the overall design (Chow, C. Y., 2016). The GIS into the parking management system was introduced to study and analyze the information display of the management system (Ghent, P., 2015). The parking guidance information board was studied to establish the model of the parking condition display optimization (Kirk, N. J., 2015). In recent years, Beijing, Shanghai, Shenzhen, Hangzhou and other cities have also built the parking guidance system. However, there are still some problems in the system, such as the coverage of the system is small, the system is backward, and the using effect is poor. The remainder of this paper is organized

as follows. Section 3 describes the topological structure of the urban parking guidance system. Section 4 gives the realization process of the parking guidance system. Section 5 presents a real experiment to evaluate the performance of the system. Conclusion is summarized in Section 6.

3. Related Technologies

3.1. Embedded Internet Technology

Embedded Internet is the combination of embedded system and Internet. The embedded system includes embedded processor, embedded operating system and application circuit. Access to the Internet must have a corresponding access protocol, such as the commonly used TCP/IP protocol. Therefore, the embedded Internet is based on the embedded processor, embedded operating system and access Internet communication protocol. The embedded system is mainly used for the control network and other information network of building, factory and home. After accessing to Internet, the embedded system not only realizes the network remote monitoring, diagnosis and system upgrade, but also provides a platform for the embedded system to share more network information resources. (Clark, D. E., Whitney, J. J., MacKenzie, K. G., Koenen, K. K., & DeStefano, S., 2015) It is more important is that the control of the network no longer needs to rent a dedicated line and makes a long distance call to maintain the operation, which also can provide an unprecedented value-added services and management functions. In short, Internet access can significantly improve the economic efficiency of enterprises and institutions, so as to change the operation mode of social organization. Compared with the field bus technology, embedded Internet technology has the following characteristics: It provides a large number of tools and functions library, reduces the two development of the client. Complete distributed structure improves system reliability. The whole network is based on the agreement, which makes the control network and enterprise management information network unified coordinated operation, and realizes the seamless access of Internet. Through browser users can monitor the running status and data of the field equipment at any time, and make the diagnosis and software upgrade to the field equipment (Hai, N. D., Phuc, N. T., Khue, D., Hai, T. H. T., Vu, P. T., & Nam, H., 2015).

3.2. TCP/IP Protocol

TCP protocol and IP protocol refer to two network protocols used in Internet (or data transmission method). They are the transmission control protocol and the Internet protocol. These two protocols belong to a large part of the TCP/IP protocol group. The protocol in the TCP/IP protocol guarantees the transmission of data on the Internet, and provides almost all the services that are currently used on the Internet. These services include: the transmission of e-mail, file transfer, the release of the press group, access to the world wide web. In the TCP/IP protocol, the protocol consists of two protocols: network layer protocol, application layer protocol. TCP/IP works by using the protocol stack, this stack is a collection of all the protocols that are used to complete a transmission between the two machines. (This is one of the pathways that data through it from one machine to another machine.) In this process, a complex system of error checking is

performed in a machine. Each layer of the stack can receive or send data from adjacent layers. Each layer is associated with many protocols. At each layer of the stack, these protocols are at work (Bajsanski, I., Stojakovic, V., & Jovanovic, M., 2016).

3.3. Micro Controller SX52

SX52 is a 8 bit communication control chip developed by CMOS technology, which is not only high speed, and can easily achieve the Internet access function. The chip can easily realize the common protocol stack in TCP/IP protocol by using the code that provided by the virtual software package. Such as HTTP, SMTP, POP3, TCP, UDP, ICMP, IP, etc.. Ethernet interface is achieved by the high integration and full duplex Ethernet controller chip RTL8019AS that produced by REALTEK company. The chip supports the sub layer protocol of IEEE802.3MAC, which can complete the data sending and receiving function of the 10Mbps rate with very few peripheral circuits. The function of the whole hardware system is achieved by the 3 data transmission channels: Ethernet interface, field bus RS485 interface and the touch screen interface. The Ethernet data channel that composed of SX52, RTL8019AS, FB2022 can make the users monitor the information of the parking lot through the Internet. The process is to send a service request to the control terminal through the browser software, the information is sent to RTL8019AS through RJ45, RTL8019AS is responsible for stripping the head and tail information of Ethernet frame, and sending the processed data packet to the TCP/IP protocol stack and application layer software of SX52.

4. Urban Parking Guidance System

4.1. Basic Working Principle of the System

The basic working principle of urban parking guidance system is that install the parking control terminal based on embedded Internet technology in each parking lot, the distribution of parking lots and parking space information is transmitted to the parking guidance server in real time by Internet through parking control terminal, lead the server to handle the information and provide the WWW services for the driver. The services include pre trip parking inquiry, parking reservation, parking route guidance and other services. At the same time, the boot server can also provide parking information dynamic advertising, parking fees, parking information management and other services for the parking operators (Kumar, K., Kozak, J., Hundal, L., Cox, A., Zhang, H., & Granato, T., 2016).

4.2. Overall Framework of the System

Parking guidance system as shown in Figure 1, which is composed of a plurality of parking control terminals and parking guidance servers. The control terminal of the parking lot is the embedded intelligent device that has the function of Internet access, which is connected with the security system, the environment control system and the parking equipment management system of the parking lot through the field bus, as shown in Figure 2. The main functions are: Implementing distributed management and polling control to each functional module of subsystem; Achieving information exchange and sharing with the aid of network and each module; As an embedded Web server, realizing

remote communication with parking guidance server through Internet, completing the exchange between parking information and control information.

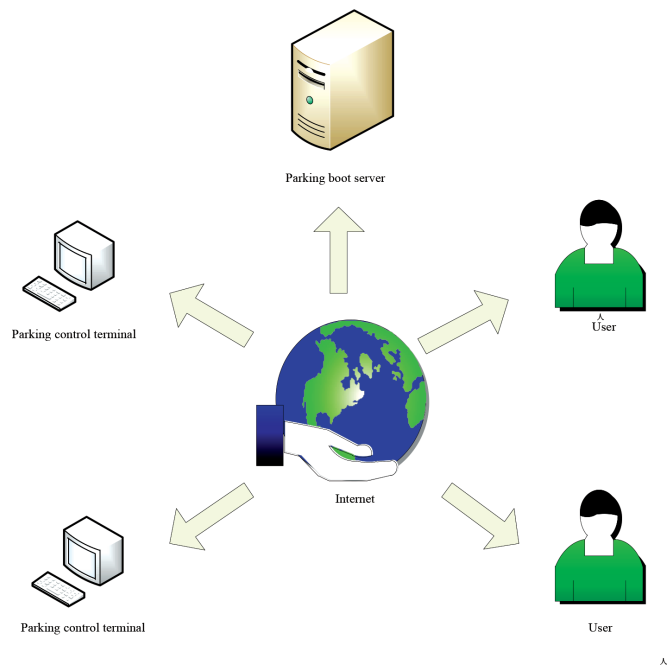


Figure 1 – Composition of Parking Guidance System

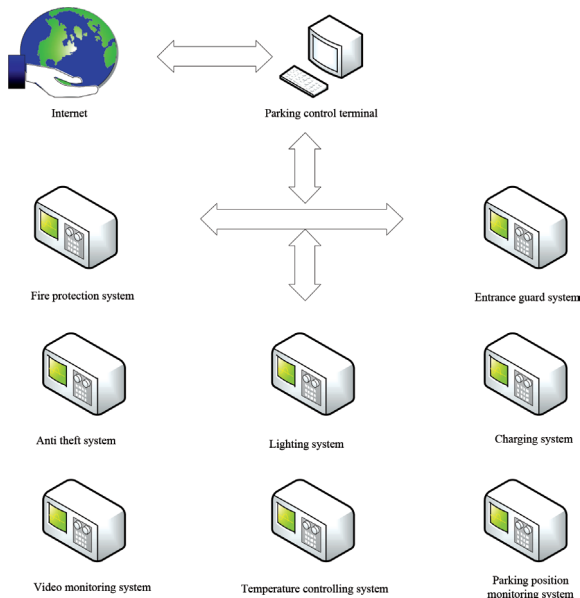


Figure 2 – Composition of the Parking Lot

Parking guidance server is the core of the guidance system. On the one hand, as the browser in B/S system, it takes turn to carry on the information query to the control terminal of the embedded web server, accesses the parking information of each parking lot timely, and refurbishes parking information database. On the other hand, as the WWW server in B/S system, it provides the necessary parking guidance information for driving users.

4.3.Composition and Realization of Hardware System

The hardware composition principle of parking control terminal as shown in figure 3. The system uses the SX52 chip from Ubicom company as the microcontroller. SX52 is a 8 bit communication control chip developed by CMOS technology, which is not only high speed, and can easily achieve the Internet access function. The chip can easily realize the common protocol stack in TCP/IP protocol by using the code that provided by the virtual software package. Such as HTTP, SMTP, POP3, TCP, UDP, ICMP, IP, etc.. Ethernet interface is achieved by the high integration and full duplex Ethernet controller chip RTL8019AS that produced by REALTEK company. The chip supports the sub layer protocol of IEEE802.3MAC, which can complete the data sending and receiving function of the 10Mbps rate with very few peripheral circuits. The function of the whole hardware system is achieved by the 3 data transmission channels: Ethernet interface, field bus RS485 interface and the touch screen interface. The Ethernet data channel that composed of SX52, RTL8019AS, FB2022 can make the users monitor the information of the parking lot through the Internet. The process is to send a service request to the control terminal through the browser software, the information is sent to RTL8019AS through RJ45, RTL8019AS is responsible for stripping the head and tail information of Ethernet frame, and sending the processed data packet to the TCP/IP protocol stack and application layer software of SX52. At the same time, the control terminal can transmit the information and data of the parking lot to the remote boot server in the opposite direction (Chester, M., Fraser, A., Matute, J., Flower, C., & Pendyala, R., 2015).

4.4.Implementation of Protocol and Software

The software general flow of the control terminal is shown in figure 4. Due to the hardware system resources of MCUSX52 are limited, there is no real time and multi task operation system resource can be utilized. So the application software and the protocol must be finished by the SX52 hardware. The system uses the program structure of sequential execution and hardware interrupt, the application layer processing tasks that are low real-time requirement and time consuming and the TCP/IP protocol stack processing tasks are put in main sequence of sequential structure to realize, while the key processing task that are high real-time requirements and time processing and other tasks are put in interrupt handler to complete. After initialization, entering the cycle part of the main program. The main program cycle includes three major functions: unpacking the received Ethernet data frames and TCP/IP protocol processing; packaging and sending parking Web data; achieving management and control to control terminal hardware resources and parking control module.

Control terminal communicates with the boot server through the Internet, the software must realize the function of TCP/IP. The standard TCP/IP protocol is composed of many protocols, which is powerful, the mechanism is complex, and the occupancy system is

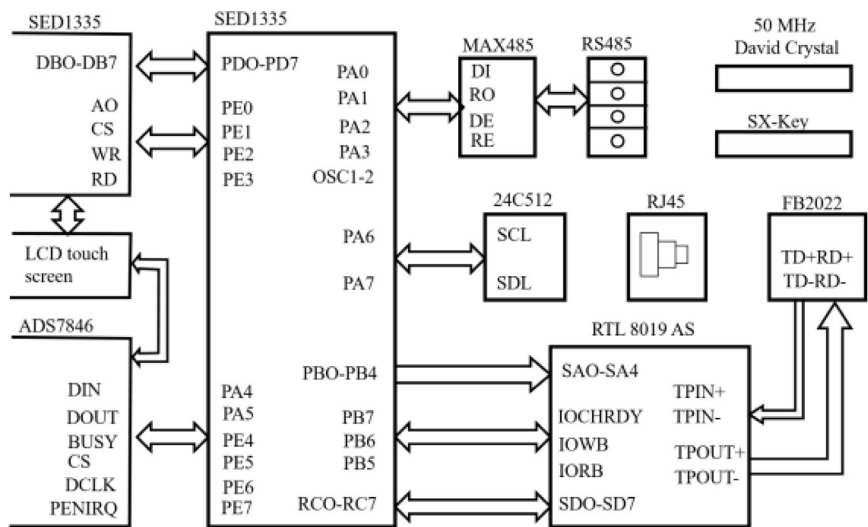


Figure 3 – Composition of Control Terminal Hardware

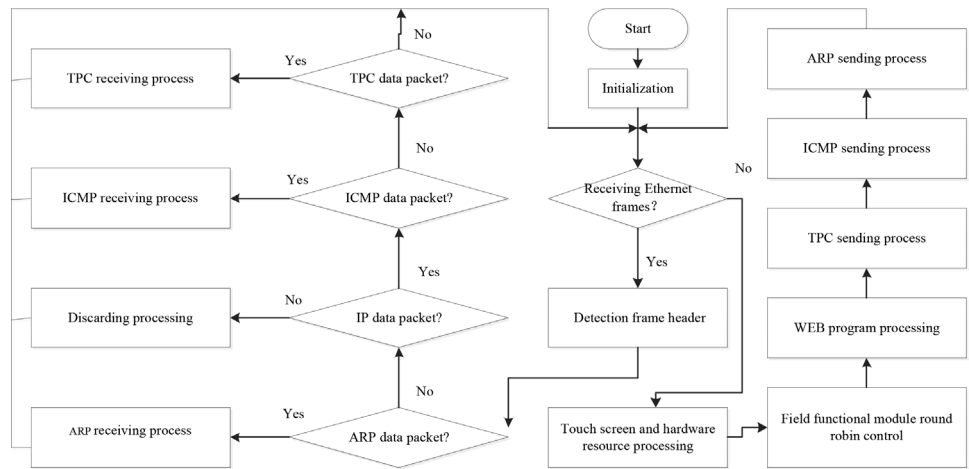


Figure 4 – Total Process of Control Terminal Software

large. It is necessary to cut and simplify the standard and large TCP/IP protocol in order to implement the TCP/IP protocol in the embedded system which is relatively short of system resources. The principle of cutting and realizing the protocol in the control terminal is as follows:

ARP protocol, can be divided into two types of requests and responses, while only the response function is needed to achieve in this system. Concrete realization process is: First, a ARP request message or a response message should be determined according to the type of operation when SX52 receives the ARP data packet from the Ethernet frame. If it is the ARP request packet, we need to compare the target IP address and own

IP address, if they are the same, we need to package own MAC address and send the response message, otherwise it will be discarded.

IP protocol, which is the core of the TCP/IP protocol cluster. Control terminal must achieve its basic functions: Addressing, encapsulation, routing, encapsulation, inspection, etc. Considering that the data of this system are generally some small amount of date of state information or control information, so we can cut off the split of IP and the reorganization function. The receiving and processing flow of IP protocol is: When the system receives the IP data packets, we firstly should judge whether the destination IP address of the IP header of the data packet is consistent with the IP address of the local machine, if they are the same, the data packet should be discarded, otherwise carries out the IP header number, check and field check, removes the head of IP data packets and takes out the data in the database after the confirmation of the correct data transmission, then decides to give this date to the ICMP protocol, or the TCP protocol do upper level processing according to the protocol type of the IP header. Sending process is: Packaging ICMP packet or TCP message, and routing the IP data packet, then sending IP data packets through data link layer.

ICMP protocol, it is mainly used to transmit error message and control message, in which, the most commonly used is the ICMP request / reply message. The control terminal just needs to be able to passively respond the request command of testing network connectivity from other hosts, and other functions can be cut off.

TCP protocol, its mechanism is complex, which can be realized by establishing and closing the connection, sending data and receiving data. The establishment and closing connection of the TCP protocol are accomplished by 3 cooperation.

4.5. Realization of Parking Guidance Server Function

Parking guidance system can provide parking guidance services for urban driving users with the aid of Internet, the implementation of the service is completed by the client browser that works in the B/S mode and the Web program of server side. System contains the main function modules:

User management module, mainly completing the user information management and registration management.

Parking information query module, not only achieving queering nearby parking information according to the place names, but achieving getting the required parking information in accordance with the parking spaces link points on the city digital map.

Parking reservation module. Registered users can make a reservation for a parking space through Internet, the reservation application is sent to the parking control terminal by the boot server, then it gives feedback to the user to confirm the information after completing the reservation;

Parking guidance module. Giving the driving route from the user's location to the purpose of the parking lot so as to navigate for users by the way of digital map and text;

Map line print output module. completing the output of guide navigation information.

Urban parking information is a series of dynamic spatial data, parking guidance system is actually a geographic information system (GIS). Running the HTTP protocol to the



Figure 5 – Parking Guidance



Figure 6 – Parking Information

WWW geographic information system (WebGIS) with the aid of Internet platform and client application software, which can easily and directly publish the geographic information data and provide inquiry, search and other related services for users. WebGIS has represented the development direction of GIS application, which has become the hot spot of current technology research. The parking guidance system is based on the WebGIS technology. American ESRI company is the leader of world's standard desktop and network geographic information system, it uses the spatial attributes of data to achieve the perfect combination between map and data, and provides a new decision support way for the system with data visualization and thinking visualization. So we use the ArcIMS9.0 that developed by ESRI company as a

development tool and platform. At the same time, the Geodatabase that developed by ESRI company is a unified and intelligent spatial database based on relational database management information system, so Geodatabase is used as a spatial data model. The parking guidance system uses SQLServer2000 as the database management system development platform, and uses the structured query language to implement the program that relates to the database operation. The development of server program is realized by JavaScript, ASP, HTML tools. System structure as shown in figure 7.

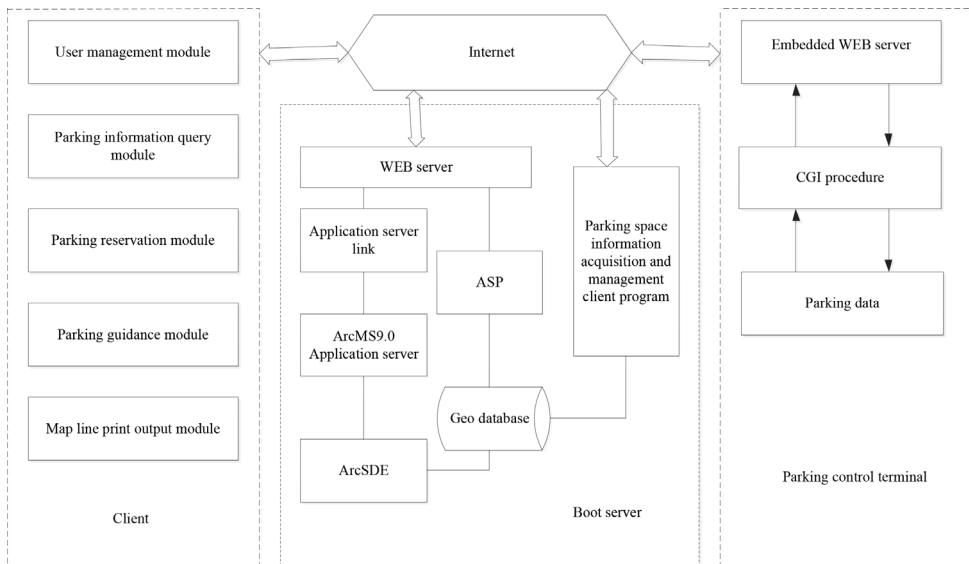


Figure 7 – Structure of the Boot Server

5. Experimental Investigation and Analysis

This paper took a parking lot as the experimental object, the parking guidance system which was studied in this paper was applied to the parking lot. After a month of use, in view of whether to improve the parking efficiency and convenience of this issue, the 500 parking users gave the answers. The experimental results are shown in the following table:

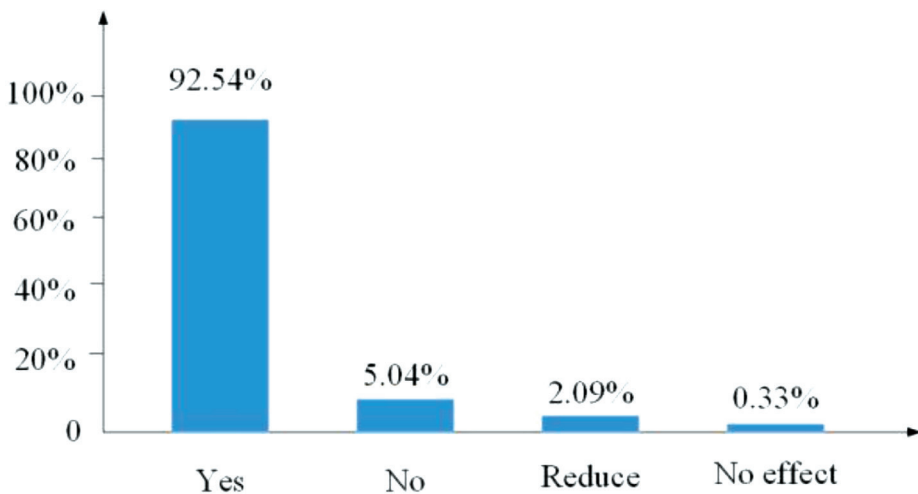


Figure 8 – Experimental Results

6. Conclusion

With the rapid development of China's economy, the improvement of people's living standards, the rapid urbanization and fast increase of car ownership, parking problem increasingly turned to be a bottleneck for the sustainable development of urban transportation system, which is not only reflected in the road congestion, but also reflected in the low efficiency of parking management and illegal parking and other aspects. Parking problem has become a common problem in the economic development of large and medium cities in the country. This paper systematically reviews the domestic and international situations of urban intelligent parking management systems; analyzes the advantages and disadvantages of some present intelligent parking management systems; discusses the importance of building urban parking guidance; analysis the composition and structure of the urban parking guidance system; proposes a scheme of urban parking guidance based on Internet; supplies the parking place control terminal hardware design and implementation methods based on the microcontroller SX52; introduces the principles and processes of the control terminal software based on the TCP/IP protocol analysis; describes the principle and method of protocol dispose in the control terminal; and explains the principle of work of guidance server. This principle and method have an important valuable reference for urban parking guidance system design. The characteristics of urban parking guidance system based on artificial intelligence are as follows: the design idea is novel, the cost is low, the utility is strong, and it is easy to spread. Therefore, it can be used as an auxiliary system of urban intelligent transportation system, which plays an active role in relieving the traffic congestion and improving the traffic environment.

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Research on the Establishment of Intelligent Cognitive Student Model

Zhang Jing¹, Zhou Ning^{2,*}

* zhouningchina@126.com

¹ President office, Agriculture University of Hebei, 071001, Baoding, Heibei, China

² College of Electronic and Information Engineering, Hebei University, 071002, Baoding, Heibei, China

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Abstract: The purpose of this article is to study on a kind of intelligent technology to get to know students, understand students' learning situation, so as to further realize the distance education and provide students with intelligent guidance. The intelligent fuzzy comprehensive evaluation model is established to study the learning situation of students. A comprehensive index system is established, and the weight of each index is set up. So the evaluation function is used to calculate the students' comprehensive performance. So it can be concluded that the main task of the intelligent student model is to evaluate the students, and the fuzzy model has a wide practicability, which provides a reference for the establishment of the cognitive model.

Keywords: Intelligent technology; intelligent guidance; fuzzy comprehensive evaluation.

1. Introduction

With the development of cognitive science and artificial intelligence technology in distance education application, intelligent teaching system (Bryce, C. M., Baliga, V. B., De Nesnera, K. L., Fiack, D., Goetz, K., Tarjan, L. M., ... & Ash, D., 2016) has become the educational technology important research field. The final purpose of the research is borne by the computer system play a main responsibility of human education, that is, give a computer system to intelligent, by the computer system in a certain extent substitute teachers and achieve the best teaching, improve the adaptability of teaching system for students and targeted, so as to become possible to realize teaching students in accordance with their aptitude. In the intelligent tutoring system, the students' model is the basis of the realization of adaptive teaching and providing real intelligent guidance. Its role is to establish the students' understanding, including the students' knowledge, cognitive characteristics, etc. System through the record, storage, accumulation or abstraction of the students' related information, the students' behavior and ability to explain, through the inference to get the students' overall learning situation, and then adapt to the students, adjust the learning content, to carry out effective and efficient learning. This requires that the system must

include a mechanism to dynamically adjust their behavior to adapt to the specific user. As a kind of data structure of students' cognitive ability, the students' model reflects the students' learning progress, the proficiency of knowledge, the misunderstanding and the gap with the expectation. We provide the basis for the realization of teaching goal, teaching strategy and teaching content in the intelligent teaching (Figure 1). Therefore, it is the key to evaluate the students' cognitive state in the learning process. Intelligent teaching system is the inevitable developing direction of digital education in human society. From the beginning of the 1970s, researchers in knowledge representation, expert system, problem solving and reasoning system such as, continuous use of the latest AI technology, a lot of research work have been done: in the late 1970s, AI techniques are used to construct student model, teacher model; in the early 1980s to, ICAI system research concentrated in using a variety of techniques to the exact said student model, teacher model, in order to make the system has higher levels of response sensitivity and global view. Comparatively speaking, the research of intelligent tutoring system is relatively early in abroad. The individuation teaching and enhance the teaching system, many foreign scholars put forward many different solutions such as (Hewitt, P., 2016), Peng-Kiat Pek and Kim-Leng Poh (Poulton, A., & Rose, H., 2015) the application of Bayesian network to establish the student model, and according to student feedback to the system information reasoning in the learning process, predict the future behavior of the students, the most appropriate choice of teaching content for the Tsunemori Mine, Akira Suganuma; and Takayoshi Shoudai (AEGIS) (Lubitz, R., Lee, J., & Hillier, L., 2015) dynamic test questions in the teaching content of hypertext structure; Dietrich Albert and Cord Hockemeyer through the analysis of knowledge space theory, the similarity of hypertext and knowledge space in the structure, modeling of knowledge. China's development of CAI research began in the 60's, due to the gap between the basis and conditions, to the 80's ICAI research to flourish. At the end of the 80's, many universities have established the ICAI Research Center (Mahmoodi-Shahreabaki, M., 2015), at the same time, the introduction of foreign advanced technology ICAI, CAI and ICAI related technologies have been a lot of research and practice (Carvalho, A. A., Araújo, I., & Fonseca, A., 2015).

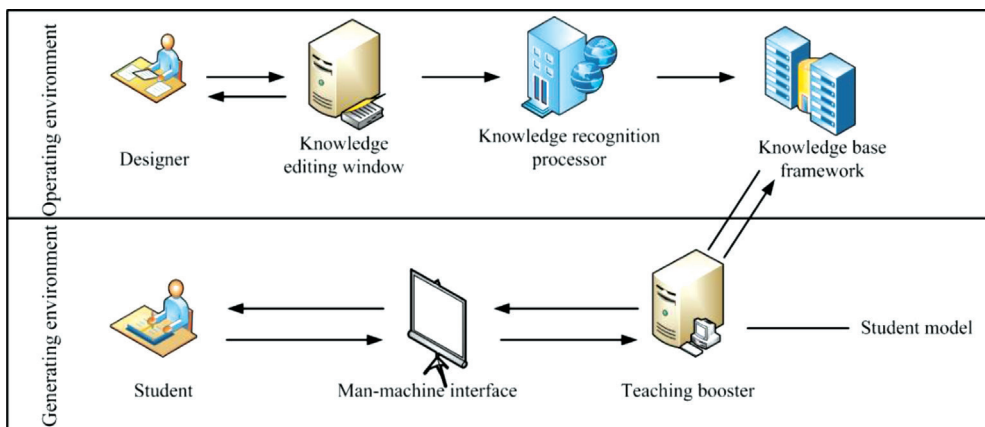


Figure 1 – Student Evaluation Model Flow Chart

2. Student Model Analysis

In ICAI system, in order to do vary from person to person of individualized teaching, must understand the current teaching object, which requires the students with appropriate data structure to record down, as the ICAI system for teaching decision-making basis. This kind of data structure used to record the student's situation is called "the student model". Student model reflects the student's learning progress, the knowledge of the degree of proficiency, the existence of misunderstanding and the gap between the expectations of the target. This information is based on the teacher's module as a teaching decision-making, so that the system can correctly evaluate the students' understanding degree, diagnose their mistakes, and provide the most suitable and effective teaching materials for each student. It can be said that the student model plays a very important role in the intelligent teaching. (Carvalho, A. A., Araújo, I., & Fonseca, A., 2015) Although a lot of descriptions of the concept of student model can be found in the academic circles, there are some common main requirements for the student model:

1. According to the historical data of the students and the input information to the current student modeling;
2. Provide information for decision making in the part of teaching strategy;
3. According to the new information to update the student model.

2.1. Classification of Student Models

1. Overlay model

It was also known as defect graph model (Widjojokoesoemo, E. S., 2015). First, it makes a detailed decomposition of expert knowledge, get a complete knowledge map, and then in the picture of the students have mastered the knowledge of the logo, this is the knowledge of the logo is a student's knowledge model.

2. Deviation model

It was Also known as diagnostic model (Fedorov, A. A., & Sedykh, E. P., 2015). Mainly through the students in the learning process of the performance to construct the student model, the basic idea is to use the student model and a student to solve problems in the process of comparison, find out where the students in the correct direction or the students what is wrong. Its difficulty is that it is difficult to find a solution to the problem.

3. Cognitive student model

The deviation model and the coverage of students' model intelligence reflect the students' learning level and neglect the main role of cognitive ability in the learning process, which cannot reflect the cognitive ability of learners and what is in the stage (Mellblom-Nishioka, C., 2015). The cognitive model can not only reflect the level of students' knowledge, but also reflect the students' cognitive ability and psychological factors.

2.2. Building Foundation of Student Model

According to the related cognitive theory (Su, S. H., Lin, H. C. K., Wang, C. H., & Huang, Z. C., 2016), in the cognitive ability, the cognitive model should be able to accurately describe the real cognitive ability of students. According to Bloom's classification

of educational objectives, cognitive ability is divided into six grades according to the complexity of the intelligence activities (Khalfallah, J., & Slama, J. B. H., 2015):

1. memory: memory or memory ability to repeat the previous presented information is the ability to maintain knowledge.
2. The understanding that the students have a more profound understanding of this knowledge, they can be systematic and intrinsic, can use their own language to explain the ability to obtain information.
3. Application: the ability to apply knowledge (concepts, principles, and laws) to a new situation (Palomino, C. E. G., Silveira, R. A., & Nakayama, M. K., 2015), students can use the abstract concepts, principles, and theories of this knowledge in a variety of specific situations.
4. Analysis: the ability to decompose a complex knowledge into a number of separate parts, and to recognize the relationship between each part.
5. Synthesis: the ability to combine the knowledge elements to form new knowledge or new patterns.
6. Assessment: students are able to make scientific judgments about the facts, ideas and methods of knowledge, and the ability to evaluate and identify the things according to the existing knowledge or given criteria.

Which remembering and understanding belong to relatively simple low-level cognitive ability (Sivakumar, N., Praveena, R., & Saranya, S., 2015), application, analysis, synthesis, and evaluation belongs to complex cognitive ability. But in the actual system, analysis, synthesis and evaluation belongs to the more complex cognitive ability. It is difficult to measure, so our assessment to the students' cognitive ability (Sundararajan, S. C., & Nitta, S. V., 2015) mainly consider three aspects of memorizing, understanding and application, student model should also can characterize the students memorizing, understanding and application of the three, student model constructed in this paper is according to the three aspects of students cognitive ability were evaluated.

3. Cognitive Student Model Based on Fuzzy Comprehensive Evaluation

Usually the evaluation of a student's learning ability is not a simple "good" or "bad", sometimes also used "can", "relatively poor" and other vague language, fuzzy concept has been applied in the evaluation of teachers. How to use the method of fuzzy mathematics, fuzzy comprehensive evaluation of the various indicators, the evaluation of the results of quantitative evaluation, is the focus of this module. This paper mainly considers the influence of students' cognitive ability and students' interest in the course of the two aspects of students' learning level and effect, so we adopt a multi-level fuzzy evaluation method to evaluate students' comprehensive evaluation (see Figure 2).

3.1. Establishment of Evaluation Index System

The evaluation index set U includes two aspects: cognitive ability U_1 , learning interest U_2 , which marked as $U = \{U_1, U_2\}$. In cognitive ability, according to Bloom's theory of "education target classification" theory and teaching experience, determine the evaluation of students' cognitive ability of the index is: memory ability, understanding ability, application ability, analysis ability, comprehensive ability. Evaluation of

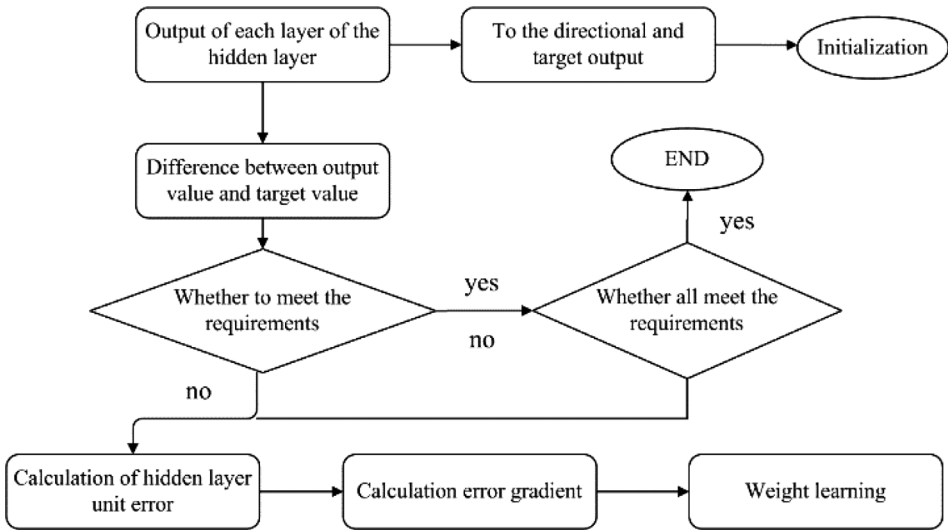


Figure 2 – The Comprehensive Evaluation of Students' Cognitive Process

students' cognitive ability in the system U_1 , it can be defined $U_1 = \{\text{memory ability, understanding ability, application ability, analysis ability, comprehensive ability}\}$. Corresponding element $U_1 = \{u_{11}, u_{12}, u_{13}, u_{14}, u_{15}\}$. The corresponding comment set v can be defined as $v = \{\text{excellent, good, medium, and pass, poor, very poor}\}$. Corresponding element $v = \{v_1, v_2, v_3, v_4, v_5, v_6\}$. It respectively represent the students' score; $80 \leq v_2 \leq 90$; $70 \leq v_3 \leq 80$; $60 \leq v_4 \leq 70$; $50 \leq v_5 \leq 60$; $0 \leq v_6 \leq 40$.

In the interest of learning, the evaluation of the index set U_2 is defined as $U_2 = \{\text{learning interest in this course}\}$, the corresponding element $U_2 = \{u_{21}\}$. The corresponding evaluation set v can be defined as $v = \{\text{very interested, interested, and more interested in general, not interested, and not interested}\}$. Corresponding element $v = \{v_1, v_2, v_3, v_4, v_5, v_6\}$. The corresponding score is $90 \leq v_1 \leq 100$, $80 \leq v_2 \leq 90$, $70 \leq v_3 \leq 80$, $60 \leq v_4 \leq 70$, $50 \leq v_5 \leq 60$, $0 \leq v_6 \leq 40$.

If each sub factor set U still contain more factors, can be divided, so there are three models, four models, etc. From the above analysis we can get the following conclusion: as long as the factors system gives the lowest layer of the fuzzy transformation matrix, namely the single factor evaluation matrix and the weight of each layer in detail value matrix can be obtained at any level in the results of any comprehensive evaluation and comprehensive evaluation of the final results. In short, the multi-level comprehensive evaluation model, which reflects the level of each factor of the evaluation object, it can avoid the disadvantages of the weight of the weight of the factors too much too long.

3.2. Constructing Membership Function

In the evaluation index set U , the membership functions of the evaluation set v can be constructed

$$\mu_{v_1} = \begin{cases} \frac{1}{10}(x-90) & 90 \leq x \leq 100 \\ 0 & x < 90 \end{cases} \quad (1)$$

$$\mu_{v_2} = \begin{cases} \frac{1}{10}(100-x) & 90 \leq x \leq 100 \\ \frac{1}{10}(x-90) & 80 \leq x \leq 90 \\ 0 & x < 80 \end{cases} \quad (2)$$

$$\mu_{v_3} = \begin{cases} 0 & x \geq 90 \\ \frac{1}{10}(90-x) & 80 \leq x \leq 90 \\ \frac{1}{10}(x-70) & 70 \leq x \leq 80 \\ 0 & x < 70 \end{cases} \quad (3)$$

$$\mu_{v_4} = \begin{cases} 0 & x \geq 80 \\ \frac{1}{10}(80-x) & 70 \leq x \leq 80 \\ \frac{1}{10}(x-60) & 60 \leq x \leq 70 \\ 0 & x < 60 \end{cases} \quad (4)$$

$$\mu_{v_5} = \begin{cases} 0 & x \geq 70 \\ \frac{1}{10}(70-x) & 60 \leq x \leq 70 \\ \frac{1}{20}(x-40) & 40 \leq x \leq 60 \\ 0 & x < 40 \end{cases} \quad (5)$$

$$\mu_{v_6} = \begin{cases} 0 & x \geq 60 \\ \frac{1}{20}(60-x) & 40 \leq x \leq 60 \\ 1 & 0 \leq x \leq 40 \end{cases} \quad (6)$$

The score of each element in the x is U .

4. Judging the Students' Comprehensive Cognitive Ability

Cognitive model and test evaluation model correspond to the cognitive evaluation module in the graph. Cognitive model reflects students' cognitive ability, and the system can provide different teaching strategies according to the students' different cognitive ability. Test evaluation model is evaluated through testing. Testing is the basis for evaluating the students' level and adjusting the teaching strategies, and the test questions can be automatically generated by the system, and the coverage model can be modified according to the test results. At the same time, it can also call the evaluation model, the student's test case combined with some of the information in the basic information model through the neural fuzzy comprehensive evaluation of the current cognitive ability and overall ability of students. Evaluation is a continuous process in the process of learning. After the completion of the evaluation of the evaluation results will be written to the cognitive model, modify student six cognitive ability and general ability. At the same time, it will activate teachers in the model of teaching strategy module to adjust teaching strategies.

4.1. Case Analysis

After the students are learning a unit (assuming first units), the system gives a set of unit tests to test the students' learning ability and learning effect. Assuming the first test of the ability of the students, the group of test questions out of 100 points, according to the students' answer with the correct answer in the database, get the students the test score of 76 points, to its fuzzy processing, according to the definition, the students belong to u_3 . The memory ability score of 76 points can be substituted into the single factor evaluation vector for $R_{11} = (0, 0, 0.6, 0.4, 0, 0)$, and if the students' understanding of the test score of 72 points, the ability to test 71 points, the analysis of the test is 68 points, the comprehensive ability of the test is 64 points, the corresponding evaluation

vector is $R_{12} = (0, 0, 0.2, 0.8, 0, 0)$; $R_{13} = (0, 0, 0.1, 0.9, 0, 0)$; $R_{14} = (0, 0, 0, 0.8, 0.2, 0)$;

$R_{15} = (0, 0, 0, 0.4, 0.6, 0)$, it can be obtained that $R = \begin{pmatrix} 0 & 0 & 0.6 & 0.4 & 0 & 0 \\ 0 & 0 & 0.2 & 0.8 & 0 & 0 \\ 0 & 0 & 0.1 & 0.9 & 0 & 0 \\ 0 & 0 & 0 & 0.8 & 0.2 & 0 \\ 0 & 0 & 0 & 0.4 & 0.6 & 0 \end{pmatrix} B = A \cdot R = (0.1$
 $0.25 \ 0.35 \ 0.2 \ 0.1) \begin{pmatrix} 0 & 0 & 0.6 & 0.4 & 0 & 0 \\ 0 & 0 & 0.2 & 0.8 & 0 & 0 \\ 0 & 0 & 0.1 & 0.9 & 0 & 0 \\ 0 & 0 & 0 & 0.8 & 0.2 & 0 \\ 0 & 0 & 0 & 0.4 & 0.6 & 0 \end{pmatrix} . B = (0.755 \ 0.10)$, this is the unit test of students

cognitive ability comprehensive evaluation results, it indicates that the students' comprehensive cognitive ability scores for the 14.5%, passed the composition is 75.5%, the poor composition is 10%, can be considered 1000 people evaluation of the students, 145 people think that the students comprehensive cognitive ability for medium, 755 people think, 100 people think poor. The representative fraction of the "good", "good", "medium", "pass", "poor" and "poor", "difference" is: 95, 85, 75, 65, 50, and 20. They

constitute a grade score matrix, and the test results of the comprehensive cognitive ability of the students are

$$S_1 = (0 \quad 0 \quad 0.145 \quad 0.755 \quad 0.1 \quad 0) \begin{bmatrix} 95 \\ 85 \\ 75 \\ 65 \\ 50 \\ 20 \end{bmatrix} = 64.95, \text{ According to the test results of}$$

students' cognitive ability and the comprehensive results of this unit, the students' grade is modified by combining teaching rules, and the corresponding learning method and reasonable teaching suggestions are proposed.

Based on the above points considered, the student model will be by the cognitive theory as the basic structure of the student model. It can not only record the student's knowledge master ability and learning history, can also record of students' cognitive ability. It uses cover model, cognitive model and test evaluation model from many aspects of students' learning of description and organization, can more aptly describe the student learning and learning behavior, but also conducive to the realization of. Constructing a student model we will focus in on the evaluation of the students' cognitive ability and in the usual practice gives the improvement: application is evaluated through test model, will learn test results using neural fuzzy comprehensive evaluation and processing the learner's knowledge level and cognitive ability, namely, neural fuzzy comprehensive evaluation in the student model. We give a complete formal description of the student model as follows:

The student model = {basic information model, security model, learning situation model}.

The basic information model or student number, name, Department, professional, class, age, gender, hobbies, learning style}.

Security model = {student number, name, login name, password}.

Learning model = {coverage model, cognitive model, model test and evaluation}.

The coverage model = {student number, name, course, learning progress}.

Cognitive model {student ID, name, course, learning and memory ability, the ability to understand, application ability, evaluation, analytical ability, comprehensive ability, general ability}.

Test evaluation model = {student number, name, exercise time, exercise scores, test time, test scores}.

4.3. Program Implementation

Knowledge representation in the student model, in theory, the framework structure method, in the actual programming design, we use the C language to define the structure of the STRUCT language.

STRUCT structure name {member}}.

The name of the structure is any valid identifier, the member tables must use a pair of braces closed, and the structure of the semicolon statement. The knowledge of training / testing aided information module processing in the student model is expressed as a structure type.

With the structure of the data, it is convenient and flexible and free of access.

The information module includes basic information model and security model, which reflects the basic situation of the students. Initial information are generally students for the first time login, the interface input the basic situation of their own, according to the information of relative stability of different divided into static information and dynamic information, including static information including student ID, name, gender, professional faculties such as relatively fixed information and dynamic information refers to the age, learning style will change with the teaching process of information. The system receives the input information, and sends the information to the student information database file, establishes the student model preliminary information. For example, the following information student class is used to describe the student's basic information module class Student Information public.

5. Conclusion

The main task of the student model is to evaluate students' cognition. This paper introduces the basic knowledge of fuzzy mathematics and fuzzy comprehensive evaluation, and then discusses the students' cognitive model of each module, the most important is to evaluate the learning level of students in the learning level evaluation module. Test evaluation model based on neural fuzzy comprehensive evaluation method, in the evaluation process of complementary advantages and disadvantages of the fuzzy comprehensive evaluation method and BP neural network, to avoid in the process of fuzzy comprehensive evaluation for a large number of evaluation factors is difficult to determine the membership degree, the construction cost time and model of subjective experience, and neural network degradation function and learning ability make the evaluation more convenient and more perfect. Neuro fuzzy comprehensive evaluation method as the combination of the two is a worthy research evaluation method.

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The Construction of English Teachers' Classroom Teaching Ability System Based on Artificial Intelligence

Yu Cuiye¹

616223760@qq.com

¹ Sias International University, Zhengzhou University, 451150, Zhengzhou, Henan, China

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Abstract: For a long time, traditional approaches to English Teaching in middle schools due to various problems and shortcomings and widely criticized, Ministry of Education promulgated a new "English curriculum standard" also on the reform of English Teaching in middle school proposed new requirements, but the crisis is often also means that a turn for the better, with advance of the integration of information technology and English course, the application of artificial intelligence in the field of teaching for middle school English teaching process optimization and bring new opportunities, intelligent, individualized English teaching environment for the creation of a new platform for. in order to improve the teaching ability of English teachers. Method: artificial intelligence technology. use expert system and natural language recognition technology of AI to construct a new teaching system of English class. from the practice of the use of teaching system of English class, we can see that the English teachers' classroom teaching ability has been strengthened, and the students' learning ability has been improved. The reason is that the teaching system of English class based on artificial intelligence can create a classroom environment with strong interactive, situational and more in line with the development of students' personality development, which helps to improve students' learning enthusiasm. the expert system and natural language recognition technology used in the process of improving English teachers' teaching ability is effective.

Keywords: Artificial intelligence; expert system; natural language recognition; English teaching.

1. Introduction

For many safety hazards, difficult to identify and resulting in a large number of engineering problems of the accident, mathematical model is established by using fuzzy recognition, which can recognition construction safety hazards. Using a lot of architectural engineering data, collecting real-time continuous information and extracting the corresponding characteristic set, identify security level, and thus realize the engineering safety hazard identification and prevention. Finally, fuzzy recognition is proved to be feasible on the engineering safety hazard identification problem by analyzing an example. This paper introduced the quasi-experiment of using the intelligent English instruction system CSIEC in English routine instruction of two classes of first year of

a middle school. In order to obtain the effect of the CSIEC, this paper analyzed the test scores of the students from treatment class and control class, and found that the system could narrow the gap of students. And the effect would be better to the students whose English level were below average. The reason was that this quasi-experiment emphasized the basic training such as words practice, and was targeted to the students whose English were in lower level. Top Abstract Teachers in today's information society are required to rethink their teaching approaches to accommodate the learning needs of children and adults, either in the traditional classroom settings or the virtual environment. Logically speaking, children require instructors to teach them by using the pedagogical methods. Likewise, adults require teachers to help them learn by using andragogical approaches such as facilitation methods. When it comes to teaching children or helping adults learn in the online teaching and learning environment, it is the epistemological positions of the teachers that predetermine their instructional methods. While theoretical approaches to error correction vary in the second language acquisition (SLA) literature, most sources agree that such correction is useful and leads to learning. While some point out the relevance of the communicative context in which the correction takes place, others stress the value of consciousness-raising. Trying to reconcile the two approaches, this paper describes an application of artificial intelligence in the second language error remediation process. These studies showed that, with chat, both the amount of learners' language production and its complexity significantly increased. The literature revealed moderate support for claims that technology enhanced learners' output and interaction, affect and motivation, feedback, and metalinguistic knowledge (Carvalho, A. A., Araújo, I., & Fonseca, A., 2015).

2. The Meaning of Artificial Intelligence

Artificial intelligence (artificial intelligence (AI) is developed on the basis of mutual penetration of a variety of disciplines in computer science, cybernetics, information theory, neurophysiology, psychology, philosophy, linguistics, etc. a new interdisciplinary subject. His main research on how to use the machine (computer) to imitate and realize the human intelligent behavior. Some people put together the artificial intelligence with atomic energy, space technology, known as the three cutting-edge scientific and technological achievements. It studies how to make the computer or smart machine, including hardware and software, imitation, and the extension of the human brain in reasoning, planning and calculation, thinking, learning thinking activity, addressed so far need a human expert to handle the complex problems. The results of artificial intelligence in a new force to enter the community, so that machine intelligence and human intelligence complement each other, mutual penetration, mutual promotion. The development of artificial intelligence, will also promote revolution of human intelligence, so that the history of human civilization into a new stage, and the system structure of the whole scientific differentiation and transformation of new and in the history of science development has far-reaching Influence. The artificial intelligence theory research how to use artificial method of simulation, and the extension of intelligent, mainly of science and technology, who are engaged in work, to natural intelligence theory as the foundation, if we can clarify all kinds of natural intelligence work mechanism and its various functional components of the structure by has been highly developed electronic, optical and biological device to build similar structure of

the for simulation, extension and expansion, so as to realize the artificial intelligence. But unfortunately, due to the highly complex structure of the human mind, due to the sharp weapon for the modern science of experiment in the study of brain mechanisms and structure cannot be free to use, until today, natural intelligence theory did not clarify some basic intelligence activities of the mechanism and the structure, the overall progress is very limited. So the main stream of the artificial intelligence theory has already moved from the structure simulation to the road of the function realization. (Rahmani, M. E., Bouarara, H. A., Amine, A., & Hamou, R. M., 2016) So-called function to achieve is to the structure of the natural intelligence is regarded as a black box, and control the relationship of input and output of the black box, as long as the simulation function can be from the relationship between input and output. To realize the function of road to artificial intelligence theory get rid of the shackles of the slow progress of the natural intelligence theory, through several decades of development, has formed a systematic theoretical system, contains extremely rich in content, and has been widely used in practice, played a significant role.

The research content of artificial intelligence: artificial intelligence theory, generalized knowledge model, Lenovo knowledge base and reasoning machine, knowledge acquisition tool, expert system development environment, intelligent robot and application research, a new generation of artificial intelligence machine, brain model with high performance, high intelligence, expert system, intelligent instrument. (Choi, Y. S., 2015) Among them, the expert system is artificial intelligence from theoretical research to practical application, from the general thinking method study into the model of specialized knowledge, has successfully penetrated into the various fields, and produced a huge social benefit and economic benefit. With the deepening of the study of expert system, constantly to people put forward new research issues and challenges, so as to promote the development of the basic theory of artificial intelligence and the basic technology, creating a computer to solve non numerical problems in an effective way.



Figure 1 – The use of AI Technology to Carry Out Teaching in English Class

The utility of AI in the teaching of English may include providing an interactive English teaching environment, providing personalized teaching, helping teachers and students to make use of English teaching resources effectively, improving teachers' teaching ability, enhancing students' problem solving ability and operation ability (Raaschou-Jensen, K., Thomsen, R. H., Gang, A. O., Aagaard, T., Niemann, C., & Bjerrum, O. W., 2016). This involves the very core of the AI technology expert system and natural language understanding (Yamashita, K., Nagao, T., Kogure, S., Noguchi, Y., Konishi, T., & Itoh, Y., 2016).

3. Artificial Intelligence Technology

3.1. Expert System

As an important research content of artificial intelligence, expert system is generally interpreted as a kind of intelligent programming system with a large amount of special knowledge and experience (Posada, R. C., Posada, G. E. C., & Martínez, R. B., 2016). It can use the experience and special knowledge accumulated by experts for many years, simulate the thinking process of experts and solve the complex problems that need to be solved by experts in the field (Lin, P. C., & Lin, P. K., 2015). Usually a basic expert system is made up of 6 parts, which is composed of knowledge base, database, inference engine, explanation mechanism, knowledge acquisition mechanism and user interface (see Figure 2), and the knowledge base and inference engine are the core of it (Barrons, K. P., 2015).

Expert system is according to provide by a domain expert knowledge and experience, judgment and reasoning, simulation of human experts in the decision-making process, can be regarded as a kind of special knowledge and experience of computer intelligent system with, its capacity from its own expert knowledge, it is generally adopted with artificial intelligence in knowledge representation and knowledge reasoning technology to simulate the usually consists of experts in order to solve the complex problems, achieve and expert equal to solve problem ability level. The knowledge based system design method is based on the knowledge base and the inference engine. The expert system is composed of 8 elements: user, human expert, system design engineer, database, knowledge base, user interface, explanation mechanism and knowledge acquisition module. Expert systems separate knowledge from other parts of the system, which emphasizes knowledge rather than method, so the expert system can also be called a knowledge based system.

Expert system is an intelligent program system, which is based on the knowledge and experience of experts, the expert system contains a lot of knowledge and experience in the field of knowledge and experience.

In the process of system operation, this knowledge and experience can be continuously increased and modified; the expert system to solve the problem is the real life of only the field experts to solve the problem.

3.2. Natural Language Understanding

Natural Language Processing (NLP) is a technology that uses natural language to communicate with computer (GREU, V., 2015). Because the key to dealing with natural

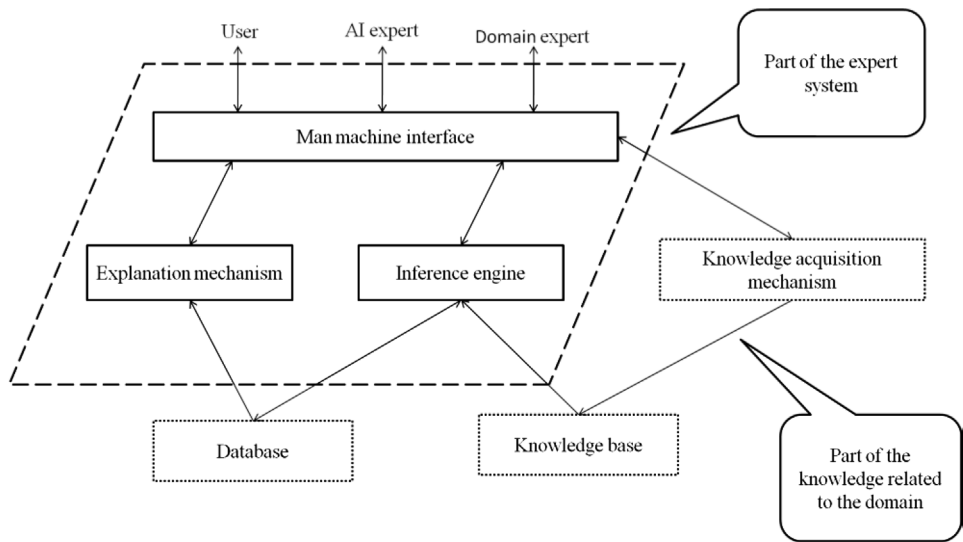


Figure 2 – Basic Structure of the Expert System

language is to let the computer “understand” the natural language, so the natural language processing is called natural language understanding (NLU), also known as computational Linguistics. On the one hand, it is a branch of language information processing. On the other hand, it is one of the core issues of artificial intelligence (Juma, K. S., Raihan, M. A., & Clement, C. K., 2016).

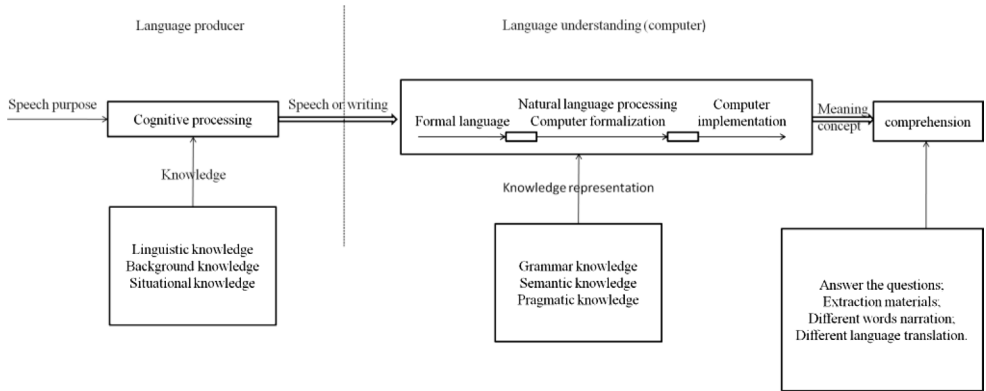


Figure 3 – Basic Model of Natural Language Understanding

4. Construction of English Teacher’S Teaching Ability System Based on Ai

4.1. Inference Mechanism

To build a system, we need to adopt a reasonable inference mechanism. Rule Condition is represented by a logical combination of learning and environmental factors, is the

main part of the students learning environment factors (Jose, J., & Abidin, M. J. Z., 2016). Action as a direct contact with the knowledge environment and learning state, the intelligent operation of the system is provided in the condition which is true. It can be expressed as:

$$\text{Rule} = \text{Rule_Head} \mid \text{Rule_Condition} \mid \text{Rule_Result} \quad (1)$$

$$\text{Rule_Result} = \text{Head_Conversion} \mid \text{Action} \quad (2)$$

Rule running algorithm is:

According to the contents of the knowledge points provided by the current teaching objectives, in the current teaching rule base, to find the same rule set for the current rule header; According to the rule set to choose knowledge and matches the knowledge content and the rule properties in the rule set; If there is inconsistency between the last rule attribute and the attribute of the knowledge point, automatic trace back to find the next rule (Ahmad, D., 2015). If the rules of the system are fully matched to a certain rule, the rule is executed.

4.2. Module Design

According to the students' knowledge level in the field of English learning, English teaching strategy module decides to adopt the teaching method (McCoy, L., Lewis, J. H., & Dalton, D., 2016). Before the students begin to learn, the configuration of these properties can be carried out, the system automatically according to the configuration to generate the corresponding teaching attributes of the teacher knowledge tree, which is actually a teaching strategy planning process, and then through the students continue to carry out the study of knowledge points, and gradually establish the corresponding students knowledge tree. Then the teacher according to the corresponding teaching knowledge tree began to teach knowledge (Gu, B., & Kwak, Y., 2015).

4.3. Attribute Assignment and Weight Calculation of English Knowledge

For knowledge point assignment, the method of this paper is to realize the process of semi automatically adding to the knowledge base. In addition to the knowledge point of the adjustment, these parameters for the knowledge point remained unchanged (Hasan, K., 2015). To set the system by the development experts and combine with the human teacher opinion as well as the system knowledge tree structure. For most of the attributes, such as the type of knowledge, the knowledge point, the link of knowledge points, the form of media, and the semantic properties, the dynamic algorithm is generally not used:

$$w_{kj} = k_2 n * r * M * f / pq \quad (4)$$

$$f = N / N_{all} \quad (5)$$

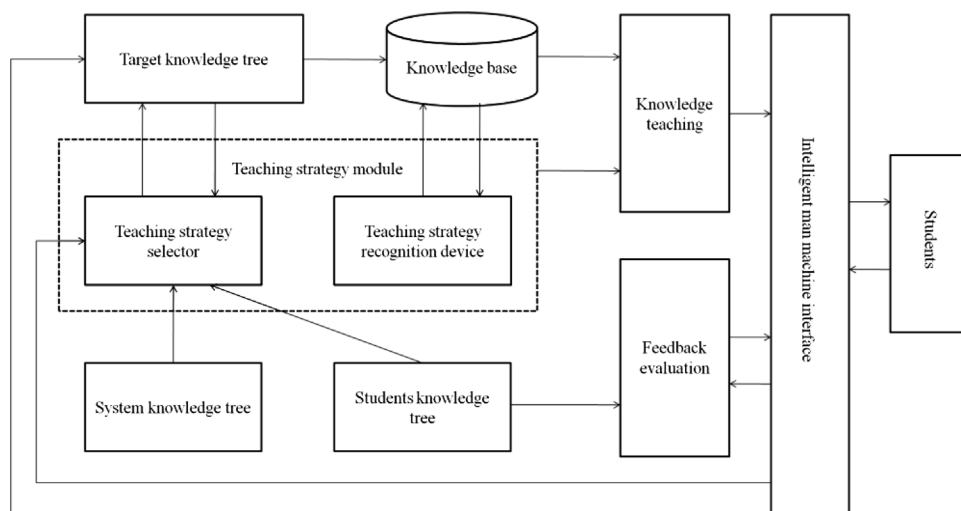


Figure 4 – Teaching Strategy Module

5. Case Analysis of English Class Teaching

Since the 1960s, image, voice, natural language processing is related to the field of research, although has achieved the rapid development, but the popularization and application of these technologies have been greatly limited, one of the reasons is the lack of efficient high-level semantic understanding and analysis of the concept model. Through the study of emotional processing to enable computer which is more close to the human mental state and emotional state recognition and traditional images, speech and language models are combined, will be able to provide an important supporting role for the analysis of the concept of computer. At the same time, the research on affective computing will also establish some new biological characteristics and behavior characteristics of the parametric model and processing ideas, thus greatly promoting the traditional image, speech, language and other related disciplines. In addition, emotional computing will also bring more harmonious human-computer interaction.

The change of mood and state of mind is always accompanied by some physiological characteristics or behavioral characteristics, which is influenced by the environment, cultural background, personality, and so on. How to deal with the feelings of the machine, we must first in-depth study of the interaction between people. So how do people express their feelings and how they perceive them?

Expression of emotion is through a series of facial expressions, body movements, voice and so on, and the perception of emotional change is through the visual, auditory, tactile and other means to achieve. The visual awareness mainly through the observation of facial expressions, gestures and body movements to; auditory perception mainly through the observation of speech in speech tone expression to achieve; and through to caress, impact, sweat secretion, heartbeat, and physical state of perception is a primary approach to realize tactile perception.

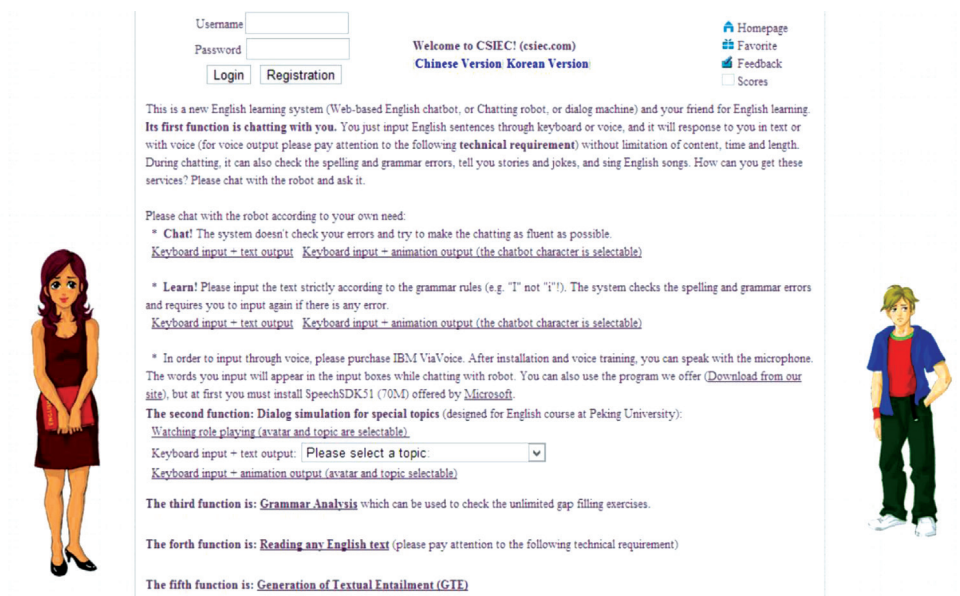


Figure 5 – The Interface of An Artificial Intelligence English Assistant Teaching System

Affective computing research focus is through a variety of sensors to obtain caused by emotional physiological and behavioral characteristics of the signal, “emotion model is established, thus creating a perception, recognition and understanding of human emotion ability of, and can according to user’s emotion to make intelligent, sensitive, friendly response of personal computing system, shorten the distance between man and machine, to create a truly harmonious man-machine environment. Affective computing is a highly integrated research topic, so far, most of the research work is still in the initial stage. Generally speaking, the process of human-computer emotional interaction includes: the acquisition of emotional information and parametric modeling, emotion recognition, emotion understanding and expression, and so on.

5.1. Experiment Purpose

The intelligent English teaching system is applied to middle school English class. It aims to show that this kind of artificial intelligence can help improve the teachers’ English teaching ability and to optimize the teaching effect.

5.2. Experiment Design

In the experiment, the two classes of English classes in the teaching object are taught by the same teacher, and the English class hours every week of each class are equal. The experiment began in July 2013 and ended in February 2013. In this semester, a 16 week study, the experimental class to reduce an ordinary classroom teaching, and take this class to the computer class.

Test name	Effect	Test content	Test property	Test results	
				Experimental class	Control class
<i>Last final exam</i>	Pre test	Listening, grammar, vocabulary, writing, etc.	Unified comprehensive review	40.62	37.56
<i>Mid-term exam</i>	Mid-term test			40.5	36.6
<i>Final exam</i>	Post test			46.91	41.4
<i>Platform final test</i>	Targeted learning effect test	Words and text detection	Special test for the learning effect of the platform	50.21	44.6

Table 1 – Students Take the Exams in the Experimental Teaching

5.3. Experiment Teaching Effect

First, we compare the results of the experimental class and the control class, can be seen that the effect of teaching system in practice is remarkable. In the control class, the average score in the mid-term exam is 36.6, the average score of the final exam is 41.4, mean difference is 4.79; In the experimental class, he average score in the mid-term exam is40.05, the average score of the final exam is 46.91, mean difference is 6.86. These data show that the result of the experimental class is better than the control class, and the gap between the experimental class and the control class expanded from 3.44 to 5.501. Both the experimental class and the control class have been improved, and the system is helpful to the improvement of students' test scores.

6. Conclusion

This paper introduces the content of artificial intelligence, analyzes the realization of the expert system based on rule, and puts forward the overall implementation scheme of the English teaching system based on artificial intelligence. Through the research of this topic, the whole research process and the test results, we can draw the following conclusions.

In this paper, the design of English teaching assistant expert system, using production mode and framework combining the knowledge expression method, uses the uncertainty reasoning technology, to complete the English teachers of students in groups of knowledge to grasp the situation of basic evaluation, to achieve the overall evaluation of a single class and multi class, reduce the burden on teachers, to improve the quality of teaching.

Design of autonomous learning system based on the artificial neural network, according to the characteristics of English teaching, this paper studies the based on neural network implicit knowledge base, knowledge representation, knowledge acquisition, using BP neural network to the training samples, the ideal parameters of neural network, composed of students independent evaluation system.

By Ebbinghaus memory forgetting curve, established knowledge forgetting mathematical model, intelligent memory algorithm, individualized instruction for students to learn, to

strengthen the students' autonomous learning ability and interest, the system has higher practical value.

In this paper, we combine the basic connotation of artificial intelligence, use the expert system and natural language recognition technology in the practice of English Teaching, design an English teaching system and conceive the implementation plan of the system. Practice shows that the system can improve the English teachers' classroom teaching ability, can actively mobilize the students' learning enthusiasm and help to improve their ability to learn English. Due to the limited level of the author, there are still many problems in the research, which still need to be improved in the future.

The remainder of this paper is organized as follows. Section 2 describes the expert system and Natural language understanding of the expert system. Section 3 gave the construction of English teacher's teaching ability system based on bisection 3presented case analysis of English class teaching. Conclusions are summarized in Section 5.

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A Study of English Intelligent Classroom Model Based on Artificial Intelligence and Emotion Judgment

Wang Ning¹

babinwn@126.com

¹ Foreign Languages Department, Harbin Engineering University, 150001, Harbin, Heilongjiang, China

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Abstract: Artificial intelligence is the study of human intelligence activities of the laws of science, in College English Teaching in the application of artificial intelligence technology, combined with Internet, to develop the computer aided teaching expert system, can be an effective solution to problems, the College English teaching reform facing the shortage of teachers, teaching pattern is unitary and so on, realizing the sharing of teaching resources, effectively improve the quality of teaching, to reduce the burden on teachers, to strengthen the students' independent learning ability. This paper introduces the principles, characteristics and application fields of artificial intelligence, analyzes the problems existing in College English teaching, and puts forward the realization scheme of College English teaching system based on artificial intelligence technology. To study English intelligent classroom model: The model of artificial intelligence and emotion judgment.: Firstly, the emotion model is built on the basis of OCC's emotion model and Ekman's basic emotion theory. Secondly, the Multi-Agent system is built based on the Agent technology in artificial intelligence. Finally, the simulation experiment is carried out.: In this paper, a method of teaching agent Emotion Modeling Based on fuzzy logic is proposed, which embodies the essence of the dynamic model and the fuzzy nature of emotion. The simulation results show that the model can be used to make intelligent response according to the students' emotional characteristics in English class.: The application of intelligent module is beneficial to the students' English learning and the communication of teacher's information in English class.

Keywords: Artificial intelligence; emotion judgment; Multi-Agent system.

1. Introduction

The current College English Curriculum Requirements indicates the direction of college English teaching reform in China by defining the objective of English teaching as developing students' ability to use English in a well-rounded way, and improving their cultural literacy and autonomous learning ability. This paper proposes that content-based language instruction, which integrates content and language learning and promotes autonomous learning, is a feasible and effective approach to achieving the objective of college English teaching in China. In the studies of acceleration conducted so far a multidimensional perspective has largely been neglected. No attempt has been made to

relate social-emotional characteristics of accelerated versus non-accelerated students in perspective of environmental factors. Aims: In this study, social-emotional characteristics of accelerated gifted students in the Netherlands were examined in relation to personal and environmental factors. We describe in this paper a new hybrid approach for optimization combining Particle Swarm Optimization (PSO) and Genetic Algorithms (GAs) using fuzzy logic to integrate the results of both methods and for parameters tuning. The new optimization method combines the advantages of PSO and GA to give us an improved FPSO+FGA hybrid approach. Fuzzy logic is used to combine the results of the PSO and GA in the best way possible. The new hybrid FPSO+FGA approach is compared with the PSO and GA methods with a set of benchmark mathematical functions. The improved hybrid FPSO+FGA method is shown to outperform both individual optimization methods. Based on theoretical knowledge of color, aesthetics and adolescent psychology, etc, adolescent emotional characteristics and its influence on color aesthetic have been analyzed through examples. Then, adolescent color aesthetic thinking methods on the basis of the special physiological and psychological have been further clarified, that are transience, intermittent and jumping characteristics. Finally, adolescent color aesthetic mode and its specific formation process have been researched. In this paper, we propose an advanced location awareness-based intelligent multi-agent technology that allows multiple users to share various user-centric mobile multimedia contents. This paper mainly focuses on (1) mobile station-based mixed-web map module via mobile mash-up technology, (2) a new location-based mobile multimedia technology using ubiquitous sensor Net.-based five senses content, and (3) location awareness-based intelligent multi-agent technology that includes a location-based integrated retrieval agent.

2. Theoretical Basis of Emotion Model

2.1. The Meaning of Intelligent Agent

Intelligent agent is a very important research field of artificial intelligence. It is widely used in the field of its autonomy, initiative and sociality. More and more intelligent tutoring systems begin to adopt intelligent agent as the support technology of building architecture, and thus form a new research direction of teaching agent. Modern cognitive science and the study of the nerve and Physiological Sciences show that emotion has an important influence on human cognition. And the educational science research field has never stopped the attention to the emotional experience of the students in the learning process. Therefore, the ability to give the teaching agent emotional processing has become a very clear research objectives in the field.

Some scholars in the field of education, such as Piaget, Goleman and others point out that the students' motivation and emotions have an important influence on their learning. Piaget stressed that the negative emotional state will have a significant effect on learning. For example, he said in a study on the study of mathematics, a considerable part of the poor performance of the students in the study reflects the emotional barrier. To this end, the skin Jiang Jibe put forward not to contain the emotional factors of the cognitive mechanism. Goleman explores the ways in which emotions affect mental activity, and points out that learning can be more difficult if students are depressed, stressed, and other negative emotions.

In our traditional English teaching mode, English teachers is more to instill a large number of vocabulary, grammar and other knowledge in the process of teaching (Li, H., 2016). Students listen carefully in class and complete the notes. When the course is over, the teacher most of the energy is consumed, students is also unable to take notes when tired in the process of learning (Semenchuk, Y., 2016). So the classroom atmosphere is often very dull and no interaction enthusiasm. Therefore, a smart classroom and teachers are particularly important for students.

Emotion has long been regarded as an important part of the human mind (Sibomana, E., 2016). In English class, the students and teachers' emotional expression can reflect the activity of the classroom and the degree of acceptance of students.

Artificial intelligence is a subject that studies the computer to simulate some thinking process and intelligent behavior of human (Yu, W. C., 2016). At present, the application of artificial intelligence technology is very extensive. Among them, the application of Agent technology in intelligent tutoring system is studied.

Therefore, this paper builds a model of English intelligent classroom based on the Agent technology and the emotion model.

The emotional model is based on the following two major theoretical bases: OCC emotion model and Ekman's basic emotion theory, and fuzzy logic algorithm.

2.2. OCC Emotion Model

Orton, Core and Collins construct an affective cognitive theory, which explains the inducement of emotion by describing the cognitive process of triggering emotion. OCC model is an important result of this theory, but also because of its good can be widely used in the field of affective computing is currently the emotional model, but also the core of the theoretical basis for the study.

According to the cognitive theory of emotion, emotion appears as a result of cognitive assessment. The OCC model holds that emotions can be assessed by evaluating the three elements of the environment: events, agent, and objects. An event is something that can be perceived by a person. Agent may be a person, an animal, or an object that has no life. For individuals, there are three kinds of value structure: purpose, standard and attitude. The evaluation of individual events is mainly to promote or hinder the realization of their own purpose. Standard is used to evaluate the activities of age, that is, to assess whether the activities of agent conform to the social, moral, or behavioral standards of the individual. Finally, whether an object is attractive to an individual depends on whether the attribute is consistent with the individual's attitude.

The OCC model suggests that if the model is applied to a machine, it can help to understand the triggering mechanism of human emotions. In spite of the fact that the initial motivation of the OCC model is not the development of machine emotion, but Pic states that the OCC model can be used for the machine's emotional synthesis.

OCC model is a highly simplified description of human emotions, because in reality the personal experience is likely to be a very complex mixture of emotions. But in order to understand whether a person's experience is a specific type of emotion, try to separate the pier each emotion is necessary.

According to different emotional stimuli, the model proposed 22 kinds of emotions, and made a detailed description of the characteristics of the stimulus generated emotion. As a result, the model is considered to be a classic model of the field (Ansarian, L., 2015). In 2003, Orton improved the model, and the classification of the stimuli tended to be positive and negative. Meanwhile, the robot should have its own goals, evaluation criteria and preferences of these three kinds of inherent consciousness. In this paper, we use this theory to solve the problem of extracting the emotional parameters in the model (Castela, N., Dias, P., Zacarias, M., & Tribolet, J., 2013).

2.3. Ekman's Basic Emotion Theory

Emotions can motivate social interactions and relationships and therefore are directly related with basic physiology, particularly with the stress systems. This is important because emotions are related to the anti-stress complex, with an oxytocin-attachment system, which plays a major role in bonding. Emotional phenotype temperaments affect social connectedness and fitness in complex social systems. These characteristics are shared with other species and taxa and are due to the effects of genes and their continuous transmission. Information that is encoded in the DNA sequences provides the blueprint for assembling proteins that make up our cells. Zygotes require genetic information from their parental germ cells, and at every speciation event, heritable traits that have enabled its ancestor to survive and reproduce successfully are passed down along with new traits that could be potentially beneficial to the offspring. In the five million years since the lineages leading to modern humans and chimpanzees split, only about 1.2% of their genetic material has been modified. This suggests that everything that separates us from chimpanzees must be encoded in that very small amount of DNA, including our behaviors. Students that study animal behaviors have only identified intraspecific examples of gene-dependent behavioral phenotypes. In voles (*Microtus* spp.) minor genetic differences have been identified in a vasopressin receptor gene that corresponds to major species differences in social organization and the mating system. Another potential example with behavioral differences is the FOXP2 gene, which is involved in neural circuitry handling speech and language. Its present form in humans differed from that of the chimpanzees by only a few mutations and has been present for about 200,000 years, coinciding with the beginning of modern humans. Speech, language, and social organization are all part of the basis for emotions.

This paper is based on the two aspects of Ekman: basic emotions and expressions. Ekman is mainly influenced by Darwin's theory, and puts forward 6 basic emotions: anger, disgust, fear, happiness, sadness and surprise (White, J. R., 2016). The basic emotions directly affect the emotional classification, which is closely related to the basic characteristics of life. In this paper, we use the theory to solve the problem of emotion space design in the model.

2.4. Fuzzy Logic Algorithm

Fuzzy control has been used extensively in applications such as servomotor and process control. One of its main benefits is that it can incorporate a human being's expert knowledge about how to control a system, without that a person need to have a mathematical description of the problem.

Fuzzy logic is one of the techniques in Artificial Intelligent (AI) that widely used to control environmental factors. The effectiveness of fuzzy logic has been proven through a lot of creation of Intelligent System using fuzzy logic application. This paper presents the research segment of development of methodology for determining odor level using fuzzy logic based algorithm. Two different gas sensors are used which respond to carbon monoxide, methane, hydrogen, ethanol and Chlorofluorocarbon.

Advances in sensing technology lead to the usage of sensors in odor detection. Sensors are capable of capturing different phenomena from environment and can last for long time. Odor detection using sensors so far is the best method for accurate odor levels detection.

Fuzzy logic is developed on the basis of multi-valued logic (Bajohr, F., 2016). It uses the linguistic truth value that extracted from natural language with fuzzy constraint operator, or fuzzy numbers instead of the exact number of logic propositional truth value (Ngoepe, L. J., 2015). In this paper, the fuzzy logic algorithm is as follows.

It assumes A, A' is a fuzzy set on the domain X. B is a fuzzy set on the domain Y. The fuzzy implication A--B is expressed as a fuzzy relationship of two elements R in space X*Y. There is a fuzzy set B' that is exported by "X is A " and "IF x is A, THEN y is B ". It is defined as:

$$\mu_{B'}(y) = \nu_x [\mu_{A'}(x) \wedge \mu_R(x, y)] \quad (1)$$

Or equivalent:

$$B' = A' \circ R = A' \circ (A \rightarrow B) \quad (2)$$

Thus, as long as the fuzzy implication A--B is defined to the appropriate fuzzy relationship, you can use the fuzzy reasoning steps to get the conclusion. The operation method of fuzzy implication A--B before A and B uses the Madman method as the main method.

$$R = A \rightarrow B = \int_{X \times Y} \frac{\mu_A(X) \wedge \eta_B(Y)}{(X, Y)} \quad (3)$$

The conclusion of fuzzy reasoning is obtained by synthesizing the facts and rules.

3. Agent technology and Multi-Agent System

Through the comparative study of the existing teaching simulation agent, and under the environment of classroom teaching students the investigation and study, this study established the three basic characteristics of emotional teaching agent, namely, to with emotion, but is not limited to the external behavior of emotional expression, so that students feel with their own interactive teaching agent more realistic and reliable, which can identify students' emotion, which is the premise of reasonable emotional decision feedback, has the emotional feedback strategy, based on the student's affective state,

motivation and other types of information for decision feedback, and the final realization of students' emotional support.

The design thought is embodied in the system structure of the agent of emotion teaching. Affective teaching agent's architecture consists of three modules, affective components, decision components and feedback components.

Affective teaching agent first of all from the environment of the perception of students' perception of information. The perceptual information is transmitted to the learning module, emotion recognition and emotion synthesis module. Emotion recognition and emotion synthesis module will be to process the information perception, and need to make use of the learning components some output information, including the expected value and purpose. Events and to identify students' emotional state, and synthetic agent of emotion. After that, the emotional information is submitted to the decision component to select the feedback strategy that can trigger the students' positive emotions. In the end, the feedback strategy is demonstrated to the students through the feedback components in the form of agent's emotional behavior and discourse information.

The research of Agent and Multi-Agent has become a hot spot in the research of Artificial Intelligence Distributed (DAI) in recent years (Manohar, L., 2016). Agent is a computing entity that can continue to play a role in a distributed system or a cooperative system (Jueng, R. N., Tsai, D. C., & Chen, I. J., 2016). Agent is aware of the communication with the outside world, and independently decides and controls its own behavior according to the perception of the external event and the change of its own state (Yin, Z., Yan, Z., Liang, Y., Jiang, H., Cai, C., Song, A., ... & Qiu, C., 2016). The Multi-Agent system (MAS) is solved by the cooperation of multiple agents. The Agent treatment of the problem size should not be too thick, and it should not be too thin (Boroujeni, H. K., Saadatnia, M., Shakeri, F., Keshteli, A. H., Saneei, P., & Esmaillzadeh, A., 2016). MAS is a large organization, which can make up for the limited capacity of the individual work (Murakami, K., & Hashimoto, H., 2016). Similarly, the division of labor and each individual is responsible for a special task, which can make up for the individual learning ability of the new task.

4. Model Design

This model is divided into two modules, which are the emotion module and the Multi-Agent module.

The architecture of virtual human is presented based on agent theory in this paper. The architecture of virtual human includes sense module, perception module, plan module, behavior module, action module, database module, knowledge base module, emotion module, internal variable module, and motor control module. These modules are integrated as a system. This paper mainly introduces function of plan module and behavior module. The architecture of virtual human is presented base on agent theory in this paper. The architecture of virtual human includes sense module, perception module, plan module, behavior module, action module, database module, knowledge base module, emotion module, internal variable module, motor control module. These modules integrate as a system. This paper mainly introduces function of plan module and behavior module.

4.1. Emotion Module

Figure 1 is the overall structure of the emotional model of this paper, which shows the process of emotional reaction in the process of learning English about students, including the extraction of emotional factors, the analysis of emotional factors, mapping to emotional space, and mapping to facial expression.

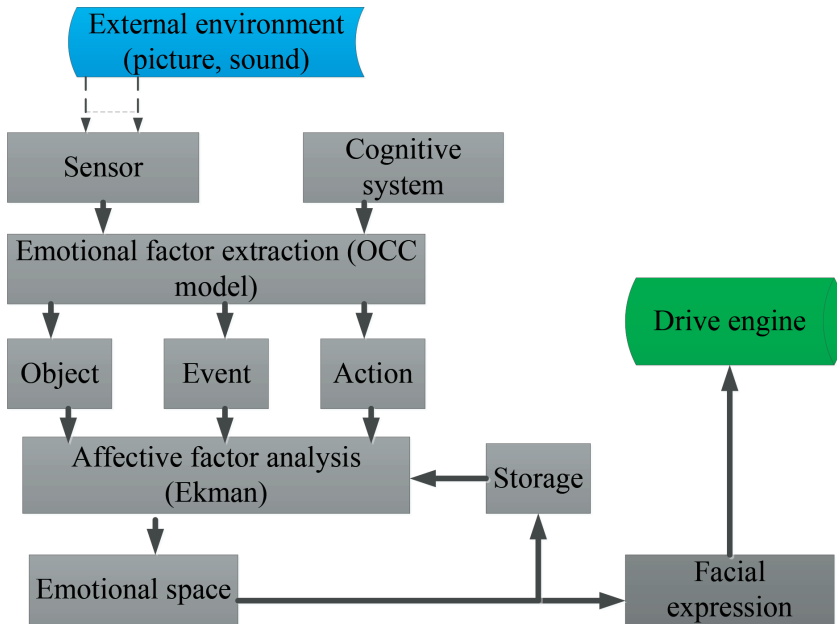


Figure 1 – The Overall Structure of the Emotional Model

This module can extract the emotional characteristics of the teacher and the students, and it can analyze, and thus more intelligently reflects the changes of students in English classroom.

4.2. Multi-Agent Module

Figure 2 is a structure diagram of the Multi-Agent module. It is mainly used for the realization of the intelligent teaching in English class (Malani, P. N., & Rao, K., 2016). English teachers can be based on the emotional characteristics of the students extracted from the above feelings, and the students are now required to carry out the study of the content and processing, such as the layout of the job, answering questions, examination, etc.

5. Simulation Experiment

The model simulation is implemented on MATLAB (Esposito, S., Mari, D., Bergamaschini, L., Orenti, A., Terranova, L., Ruggiero, L., ... & Principi, N., 2016). Figure 3 simulated the students of thinking, dozing, chat, desertion of an emotional action in the English class, and shows the teacher's response to a majority of the students' emotional reactions to the course content, including the exchange, question answering, and exams, and so on.

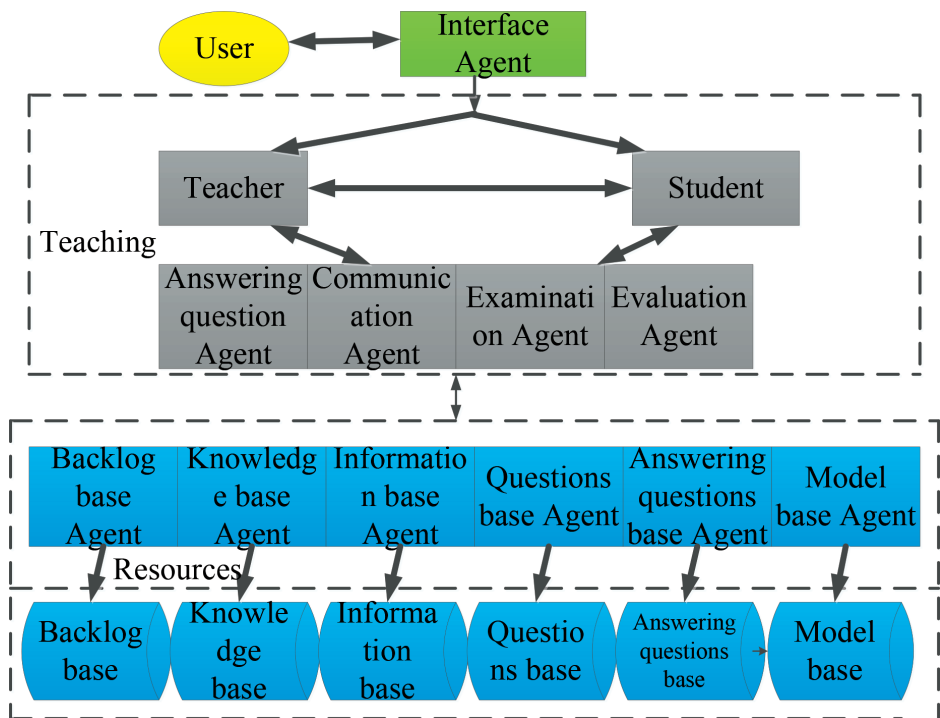


Figure 2 – The Structure Diagram of the Multi-Agent Module

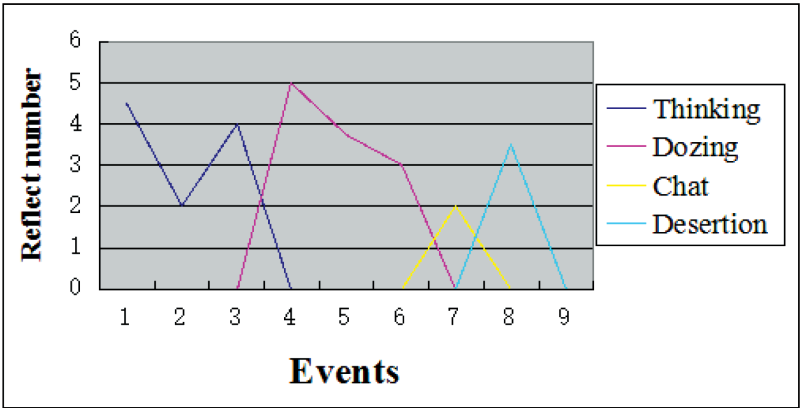


Figure 3 – The Figure of Simulation Results

From Figure 3 can be seen that the model can provide English teachers to need to do things based on the emotional performance of students in the classroom. It has intelligence.

Agent can obtain the students' observable behavior information at any time in order to predict the students' emotional state. All of these data are obtained by the perception

module. The so-called sensor is actually responsible for the process of obtaining information about the behavior of students.

The student information which is acquired by the knowledge module is transmitted to the emotion recognition module, and the latter is responsible for reasoning the students' affective state, and transmits the information to the decision module. The core of agent's decision making module is the BDI cognitive kernel, which is responsible for the affective strategy of the information selection based on the student's emotional state and the degree of effort.

Once the student's emotional state is identified, it will be stored into the emotional memory module of the decision module, then it will enter the process of selecting the affective strategy. In addition, it is very important for the students to recognize the emotion because of the students' goal orientation (motivation type, mastery orientation, orientation). Therefore, the emotion module must obtain the student's motivation type from the emotion model when identifying the student's emotion.

If emotional feedback strategy is the performance of a certain emotional behavior (for example, to encourage students in practice to obtain good results), speech and behavior selection module will be in action database according to the emotional feedback search strategy requires the expression of behavioral data.

Emotional teaching agent is also responsible for receiving teaching strategies from cognitive agent based on student achievement and ability. If the feedback strategy is only to show the content of teaching, emotion teaching agent will send a corresponding request to the cognitive agent instruction, the client knows agent will show the specific teaching content to the students.

6. Conclusion

In this paper, the main research work is modeling and design to identify the students' emotion, inspire the students' positive emotion and then give the students emotional support age. Specifically includes the following three aspects.

Emotion Modeling Method Based on fuzzy logic and machine learning.

Fuzzy sets are used to represent the degree of impact of events upon objectives, to an important degree and expectations, and to explore the emotional evaluation method based on fuzzy logic rules, with relatively few fuzzy rules to achieve in the event observation and emotional state of smooth conversion, embodies the human sense of dynamics and fuzzy characteristics; using a machine learning algorithm of events expected value information of experience learning, to enhance the adaptive model for emotion.

An emotion recognition method based on the type of students' motivation is proposed. The study of students' learning motivation shows that students' learning motivation types (performance orientation and mastery orientation) have an important influence on the emotional state of their learning. In this study, the students' motivation types are introduced into the emotion recognition method, which reflects the individual differences in the process of emotion recognition.

The agent feedback strategy is designed to support the students' emotional support. Studies in psychology and education research show that students' negative emotions can be an obstacle to their learning, while positive emotions can promote students' learning. In this study, in recognition of students' emotional state, informed based on the type of motivation, emotional and pedagogical agents designed a series of emotional feedback strategies and decision-making mechanism, through the emotional behavior and discourse information trigger the students' positive emotion and eliminate the influence of negative emotion, realize the students emotional support.

Along with the development of artificial intelligence technology, the development of intelligent classroom and intelligent course will be more and more extensive, and can better serve the teachers and students. The learning of English will have a huge role in promoting.

The remainder of this paper is organized as follows. Section 2 describes the orifical basis of emotion models like OCC emotion model, Ekman's basic emotion theory and fuzzy logic algorithm. Section 3gave Agent technology and Multi-Agent system. Section 4 presented Emotion module and multi-Agent module. Section described the model can provide English teachers to need to do things based on the emotional performance of students in the classroom and it has intelligence. Conclusions are summarized in Section 5.

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Research on Digital Art Creation Based on Artificial Intelligence

Yu Yu¹

gutyuyu@163.com

¹ Guangdong South China Institute of Industrial Design, Guangdong University of Technology, 523808, Dongguan, Guangdong, China

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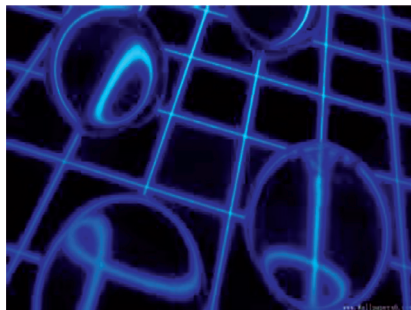
Abstract: With the development of digital information technology and the wide application of artificial intelligence technology, digital art creation is developing towards the direction of artificial intelligence. In order to establish an intelligent design system for digital art, this paper introduces the application of artificial-intelligence technology in the management system. It describes the definition and characteristics of digital art, and establishes a mathematic model for intelligent calligraphy creation. On the basis of the establishment of the mathematic model, this paper analyzes the process and the result of the digital art design, carries out the value of it, and carries out experimental analysis of the effective demand of Chinese Digital Art. In a word, AI technology can improve the development of digital art design, and the digital art has an important role in the social development.

Keywords: AI technology; digital art; mathematic model; calligraphy creation.

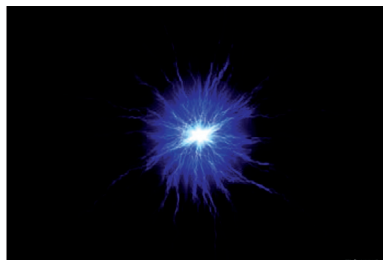
1. Introduction

Since 1990s, a new art form has been quietly emerged in the social life of human beings when people are still lack of enough mental preparation, that is the digital art which has become increasingly familiar to people today. (Castela, N., Dias, P., Zacarias, M., & Tribolet, J., 2013) In the face of this new art scene, some visionary scholars have begun to pay attention to and study the phenomenon of digital culture based on different subjects (Dubino, J., 2016). Among them American digital culture scientist Negroponte's opinion is the most influencing. Negroponte is a scholar who has a strong optimism about the digital culture. His new view of that the "bit world" is beyond the "atomic world" is still being talked about, and his so-called "digital life" is a new way of life, which includes some aspects of the digital culture (Carrasco-Bonet, M., & Selvas-Gardeñas, S., 2015). So far, domestic and foreign scholars have paid attention to the social life caused by digital technology, and some scholars of them have discussed some essential problems of digital culture, but the special research on digital art is still very rare. "Computer art designing and digital creation" points out that the responsibility of this paper is to find the aesthetic connotation through

the superficialities of digital art presented to us by history (Ingrey, L., 2016). There are plenty of people who have the digital culture optimism attitude in the western world such as Negroponte. In China, some scholars followed the steps of Negroponte and others, they began to express their understanding of the digital survival since the beginning of the new millennium. “The Integration of Art and Science” from the point of view of information theory, systematically discusses the various problems that the information culture may face and the information behavior under the influence of information culture (Boydell, K. M., Solimine, C., & Siona, S., 2016). Although he insisted that what he called the information culture in a sense refers to the digital culture, but in my opinion, there should have a world of difference, that is from the perspective of digital culture, his research has yet reached its essence. Many views of “Digital holography for quantitative phase-contrast imaging” are almost the replica of Negroponte’s “Digitized survival”, and he is from science level to describe the digital phenomenon, although the culture and art are involved, but it’s only a preliminary explanation of the phenomenon (Hain, M., & Martin, M. T., 2015). Combined with the basic theory of artificial intelligence and digital art, this paper studies the creation of digital art. Figure 1 (a)-(d) show part of the results of the development of digital art (Roman, T., Xie, L., & Schwartz, R., 2016).



(a) 3D Digital Art



(b) Digital Lighting Art



(c) A Superb Digital Art Work



(d) Digital Art Illustration

Figure 1 – Several Pieces of Exhibition Pictures of Digital Art

2. The Definition and Characteristics of Digital Art

The so-called digital art is a kind of aesthetic system which is created on the basis of digital technology. (Malleshaiah, M., & Gunawardena, J., 2016) This definition emphasizes three limiting conditions as follows: Firstly, it must be based on the artistic activities of digital technology. That is to say, all the aesthetic elements of digital art must be arranged by the digital technology to generate a new quality of digital, which also means that the whole processes of creation, dissemination and acceptance of digital art are all based on the digital technology environment. Secondly, it must be the activities led by aesthetics. This condition firstly draws a line to other non-aesthetic social practices such as the economic activities, political activities, ethical activities, etc. Although there may be occasional emotional activity in the process of engaging in these activities, this kind of emotional activity is only a kind of attributed activities. Thirdly, we emphasize that digital art is a system (Romão, T., Nijholt, A., & Cheok, A. D., 2015). What is the difference between the technology of the digital art and the atomic model of the atomic art? If we call the expression of the atomic art as atomic symbol, then we may also wish to call the digital art expression as digital symbol. The atomic symbol is encoding through the analog signal, digital symbols are encoded by using digital signal. The difference of the two ways of encoding also leads to the

difference of the two systems: First of all, digital art is an interactive art. The creation and appreciation of digital art are in the way of interaction, this is totally different from the one-way atomic art and the process of creation and appreciation, which is a new aesthetic paradigm appeared in human history. Interactivity helps to shape a harmonious development, solidarity, friendship, mutual respect of human society. Secondly, digital art is a powerful open system. It has a stronger productivity, creativity and cohesion, it has only theoretical origin, but there is not a clear end, it has the ability to generate a myriad of Arts systems. This is the atomic art system without match. Again, digital art is a free and democratic system. It is a system of respect for individuality, contempt for the elite, and contempt for power, the “silent majority” in the atomic art system has become the real master of the digital art system. In addition, the system can be transformed by digital art system. Digital art truly reflects the natural return of human nature, it is a humanitarian art. Thus, digital art is completely different from the atomic art on the basis of technology, it presents a new form of creative ideas, principles and methods (Rice, P. M., & South, K. E., 2015; Lucie, A. T., Patricia, W. S., Ephrem, K. K., Salomon, N., Florent, B. O. S., Ponel-Béranger, L. D., ... & Mbacké, S., 2016). The basic features of digital art are shown in Figure 2.

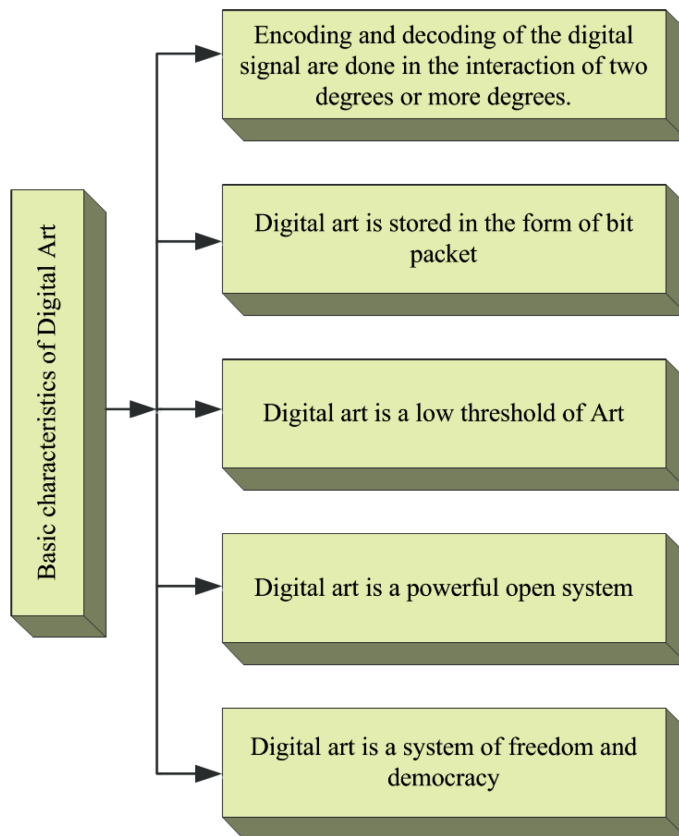


Figure 2 – The Basic Features of Digital Art

3. Comprehensive Reasoning and Intelligent Calligraphy Creation

The representation of number and parameters of the calligraphy works is the problem of knowledge expression in artificial intelligence. In this chapter, the calligraphy works are represented as a cluster of planar-strip regions covered by ellipses. Assume that the elliptic cluster C is composed by $numo$ ellipses, which are $P_1, P_2, \dots, P_{numo}$. Note $Fo = \{1, 2, \dots, numo\}$; x_i, y_i, a_i and b_i respectively are the horizontal coordinate, longitudinal coordinate of the center of ellipse P_i , the long axis and short axis of ellipse P_i , so the calligraphy works are defined as:

$$Area \triangleq \left\{ (x, y) \in R^2 \mid \exists i \in Fo, \frac{(x - x_i)^2}{a_i^2} + \frac{(y - y_i)^2}{b_i^2} \leq 1 \right\} \quad (1)$$

where R is an equivalence relation of domain of discourse, it is reflexive, symmetric, and transitive (Cuozzo, G., 2015).

Assume that the No.s generating element on layer k of the calligraphy works is $P_{k,s}$, whose parametric expression is $E_{k,s}$, $k = 0, 1, \dots, 4$, $s \in F_k$. Lead augmented operator ∇_n^c into the matrix, according to the matrix whose order number is $m \times d_l$:

$$M_l = (a_{l,i,j})_{m \times d_l} \quad (2)$$

where $l = 1, 2, \dots, n$, the operator generates the following matrix whose order number is $m \times \sum_{i=1}^n d_i$:

$$M = (a_{i,j})_{m \times \sum_{i=1}^n d_i} \quad (3)$$

Then, if

$$\nabla (M_1, M_2, \dots, M) = M \quad (4)$$

There is:

$$a_{i,j} = \begin{cases} a_{z+1,i,j} - \sum_{t=1}^z dt & \text{when } \sum_{t=1}^z dt < j \leq \sum_{t=1}^{z+1} dt, z = 1, 2, \dots, n-1 \\ a_{1,i,j} & \text{when } j \leq d_1 \end{cases} \quad (5)$$

where $i = 1, 2, \dots, m$. Define the repeated augment operator of the matrix ∇_n^d :

$$\nabla_n^d(A) \triangleq \nabla_n^c(A_1, A_2, \dots, A_n) \quad (6)$$

where A represents the domain of discourse, then the hierarchical structure of the calligraphy works can be expressed as follows:

$$\begin{cases} E_{o,i} = [x_i' & y_i' & a_i' & b_i']^2 & i \in F_o \\ E_{k,s} = \nabla_{|P_{k,s}|}^c (\nabla_{k-1,1+l}^e E_{k-1,1+l}, \nabla_{k-1,2+l}^e E_{k-1,2+l}, \nabla_{k-1,|P_{k,s}|+l}^e E_{k-1,|P_{k,s}|+l}) \end{cases} \quad (7)$$

where $l = \sum_{i=1}^{s-1} |P_{k,i}|, k=1,2,3,4, s \in F_k$.

4. Value of Digital Art Design

We have a series of research and Analysis on the mechanism of digital technology and digital art, and can get some important characteristics of digital art.

Firstly, the digital signal of encoding and decoding are in the two direction or the degree of interaction to be completed. On the creation of digital symbols, without exception, they are in the man-machine dialogue interface, in this process, it is possible to generate any aesthetic text in theory, the creator can change without leaving any trace. For the appreciation of digital symbols, it is also a multi linear interactive. For example, online readers can enter a hypertext novel from any link, he could even be involved in the creation of the novel if he wanted to. Secondly, digital art is stored in a bit package. This caused the number of symbols in the terminal may show a lot of different text styles. Therefore, not only the digital art text is not fixed in the process of creation, but also the sending terminal is not fixed. Thirdly, digital art is a kind of low threshold art. That is to say, as long as there is a computer, any person who can participate in the creation of digital art as long as he is willing to participate in the digital art. In this way, it has shaken the high threshold that the atomic art has been built up, making it possible for everyone to become an artist. Fourthly, digital art is a powerful open system. It has a stronger productivity, creativity and performance; it has only theoretical origin, but there is no obvious end; it has the ability to generate a myriad of artistic systems. This is what the atomic art system can not match. Fifthly, digital art is a free and democratic system. It is a system of respect for individuality, contempt for the elite, and contempt for power. The sense of the elite in the atomic art has lost the market here. The “silent majority” in the atomic art system has become the real master of the digital art system. Through the digital art system, we can get the basic transformation. Therefore, the digital art can promote the natural return of human nature, is a kind of humanistic art.

Characteristics of digital art:

Commodity: commodity is the digital art design of the labor product, and it's used for the exchange of labor products, which is the common characteristic of all large machinery mass production of cultural products, and is the premise of Emmanuel “after the disappearance of cultural products to the public order. Since the digital art design also includes “the concept of the formation of a variety of carriers after the formation of the results”, then we can think of this design as a mean of making a living, which is to wait for the right price to sell or ready for the exchange. Marx will be used to exchange the definition of labor products as goods, we therefore consider the results of the work of the designers used to exchange goods. This is the character of the digital art design, only then urges us to further explore its value composition based on this. Value added: the value added is the excellent digital art design which can be authorized by intellectual property rights, to creative elements as the core, in a number of industries, to achieve the value of multiple sales.

Crossover: cross refers to the field of digital art design and is composed of three industries of information, culture and creativity. Digital art design itself is a combination of technology and art, in the production stage, it is needed to complete the artistic creation based on the hardware platform, and it also covers the design of the “labor result” which is formed by the concept of the carrier, and has multiple benefits. For example, in one of the final design results, it is possible to have an image designer, web architecture designer, producer and other art workers work together, it also may include funding providers, group rendering server platforms such as the contribution of hardware providers. These stakeholders contribute to the process of digital art design in different ways, they should be rewarded for fair value, So we have to analyze the value of digital art design in detail.

Easy to copy: digital art design is easy to copy the digital art design which can make use of advanced technology means to carry out real-time, efficient, inexpensive, lossless copy. Easy reproduction is to be aimed at and it is the difficulty of the early stage of the creation of the idea. Science and technology is more developed, the easier and cheaper to copy. The history of human beings has been copied by hand, digital copy is a two edged sword, it brings a timely, rapid, convenient and inexpensive way to spread the creative culture industry, making the design of digital art as the core of the creative cultural products which is not subject to geographical constraints, sales in the world, it also makes creative product piracy more hidden than traditional cultural products and rampant.

Non physical: It refers to the process of digital art design in the production process and that the results of the production is virtual, the virtual nature of the process of production refers to the idea that the process exists in the mind of the designer, the result of production is that the object of the work of the designer does not have the physical form, it can not be like ceramics, painting, graphic design, such as the formation of tangible products can be touched. Digital art design of this new type of knowledge consumption, creative consumer products, network, computer, digital TV is only their communication carrier and receiving terminal, it is not the value of the final product with these design products.

The value of digital art design is defined as the labor of digital art designers and other staffs that is coagulated in the process and the results of the digital art design. The value of digital art design mainly comes from the work of the designer, in addition to the necessary physical input of the designers, most of the value comes from their mental work (Arámburo-Lizárraga, J., & Sanabria, J. C., 2015). Whether it's the designer to interpolate frames for the animation, light for 3D background, or give a programming, regardless of the specific form of their labor, their work needs to master the knowledge, aesthetic perception, creation of imagination, and communication skills and so on, it's a long-term training and also a kind of energy consumption which helps to improve the process of thinking in practice. Their energy and energy consumption are condensed in the final design results, and form the value (Avarvarei, S. C., 2015). Today, we still think that human labor is the source of commodity value. The value structure of digital art is shown in Figure 3.

The recessive non-material production is a kind of “soft material”, which can be sensed, and unspeakable. It depends on the existence of the designer, if the designer leaves a design enterprise, the tacit knowledge will all disappear, can not bring benefits for the enterprise.

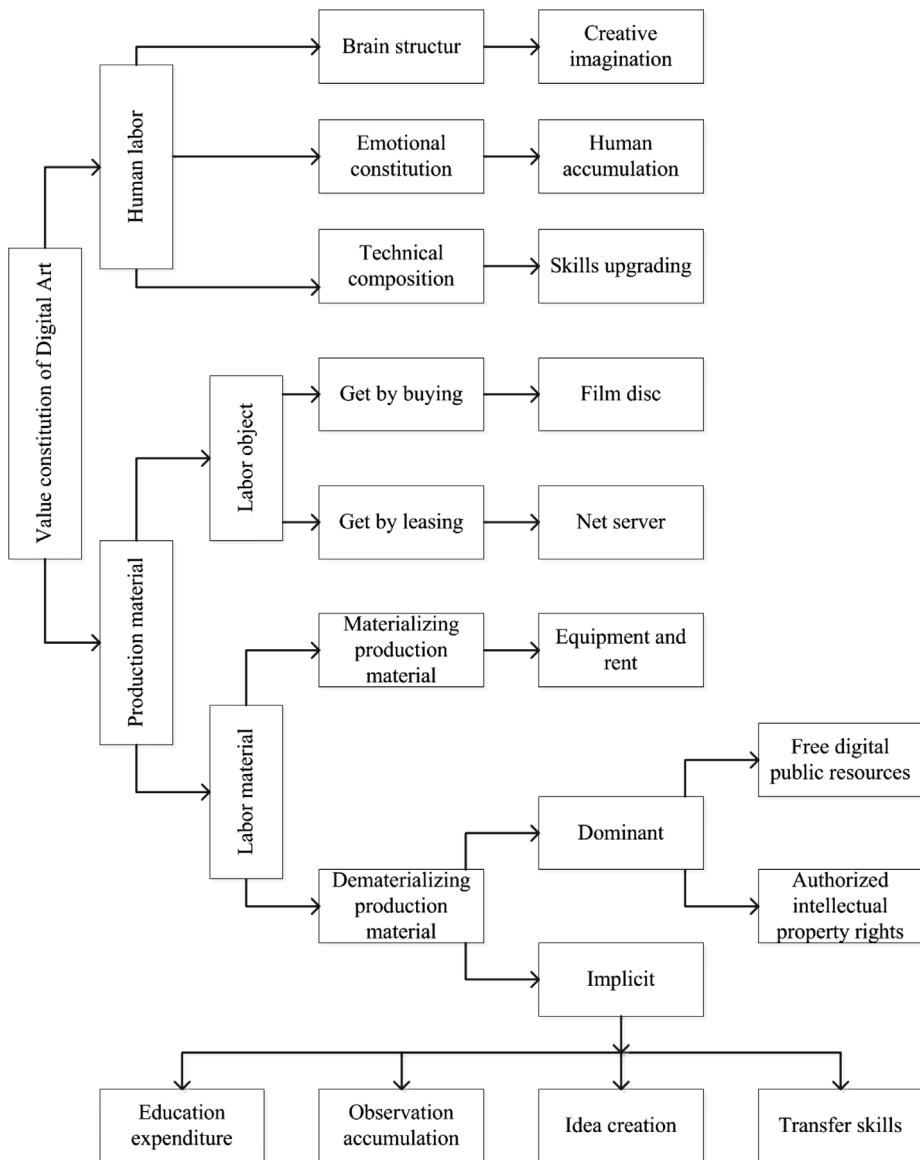


Figure 3 – The Value Structure of Digital Art

Expenditure on education: Rely on the education to gain access to knowledge is the accumulation mode of each industry practitioners, which includes education in general knowledge and expertise in the field of knowledge, it also includes the application technology in vocational education and higher education in theory accomplishment. The length of education and quality directly affect the size of the working capacity of workers, the working ability of the workers will affect the combination of the production

materials. This combination is not just the use of equipment and hardware, for a designer the more closely his own knowledge structure is related to the work where he is engaged in, the more perfect the results of its work is. It's not hard to understand, an original design of the study room designers can play an important role in the company's background design work, but it's difficult to let him adjust the action figures together.

Observed accumulation of cost: Observation is the active acceptance of external information in the life practice and work practice, an activity of forming an aesthetic object in the mind. Observation has two levels, one is the sensory stage, the other one is the perceptual stage. The sensory stage is the collection of physical surface, complex, fragmented, local form, it is accompanied by the corresponding emotional experience of art workers. This is a kind of material "caused moved by sight, aesthetic attention workers with its unique existence... Isomorphism relationship between psychological and emotional patterns of objects exist mode and structure and art of workers. The stage of consciousness refers to the stage of the artistic workers seeking the excitement consciously and following the rational thinking. This stage by introspection to self-knowledge, art workers is very clear to the purpose and scope of their observations. For example, a designer may take a camera with the camera, to increase his database, often visit the exhibition, enrich the field of vision, absorb new ideas.

Late creative staff will buy the quality of the advertising of the disc material or the film's promotional film, to ponder over and over. These actions are the art of workers active for the outside world to filter the signal filter, accumulation of their own artistic accomplishment of the process.

The idea of creating the energy to pay: Observation data are collected at the bottom of the base in Pyramid, its aim is to build the top of Pyramid's creative work, on the basis of the discovery, filtering and selection of perceptual materials, the creation of the subject is actively recalled and meditation, the use of perceptual representation to expand the rich creative association and imagination. Through the art of generalization and integration, the construction of aesthetic image in the minds of the system.

Creation is a kind of complicated mental work, he relies on more abstract thinking, and give up concrete perceptual image, it is the result of the subject to grasp the emotion and logic from the height of reason. Creation is a kind of ability and experience, which is the core of the art workers. Here including the way of thinking, thinking mode, the breadth of the association, the depth of the analysis, call the rate of daily observation data, deconstruction, integration of data entry point, the feeling of art workers, thinking inertia, common sense and even habits can affect his creation (Gillespie, M., 2015).

5. Experimental Simulation Analysis

Effective demand refers to the absorption of supply, digestion and supply of demand. Purchase pirated products and purchase foreign cultural products, for China's digital art design industry, it can not constitute a valid demand. Compared with the effective supply, the effective demand is more serious. The majority of our city residents has entered the "affluent society", which means that the vast majority of the population has crossed the basic needs of the stage, enter the business through the media and advertising to create the demand of the times. Our material needs are fully satisfied. In the creative and

cultural products consumption, our needs are fully satisfied? According to the “National Games and entertainment industry index and ranking” in “China Cultural Industry International Competitiveness Report”, China’s demand for entertainment is as follows:

Index	China	U.S.A	Japan	The republic of korea
Demand situation	0.66	0.65	0.48	0.38
Production factors	0.28	1.00	0.61	0.61

Table 1 – The Effective Demand of Digital Art

From the above table, we can see that the needs of our creative cultural products have just been inspired, that is far from reaching saturation, our production capacity in four countries in the end, the consumer demand is the highest, but, these needs are pirated products and foreign manufacturers to absorb, unable to form the effective demand of the digital art design in our country.

6. Conclusion

Digital art is a new aesthetic paradigm in human history, it can promote the natural return of human nature, so it is a kind of humanism art. In addition, digital art is a powerful open system, which has strong productivity, creativity and cohesion and helps to create a human society of harmonious development, solidarity, and mutual respect. Besides, digital art is a kind of system based on artificial-intelligence technology, its development cannot be separated from the development of AI technology, at the same time, it can promote the development of AI technology. So, the development of digital art is of great significance and broad prospects.

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Research on Innovation Design of Chinese Paper Cutting Pattern Based on Evolutionary Algorithm

Guo Chenyuan¹

gxhuangfan@126.com

¹ Lu Xun School of art, Yanan University, 716000, Yan'an, Shaanxi, China

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Abstract: At present, the paper-cut art inheritance is still hand mouth, making the quality of the products is also vary from person to person, quality is uneven, is not conducive to the development of paper-cut art. Therefore, in the era of intelligence, informationization, innovation is a new method of paper-cut art, with computer to replace artificial to pattern design is very necessary. According to the analysis of the characteristics of the paper-cut patterns, the use of evolution, the computer system can search multiple point in the global, automatically optimize the mathematical model, to make it more close to the real state, so as to realize the design of a single pattern, at the same time, because of the evolutionary algorithm can find the optimal solution in a short period of time, the effective close to user requirements, the system also can be a combination of all sorts of design design. Through the simulation shows that although the computer design of paper cutting is still at the preliminary stage, but evolutionary algorithms in the application of computer paper cutting design system can be implemented, the value of the research, development, promotion.

Keywords: Evolutionary algorithm; paper cutting; pattern design.

1. Introduction

1.1. Literature Review

For the purpose of this article put forward the question, there are many experts and scholars are studied, and important conclusions are obtained and results. On the second side, on the basis of continuous pattern research, using evolutionary art thoughts make a selection and mutation operation, produce different shapes of decorating pattern, through evaluate the works of art and innovation, get rich variety of pattern library, at the same time to extract the feature set of excellent works in the knowledge base for designers reference. The control key point of rational b-spline curve and surface, power factor and three node vector control factors using hierarchical coding genetic algorithm, by the user to evaluate the interactive entity, eventually to the public satisfaction as the fitness function of genetic algorithm, then the genetic encoding, crossover and mutation operators filtered through the size of the fitness function, finally get a satisfactory solution. Apply genetic algorithm to base on the curve. (Reynares, E., Caliusco, M. L., & Galli, M. R., 2014) In the process of flower pattern design using local lines in the process

of flower pattern design variable and the overall symmetry characteristics put forward a kind of method in view of the local change of design. Through the initial design line control point code generating initial population by using the genetic algorithm of genetic operation, resulting in a partial similar overall different design results. In view of the specific design requirements is constructed for the coding scheme of produce method, population, genetic operators and the various parameters, such as constraint conditions. Examples show that this method can be used to make the initial design produces a variety of changes, the flowers design innovative design provides an effective method. (Harzer, E., 2015) Through the analysis of paper-cut patterns and generalization, abstract the paper-cut patterns required, using real number coding genetic algorithm and complex coding genetic algorithm based on double structure generates a large number of flexible patterns; At the same time, in the process of operation, the improved genetic strategy, in terms of the selection of fitness function, through the deep research in contour curve, the introduction of homogeneous factor and smoothing factor, etc.; And according to the different encoding, to improve the genetic operation such as crossover and mutation, to improve the diversity of population is generated, so rich and colorful pattern library construction. This paper on the basis of wavelet analysis to extract the energy characteristics of singular value features of NMI (normalized moment and wavelet moment characteristics, and made a comparison recognition test. Effective use of the combination of the wavelet multi-resolution characteristics, to eliminate the interference of noise, while maintaining the singular value and the characteristics of NMI (normalized moment, and this method is simple, easy to implement. Wavelet moment features strong grasp the ability and the ability to resist noise, the details of the image through the paper-cut patterns extracted wavelet moment, to obtain a multi-scale feature of image. Mean and standard deviation of the component with different characteristics, to achieve N class model of feature selection. Experiments prove that the method can effectively remove the noise, the better identification has a certain artistic exaggeration of paper-cut patterns (Runa, A. I. D. N. F., & Miranda, G. L., 2015).

The current for the purpose of this article put forward the research mostly focused on the paper-cut patterns were collected for image preprocessing, eliminate noise, the image segmentation, isolated from the paper-cut image of complex individual patterns. And then through the analysis of the characteristics of paper-cut patterns, using the method of algebra, geometry, statistics and so on, established the library of paper-cut patterns, these patterns covers the basic pattern of the paper-cut art creation, and then through the genetic algorithm of basic patterns for various calculation methods such as combination, covering various operations of want paper-cut patterns. The existing research results, in their zeal to pattern is already relatively mature, but subsequent algorithm is more complex and difficult. So in this article, we want to be able to get a relatively simple algorithm to implement the innovation design of paper-cut patterns.

1.2. Computer Aided Design

Computer Aided Design (CAD Computer Aided Design) refers to the use of computers and graphics.

Ready to help designers to design work. Often want to use the computer in the design of different schemes are a lot of calculation, analysis and comparison, to determine the

optimal solution. All sorts of design information, whether it's digital, text or graphics, can be stored in the computer's memory or CRT, and can quickly retrieve. Designers often use drawing design, the sketch into a working drawing of hard work can be done to the computer. Designed by the computer automatically generated as a result, can quickly make graphics, make a design personnel in a timely manner to judge for design and modification. Using the computer can carry out with the graphic editing, amplification, narrow, translation and rotation and other related graphic data processing work.

CAD (Computer Aided Design, Computer Aided Design) is a concept developed by the Massachusetts institute of technology, a CAD team take the lead in the early 1960 s. In 1967, the United States, lockheed developed commercial CADAM system, the use of CAD (mainly in the field of aerospace, automobile and ship manufacturing) began to enter into the practical phase. But the vast majority of the CAD system is developed using itself is given priority to, and often for a topic, independent research and development, for the specific purpose of professional program to complete the design of automation, so the designer's intention in a timely manner to reflect to the design. In the mid - 70 - s, the mainstream of the computer from the mainframe to the direction of the individual machine and a single-chip, CAD system developers and users have differentiated, a professional CAD system developers. Into the 80 s, CAD combined with microcomputer and the working station look, not only in the field of CAD using the traditional aspects such as mechanical, electronic circuit development, and in the construction industry, household electrical appliances such as the use of industrial design presents the diversified forms. In the late 80 s, CAD and Computer Graphics technology (CG - Computer Graphics), the 2 d plane mapping system to the production and processing data with the direction of 3 d CAD system of rapid development. To enter in the late 90 s, with the rapid development of network technology for the integration of CAD and collaborative provides a strong support, making it possible to handle concurrent engineering assignments. Engineering project as the core, production of different regions in a "virtual community" can timely sharing graphics library, database, material storage and all resources on the Internet.

In the 70s, small computer costs decline, American industry began to use interactive drawing system.

In the 80s, due to the application of PC, CAD development rapidly, and a specialized company engaged in the development of CAD system. Versa CAD is a professional CAD production company at that time, the development of CAD software is powerful, but because of its expensive, it cannot be widely applied. At a time when the Autodesk company is a small company, only a few employees function while CAD system of its development is limited, but because of its free copies, so is widely used in society. At the same time, due to the openness of the system, the CAD software upgrade quickly.

The designers have long started to use the computer to calculate. Some people think that Ivan Sutherland in 1963 at the Massachusetts institute of technology development of the Sketchpad is a turning point. SKETCHPAD outstanding characteristic is that it allows designers and computer graphic way interaction: can be designed using a light pen on a cathode ray tube screen drawing into the computer. In fact, this is the prototype of the graphical user interface, the interface is indispensable to modern CAD properties.

Is one of the earliest application of CAD in automobile manufacturing, aerospace and electronics industry in big companies. As computers become cheaper, wide application range is gradually get.

The realization of the CAD technology after many evolved since that time. The beginning of this field is mainly used to produce or hand-painted drawing drawings. The development of computer technology makes the computer get more skilled application in design activities. Today, CAD has not only used for drawing and display, it began to enter the designer's expertise in more a part of the "smart".

With the development of computer technology, the performance boost and the cheaper price, many companies have adopted the three-dimensional drawing design. The limitation of the past, because of the computer performance, drawing software can only stay in the plane design, lack of sense of reality, and 3 d drawing to break through the limit, make more materialization design blueprint.

CAD type belong to emerging cross discipline. At the beginning of the development of CAD software, the simple meaning of CAD is substitute for board, is the Computer Aided Drawing or Drafting, stands for Computer Aided Drawing, rather than now we discussed in the CAD (Computer Aided Design) all of the content. Until the late 70 s, CAD technology in two-dimensional drawing as the main target, then 2 d graphics as a branch of CAD technology and relatively independent, the smooth development. In today's China CAD users, especially in the initial CAD user, still occupies a considerable proportion of the 2 d drawing.

CAD technology in the early stages of development in our country, since the '60 s in basic theory research, software environment and the development of practical CAD system has made some achievements, but due to various reasons, the commercialization of the CAD system level is not high.

1.3. Paper-Cut Art

Folk culture is the basis and cultural roots of the culture. Folk art is an important carrier of folk culture in our country, therefore, like the pattern of Chinese folk paper-cutting art style of promote, heritage is of great importance, lost its style characteristics, will loose that collapsed the basis of national culture, losing their culture. Losing their ethnic culture, it is hard to stand on its own among the nations of the world's racial discrimination in today's world, in particular, can also interact with strong culture. In our country is a developing country, although there are economic development, but has not been developed, based on the economy of the Chinese civilization, although is a great, glorious and has a long tradition, it is still in a vulnerable position. If that is blind to this point, let the impregnation of strong culture, like China's folk paper-cut art style of national culture will lose its own characteristics. Take the content of national art style, embodied in the Chinese folk paper-cut art forms such as function, national content includes: the national spirit, feelings, self-esteem, self-improvement, will as well as the historical and cultural experience and so on. Because of this, we can from Poland will style the paper-cut works apart from the Chinese folk paper-cut works. China's folk paper-cut art to labor people's life, thoughts and feelings have great influence and penetration. Excellent heritage of folk art style, which is beneficial to cultivate the national spirit,

strengthen, national cohesion. Therefore, the research and understanding, grasp the style of Chinese folk paper-cut art, for passing on China's folk paper-cut art has an important guiding role, protection. Correct understanding of China's folk paper-cut art style, but also to the exploration and development of China's folk paper-cut art itself. This is my understanding of folk art style on purpose, is willing to China's folk paper-cut art style of evergreen tree.

With the rapid development of computer aided design technology, people have already taken the computer as a visualization tool to realize the design scheme. Pattern innovation design is a new and active important branch in the field of computer application (Liu, K., Wu, L., Lü, J., & Zhu, H., 2016). Innovative design method based on evolutionary algorithm is a kind of mature optimization and search algorithm, which could apply to the Aided Design field by simulating the evolution in nature to achieve the function optimization, automatic control, production scheduling, etc. (Jakob, G., Stephens, E., Feller, R., Oey, M., Hankamer, B., & Ross, I. L., 2016).

Paper-cut art is one of the most ancient han Chinese folk art, as a kind of hollow out art, it can give a person with the vision to the feeling of nearby and art enjoyment. Paper cut with scissors to cut paper into all sorts of patterns, such as window, door depicting flowers, snuff, ceiling, wall, etc. Whenever festivals or wedding celebrations, people will be beautiful colorful paper-cutting to stick on the Windows, walls, doors and lanterns in the home, festive atmosphere foil as more warmly. In the countryside, paper cuttings are usually done by women and girls. In the past, paper-cutting is almost every girl must master the art by hand, and it has been a standard to evaluate the bride. In China north and south of paper-cut art, through a pair of scissors and a piece of paper, can express all kinds of joys and sorrows of life.

But because of the traditional paper-cutting is made by hand, low efficiency, high production cost, time is long, the quality is also vary from person to person (Xiao, L., Ma, H., Liu, J., Zhao, W., Jia, Y., Zhao, Q., ... & Jiang, K., 2015), so it is difficult to passing on carrying forward, let more people know. In order to break through these limitations, people think of using a computer aided design system, programming and the design of mass production, improve efficiency, ensure the quality. Formal based on this consideration, this paper studies using computer aided design technology to simulate the paper-cut design method.



Figure 1 – Chinese Traditional Handmade Paper Cutting

2. Evolutionary Computation

2.1. Basic Concepts

Evolutionary computation uses a simple encoding technique to represent a variety of complex structures, it includes genetic algorithms, genetic programming, evolutionary programming and evolutionary strategies, etc. (Koltick, N., 2015). Although it has a lot of change, with different genetic gene expression, different crossover and mutation operator, the special operators references, as well as the different regeneration and selection methods, but they produce inspiration comes from the nature of biological evolution. With the traditional method based on calculus and exhaustive method compared to the optimization algorithm such as evolutionary computation is a kind of mature has high robustness and global optimization method of wide applicability, has the characteristics of self-organizing, adaptive and self-learning, cannot restricted by the nature, effectively deal with the traditional optimization algorithm is difficult to solve complex problems. Evolutionary design is a technique that is used to design the computer aided design, in this paper, the evolutionary computation method is applied to the research of Chinese paper cutting innovation design, it is a changed and improved design process (Niazi, M. A., 2015).

The strategies used in evolutionary computation have the following characteristics: the evolutionary algorithm is not directly in the solution space, but the use of the solution of a kind of encoding said; evolutionary algorithm searches from multiple points, which is one of the main reasons that it can find the global optimal solution in a large probability (Li, L., 2015). the evolutionary algorithm uses adaptive information of the solution, and carries on the trade-off between increasing the income and reducing the cost; evolutionary algorithms use random transfer rules instead of deterministic transfer rules (Staff, C. A. C. M., 2015).

Evolutionary computation is a robust method, can adapt to different environment, different problems, and in most cases can be satisfactory efficient solution. His whole parameter space of the problem gives a kind of coding scheme, rather than to deal with problems of specific parameters directly, not from a single initial point search, but from a set of initial search point. Search is used in the objective function value of the information, you don't have to use the objective function of derivative information or special knowledge related to the specific problems. Thus evolutionary algorithm has extensive applicability, highly nonlinear, easy to modify and parallelism. In addition, the algorithm itself can be used in a dynamic adaptive technology, automatic adjustment in the process of evolutionary algorithm and coding accuracy control parameters, such as using fuzzy adaptive method.

2.2. Evolutionary Strategy Algorithm Commonly

Evolutionary strategy algorithm commonly

1. the problem is to find real value n dimensional vector x , make the function $F(x): R \rightarrow R$ take extreme value. Do not break general, set up the program for the minimization process.
2. from the dimension range of possible random parent x_i , $i = 1, \dots, p$ value. The distribution of initial test is generally evenly distributed.

3. by adding zero mean for each component x and the standard deviation of the gaussian random variables selected in advance, the offspring from each parent x_i, x_i' .
4. by using a fitness $F(x_i)$ and $F(x_i')$, $i = 1, \dots, P$ to sort, select and determine which vector. Has the smallest fitness P vector into the next generation of new parents.

New trials, choose new offspring with least variance, until fully solution, or until a terminating condition is satisfied.

In this model, the weight of the test solution as the behavior of the individual characteristics, rather than along the chromosome arrangement of genes. Assume that no matter what genetic transformation, each individual behavior changes are caused by a zero mean and a standard deviation of the gaussian distribution.

Because of pleiotropy and multiple genes, specific genetic change can affect a number of phenotypic traits. So when creating new sub system, a more appropriate change at the same time all parents.

2.3. Algorithm Flow

Step 1: initialize. Set number of genes m , individual number q , choose the standard deviation σ Gauss white noise as the random mutation factor gene, select the appropriate function $fit(x)$ according to the problem and individual capability evaluation function $f(x_i)$ that match with $fit(x)$, and $f(x_i)$ meet:

$$fit(X) = \frac{\sum_{i=1}^v f(x_i)}{q} \quad (1)$$

Step 2: in the solution space of the problem, produce 5 individuals as the initial species $X^{(0)}$ uniformly and randomly, according to the formula (1) to get each individual gene (Rössler, C., Oehri, D., Zilberberg, O., Blatter, G., Karalic, M., Pijnenburg, J., ... & Wegscheider, W., 2015).

Step 3: $fit(x)$ is calculated by the fitness function of the population. To determine whether to meet the evolution of the conditions or to reach the maximum reproductive algebra. If it is "YES" the end, otherwise continue.

Step 4: calculate the number of individuals M within the population with the ability to reproduce:

$$M = q \cdot \frac{fit(X^{(0)})}{o} \quad (2)$$

Individuals within populations are evaluated according to the individual's ability of $f(x_i)$ in order to rank from high to low. the first M individuals with the strongest ability obtain the breeding opportunity and to breed q offspring (Ganguly, A., Anjaneyulu, O., Ojha, K., & Ganguli, A. K., 2015). The probability of mating is obtained by the j individual in the individual M is:

$$P_{mj} = \frac{f(x_i)}{\sum_{i=1}^M f(x_i)} \quad j = [1, 2, \dots, M] \quad (3)$$

When i and j individuals have access to mating, the same probability of their offspring's genes and i individual gene is:

$$P_G = \frac{f(x_i)}{f(x_i) + f(x_j)} \quad i, j \in [1, 2, \dots, M] \quad (4)$$

The same probability of their offspring's genes and j individual gene is:

$$P'_G = 1 - \frac{f(x_i)}{f(x_i) + f(x_j)} \quad i, j \in [1, 2, \dots, M] \quad (5)$$

3. A Single Pattern Design Method for Paper Cutting Based on Evolutionary Computation

3.1. Design System Framework

In this paper, we use the evolutionary algorithm, based on the analysis of the characteristics of paper cutting patterns, to propose an evolutionary pattern design method (Chen, S., Slattum, P., Wang, C., & Zang, L., 2015). Evolution carpet pattern design system (ECPDS) is flexible to control the evolution layer, the open type of evolution strategy ensure the smooth and complete pattern to design. System framework as shown in figure:

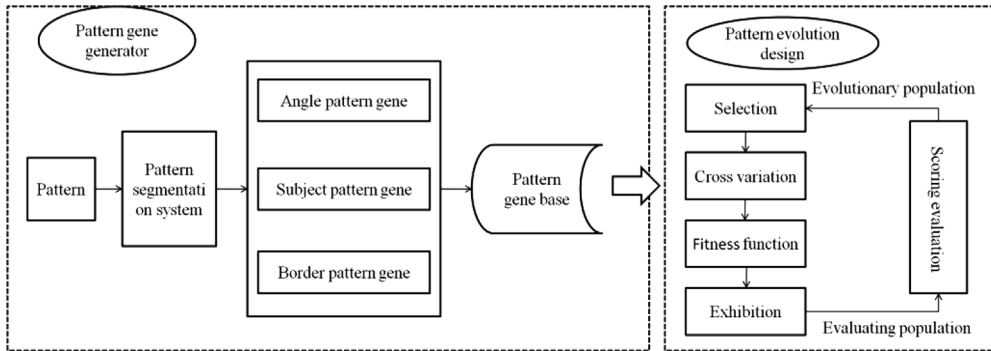


Figure 2 – Frame of ECPDS

3.2. The Design and Production of Specific Graphics

Taking the design of the flower pattern as an example: the pattern flower in the paper cutting can also be called plum blossom pattern, it is a common pattern, the algorithm is relatively simple.

The following is according to the algorithm get the petals of graphics.

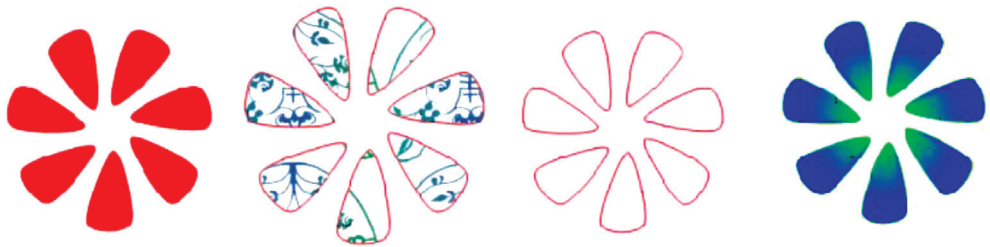


Figure 3 – Using the Evolutionary Algorithm to Draw a Pattern of Flowers

4. Paper Cutting Pattern Assembly Scheme Based on Evolutionary Computation

4.1. Process of Paper Cutting Pattern Assembly Plan

After the execution of the evolutionary operation, if the generated results meet the requirements of the designer, it can be saved, otherwise, it can be carried out in the visual environment by copying, deleting, moving, rotating, scaling and so on (Moreno, L. B. A., 2015). The whole specific process of the assembly plan is shown in figure.

4.2. Generation of Paper Cutting Pattern Assembly Plan

Mutation operation selected patterns, features from some successful design, then randomly selected individuals as fathers, and appropriately selected the variation points for variation operation (Berson, C., Roux, S., & Verdugo, G., 2015). The operation can draw on the successful design experience to reuse the design results, improve the evolution of the group (Fournier, V., Spranzi, M., Foureur, N., & Brunet, L., 2015).

5. Conclusion

As the society into information and intelligence, artificial intelligence and computer technology have great development, many have a surprising change in traditional industry, science and technology and the traditional collision sparks of human wisdom. Paper-cut art of treasure of the Chinese traditional arts and crafts, nature also can't lag behind, designers try to create a system, can let the computer automatic design pattern, complete paper-cutting innovative design (Berson, C., Roux, S., & Verdugo, G., 2015).

In this article, we study the characteristics of the evolutionary algorithm, a typical process and program algorithm, and analyze the structure of the paper cutting process, steps and key points of modeling, and puts forward a kind of paper-cut design based on the pattern and pattern in the assembly of computer automatic design system. The system is based on evolutionary algorithm, which can be continuously optimized mathematical model, the simulation function is closer to the real situation, improve the effect of the system code generation, make the design more close to the intended target. At the same time, the system also have artificial operation interface, the user can control the shape

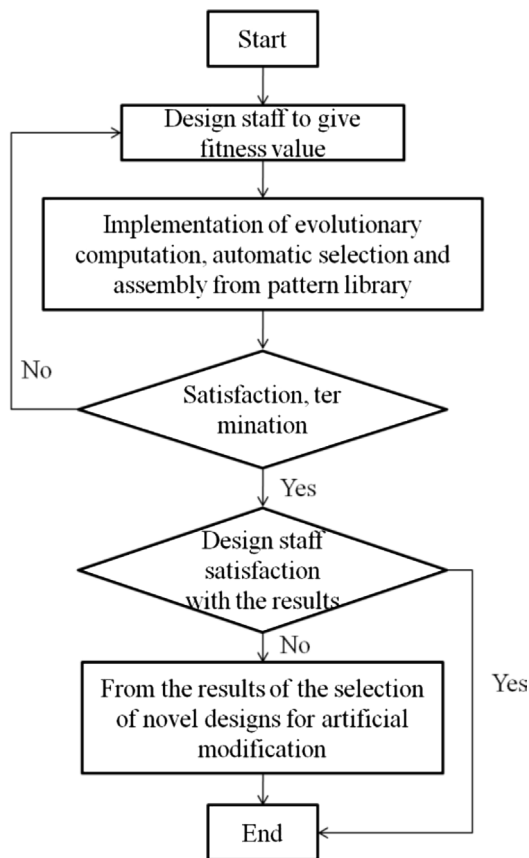


Figure 4 – Process of Paper Cutting Pattern Assembly Plan

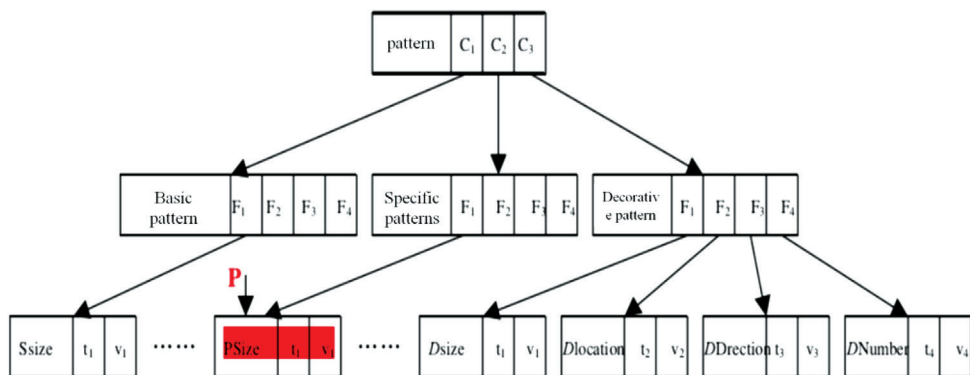


Figure 5 – A Paper Cut Product Tree With 'P' As A Cross Point

of decorative pattern in the form of control parameter and the model of adjustment, it is very easy to edit operation, improve the applicability and scalability of the system.

Must face is that, of course, our study and put forward the paper-cut design computer innovation design system is still in the primary stage, we have a lot of work remains to be further research and exploration. There is no denying that, however, with the continuous development of artificial intelligence and computer technology progress, and all kinds of professional and technical personnel to advance wave upon wave of continuous efforts, paper cutting process will be realized in the near future computer automatic design, for the paper-cut art inheritance development contributes own strength.

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Research on the Architecture of Sports Decision Making System Based on AI Technology Expert System

Chen Jun¹

85448118@qq.com

¹ College of Oujiang, Wenzhou University, 325035, Wenzhou, Zhejiang, China

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Abstract: With the continuous improvement of scales of sports events, the decision-making process of the competition is becoming more complicated and the risk of hosting events is growing. So AI technology expert system is used to establish a more effective sports decision-making system. Sports decision-making is to make choices in several guiding action plan. And sports decision is under the influence and restriction of many factors. Therefore, it is necessary to make full use of the information and effect, but also pay attention to the feedback oscillation phenomenon in the process, and pay attention to the decision-making level, scientific sex and stability. Sports decision making is a process that involves all the activities that must be performed before making the final choice. AI Expert system is an intelligent computer program system, which contains a large number of experts' knowledge and experience, could deal with the problem by knowledge and methods of human experts, also applies artificial intelligence technology and computer technology. It is a computer program that simulates the domain problem of human experts. Combine the sports decision making system with technology expert system can make the whole system more scientific.

Keywords: Artificial intelligence; expert system; sports decision system.

1. Introduction

With the continuous improvement of scales of sports events, the decision-making process of the competition is becoming more complicated and the risk of hosting events is growing. Therefore, it is very difficult to make a rational and comprehensive decision analysis of the large-scale sports events by experts in the field. The early selection of artificial intelligence researchers is easy to direct people a machine "intelligent" comparison of chess game as a breakthrough. In 1955, using game theory and heuristic search technology, the preparation procedure of checkers can with a good chess player as look ahead a few chess (Lui, T. H., Chang, J. J., & Maffulli, N., 2016). In 1959, it defeated the machine designer, and beat a U.S. state champion, and thus create a great sensation (Maffulli, N., 2016). Since the late 60's, scientists have developed a variety of expert systems, such as the PROSPECTOR system for geological prospecting, MACSYMA system for mathematical solutions (Kahrl, A. W., 2016). In 1976, it took only

1200 hours on the machine to prove that mathematicians have not been able to solve the problem of the four color problem for more than one hundred years (that is, four colors on the map can be used to distinguish between different countries and regions), which shocked the world (Reka, S., & Tamas, D., 2015). In the 80's, the expert system is more rapid development, the advent of thousands of expert systems, and began to apply in various fields of society, has become an industry (Rauschenbach, J., & Swartz, D. R., 2016). Artificial intelligence is a new subject which is forming and developing, and its significance has been recognized by more and more people. Its social significance is that it will make some of man's mental labor machinery has become a reality, helps to uncover the secret of human creative thinking, and after the machine makes the human physical liberation, human opens the intellectual liberation road (King, S. B., 2016).

Modern information technology includes computer technology, communication technology, intelligent technology, it have had a profound impact on modern education, education caused profound changes with the development of modern information technology and popularization, more and more application of modern information technology in education and teaching in the broad education workers to carry out the teaching reform practice the development of a large number of study sites, educational software, courseware and other teaching resources, showing a multi media and network interactive features of modern information technology on the development of education and teaching reform, and the role has become increasingly prominent, in the background of the extensive application of modern information technology, (Waddington, G. S., 2016) using computer assisted instruction technology the preferred way of teaching reform. People of artificial intelligence research is carried out through three ways: (1) from a physiological perspective, the structure was simulated; (2) from the point of view of psychology, psychological simulation; (3) from the angle of engineering technology, namely the use of control theory, to avoid the internal structure of the prototype, the direct simulation of the external function of the prototype, to achieve functional simulation. At present, the latter research continues to make gratifying progress, and research activities are very active, research results continue to emerge (AleAhmad, A., Zahedi, M., Rahgozar, M., & Moshiri, B., 2016).

The structure of the traditional expert system is mainly composed of the pre - set knowledge base and the reasoning machine. The system only can make decision in the framework of one theoretical index system to bid sports events. When the theoretical index system updates, it needs to design the relevant knowledge base and inference engine by the new theoretical framework (Runa, A. I. D. N. F., & Miranda, G. L., 2015).

Decision making system of environment includes social environment (people's cultural level, values, social consciousness), economic environment (domestic and international economic situation and people's living conditions), the natural environment (geographical location, climatic conditions, etc.). These environmental factors are not with the change of time and change. These environmental factors change, so that the uncertainty of sports decision-making increased. Therefore, the decision maker must collect new information in a timely manner, in order to reduce the risk of decision-making and improve the reliability of decision-making (Alkan, M., & Gökbuga, F., 2015).

Sports decision-making object includes competitive sports, school sports, mass sports in the development of the problems to be solved and the strategic development of the goal, it is the main content of the decision. Like the external environment of the sports system,

the internal structure of the object itself is constantly changing. Therefore, the decision makers must carefully analyze the decision-making object - competitive, schools, mass sports - their own changes in the law, in order to make a good foundation for decision-making (Yagi, T., 2016).

2. AI Technology Expert System

AI Expert system is one of the most successful branches in the field of artificial intelligence. (Dias, G. F., Mendes, P. C., Santos, J. C., Gama, J. M., Mendes, R. S., Antúnez, R. M., & Garcia, J. P. F., 2015) As a discipline, it is to take the automaton system as a means to simulate human thinking as the method, in order to achieve the purpose of human complex mental work of science and technology. It appeared during the latter half of the 1950s, with mathematics, electronics, control theory, information theory, bionics, biology, psychology, linguistics, computer science and technology development. Early artificial intelligence research is based on the development of mathematical logic and computational theory, and draws on the theories and methods of many relevant disciplines. When people found computer not only can be used as a high-speed digital computer, and can also be used for non numeric symbolic processor, (Alam, M. A., & Akter, M., 2015) and can be processed through the general symbol to deal with knowledge, artificial intelligence research from intelligent games quickly extended to solve the problem for the core content of the many fields of application. In a word, it is an intelligent computer program system, which contains a large number of experts' knowledge and experience, could deal with the problem by knowledge and methods of human experts. AI expert system is a program system with a large amount of special knowledge and experience, which applies artificial intelligence technology and computer technology. According to the knowledge and experience provided by one or more experts in one field, reasoning and judgment, simulating the decision-making process of human experts to solve the complex problems, it needs to be treated by human experts. In short, AI expert system is a computer program that simulates the domain problem of human experts. General artificial intelligence system mainly consists of knowledge base, reasoning machine and intelligent interface system. At present, the research of artificial intelligence system such as pattern recognition, expert consultation, robot and so on, the development is fast, and the research of artificial intelligence system such as natural language understanding, automatic programming is very difficult. At the same time, the research of artificial intelligence language has made progress, and more advanced LISP and PROLOG language have been applied to the preparation of artificial intelligence program. From the point of view of artificial intelligence, intelligent computer assisted instruction system is actually a computer aided decision-making based on computer by making system of artificial intelligence in education, it gradually shows its importance and practicality, is a trend in the development of education reform and modernization of teaching process.

2.1. Imprecise Reasoning Model

The uncertainty reasoning model: use credibility CF (h,e) as an uncertainty measure, represents a modification of hypothesis h subjective trust degree in evidence e. Reflect the increase or decrease the trust degree of domain experts on the uncertainty of knowledge. Credibility of Rule e to h:

$$CF(h,e)=\begin{cases} (P(h/e)-P(h))/(1-P(h)) & \text{when } P(h/e) > P(h) \\ (P(h/e)-P(h))/P(h) & \text{when } P(h/e) < P(h) \end{cases} \quad (1)$$

when $P(h/e) > P(h)$, $CF(h,e) > 0$ Indicates the degree of support for h on e;

when $P(h/e) < P(h)$, $CF(h,e) < 0$ Indicates the degree of not-support for h on e.

The credibility of H is calculated by the following formula:

$$CF(h) = CF(h,e) * \max(0, CF(e)) \quad (2)$$

The significance of $\max(0, CF(e))$ in the formula is: if $CF(e) < 0$, indicating that this rule cannot be enabled, otherwise, the credibility of the h is equal to the product of the rule's strength and the reliability of the condition.

2.2. Reliability Method

Human intelligence is fundamentally the ability to use knowledge to solve practical problems, so, so that the machine can simulate human use of knowledge to solve practical problems, that is, to solve the problem, it becomes the core issue of artificial intelligence research. Solving the problem depends on knowledge, it is a problem of how to deal with knowledge (Wharton, D., 2015).

In order to make the machine with the ability of solving problems, it is necessary to machine studies how to obtain knowledge acquisition; studies on how to describe the knowledge through stipulated symbols and methods to be formalized and suitable for solving the problem of machine, namely knowledge representation; machine study how to use knowledge reasoning, the mechanical approach to problem solving, reasoning machine; research is suitable for the use of knowledge to solve the problem of computer system and artificial intelligent language support, the problem solving process automation and system design.

The reliability method is an uncertainty reasoning method which based on the certainty theory and combing the probability theory, It is relatively simple, and the effect is good. In the C-F model, uncertainty reasoning starts from initial evidence of uncertainty, to deduce the reliability of the conclusion by using the relevant knowledge.

Combined evidence $E=E_1 \text{ AND } E_2 \text{ AND}.....\text{AND } E_n$, multi evidence of conjunctive, known $CF(E_1), CF(E_2),.....CF(E_n)$, then:

$$CF(E) = \min\{CF(E_1), CF(E_2), CF(E_n)\} \quad (3)$$

Conclusion H of the reliability $CF(H)$ has the following formula:

$$CF(H) = CF(H, E) * \max\{0, CF(E)\} \quad (4)$$

The problem solving process showed as follows:

Through R2, R1 get:

$$\begin{aligned} CF(C, AB) &= CF(C, A) + CF(C, B) - CF(C, A)CF(C, B) \\ &= 0.75 + 0.5 - 0.7 \times 0.5 \\ &= 0.85 \end{aligned} \quad (5)$$

Through R3 get:

$$\begin{aligned} CF(D, AB) &= CF(D, C) * \max\{0, CF(C, AB)\} \\ &= 0.6 \times 0.85 \\ &= 0.51 \end{aligned} \quad (6)$$

Through R4 get:

$$\begin{aligned} CF(F, AB) &= CF(F, D) * \max\{0, CF(D, AB)\} \\ &= 0.8 \times 0.51 \\ &= 0.408 \end{aligned} \quad (7)$$

By synthesis algorithm $CF(F, ABE) = 0.572$, finally can be obtained, conclusion F's comprehensive credibility CF is 0.572.

2.3. Direction of Reasoning

The decision-making process of sports is a complex function of dynamic dependence on time and space. In order to objectively reflect the sports decision-making is reasonable or not, the general need to make the reliability analysis. The meaning of the reliability of sports decision-making is the possibility of completing the scheduled strategic objectives in the specified conditions and the predetermined time. Because the possibility of the reliability of the sports decision-making system is a pair of contradictions, so it can be used to show the reliability of the decision making system. If the failure rate of the policy measures implemented by a strategic target is large, it is necessary to investigate the reason of the poor reliability of the decision-making system.

What kind of decision-making is a good decision? Because the decision is to predict and plan for future action, the situation is very complex, some estimates are not the factors that affect the effectiveness of the implementation of the decision. Usually say,

reasonable sports policy in the implementation process, and its failure can generally be divided into three stages: early stage of failure, random failure period and wear out failure stage. The goal of strategic decision is used as a function of the internal and external conditions of the sports decision-making object. It is necessary to set up the decision-making goal of the development of sports strategy according to the internal and external information. But by people obtain information ability is limited, therefore rely solely on internal and external information to develop objective decision sometimes will also lead to mistakes in decision-making. Therefore, after the implementation of sports decision-making, decision makers must also follow the implementation of the decision to follow the investigation, the effect of the implementation of feedback to the decision-making system, so that the initial target at any time to adjust. And then the decision-making system can ensure the dynamic balance between the internal and external conditions.

Forward reasoning: the process of the conclusion of the fact, also known as data driven control strategy. It actually starts from the existing information (FACTS), searching and executing the knowledge, and changing the solution state gradually until the problem is solved.

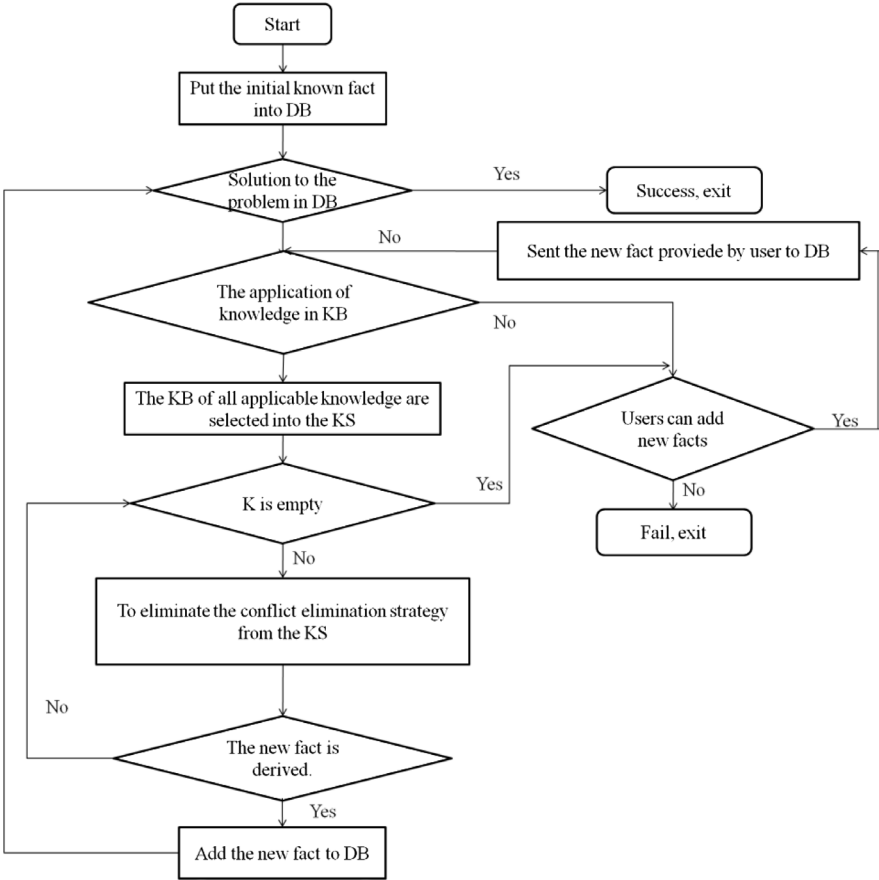


Figure 1 – Forward Reasoning

Reverse reasoning: a reasoning based on the assumption that the target is the starting point. Also known as goal-driven reasoning, reverse chain reasoning, target guided reasoning and reasoning, etc.

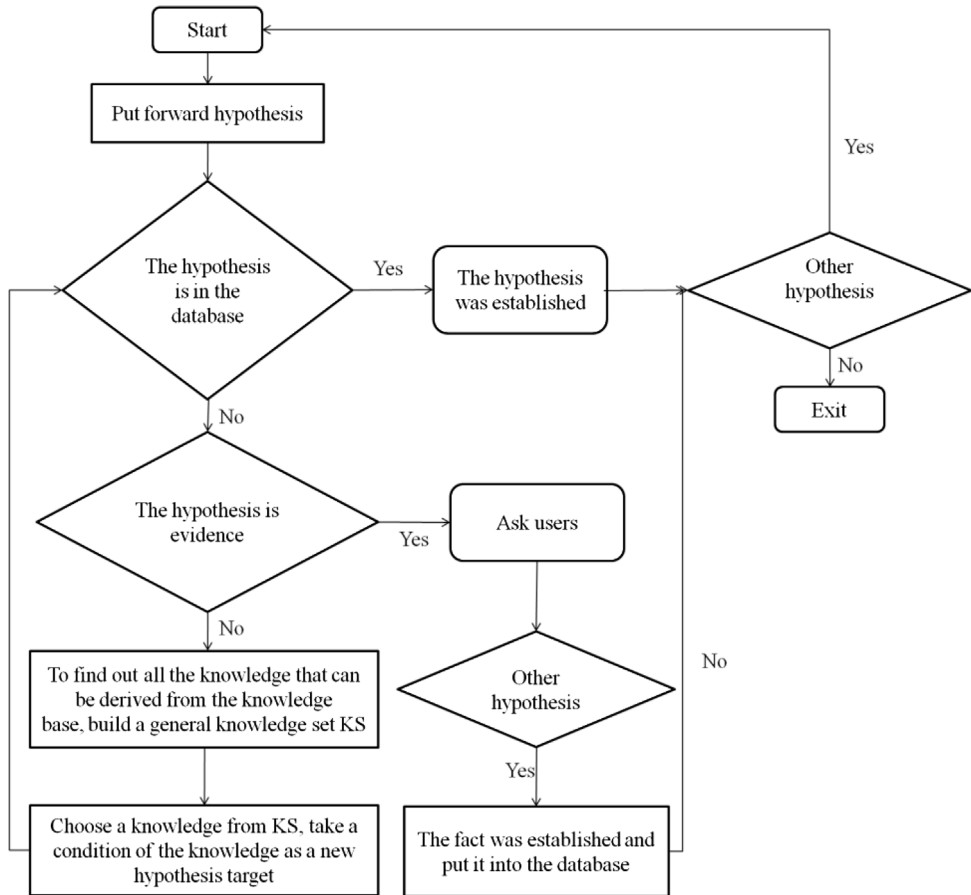


Figure 2 – Reverse Reasoning

3. Sports Decision Making System

During the sports' development, we usually face that if “what” and “how to do” the problem, this is a decision. In a narrow sense, sports decision making is to make a choice in several kinds of guiding actions. However, the purpose of leisure decision making is to make sure that the rationality of the consciousness should be judged as a precondition for the future sports.

Input part of decision making is composed of the information of the internal conditions and the external environment. Policy or strategy is the output part, the intermediate process is the decision making of the decision maker or the decision-making body.

To use the bottom-up approach based on multi agent modeling, through the interaction between the agents, dynamic construction of decision making expert system model could be for the complex adaptation of sports events.

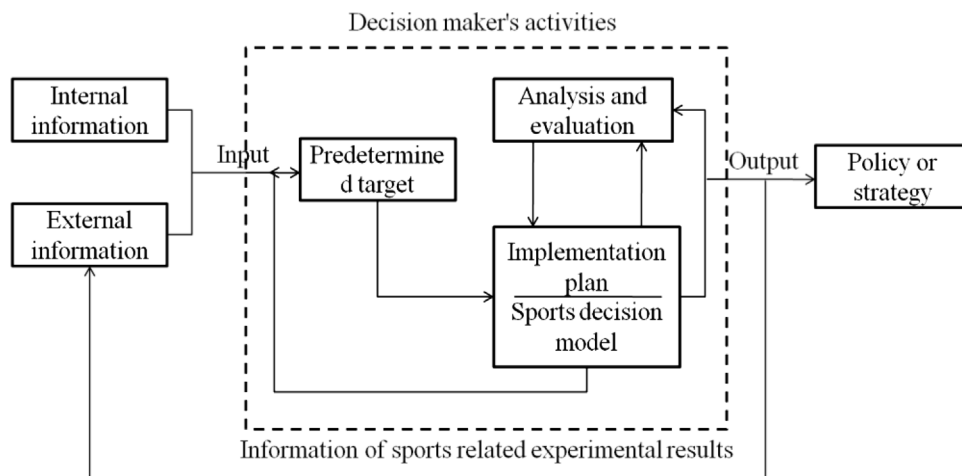


Figure 3 – Sports Decision-Making System

4. Construction of Decision Making System of Sports Based on Ai Expet System

The expert system model is designed for sports events' bid selection and decision making. This process illustrates that who in the process of signing before the bid has the intention to hold and determine specific sports events.. In the sports development strategy, we usually face if the "what" and "how to do", in fact, this is a decision problem. In a narrow sense, sports decision-making is making a choice in several guiding actions in the plan. In a broad sense, the purpose of leisure education is to have a sense of rationality to make certain judgments for the future of leisure. Sports decision making is a process that involves all the activities that must be performed before making the final choice. Strictly speaking, the scientific decision-making of sports is under the guidance of scientific theory and thought, through scientific procedures and methods, so as to achieve in the same day, many of the action plan, select an optimal plan of action. Using the system thought to analyze the decision-making process of sports, the sports decision-making can be regarded as a system, which is called the sports decision-making system. The input of this system is information about the internal conditions of the decision object (called the internal information) and the external environment (called the external information). Output is a kind of policy, strategy and so on. In the process, the process is the decision of the policy maker (or the decision making mechanism). In order to make their decisions more reliable, the decision makers must give feedback to the information in order to adjust their decision making. After entering the implementation of a strategic decision, began to have an early failure. This is because the decision from the implementation of the beginning to bear fruit, there must be a time delay, the failure is not that this decision is not feasible, but due to the inertia of the external environment caused by the

rather than the decision itself. When the decision is implemented for some time, the loss of efficiency should be reduced quickly and relatively stable over a long period of time. Otherwise, the decision has a problem. After the “accidental failure stage, decision failure rate suddenly increases, indicating that with the passage of time, internal and external environment factors have undergone great changes, the original strategic goals and decisions has not adapted to the development and changes of the new situation.

4.1. System Overall Structure

According to the task requirement, the system includes bidders' name, types; Tournament bid main body; Time and place; Task type, etc. Combined with the event risk factors such as government attitude, macro environment, urban development, market environment and others, the final decision has made by the comprehensive analysis of the AI technical expert system. The design of the sports decision-making system is based on the AI technology expert system that can solve the problem of large-scale sports event's application. As the system is composed of user reception layer, task perception layer, task solving layer, and the comprehensive analysis result, then it owns the self-learning and adaptive ability by analyzing all kinds of intelligence information.

Decision-making process is hierarchical, each decision has a different nature and functions. Through each level of decision-making through progressive and in-depth, and finally close to the decision-making objectives. They restrict and feedback each other so that the whole decision-making process is scientific, rational and objective and effective.

The goal of sports development strategy can be adjusted, but it is not equal to the beginning of the development of strategic objectives is not important. No matter how good the feedback system, as a national or regional sports development strategy, is very important, it is related to a series of principles, policies, establishment of economic investment and so on. Especially as we such a for thousands of years has formed a large inertia, inertness of the so-called super stable structure of society, the execution of a policy, a policy, economic investment, tend to after a long time to see its effect. If the initial target of the development strategy of the wrong, or deviate from the actual situation is large and needs to be modified or changed according to the original development strategy aims to standard and the development of the guidelines, policies and, you need to after a long time, re entered the implementation, the effect of the new.

4.2. System Work Flow

Arrange the system work flow according to the arrangement of the structure, there is three functional frameworks, that are comprehensive analysis, task solving and decision output.

5. Conclusion

When a user submits a decision task to the expert system, user reception procedures will receive the corresponding decision-making tasks, and the perception of these tasks by the perception of intelligent body, then the perception of the intelligence body will transmit the corresponding task to solve the problem.

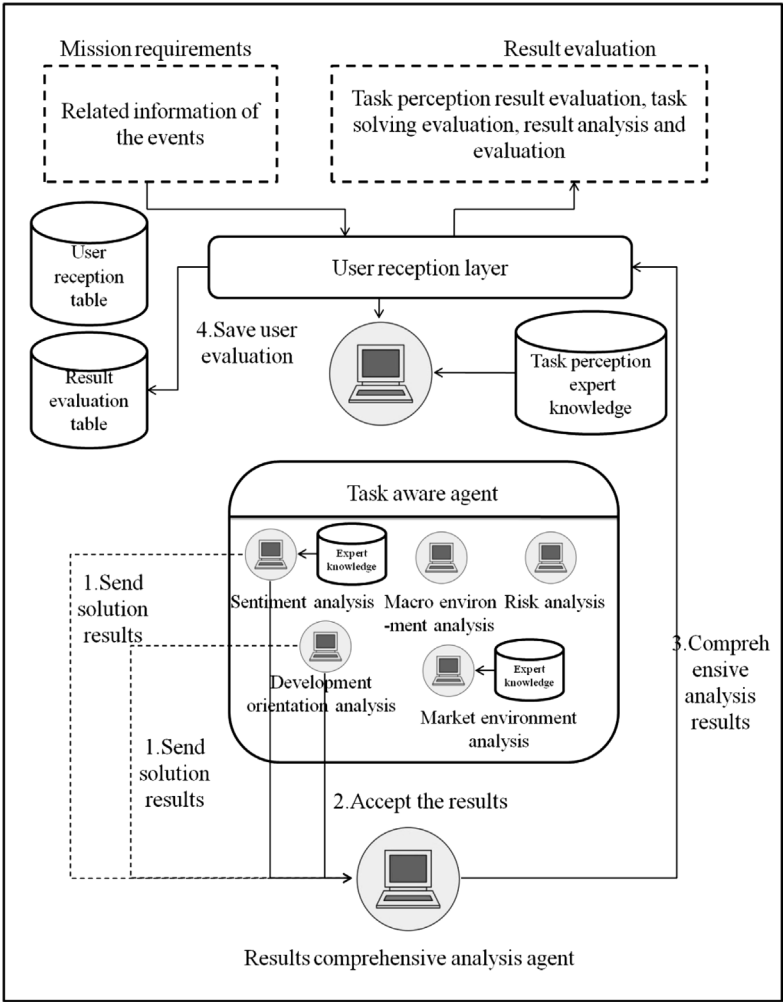


Figure 4 – System Overall Structure

Artificial intelligence has been gradually applied in computer aided teaching, and has a close relationship with the modern education, the development of artificial intelligence technology will play a huge role in promoting the education. With the development of artificial intelligence, the wide application of virtual network technology, intelligent computer assisted instruction system will be further improved, and promote the comprehensive reform of the field of education and teaching. From the point of view of artificial intelligence, intelligent computer assisted instruction system is actually used by teachers in computer aided teaching, based on the artificial intelligence computer aided instruction system in higher vocational teaching education teaching gradually shows its importance and practicality, it is a trend in the development of higher vocational education reform and modernization of teaching process.

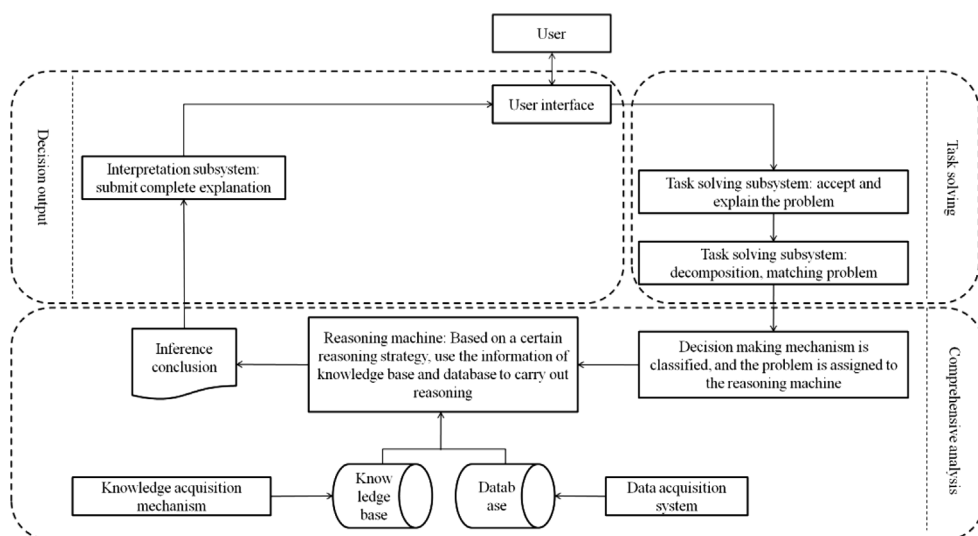


Figure 5 – System Work Flow

In summary, we build a unified intelligent system, coordinate the knowledge base and the reasoning machine with different standards; it can realize the decision-making better. Thus, the expert system based on AI technology is introduced into the construction of sports decision-making system. And the AI technology expert system is in the process of building a smart sports decision-making system that be effective, hierarchical and scientific.

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Research on the Application of Artificial Intelligence Computer Assisted Instruction System in College Physical Education

Chen Ying^{1,*}

Angel_75@126.com

¹ Department of physical education, Ningxia Medical University, 750004, Yinchuan, Ningxia, China

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Abstract: With the rapid development of modern educational technology, the application of artificial intelligence computer assisted instruction (ICAI) as the representative of the teaching technology in the field of education has promoted the development of the theory and practice of education. But there are still many deficiencies in the application of ICAI. Therefore, a cognitive student model based on the ICAI system is constructed in this paper. The advantages and disadvantages of ICAI in the college physical education are analyzed on the basis of the current situation of physical education teaching, and the principles and design methods of the cognitive student model based on ICAI system are put forward to construct the model, then the use of fuzzy mathematics theory and artificial neural network theory to design the cognitive student model is briefly introduced and the evaluation is carried out, so as to achieve certain intelligence. The experimental results show the effectiveness of this teaching model. The artificial intelligence computer assisted instruction system designed in this paper makes the teaching modernization of physical education to be a new level.

Keywords: ICAI; physical education teaching; cognitive model; artificial intelligence; computer technology.

1. Introduction

The application of computer assisted instruction (CAI) technology in physical education teaching is an important way for the transition from the traditional mode to the scientification, information and modernization, and it is also one of the important issues in the reform of physical education. The technology of artificial intelligence plays an important role in intelligent computer assisted instruction, and the combination of AI and CAI can make the teaching system more perfect, so as to effectively distinguish the teaching content, teaching subject and teaching method of the course unit, this will be able to start from the individual differences of students to provide different teaching methods for different stages of the students, so as to form the intelligence computer assisted instruction system, as ICAI. (Gupta, C., Srivastav, M., & Gupta, V., 2015) The research of ICAI not only indicates the new development of computer science, but also means that the idea and method of physical education are renovated. The traditional teaching method only emphasizes the learning of motor skills, but seldom to understand

the motivation and interest of learners. Therefore, the effect of school physical education is not satisfactory, thus the students can't develop the habit of sports. Since twenty-first Century, with the continuous development of information technology, the application of various teaching media has become an inevitable trend in school education, although ICAI in our country has been carried out for several decades, but which has been far from many other countries in the world in terms of the concept of teaching media as well as the use of computer technology. Based on the analysis of the advantages and disadvantages of ICAI in college physical education, this paper puts forward the principles and design methods of the cognitive student model based on ICAI system, and briefly introduces the use of fuzzy mathematics theory and artificial neural network theory to design the cognitive student model and carry out the evaluation, so as to achieve certain intelligence (Abreu, A., Rocha, Á., Cota, M. P., & Carvalho, J. V., 2015).

2. Application Status and Problems

Intelligence Computer assisted instruction (ICAI) refers to a method which can achieve the purpose of teaching through the interaction between students and computers with the computer as the teaching medium. Back in 1950s, (Milijasevic, N., 2014) ICAI has begun to appear in the education. The United States has began to implement ICAI physical education in the universities in 1980s, and our country also has increased the degree of computer science teaching in the beginning of this century, many universities have established the ICAI courseware on the Internet to facilitate students' learning. In recent years, with the continuous improvement of the level of computer software and hardware, the function of the computer is more and more powerful, more and more schools begin to use ICAI. Although the use of ICAI is relatively late in the sports disciplines, but its development speed is very fast. At the same time, the research of ICAI is also more and more in the field of sports. At present, there are many researches on network teaching support platform in foreign countries. Based on the essence of the concept of NLE, Blackboard integrated the teaching and learning environment with the curriculum as the center, it provided a powerful teaching and learning online virtual environment for teachers and students, and became a bridge of communication between teachers and students (Churpek, M. M., Yuen, T. C., Winslow, C., Meltzer, D. O., Kattan, M. W., & Edelson, D. P., 2016). Web Course Tools (CT Web) was a basic server program, it was the network teaching courseware development and management system based on the Web browser, it could be used for online development courses, but also could be used to publish the contents of the existing courses on the internet, the system used the browser as the curriculum development environment of the client (Gonzalez, L. F., Montes, G. A., Puig, E., Johnson, S., Mengersen, K., & Gaston, K. J., 2016). Vritual-U was an integrated tool for teaching and training based on WEB, it could allow teachers to facilitate the establishment and management of collaborative teams, create a meeting to facilitate thematic discussions, and allow students to role play and insert multimedia material in the message (Li, J., Wei, Z., & Hakonarson, H., 2016). WEB Instructional Services Headquarters (WISH), the feature of this system was to provide the management of teaching resources, including classroom management, electronic communication, curriculum bulletin board, electronic whiteboard, real time audio system, mailing list and other system modules (Liu, T., Wang, Y., Eickholt, J., & Wang, Z., 2016). Class Fronter network teaching platform provided more than 40

modules, including calendar, planning activities, contact list, chat rooms, forums, writing board and testing function, it could achieve multiple students real-time collaboration writing a file (Rocha, H., Peretta, I. S., Lima, G. F. M., Marques, L. G., & Yamanaka, K., 2016). In China, the network teaching support platform is still in its infancy. With the efforts of our country's educational technology workers, more and more colleges and universities have begun to realize the importance of the network teaching support platform for the network teaching. Some representative studies are as follows: TCL open education platform provided synchronous and asynchronous way of teaching, including the teaching support system, educational management system, curriculum development system, service supplement system and teaching resource management system, and introduced advanced video interactive WebEx technology and Tamino database technology based on XML language environment, so as to make the platform's functionality, convenience and interactivity to achieve a better level (Sanford, J. F., & Naidu, J. T., 2016). However, although the current ICAI is widely used in various colleges and universities, and achieves good teaching results, but the application of ICAI still exists several problems: Firstly, the purpose of the teaching is not clear; Secondly, part of the practical teaching software are relatively absent; Thirdly, the level of the teaching software of physical education need to be improved. Teachers shouldn't pay too much attention to the appearance of courseware, but should highlight the focus and difficulty of the course, so as to achieve the expected teaching effect, thus give full play to the advantages of ICAI. The remainder of this paper is organized as follows. Section 3 describes the ICAI system and its characteristics. Section 4 gives the realization process of the cognitive model. Section 5 presents Experimental analysis. Conclusion is summarized in Section 6 (Riddle, A., 2015).

3. ICAI System and Its Characteristics

3.1. ICAI System

The core of the ICAI system is based on the cognition, and the content of the teaching system is designed. (Wang, Q., 2015) After the combination of artificial intelligence (AI) technology and CAI, the ICAI teaching system is obtained. This kind of assistant teaching system can effectively distinguish between the methods and contents of the physical education teaching, and which is based on the information feedback from the cognitive model of students, so as to carry out the collation and reasoning in the AI system, and ultimately generate the physical teaching content and teaching methods which meet the individual differences of the students (Vashirawongpinyo, P., & Pianthong, N., 2015).

3.2. Necessity and Superiority of ICAI

There are some limitations in the traditional physical education curriculum teaching in both subjective and objective, which reflects the necessity of ICAI. Subjectively, students tend to think that physical education is too difficult and boring, therefore they aren't interested in sports; Objectively, the traditional physical education curriculum teaching has very big limitation, the students can't obtain the complete image memory from the teacher's explanation. Therefore, the application of ICAI is very necessary, such as stimulating interest, correcting the wrong action and so on (Pennisi, E., 2016).

On the one hand, the application of ICAI is flexible. The function of the computer and the influences of the light, color, color and shape on the psychology of students can stimulate learning interest. On the other hand, it is helpful for stimulating the learning enthusiasm of students, broadening their horizons (Obidinnu, J. N., & Ibor, A. E., 2016).

3.3. Application Premise of ICAI

3.3.1. Principle of Choice

Necessity principle: First of all, it is necessary to understand the selected teaching materials whether are the content that the current teaching and students need or difficult to grasp in the teaching. Secondly, it is needed to study teaching difficulty, and grasp the essence, if the conventional teaching method can make good teaching, it is unnecessary to use ICAI teaching, so as to avoid superfluous (Wang, J., Wang, H., Qin, X., Wei, Z., & Zhang, Z., 2016).

Feasibility principle: The selection and determination of subjects not only need to consider the actual needs of teaching, but also take into account the production, equipment conditions, technical level and other factors of existing school, and give full play to their own advantages; In the actual production, it is needed to take into account the effectiveness and timeliness of the courseware, and expand the scope of knowledge of students (Gunawan, S., Shieh, C. J., & Pei, Y., 2015).

Scientific principle: The content of ICAI teaching courseware is an important embodiment of the teacher's teaching content, which reflects the teacher's teaching idea to a certain extent. Therefore, it must be scientific, and must accord with the principle of education and advanced teaching idea; Then, it must follow the curriculum standards and teaching materials; in addition, it is needed to give full play to the general cognitive law, and right to edit the courseware.

3.3.2. Matters Needing Attention

Writing courseware script is an important part of ICAI courseware design, so the writing quality of courseware script directly affects the using effect of courseware. The design and manufacture of manuscript should pay attention to the following aspects: dynamics, practicability, graphics, operability, innovativeness.

3.4. Concrete Application of ICAI in College Physical Education

The basic teaching modes of physical education teaching are the traditional teaching mode, the integrated teaching mode, the open teaching mode and so on. The traditional teaching mode is in strict accordance with the idea of preparing for lessons, which bounds the students' thinking, and the amount of information is small. In the comprehensive teaching mode, the students' independent space is expanded, and the knowledge and training of the students are enhanced. But the independent learning, self diagnosis, self evaluation of the desire and ability of students don't get a full release, the two-way communication between teachers and students is not very good. As shown in Figure 1.

The characteristic of open teaching mode is that the students have more space to study independently, and the information content of the courseware is large. As shown in Figure 2, Figure 3.



Figure 1 – Comprehensive Teaching

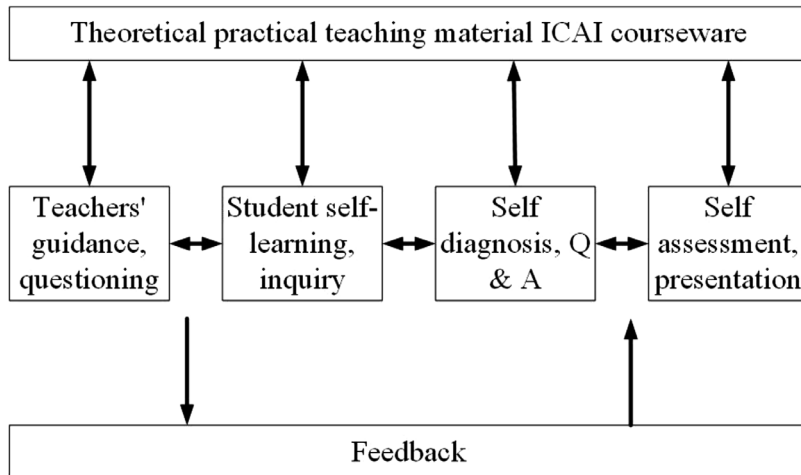


Figure 2 – Basic Structure of Open Teaching Mode

4. Realization of ICAI System

4.1. Structure of Student Model

Based on the theory of AI, cognitive science and thinking science, this teaching model of ICAI system seeks learning cognition through the study of the characteristics and process of human learning, which enables students to acquire knowledge through individual adaptive teaching. ICAI system has four independent modules: knowledge



Figure 3 – Opening Teaching

base, student model, teacher model and man-machine interface. ICAI system can use the teacher model and student model to infer the students' learning needs, judge the students' error sources, and make a flexible and targeted teaching strategies, so as to choose the teaching content and teaching methods for the current students. The general structure of the student model is shown in Figure 4.

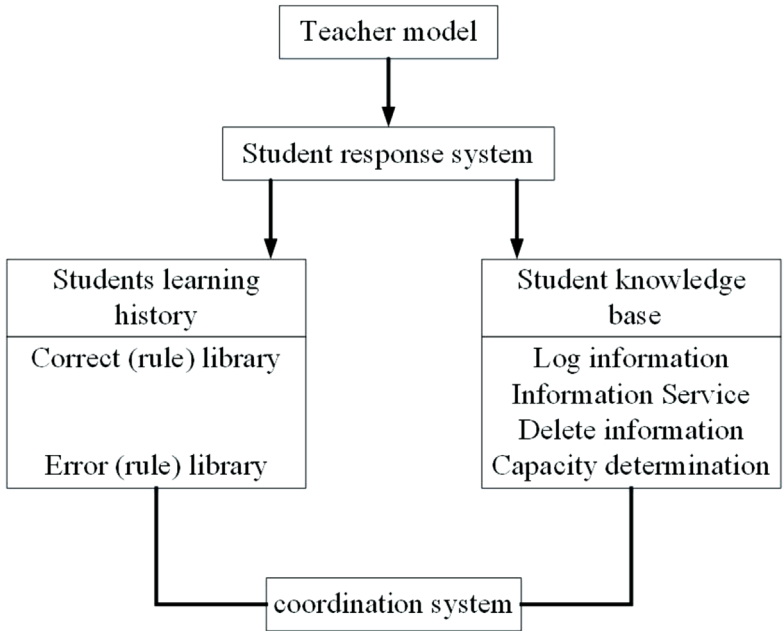


Figure 4 – General Structure of the Student Model

4.2. Structure of cognitive student module

In the model of ICAI system, the main function of the student model, on the one hand is the login of learner ID, name, gender and so on; On the other hand, also the most important one is to accurately reflect the level of knowledge, learning ability, so as to provide the basis for the intelligent teaching. ICAI is based on cognitive theory. But at present, the establishment of the student module (such as bias model, cover model) can only reflect the students' learning level, which ignores the important role of cognitive ability in the learning process, and can't reflect the cognitive ability of learners and stages. And this is very important for both students and teachers. After the learners doing the tests (exercises, quizzes, midterm, final exam and so on), we use vector method, fuzzy evaluation algorithm and BP algorithm in neural network and combine the cognitive theory to evaluate students, and put forward the following student model. The model is composed of three parts: information input, first grade and two grade, and the structure is shown in Figure 5.

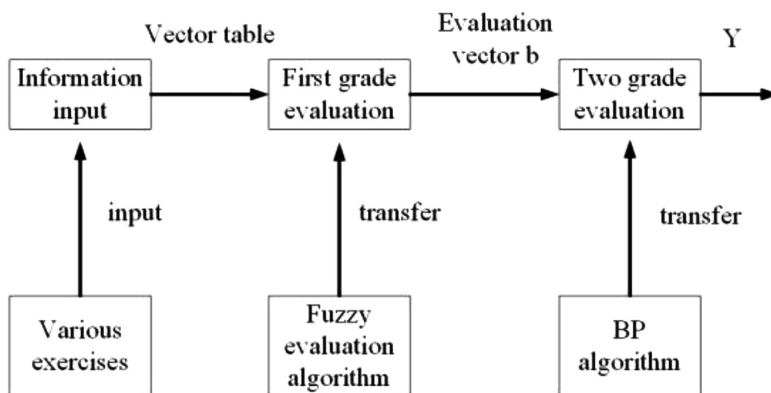


Figure 5 – Structure of Cognitive Student Module

4.3. Realization of Cognitive Model

4.3.1. Information Input

The process of information input is completed by recording a series of process of the students' exercises. Which reflects the cognitive type, knowledge, cognitive ability, difficulty and so on. Among them, the cognitive ability references to the educational objective classification theory of the famous American educational psychologist Bloom (B.S.Bloom), which is divided into: memorizing, understanding, application, analysis, synthesis, for a total of six, that is to say, each question reflects one or more cognitive learning skills. Using a vector table to record each set of exercises. There are six cognitive learning skills in the n models, m rows correspond to the number of exercises. For each teaching unit, the n is generally fixed, while the number of exercises of the m is variable, both of which are determined by the teacher model, and how many sets of questions can be carried out information input are also determined by the teacher model. Because

each test isn't necessarily able to reflect all the cognitive skills of students, so it requires that if the test doesn't reflect the cognitive skills of students, the corresponding elements of which is 0, that is not to participate in the evaluation of this skill. In this evaluation model, after the off-line judging, the results of the tests and other practice information will be recorded as a vector table. In the information input, first of all, the elements of the vector table need to be set to 0. Analyzing the answers and steps of the students' problem-solving, and comparing with the standard answer, then according to the matching rate of the two cases, the difficulty of the problems, the correlation and the type of the topic, the corresponding value of the corresponding vector table is given. In order to facilitate, when the matching rate is above 90%, the corresponding element is 1, otherwise it is -1; When the students finish a set of questions, they can get a record vector table. Supposing that a training record vector is obtained. As shown in table 1.

Question No.	1	2	3
<i>Memorization</i>	1	1	-1
<i>Understanding</i>	0	-1	1
<i>Application</i>	-1	1	0
<i>Solution</i>	1	0	0
<i>Analysis</i>	1	0	1
<i>Comprehensive</i>	1	0	1

Table 1 – Record Vector Table

This record vector table shows that there are 3 kinds of exercises and six kinds of corresponding cognitive skills in this set. The first problem involves memorizing, application, analyzing, synthesizing, solving five cognitive skills, the students correctly use memorization, solving, analyzing and synthesizing four sub cognitive skills, mistakenly use the sub cognitive skill. 2, 3 problem similarly.

4.3.2. Fuzzy Level Evaluation

From the exercises record vector table, the correct using rate $r(e_i)$ of the students' cognitive skills e_i ($i=1,2,3...n$) can be calculated.

$$R(e_i) = N_{ei}(1) / (N_{ei}(1) + N_{ei}(-1)) \quad i = 1, 2, 3 \dots \quad (1)$$

Where $N_{ei}(1)$ and $N_{ei}(-1)$ respectively are the number of the correct using and wrong using of sub cognitive skills in the practice, according to the above formula, correct usage rate vector can be got:

$$R = (r_1, r_2, r_3 \dots r_n) \quad (r_i = r(e_i) \in [0,1]) \quad (2)$$

From the above table, the correct usage rate vector can be got:

$$R = (2/3, 1/2, 1/2, 1, 1, 1) \quad (3)$$

Now setting the domain U is the collection of correct usage rate, namely $U \in [0,1]$. The evaluation of students learning quality is (excellent, good, medium and poor), then which are the fuzzy subsets of U . A is set to express the fuzzy subset “excellent”, $U_A(u)$ is the membership function of A , so we can make that:

$$U_A(u) = \begin{cases} 0 \\ \left[1 + \left(\frac{u}{0.12}\right)\right]^{-1} \end{cases} \quad (4)$$

In the formula, $0 \leq u \leq 0.5$. Through the correct usage rate vector and the arithmetic expression of the specific membership function, the membership degree of the sub cognitive skills can be calculated, and thus forming a evaluation vector:

$$A = (a_1, a_2, a_3, \dots, a_n) \quad (5)$$

Where a_i represents the membership degree of the i sub cognitive skills is “excellent”. Hypothesis, the exercises are P sets, so there are a number of corresponding evaluation vectors. Thus we can get a p times n dimensional evaluation matrix about “excellent”.

$$G = \begin{bmatrix} a_{11}, a_{12}, \dots, a_{1n} \\ a_{21}, a_{22}, \dots, a_{2n} \\ \dots\dots\dots \\ a_{p1}, a_{p2}, \dots, a_{pn} \end{bmatrix} \quad (6)$$

In the formula, the rows of the matrix G corresponds to the evaluation vector of a set of questions.

Due to each exercise in P sets of exercises plays different roles (such as some are unit tests, some are usual practices), so different sets of exercises corresponds to different weights. Setting weight vector:

$$W = (W_1, W_2, \dots, W_p), \sum_{i=1}^p W_i = 1 \quad (7)$$

According to the weighted average algorithm, the comprehensive evaluation vector b can be got, which reflects the learning ability of the students.

$$b = WG = (b_1, b_2, \dots, b_n) \quad (8)$$

4.3.3. Two Level Evaluation Decision

The comprehensive evaluation vector is not enough to be used as a decision parameter of teaching strategy. In order to control the students' learning whether to enter the next chapter, which not only needs the test results as the basis, but also needs the comprehensive evaluation of the cognitive ability. The idea is as follows: The test Score, b_1, b_2, \dots, b_n , age, education, physiological conditions, learning environment, mood, learning efficiency and other parameters are regarded as the input node of the BP network, the output value of the network is Y , in fact, which is a nonlinear mapping of a multidimensional space to 3 dimensional space.

$$F_{bp} X = Y.$$

$$X = \{ \text{Score}, b_1, b_2, \dots, b_n, a_1, a_2, \dots, a_7 \} \quad (9)$$

$$Y = \{ Y_1, Y_2, Y_3 \}.$$

Where $Y_i \in \{\text{bad (0 -59), pass (60 -69), medium (70 -79), good (80 -89), excellent (90 -100)}\}$. $a_1 \sim a_7$ respectively present the students' age, physiological conditions, mood, learning environment and so on. Y_1, Y_2, Y_3 respectively present the mastery degree of students on the concept, skills and application.

The design of the cognitive evaluation student model uses the fuzzy mathematics theory and artificial neural network theory to make this model has a certain intelligence, adding the model to the ICAI system will be helpful for improving the performance of the intelligent tutoring system.

5. Experimental Analysis

5.1. Object of Research

This paper takes a school of male and female students as the research objects, the number of samples is a total of 2600, 1800 boys, 800 girls.

The object in this research is divided into two groups, the theory group and the experimental group (in which, male and female are 15 people respectively), The experimental group uses the multimedia assisted instruction, and the theory group don't use. Before and after the experiment, the questionnaire of physical education learning effect is measured.

5.2. Experimental Result

The influence of the differences in the effect of the students' learning. In the table 2, T represents the theory group, E represents the experimental group, it can be seen that the average score of the experimental group was 0.23 is higher than that of the theoretical group, the average score of the latter is -1.35. The three components of cognition, emotion and skill in the experimental group are 0.12, 0.28, 0.26, which is also higher than that of the theoretical group, the latter are -0.12, 0.25, 0.14. This result shows that the

use of ICAI has a significant difference on the students' movement learning, and tends to be positive, only the impact of the difference in the skill component is small.

	Group	Number of people	Average	Standard deviation
<i>Learning quantity</i>	T	22	-1.35	0.22
	E	22	0.23	0.23
<i>Cognitive component</i>	T	22	-0.12	0.27
	E	22	0.12	0.38
<i>Emotional component</i>	T	22	0.25	0.48
	E	22	0.28	0.38
<i>Skills component</i>	T	22	0.14	0.34
	E	22	0.26	0.33

Table 2 – Descriptive Statistical Differences Between Experimental Group and Theoretical Group

From table 3, it can be seen that the difference value between the experimental group and the experimental group in the the sports learning, $t = -4.72$, $p = 0.01$, which reach the level of 0.05. In the two components of cognitive and emotional, which also reach a significant level.

	T	Freedom	P	Mean difference
<i>Learning quantity</i>	-4.72*	45	0.01	-3.0
<i>Cognitive component</i>	-2.29*	45	0.04	-2.2
<i>Emotional component</i>	-4.03*	45	0.01	-0.53
<i>Skills component</i>	-1.48	45	0.16	-0.15

* $p < 0.05$

Table 3 – Difference Test Results Between Experimental Group and Theoretical Group

5.3. Interpretation

Compared with the common class, the class with the use of ICAI in physical education has a significant impact on improving the learning effect.

6. Conclusion

Although the Intelligence Computer Assisted Instruction (ICAI) in our country has been carried out for several decades, but which has been far from many other countries in the world in terms of the concept of teaching media as well as the use of computer technology. Based on the analysis of the advantages and disadvantages of ICAI in college physical education, this paper puts forward the principles and design methods of the cognitive student model based on ICAI system, and briefly introduces the use of fuzzy mathematics theory and artificial neural network theory to design the cognitive student

model and carry out the evaluation, so as to achieve certain intelligence, in addition, this paper also carries out the experimental analysis. Experimental results show that the class with the use of ICAI in physical education has a significant impact, and the application of ICAI technology still has a huge development space.

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Research on Curriculum Inquiry Teaching Based on Artificial Intelligence

Wang Fu^{1,*}, Ma Chao¹

* jy47164601@gmail.com

¹ Teachers College, Shihezi University, 830002, Shihezi, Xinjiang, China

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Abstract: Objective: In order to improve the teaching quality of higher education institutions in our country. Methods: To establish the curriculum inquiry teaching mode based on artificial intelligence. Process: The paper introduces the application of artificial intelligence in the teaching of higher learning institutions, describes the characteristics and objectives of the artificial intelligence course, and establishes the teaching model of artificial intelligence course on the basis of inquiry teaching theory. Result & Analysis: This paper studies the content adjustment of intelligent teaching system, analyzes the application of artificial intelligence algorithm in the experiment of school scheduling, and finds that artificial intelligence technology can improve students' learning and practice ability. Conclusion: The curriculum inquiry teaching mode based on artificial intelligence established in this paper has good teaching effect.

Keywords: Artificial intelligence algorithm; curriculum inquiry; teaching mode; intelligent teaching system.

1. Introduction

Artificial intelligence is a broad objective and cross discipline, is performed by the study of intelligent machines usually with human intelligence related functions, such as judgment, reasoning and proof, identification, perception, understanding, design, thinking, planning, learning and problem solving thinking activity, to solve the humans to deal with the complex problems (Keys, C. W., & Bryan, L. A., 2001). Artificial intelligence is a computer science, cybernetics, information theory, neurophysiology, psychology, linguistics, etc. many cross subjects, mutual penetration and development of a new interdisciplinary, so artificial intelligence research has been in the forefront of the information technology, its research, application and development of the study in a certain extent determines the direction of the development of computer technology, (Gasca-Hurtado, G. P., Peña, A., Gómez-Álvarez, M. C., Plascencia-Osuna, Ó. A., & Calvo-Manzano, J. A., 2015) at present, there are many research results already entered people's life, has become an important part of information technology is indispensable to the. It is necessary to carry out the teaching of artificial intelligence course in Colleges and universities. Artificial intelligence research results at present, the majority of colleges and universities computer and related professional opened the artificial intelligence

this course, many famous universities and research have independent of the artificial intelligence laboratory, agriculture and gardens and other major urgent need the theory and method of artificial intelligence to solve actual problems in scientific research, and the combination of good success stories, such as: College of horticulture and information technology cooperation developed jujube expert system, agricultural college are studying crop growth simulation system, information science and technology, and the course opened provides the typical teaching case. Based on the author's teaching practice, from the teaching material selection, teaching system and content, teaching methods and teaching methods, practice teaching and other aspects of artificial intelligence this course are explored (Anderson, J. R., Boyle, C. F., Corbett, A. T., & Lewis, M. W., 1990). Figure 1 is the intelligent course teaching situation.



Figure 1 – Intelligent Course Teaching

2. Data and Methods

2.1. The Characteristics and Objectives of the Artificial Intelligence Course

Due to the artificial intelligence is a comprehensive and interdisciplinary, technical discipline with very strong practicality, wide application of outward discipline and the great vitality of the young subjects, so the course has the following two characteristics: The meaning of curriculum content is extremely rich. This is determined by the characteristics of the artificial intelligence itself. Its content relates to computer science, information science, control science, system science, mathematics, psychology, electronics, biology, linguistics and philosophy and so on (Sleeman, D. H., & Smith, M. J., 1981). Almost all scientific workers can find themselves interested in artificial intelligence. They can also make its own contribution for the development of artificial intelligence. Due to the core content of artificial intelligence course is mainly focused on the understanding of the basic concepts, basic principle of the method and algorithm and its application, despite all the basic concepts, principles, methods and algorithms in a certain extent self system, more independent, but between them and there is a many internal relations and rules.

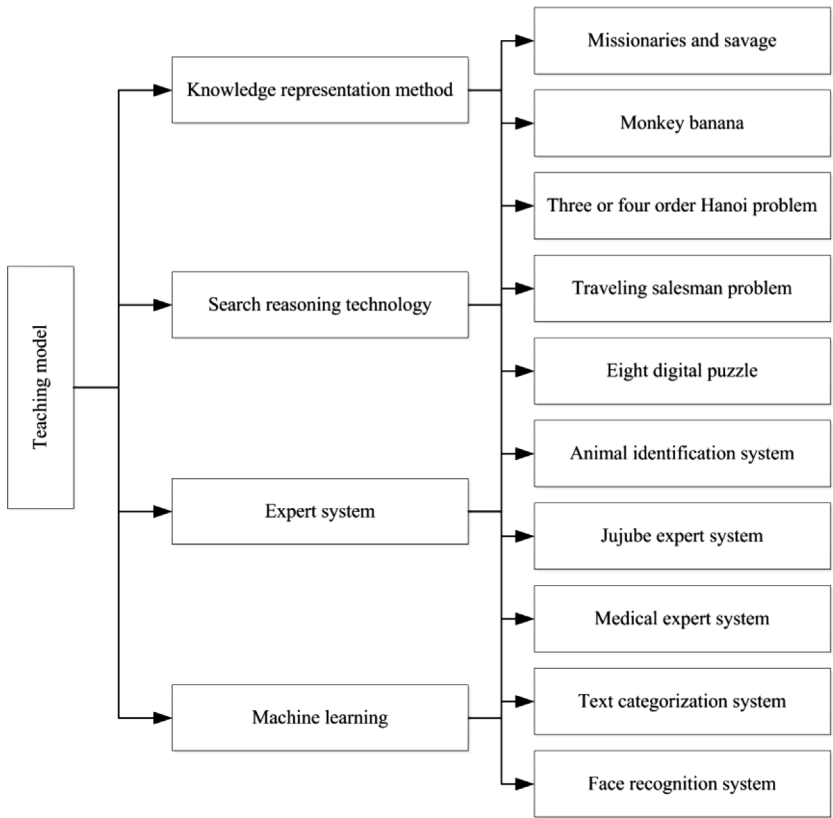


Figure 2 – Part of the Teaching Model of Artificial Intelligence

From this point of view, artificial intelligence courses and many other computer courses are different. This also makes the teaching of artificial intelligence courses have the corresponding characteristics. For example, in practice curriculum design, single chip microcomputer principle course exercises can be a simple microcontroller system design, comprehensive training of MCU principle of each part. It is convenient for the students to the course of knowledge, which can play the effect of giving top priority in future work. And for artificial intelligence course, it is almost impossible to construct a exercises to all of the concepts, principles, methods and algorithms are contained inside. And, in fact, it's not good to do so. Because artificial intelligence itself is expanding. In the study, master the basic concept, principle, method and algorithm on the basis of knowledge to be summarized in an effective and flexible interpretation is the most important. So in the teaching process of artificial intelligence curriculum should emphasize problem solving methods and habits of the culture, publicize these seemingly separate content between the internal regularity of Tong said through, help the student to discover the implicit in the problem solving model of behind these basic concept, principle, method and algorithm, and ultimately enable students to obtain by analogy (Soller, A., 2001).

Curriculum content extension is extremely wide. Artificial intelligence to the whole scientific system as its potential application areas. Any work can not be separated

from the intelligence, so any field is the potential application of artificial intelligence. The wide application of artificial intelligence to the human from low-level tedious and monotonous operation and control decision liberated, to help human to vacate more time and energy to complete the high level that need more creative. Therefore, artificial intelligence is a shoulder the great historical mission of discipline, it will make the whole system of science and the human way of life change nature. Artificial intelligence will enable the evolution of human intelligence into a new stage of development. In view of this, students with the help of artificial intelligence to complete all kinds of actual problem solving keen insight and effective execution is very necessary and urgent. Education has always been a “two way” choice, one is to give students a basket of fish, one is to teach students how to fish. The teaching reform in teaching contents and teaching methods, always in the “fish” and “fishing” between these two points is shaking (Darling-Hammond, L., 2008). Kong Zi said: “learning without thought is labor lost, thought without learning is perilous.” Learning is like fish, think about fishing, in the view of Confucius, the analysis of knowledge does not, just confused; lack of specific knowledge, but because of ignorance and fearless, stability analysis chaos, it will do bad things out of the question. In view of the current teaching situation, we should advocate the equal emphasis on both the fish and the fishing. Kong Zi said: “learning without thought is labor lost, thought without learning is perilous.” Learning is like fish, think about fishing, in the view of Confucius, the analysis of knowledge does not, just confused; lack of specific knowledge, but because of ignorance and fearless, stability analysis chaos, it will do bad things out of the question. In view of the current teaching situation, we should advocate the equal emphasis on both the fish and the fish. Specific to the teaching of artificial intelligence course, we hope that through the course of learning, so that students of artificial intelligence in the general situation of the development, basic principles and applications of have a preliminary understanding, the main technology and application of a certain master. At the same time, to inspire and train students interested in artificial intelligence, improve their learning initiative, and further develop their knowledge innovation and technology innovation ability and lay a solid foundation. Based on the purpose and characteristics of artificial intelligence course, set up with matching teaching model will effectively enhance the teaching level and effect of the curriculum (Wallace, C. S., & Kang, N. H., 2004).

2.2. Intelligent Teaching System and Content Adjustment

Artificial intelligence which is rich in content, involving a wide range, select teaching content, to enable students to understand the basic knowledge, the main purpose of the teaching of artificial intelligence is to understand the specific application of this field. We need to deal with the problem of knowledge representation in solving the premise of the application of artificial intelligence, namely the basic processing unit of artificial intelligence is the knowledge, the artificial intelligence course teaching content should be to knowledge as the main line, to knowledge representation, search and reasoning as the cornerstone of the organization. The teaching content is divided into two parts (Merrill, D. C., Reiser, B. J., Ranney, M., & Trafton, J. G., 1992).

Points: the first part is the basic theory and methods, including knowledge said methods (state space method, problems of the statute of the law, predicate logic, semantic network, frame representation and the script), the search reasoning technology

(search theory, resolution principle and rule deduction system); the second part for the advanced application of artificial intelligence techniques, including neural computing, fuzzy computing, evolutionary computing, expert system, machine learning, automatic planning, natural language understanding, in addition, in order to enrich the teaching content of artificial intelligence, although there is no mention in the textbook, the content of knowledge discovery and data mining is added. The author prepares a teaching case for each section of the course, to stimulate students' interest in solving practical problems (Keys, C. W., & Kennedy, V., 1999). Figure 2 for the part of the teaching model of artificial intelligence.

2.3. Research on the Basic Form of Inquiry Based Teaching Theory

"Inquiry teaching model refers to in the teaching process, learners are required under the instructor's teaching through to 'autonomy, inquiry and cooperation' for the characteristics of learning style of the main content of the current teaching of knowledge of autonomous learning, in-depth study and group cooperation and exchange, thus effectively reached the curriculum standard on cognitive and affective objectives and requirements of a teaching mode. Explore the basic features of the teaching mode can use a word to sum it up: 'leading and the main body' 'the combination of teaching methods, not only attach importance to the role of teachers in teaching in the process of leading role, but also fully embodies the learners in the learning process in the dominant position'. In the teaching of computer course, all kinds of scientific knowledge can be used to develop the inquiry teaching (Du Boulay, B., & Luckin, R., 2001). In order to fully express the whole teaching activities, it is established as the following mathematical functions:

$$Q = F(A_T, A_S, P) \quad (1)$$

Type and Q represents the inquiry teaching mode, $F()$ is a process function, A_T is teaching the action set, A_S is the learner's action set. P represents the inquiry questions raised. Usually, around P of the A_T and A_S more, between the teachers and students exchanges, knowledge migration and development more can realize. Inquiry teaching in the "double master" condition, A_T and A_S are basically the same or equivalent in principle.

Teaching the use of A_T in the series of teaching means and methods to guide the learning from these aspects of the A_S to think about problem solving methods and techniques.

Generally, A_T and A_S have the following action sets:

$$A_T = \{q, i, r, h, c\} \quad (2)$$

$$A_S = \{l, t, a, d, m\} \quad (3)$$

The Q of A_T said the inquiry, stimulate learning motivation and study motivation, I said the proposed heuristic problem, provide learning strategy guidance, R said to provide

learning resources, and provide guidance for cognitive tools, monitoring learning process of the learners, h provides the tools for problem solving, cooperation strategy the guidance, C said the comment, summary, put forward development problems and transfer of knowledge; L of A_s said in the study situation, the formation of learning psychology, t said according to the thinking of heuristic teaching, the formation of the corresponding learning action, a said the collection, analysis, information processing, d said the group collaborative discussion, the sharing of learning resources, internalized knowledge and learning methods, construct their own learning framework, the M said.

Discussion, reflection, mutual assessment, transfer, expansion of knowledge and so on. Under the guidance in the implementation based on CT of the inquiry teaching process, requires the learners to use CT a series of methods to explore, find where the essence of the problem, and to the scientific inquiry methods in training learners independent as scientists like to think and solve problems. To achieve this objective, the science of CT into the inquiry teaching process, can greatly improve teaching and learning quickly found and problem solving ability.

In the inquiry teaching into the CT method is the important teaching idea, using the CT method for learners to learn and explore, and better play the effectiveness of the two, the comprehensive utilization of CT teaching strategies, construct to teach scholars as the leading study as the main body, to ability training for the purpose of thinking dimension teaching new pattern. Its mathematical model is expressed as:

$$Q_{CT} = F(A_T', A_S', P, CT) \quad (4)$$

Type, Q_{CT} said the inquiry teaching mode based on CT, CT said computational thinking, the meaning of $F()$, P and formula (1) in the same, A_T' is teaching action set, A_S' is the learner's action set. Clearly have:

$$A_T \subset A_T' \quad (5)$$

$$A_S \subset A_S' \quad (6)$$

Usually case, A_T' increased the CT recursive, separation, reduction, embedding, transformation, simulation and heuristic reasoning to guide the learners to learn the method, A_S' increased the CT recursive, separation of concerns, reduction, embedding, transformation, simulation and heuristic reasoning thinking and problem solving methods (Wong, L. H., Quek, C., & Looi, C. K., 1998).

2.4.The Application of Artificial Intelligence Algorithm in the Course Arrangement of School

Artificial intelligence is a computer technology development to a certain stage of a computer science branch categories, the main research how to use the computer to simulate the human brain to complete a variety of artificial intelligence activities, in simple terms, artificial intelligence is the study of how to use the computer to complete a

series of human reasoning, thinking, planning and other activities, to solve some of the original need human to complete the complexity of the problem. At present, artificial intelligence have been widely applied to medicine, factories, biogeographical studies even game development, mainly in a variety of symbols instead of knowledge as the object of study. At the same time, the non conventional heuristic reasoning method to carry out (Tiruneh, G., & Ayalew, M., 2016).

According to the general education work arrangements and the current education reform put forward to the daily management of the school of new requirements, scheduling system in the design should try to be flexible, convenient and practical, should make full use of school teaching resources, the teaching quality is maximized, which requires scheduling software to do as much as possible flexible scheduling, according to different application object and teaching practice to a reasonable allocation of teaching resources, in the actual application of artificial intelligence algorithm to design course work should take into account the following factors: teacher factors: every teacher taught by categories are relatively stable, so the time course scheduling software according to the artificial intelligence to the design in the distribution of teacher resources can use relative one-to-one correspondence, but also should take care of the actual characteristics of each teacher. Flexible distribution, such as a teacher because of some special reasons in one day is unable to attend class. These will be in the actual teacher curriculum be considered for flexible arrangements. curriculum arrangement: the course itself on the arrangements for the school curriculum also has a direct restriction, in the arrangement of the curriculum should be effectively taken into account the course itself and the actual situation of the students' psychological characteristics to carry out scientific and rational arrangement, such as relatively important basic curriculum courses, foreign language, mathematics courses such as should be arranged in the morning, can not be arranged in the afternoon or late on a Friday afternoon, and such as physical education courses cannot arrange in the morning, these courses are factors in the arrangement of time should be actually considering. The class constraint: curriculum also can not ignore the class of the actual situation, such as a class in a week for a specific time to practice, at this time will not be able to the row of class. The factors of the school itself: it should also take care of the school when arranging the curriculum (Sakulsri, T., Phlainoi, S., Pattanakiat, S., & Punpuing, S., 2015).

The actual situation, for example school every Wednesday afternoon last section class unity of class or other activities such as cleaning, etc., in the row of class to take these factors into account, the course scheduling software should be able to according to the actual situation to carry on the intelligent course scheduling, as do practical and efficient, reduce the workload of school administrators.

To time as the core of curriculum arrangement conforms to the actual situation of the school teaching, to influence the school curriculum arrangement in most of the three factors of teachers, students and classroom as the core, assuming a school weekly teachers, students and classroom has 36 available teaching time, then arrange a course must be selected in a specific period of time, the three can also use to organize a course. According to this idea, based on artificial intelligence algorithms for timetabling elementary path, as shown in Figure 3. The use of artificial intelligence algorithms for scheduling, the system can quickly from the management staff prior input information

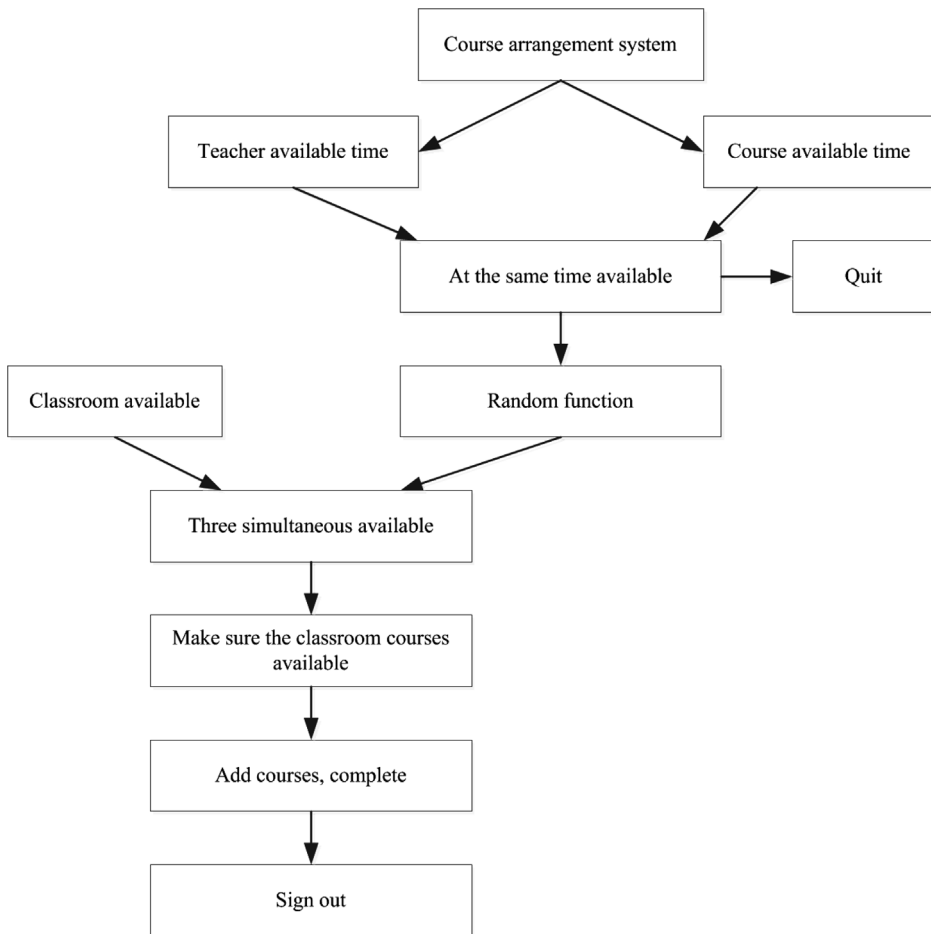


Figure 3 – Based on the Artificial Intelligence Algorithm for Scheduling Process

base that database extracted relevant data and information in the selection and extraction of relevant information when automatic intelligent considering related conditions and limitations, such as teaching factors and student factors, class factors, after the choice of relevant data in automatic hybrid algorithm about data analysis, screening, we conducted a comprehensive matching and collocation of various factors. Finally, we get the numerical optimization, of foreign experimental results have been proved, using artificial intelligence algorithm can well adapt to the various special cases of the school curriculum, high practicability and low adverse effects on the school curriculum arrangement, curriculum arrangement science greatly increased (Wilson IV, C. A., Matthews, K., Pulsipher, A., & Wang, W. H., 2016). Therefore, the use of artificial intelligence theory and numerical method to carry out the school curriculum arrangement should become the future of China's school system, curriculum design and selection of the preferred.

Sample input			Sample output		
Time(minute)	External temperature 1(°C)	External temperature 2(°C)	External temperature 3(°C)	Internal temperature 1(°C)	Internal temperature 2(°C)
1.5	113.8	27.5	98.8	50.6	56.4
2	119.4	26.6	104.6	53.1	61.5
2.5	121.9	29.8	135.6	55.7	66.0
3	122.0	32.9	145.9	58.2	70.8
3.5	124.1	36.3	152.5	60.8	74.9
1.5	113.8	27.5	98.8	50.6	56.4

Table 1 – Experimental Data

3. Data and Analysis

Current in the production of rubber products the in front of the mass production of the product and on the product of sulfide, with thermocouple measured different parts of the products of different rubber layer of actual temperature data. In the actual production, and according to the time and external temperature to accurately estimate the internal temperature of the product by using these data. Now, our present task is known of the vulcanized products in vulcanization process, instrument measured out the product internal and external to the measuring point temperature data over time changes as shown in Table 1 shows, and according to the vulcanized products in the mass production of a time point on the external measuring point temperature, fast to infer the difficulty in measuring the internal temperature and the corresponding (Guerra, S. M. S., da Silva, A. M. R. B., Araújo, S. P., Corrêa, M. M., da Silva, V. L., & Santos, B. R. T., 2015). Figure 4 shows the graph of some data.

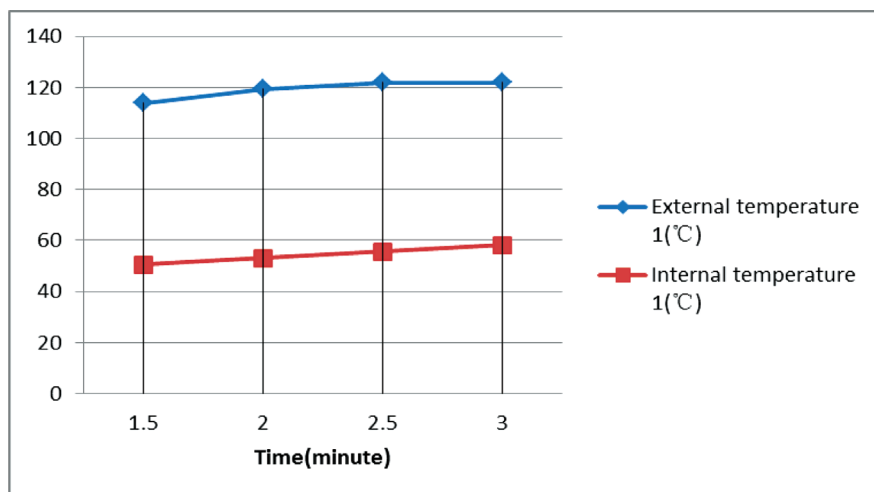


Figure 4 – Part of the Input and Output Data Curve

Teachers at this stage should be able to help students to summarize the nature and characteristics of the task, and in carding learning artificial intelligence techniques to situations based on and let the students find the method to solve the problem. Through the analysis of the above task, the task has the following four characteristics: the relationship between internal and external temperature of the object is a complex nonlinear problem, and at the level of the current understanding of the difficulty through the mechanism of the internal reaction object change to deduce the mathematical expressions of the actual availability; the task is a mathematical approximation the task includes temperature; corresponding relation between the off-line measuring objects of internal and external changes with time in the known conditions, so it is a supervised learning problem; the service requirements in the actual mass production process according to the online measured external temperature quickly inferred the internal temperature of the measured object, which requires the temperature model of learning success can quickly produce output according to the input parameters (Joo, H. T., Jeong, B. J., Cho, I. W., Shin, H. S., Lim, M. H., & Park, J. C., 2015). Which leads to the artificial intelligence in the various available techniques and methods, and referring to the characteristics of the task, compare and summarize characteristics of these technologies and methods.

4. Conclusions

With the full implementation of quality education and the rapid development of intelligent science technology in our country, the artificial intelligence disciplines in the teaching field has an increasingly important position based. Aiming at the teaching content of this course, it sums up the characteristics and objective of the course, analyzes the application of artificial intelligent algorithm in the school class work. At the same time, the article also studies the actual case of the teaching of artificial intelligence course, through the analysis of experimental data, it's found that the inquiry teaching model of curriculum based on Artificial Intelligence has a good teaching effect.

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Video Face Tracking and Recognition Method Based on Adaptive Feature Subspace

Liu Zhi^{1, 2}

421526831@qq.com

¹ College of automation, Nanjing University of Aeronautics & Astronautics, 210016, Nanjing, Jiangsu, China

² Network and modern education technology center, Guangxi University of Science and Technology, 545006, Liuzhou, Guangxi, China

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Abstract: Objective: A video face tracking and recognition method based on adaptive feature subspace is proposed. Method: Feature subspace method, tracking and recognition algorithm, likelihood function and feature subspace updating algorithm. Process: Firstly, we study the training images and get the feature space of each object. In the process of testing, the method was used for the method of particle filter to perform the tracking and recognition. At the same time, in order to improve the performance of tracking and recognition, the identification of the identification of the object's feature space should be updated after each frame tracking is completed. Result& Analysis: The proposed algorithm is verified in the MoBo video database, and the results are good. Result: The method proposed in this paper has good tracking performance.

Keywords: Face tracking and recognition; algorithm.

1. Introduction

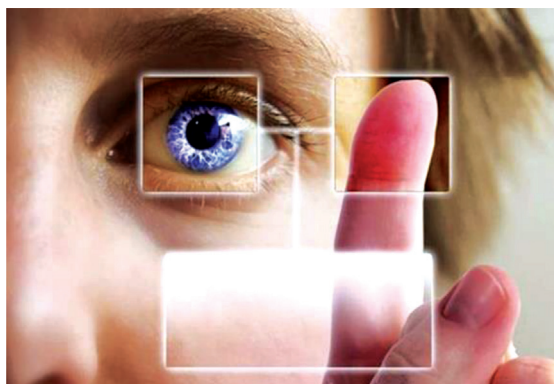


Figure 1 – Video Face Tracking and Recognition

Video face tracking and recognition is to determine the position of the human face in the video sequence and identify its identity, it needs to solve the problem of tracking

and identification two. According to the types of training and test data, the tracking and recognition of video face is divided into the identification of video sequences and the identification of video sequences (TAMURA, K., HASHIMOTO, K., & AOKI, Y., 2016).

In face recognition, static face recognition has been widely studied. The research on video face recognition is relatively small. This is mainly due to the video face recognition. It has been studied by some challenges, such as poor video quality, illumination and pose. However, with the development of computer technology, the limitation of static face recognition performance and the need of practical application, people begin to pay attention to the recognition of video (Takano, A., Miyamoto, Y., Kawakami, N., & Matsumoto, T., 2016).

In recent years, the static image has received more and more attention to the face tracking and recognition of video sequences. So far, many scholars have proposed some algorithms for face tracking and recognition of video sequences. A method of automatic video face recognition is proposed, which is based on the method of tracking the human face in the video, and then the RBF network is recognized. A system called PersonSpotter is described in the literature. The system can automatically capture the people through the camera, and its tracking and recognition. The system has a head tracker, a face tag search device and other modules. (Simmons, K. C., 2015) First, the system can learn from the 25 training faces, get a dense graph with 48 points, then use the dense graph to find out the eyes, nose, etc., and finally the method of elastic graph matching is used. The two methods proposed in the literature are divided into two independent modules, the tracking and identification, first complete the face tracking, and then the tracking of the face image recognition. In the system, the image matching is used for recognition of the image. There are some problems, such as the choice of the standard of the image, the estimation of the registration parameters, and so on. The essence of these methods is the identification method of static images, they do not use dynamic time information. For this purpose, a method is proposed for simultaneous tracking and identification. The proposed method uses particle filter method to estimate the joint posterior probability of motion and identity variables. (Shi, J., Fan, L., Zhang, X., & Shi, T., 2016) A method of simultaneous tracking and recognition is proposed, which uses EM algorithm to update the initial template in the process of tracking and recognition. (Hu, C., Di, X., Eickhoff, S. B., Zhang, M., Peng, K., Guo, H., & Sui, J., 2016) This method is used to track the probability density function. Time information is proposed by the method of literature, which can be used to calculate the density of tracking and tracking. But the density of tracking and tracking can be used in different models (Bortolon, C., Capdevielle, D., Salesse, R. N., & Raffard, S., 2016).

In this paper, we propose a video face tracking and recognition algorithm based on adaptive feature subspace, which is based on the static image and the test data is the video sequence. (Kotlowska, I., & Nowicka, A., 2015) The feature space method is applied to the tracking and recognition. (Gasca-Hurtado, G. P., Peña, A., Gómez-Álvarez, M. C., Plascencia-Osuna, Ó. A., & Calvo-Manzano, J. A., 2015) The particle filter algorithm is used to set the motion variables and the identity variable into a unified module. In tracking and recognition process, the algorithm will also according to the specific circumstances of recognition of the face subspace are updated adaptively. (Serino, A., Sforza, A. L., Kanayama, N., Elk, M., Kaliuzhna, M., Herbelin, B., & Blanke, O., 2015) Improve the

robustness of recognition tracking. In the process of implementation, the algorithm first builds the PCA subspace according to the training images of each individual; In the process of tracking and recognition, the likelihood function is obtained by tracking the human face space. Then, the likelihood function is obtained by using the method of particle filter to track and recognize the likelihood function; Finally, we calculate each object recognition likelihood values, to find out the maximum of the two values, if the two value ratio is greater than the set threshold, we are to identify human face subspace update (Guan, L., Chen, Y., Xu, X., Qiao, L., Wei, J., Han, S., ... & Liu, Y., 2015).

2. Algorithm Principle

The essence of the Monte Carlo method is to use a series of discrete samples to approximate a probability distribution $\pi(x)$. In some cases, especially for some important distribution $\pi(x)$, we are very difficult to select a random sample based on the importance of $\{x^{(j)}\}_{j=1}^J$. (Kurth, S., Moyses, E., Bahri, M. A., Salmon, E., & Bastin, C., 2015) However, by means of an importance function $g(x)$ it is easy to select the sample $\{x^{(j)}\}_{j=1}^J$. In this case, each sample can be assigned a weight function $w^{(j)} = \pi(x^{(j)}) / g(x^{(j)})$, and this method is called the importance sampling. From the literature, we can see that the important sample set $S = \{x^{(j)}, w^{(j)}\}_{j=1}^J$ is the weighted target distribution $\pi(x)$. In video sequences, we can use a continuous importance sampling, which derives the importance of the sequence sampling. Sequence importance sampling is passed through a sequence of importance function $g(x_t | x_{t-1})$ to pass S_{t-1} , and the weight is calculated by formula (1):

$$w_t = w_{t-1} \frac{p(z_t | x_t) p(x_t | x_{t-1})}{g(x_t | x_{t-1})} \quad (1)$$

In the Condensation algorithm, $g(x_t | x_{t-1}) = p(x_t | x_{t-1})$, the formula (1) can be expressed as:

$$w_t = w_{t-1} p(z_t | x_t) \quad (2)$$

In this way, we can get the weight of the current moment according to the likelihood function $p(z_t | x_t)$ and the weight of the previous moment. The following two theorems can help us to further develop the sequential importance sampling in tracking recognition:

Theorem 1 if $\pi(x)$ is a function of mass distribution defined on a finite sample space, the sample set should contain all the samples in the sample space (Sousa, E., Erlhagen, W., Ferreira, F., & Bicho, E., 2015).

Theorem 2 if a weighted sample set $\{x^{(j)}, y^{(j)}, w^{(j)}\}_{j=1}^J$ the quality distribution function is $\pi(x, y)$, then we can construct a sample set $\{y^{(k)}, w^{(k)}\}_{k=1}^K$, the quality of the sample set of the $\pi(y)$ is the edge function of $\pi(x, y)$:

- (1) the $\{y^{(j)}\}_{j=1}^J$ is removed from the sample, and the $\{y^{(k)}\}_{k=1}^K$ is obtained, which makes each $y^{(k)}$ have different values;
- (2) the weight $w^{(j)}$ of the $y^{(k)}$ of the same sample will be obtained by $w^{(j)}$ in accordance with the formula (3) (Barros, P., Jirak, D., Weber, C., & Wermter, S., 2015).

$$w^{(k)} = \sum_{j=1, y^{(j)}=y^{(k)}}^J w^{(j)} \quad (3)$$

Video face tracking and recognition is designed to estimate the position of the human face in the video and identify its identity. Assuming that the variable is α_t , the identity variable is n_t , we can make the state variable and the status variable $\theta_t = (n_t, \alpha_t)$, then the $\pi(n_t, \alpha_t)$ can be expressed by a series of weighted $S_t = \{n_t^{(j)}, \alpha_t^{(j)}, w_t^{(j)}\}_{j=1}^J$. According to theorem 2, we can add the weight of the same variable n_t to get the sample set $\{n_t, \beta_t\}_{n_t=1}^K$, which is used to represent the posterior probability of the identity variable $\pi(n_t)$, K is the number of objects in the database. According to the above ideas, we can directly use the particle filter algorithm to complete tracking and recognition. However, when we want to track the recognition of the object space $N = \{1, 2, \dots, K\}$ is a finite sample space, according to theorem 1, the identity of the variable n_t is required for K samples. For each variable n_t , J_1 samples are required to represent the motion state variable α_t , so the total sample number is $J = J_1 \times K$. We assume that in the particle filter algorithm, a resampling process requires T_r unit time, the prediction process requires T_p unit time, the update process requires T_u unit time, the normalized process requires T_n unit time, the edge of the process requires T_m unit time. Obviously, processing a frame of video images, a total of $J_1 \times K \times (T_r + T_p + T_z + T_l) + T_n + T_m$ unit time. Because the sample space upsample is limited, we can conduct a comprehensive search in a limited space. In this way, we can disperse the sample number of any sample to the identity variable n_t . For each $\alpha_t^{(j)}$, we can construct a sample $\{(1, \alpha_t^{(j)}, w_{t,1}^{(j)}), (2, \alpha_t^{(j)}, w_{t,2}^{(j)}), \dots, (K, \alpha_t^{(j)}, w_{t,K}^{(j)})\}$, so that we can get the sample set $S_t = \{\alpha_t^{(j)}, w_t^{(j)}, w_{t,1}^{(j)}, w_{t,2}^{(j)}, \dots, w_{t,K}^{(j)}\}_{j=1}^J$, wherein $w_t^{(j)} = \sum_{k=1}^K w_{t,k}^{(j)}$. (Oliveira, M., Lopes, L. S., Lim, G. H., Kasaei, S. H., Tomé, A. M., & Chauhan, A., 2016).

According to the above ideas, we can first take a sample of the edge of the $\{\alpha_{t-1}^{(j)}, w_{t-1}^{(j)}\}_{j=1}^J$ sampling $\alpha_{t-1}^{(j)}$. After resampling, the weights, supposed that $w_{t-1}^{(j)} = 1$, $w_{t-1,k}^{(j)} = \frac{1}{K}$, $k \in \{1, 2, \dots, K\}$, and joint distribution can be expressed as:

$$w_{t,k}^{(j)} = w_{t-1,k}^{(j)} p(z_t | n_t, \alpha_t^{(j)}) \quad (4)$$

The key of this algorithm is to carry out the sample number of the identity variable, and only carry out random sampling of the moving state variables. Compared with the traditional particle filter, the algorithm uses the algorithm to process a frame of video image, and it cost time $J_1 \times (T_r + T_p + T_{zl}) + J_1 \times K \times T_l + T_n + T_m$. (Robichaud, A. L., 2015).

3. Face Tracking and Recognition Algorithm Based on Adaptive Feature Subspace

3.1. Feature Subspace Learning

The feature subspace learning is the first of the tracking and recognition algorithm. It is designed to find the feature space of each object training data set. If there are K objects in the test, each object in the training database is L, for either $k, k \in [1, 2, \dots, K]$, we find the mean \bar{x}_k of the training image set $X_k = [x_{k1}, x_{k2}, \dots, x_{kL}]$, and the PCA transform to get $\{\lambda_{k1}, \lambda_{k2}, \dots, \lambda_{kM}\}$ that is Maximum eigenvalue of M and Their corresponding feature vector is composed of a projection matrix $\Phi_k = \{w_{k1}, w_{k2}, \dots, w_{kM}\}$.

In this way, we can find the feature space and feature value of all the objects, which can be used to test the tracking and recognition of sequences.

3.2. Tracking and Recognition Algorithm

3.2.1. Motion Model

Target motion model is one of the basic elements of target tracking theory. Any tracking algorithm is based on a certain or some model of the target motion. In the establishment of target motion model, the general principle is that the model should be consistent with the actual situation, but also facilitate the mathematical treatment. For video objects, the mobility of the target is not very large, so in most cases, a random motion model can be used to describe the motion law. The video object and point target tracking are different: the video object's status not only includes the target location, but also includes the target's size and direction. (Fleischer, F. S., & Garrow, W. G., 2016) In this paper, we use a rectangle to represent the shape of the object, and the location of the pixels in the rectangle region is $[X, Y]^T$, and the specific parameters of the motion state are described:

$$\alpha_t = [S_t, \vartheta_t, T_{xt}, T_{yt}]^T$$

Wherein, S_t represents the size of the rectangle, ϑ_t represents the direction of the human face, T_{xt} and T_{yt} represen X, Y axis direction of the displacement respectively.

Let $[X_o, Y_o]^T$ represent the initial position of the pixels in the face, and the position of the pixels in the candidate face image can be represented at moment T:

$$\begin{bmatrix} X_t \\ Y_t \end{bmatrix} = S_t \times \begin{bmatrix} \cos \vartheta_t & \sin \vartheta_t \\ -\sin \vartheta_t & \cos \vartheta_t \end{bmatrix} \times \begin{bmatrix} X_o \\ Y_o \end{bmatrix} + \begin{bmatrix} T_{xt} \\ T_{yt} \end{bmatrix} \quad (5)$$

The moving state of the target can be described as follows:

$$\alpha_t = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \alpha_{t-1} + \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} U_t \quad (6)$$

Wherein, the U_t is a 4×1 dimensional noise vector, $U_t = [N(0, \sigma_s^2) N(0, \sigma_g^2) N(0, \sigma_x^2) N(0, \sigma_y^2)]^T$ represents the mean of 0, the variance is $N(0, \sigma_s^2)$ Gauss white noise.

3.2.2. Identity Variable Model

If there are K objects in the test, we need to identify the identity of the moment T , which is n_t , $n_t \in [1, 2, \dots, K]$, we assume that the identity variable remains constant in the process of tracking and identification:

$$n_t = n_{t-1} \quad (7)$$

3.2.3. Observation Model

We give the motion state of the moment t α_t , the position of the pixels in the face image can be obtained by the formula (6), the observation model can be expressed as:

$$z_t = I_t(X_t, Y_t) \quad (8)$$

Wherein $I_t(X_t, Y_t)$ represents the gray value of the current image at position (X_t, Y_t) .

Assuming that all the noise variables and the prior probability distribution $p(\alpha_0 | z_0)$ and $p(n_0 | z_0)$ are independent, the state variables in the formula (7) and the formula (8) can be merged into the total state variable $\theta_t = (n_t, \alpha_t)$, which can be expressed as the state transition probability:

$$p(\theta_t | \theta_{t-1}) = p(n_t | n_{t-1}) p(\alpha_t | \alpha_{t-1}) \quad (9)$$

The goal of a given target state model, the tracking and identification of the purpose is to require the state NT, at of the posterior probability, which are $p(n_t | z_{0:t})$, $p(\alpha_t | z_{0:t})$. Because of the $n_t \in [1, 2, \dots, K]$, the $p(n_t | z_{0:t})$ is actually a mass distribution function (PMF), which is also the edge concept of the mixed distribution.

$$p(n_t, \alpha_t | z_{0:t}) \quad (10)$$

3.2.4. Identification of A Posteriori Probability

In the face tracking and recognition, we assume that the identity variable remains constant, i.e., $p(n_t | n_{t-1}) = \delta(n_t - n_{t-1})$, $\delta()$ is a pulse function. We can draw the use of Markov's property, statistical independence and time recursive algorithm:

$$p(n_{0:t}, \alpha_{0:t} | z_{0:t}) = p(n_0 | z_0) p(n_0 | z_0) \prod_{i=1}^t \frac{p(z_i | n_i, \alpha_i) \delta(n_i - n_{i-1}) p(\alpha_i | \alpha_{i-1})}{p(z_i | z_{0:i-1})} \quad (11)$$

And then on the edges of $\alpha_{0:t}$ and $n_{0:t-1}$, we can get:

$$p(n_t = k | z_{0:t}) = p(k | z_0) \int_{\alpha_0} \dots \int_{\alpha_t} p(n_0 | z_0) \prod_{i=1}^t \frac{p(z_i | n_i, \alpha_i) \delta(n_i - n_{i-1}) p(\alpha_i | \alpha_{i-1})}{p(z_i | z_{0:i-1})} d\alpha_t d\alpha_0 \quad (12)$$

Therefore, $p(n_t = k | z_{0:t})$ is determined by the product $\prod_{i=1}^t p(z_i | n_i, \alpha_i)$ of the prior probability ($k | z_0$) and the likelihood function. False assumption that the first test rate is full uniform distribution, that is $p(n_0 = k | z_0) = \frac{1}{K}, k \in \{1, 2, \dots, K\}$. Then, the product of the posterior probability is determined only by the likelihood function.

3.3. Likelihood Function

3.3.1. Tracking Likelihood Function

In the process of tracking and recognition of video face, tracking plays a very important role, good tracking results can improve the accuracy of identification. Therefore, the tracking likelihood function is very important. In this chapter, we use the method of the feature subspace based on the previous frame to recognize the object to obtain the tracking likelihood function, which can improve the performance of tracking.

Assuming that z_t is a candidate observation value of the input image in moment t , α_t is the current state of motion, and k_t^* is the first time to recognize the object number, tracking likelihood function can be calculated by the distance between the face image and the reconstructed image, which can be expressed as:

$$p_1(z_t | \alpha_t) = \frac{1}{\sqrt{2\pi} \sigma_1} \exp\left(-\frac{\|dist_1\|^2}{2\sigma_1^2}\right) \quad (13)$$

Wherein, σ_1 is a set of parameters, $dist_1 = (z_t - \bar{x}_{k_{t-1}^*} - \Phi_{k_{t-1}^*}^T (z_t - \bar{x}_{k_{t-1}^*}))$, $\Phi_{k_{t-1}^*}$ as the object of k_{t-1}^* 's training image feature vector space, $\bar{x}_{k_{t-1}^*}$ is the object of the average gray image vector.

3.3.2. Tracking and Recognition Likelihood Function

In our proposed tracking and recognition algorithm, the tracking and recognition of the same model, tracking and identification of the likelihood function of the same tracking likelihood function, the use of feature subspace based method to obtain. Let n_t be the identity variable of moment t , $n_t \in (1, 2, \dots, K)$, and trace the recognition likelihood function can be obtained by the following:

$$p_2(z_t | n_t, \alpha_t) = \frac{1}{\sqrt{2\pi} \sigma_2} \exp\left(-\frac{\|dist_1\|^2}{2\sigma_2^2}\right) \quad (14)$$

Wherein, σ_2 is a set of parameters, $dist_2 = (z_t - \bar{x}_{n_t} - \Phi_{n_t} \Phi_{n_t}^T (z_t - \bar{x}_{n_t}))$.

3.3.3. Mixed Likelihood Function

In the process of tracking and recognition of the video face, tracking and recognition are mutual influence, good tracking results can improve the recognition performance, while the correct recognition results can also be improved in turn to the robustness of tracking. In the particle filter algorithm, the selection of the likelihood function is very important. So we use the mixed likelihood function, the likelihood function can be expressed as:

$$p(z_t | n_t, \alpha_t) = p_1(z_t | \alpha_t) p_2(z_t | n_t, \alpha_t) \quad (15)$$

The trace recognition likelihood function obtained by the formula (14) has not utilized the previous frame recognition results. We will track the likelihood function and tracking the likelihood function, can make full use of the results of the previous frame, the likelihood function can provide more information to ensure that the performance of tracking and recognition.

3.4. Feature Subspace Update Algorithm

In order to improve the performance of tracking and recognition, we use subspace update algorithm to update the subspace of the object to improve the tracking performance. In recent years, researchers have proposed a number of mature subspace update algorithms. Only in the literature, the training data and the covariance matrix are not preserved in the update subspace, and only the average vector and the feature base are updated. We use the proposed update algorithm to update the subspace.

Assuming that the dimension of the training image vector is D , the feature space L_k of the K object can be expressed as: $\{\bar{x}_k, W_k, \wedge_k, N_k\}$. The mean vector of the trained face image is represented by \bar{x}_k ; W_k represents a matrix of the feature vectors corresponding to the maximum of the first M of the PCA transform for the training data; \wedge_k is the diagonal matrix of the largest eigenvalues of the former M ; N_k is number of samples in the initial training database. When the update is located in the sub space of L'_k , it can be expressed as: $\{\bar{x}'_k, W'_k, \wedge'_k, N'_k\}$. The covariance matrix of the training image is \sum_k , and the PCA method is actually the characteristic solution of the equation (16):

$$\sum_k' W_k' = W_k' \wedge_k' \quad (16)$$

Wherein, \sum_k' is the new covariance matrix, W_k' and \wedge_k' are the corresponding eigenvectors and eigenvalues matrix. For a new data x , the projection and the residual vector can be expressed as a L_k in the current subspace:

$$g = W_k^T (x - \bar{x}_k) \quad (17)$$

$$h = x - \bar{x}_k - W_k g \quad (18)$$

The new mean vector and covariance matrix can be obtained by the following two formulae:

$$\bar{x}_k' = \frac{1}{N_k + 1} (N_k \bar{x}_k + x) \quad (19)$$

$$\sum_k' = \frac{1}{N_k + 1} \sum_k + \frac{N_k}{N_k + 1} \bar{x}_k \bar{x}_k^T \quad (20)$$

New sample number is:

$$N_k' = N_k + 1 \quad (21)$$

At the same time, a new vector would be obtained:

$$\hat{h} = \begin{cases} \frac{h}{\|h\|_2} & \text{if } \|h\|_2 \neq 0 \\ 0 & \text{otherwise} \end{cases} \quad (22)$$

A new feature vector based on the \hat{h} and the original feature vector is synthesized in the $[W_k, \hat{h}]$.

We assume that the feature vector of the new feature subspace is obtained by a rotation matrix R via a rotation matrix $[W_k, \hat{h}]$, then:

$$W_k' = [W_k, \hat{h}] R \quad (23)$$

$$[W_k, \hat{h}]^T \left(\frac{N_k}{N_k + 1} \sum_k + \frac{N_k}{N_k + 1} \bar{x}_k \bar{x}_k^T \right) [W_k, \hat{h}] R = R \wedge_k' \quad (24)$$

Covariance matrix \sum_k can be approximated as:

$$\sum_k \approx W_k \wedge_k W_k^T \quad (25)$$

After a series of algebraic operations, the formula (24) can be written as:

$$\left(\frac{N_k}{N_k + 1} \begin{bmatrix} \wedge_k & \mathbf{0} \\ \mathbf{0} & \mathbf{0} \end{bmatrix} + \frac{N_k}{(N_k + 1)^2} \begin{bmatrix} gg^T & \gamma g \\ \gamma g & \lambda^2 \end{bmatrix} \right) R = R \wedge_k' \quad (26)$$

Because of the size of the matrix R , the eigenvalues and eigenvectors of the formula (24) are $(M + 1)$. We are arranged in the order of large to small, and only retain the former M eigenvalues and their corresponding eigenvectors are respectively \wedge_k' and W_k' .

4. Tracking Recognition Algorithm Description

In this section, we will focus on how to design a good model to the particle filter algorithm for tracking and recognition of human face recognition. In the design of particle filter algorithm, the state parameter is the movement state and the collection of the identity variable, that is $\theta_t = (n_t, \alpha_t)$. There are K objects in the training database, the number of particles is J , and the $\alpha_{t-1}^{(j)}$, $j \in \{1, 2, \dots, n\}$, we can get the sample set:

$$S_{t-1} = \left\{ \alpha_{t-1}^{(j)}, 1, w_{t-1,1}^{(j)}, w_{t-1,2}^{(j)}, \dots, w_{t-1,K}^{(j)} \right\}_{j=1}^J \quad (27)$$

Wherein, $w_{t-1,k}^{(j)} = 1/K$.

In this chapter, the following can be described as follows: Firstly, we can get a sample of $\alpha_t^{(j)}$, according to the sample set S_{t-1} , through the formula (7) of the motion model; Then, according to the formula (28), the weight of each particle $w_{t,k}^{(j)}$ and the identification of each object is obtained by the $\beta_{t,k} = \sum_j w_{t,k}^{(j)}$; Then the particles are re sampled and the new sample set $\left\{ \alpha_t^{(j)}, 1, w_{t,1}^{(j)}, w_{t,2}^{(j)}, \dots, w_{t,K}^{(j)} \right\}_{j=1}^J$; At last, we judge whether the feature subspace of the object is updated, and then we use the update algorithm to update the feature subspace of the object.

One of the most important steps in the sub filtering algorithm is the selection of importance function. We use today's more common choice method, the importance function is chosen as the state transfer model, that is $q(\theta_t | \theta_{t-1}, Z_t) = p(\theta_t | \theta_{t-1})$. When we choose $q(\theta_t | \theta_{t-1}, Z_t) = p(\theta_t | \theta_{t-1})$, the weight of each particle is calculated according to the formula:

$$w_{t,k}^{(j)} = w_{t-1,k}^{(j)} p_1(z_t | \alpha_t^{(j)}) p_2(z_t | n_t = k, \alpha_t^{(j)}) \quad (28)$$

By the formula (28), it can be seen that the weight of the particles is determined by the tracking likelihood function and the likelihood function, which can improve the performance of the tracking, and can complete the recognition.

5. Test Results and Analysis

In order to verify the validity of the proposed method in this chapter, we will use this method to test the MoBo database. MoBo database is the human body movement data collected by Carnegie Mellon University in the HumanID project. The database consists of 25 objects, each of which has a natural walking on the falling car, and a head movement and facial expression changes. Analog video the real life in some attitude, contains the following four different attitude: slowly walking, brisk walking, leaning walking and carrying the ball walk. The database is a total of 99 video. Video test we selected 24 objects walk slowly. Each video consists of 300 frames, each frame of 486 x 640. Figure 3.2 shows a few frames in the MoBo database. We first cut 10 pieces of face images from each person's video sequence to form a training database. We train each object in the training database, and get the mean value, feature vector and feature value.

During the test, the first frame we use the artificial method to get the position of the human face, and then the face image is identified. When we enter the next frame of image, we first use the particle filter method to complete tracking and recognition, and then determine whether the need to identify the characteristics of the object to be updated, if necessary, then the update, until the last frame. In the experiment, we chose the number of particles as 100, $\sigma_1 = 0.8$, $\sigma_2 = 1.5$ and the domain value $\gamma = 2$. Tracking results with a blue rectangle.

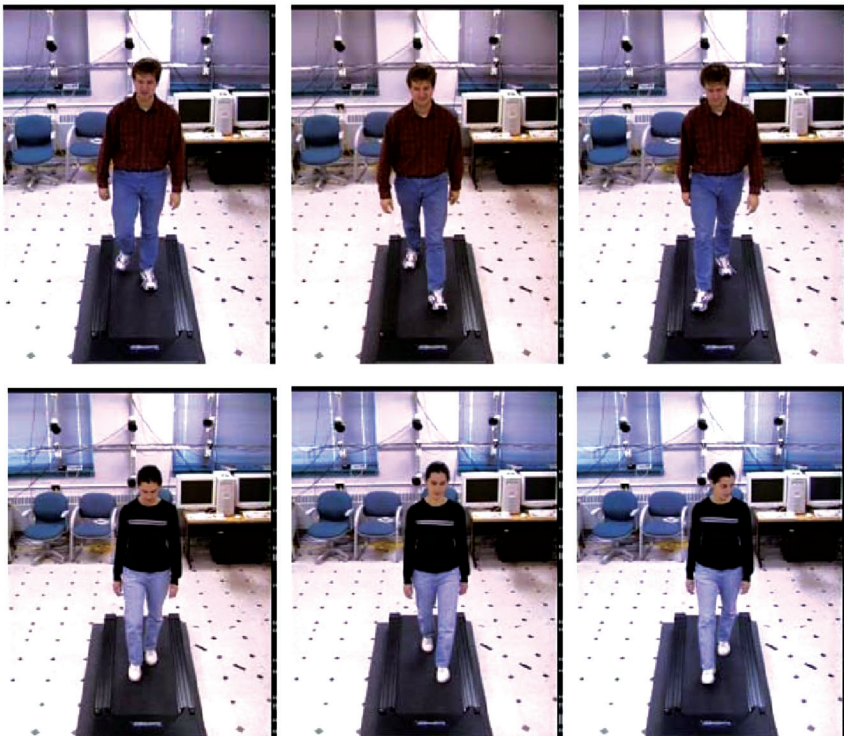
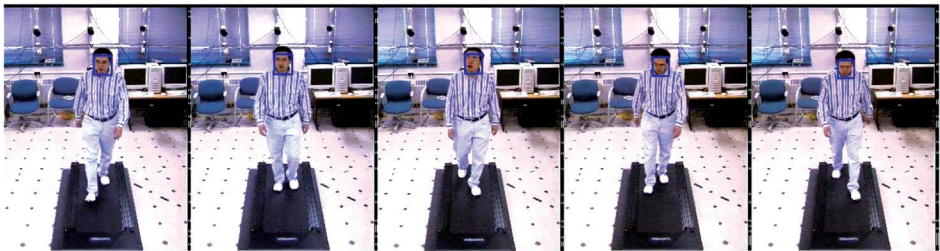


Figure 2 – Example Images of the Videos in MoBo Database

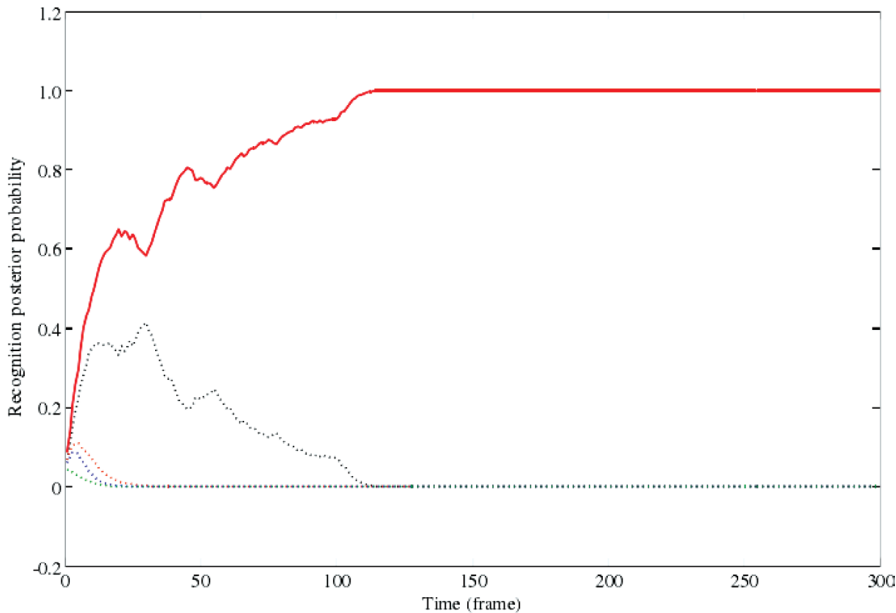
5.1. Tracking and identification Results Under Pose Variations

Fig.3 shows the results of the tracking and recognition of the tracking and recognition method proposed by this chapter. Fig.3 (a) lists in the tracking process identification in some tracking results, 3 (b) draws the in the test process, after the first five largest recognition probability with time variation diagrams, which, after the red solid line represents the real object recognition probability and the rest of the dotted line said other four largest recognition of posterior probability.

From Fig.3 (a), it can be seen that the tracking and recognition method proposed in this chapter can well track the human face, and we can see from 3 (b) that the recognition of the object to be identified is greater than the probability of other objects.



(a) Tracking result



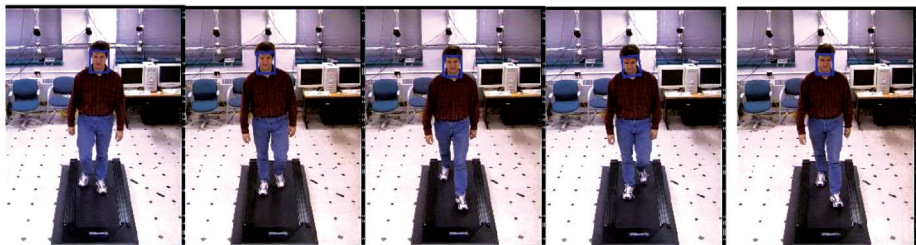
(b)

Figure 3 – Tracking and Recognition Results Under Pose Variation: (a) Tracking Result (b) Recognition Posterior Probability

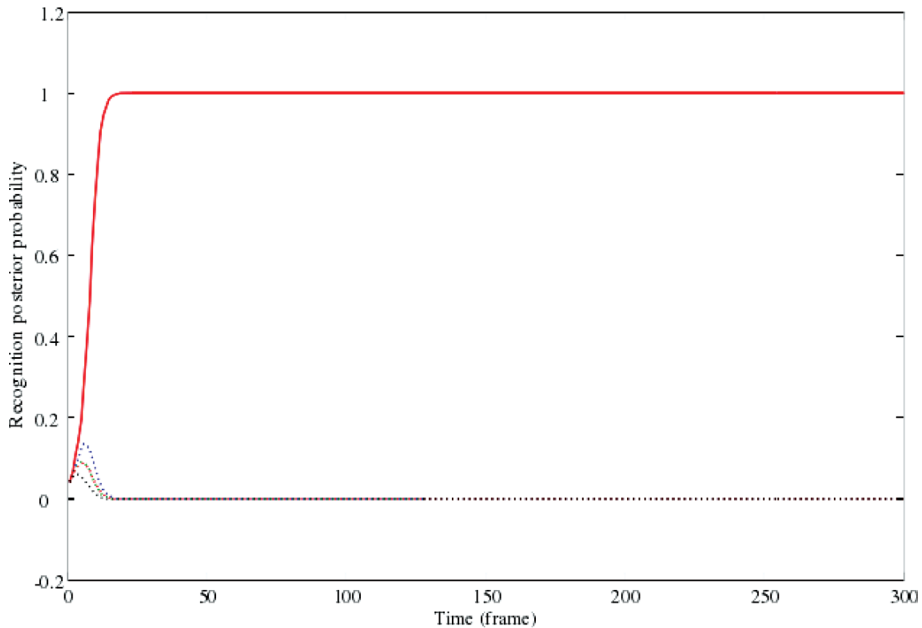
5.2. Tracking and Recognition Results Under the Change of Attitude And Expression

Fig.4 shows the tracking and recognition results obtained by the proposed method in this chapter. Similarly, fig.4 (a) listed in the tracking process identification in some tracking results, fig.4 (b) draws the in the test process, identification of the top five largest posterior probability with the variation of time. Among them, the solid red is the recognition of object recognition and tracking a posteriori probability and the rest of the dotted line said four other maximum recognition of posterior probability.

As can be seen from Fig.4, when the face is changing, the tracking and recognition algorithm proposed in this chapter can get better results.



(a)



(b)

Figure 4 – Tracking and Recognition Results Under Pose and Expression Variations: (a) Tracking Result; (b) Recognition Result

6. Conclusions

In this paper, we propose a video face tracking and recognition algorithm based on adaptive feature subspace, which is based on the data of the training data as a finite static image, and the test data is a video sequence. Firstly, we study the training images and get the feature space of each object. In the process of testing, the method uses the method of particle filter to perform the tracking and recognition. At the same time, in order to improve the performance of tracking and recognition, we need to update the feature space of the object.

We apply the proposed algorithm to the MoBo video database. The results show that the proposed method has better tracking and recognition performance.

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Research and Analysis of Computer Aided of Table Tennis Training

Li Shuaixu¹

1020730995@qq.com

¹ Department of Physical Education, Tarim University, 843300, Alar, Xinjiang, China

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Abstract: Objective: The method of computer multimedia CAI courseware to be used in the teaching of table tennis in college students and explore the teaching effect of multimedia teaching to improve the teaching effect of table tennis. Method: Questionnaire survey, comparative experiment, mathematical statistics, logical analysis. Process: Through the experimental group and the control group of students in the average score of the comparison, a mathematical analysis; A questionnaire survey was conducted on the students in the experimental group. Result& Analysis: There is significant difference between subject test scores and learning attitude of students in experimental group and control group, and most of the students think that the effect of multimedia teaching is good and willing to accept it. Result: Multimedia CAI courseware can effectively improve the teaching effect of table tennis technology and worthy to be promoted.

Keywords: Multimedia CAI; table tennis teaching.

1. Introduction

1.1. Application of Cai in Table Tennis Teaching

Into twenty-first Century, the development of science and technology, new technology, new achievements, for the development of social productive force has played a very good role in promoting the development of education, the pace of development is more rapid. (Wu, D., Wang, J., Hu, R., Cai, Y., & Zhou, L., 2014) In recent years, the reform of education in our country is carried out, and the reform of teaching methods and means is the focus of teaching reform. In August 2002, the national Ministry of education, "National College Physical Education Curriculum Teaching Guide" in the eighth pointed out: "in the practice of sports teaching in the infiltration of the relevant theoretical knowledge, and the use of a variety of forms and modern teaching methods, expand students' knowledge of sports, improve students' cognitive ability." Obviously, the reform of teaching method and teaching method is not only a tactical problem, but also a strategic issue (Zhang, W., Wen, Y., Cai, J., & Wu, D. O., 2014).



Figure 1 – Table Tennis Teaching

Since entering in twenty-first Century, the modern educational technology, which is the core of computer, has been playing a more and more important role in our country “s teaching reform. (Zhang, L., Gao, Y., Hong, C., Feng, Y., Zhu, J., & Cai, D., 2014) As an important part of education, the reform of teaching methods and means is imperative. The teaching of traditional physical education technology is mainly “demonstration + explanation + practice”, it is not difficult to find a lot of disadvantages: sports events are often faster, students are difficult to distinguish the details of the action in a short time; Sports teachers’ business level is uneven, not every teacher’s demonstration of the action can be done accurately, even if the same teacher can not be the action of each project to do accurate; Sometimes the limits of space and equipment may also affect the effect of teaching. (Lo, A. C., Guarino, P. D., Richards, L. G., Haselkorn, J. K., Wittenberg, G. F., Federman, D. G., ... & Bever Jr, C. T., 2010) Thus, the traditional teaching methods and means have been unable to keep up with the situation of teaching reform (Gasca-Hurtado, G. P., Peña, A., Gómez-Álvarez, M. C., Plascencia-Osuna, Ó. A., & Calvo-Manzano, J. A., 2015).

Chen Huajie, Zhang Huanwei, Wang Jie’s “table tennis teaching CAI courseware development and application” in sports teaching and modern educational technology theory and methods, the design and application of table tennis CAI courseware, analysis of the structure design, teaching content, functional design and other aspects, and the application of multimedia technology and multimedia teaching. (Brown, S., 2016) “The development and application of multimedia courseware in the construction of” table tennis sports curriculum system in, Liu Juanni, Ni Xianghong in their own school curriculum of Hunan Institute of Engineering as the research object, in their school education by a research on the development and application of multimedia courseware

in table tennis teaching practice, the teaching content of table tennis forehand “the attack” and “table tennis Guoqiu” technology in the control group and the experimental group were studied by experimental method, the following results are obtained: (1) the use of multimedia courseware in table tennis can stimulate students’ interest in learning; (2) the use of multimedia courseware can make the action technology difficult and easy; (3) the use of multimedia courseware can make the students form a clear and coherent action! Representation; (4) the use of multimedia courseware can inspire students’ innovation spirit and innovation ability. Hou Lingzhong’s “table tennis teaching experimental study” to the multimedia aided teaching method and the conventional teaching method to students learning effect in the comparison and analysis of the impact of the students in table tennis teaching, this is also in line with the basic rules of the formation of the movement, through the visual and auditory repeated stimulation, in the brain constantly strengthen the correct movement technology, so as to improve students understanding of sports technology, therefore, it is more easy for students to master sports technology. (Sligo, F., 2015; Deszcz-Tryhubczak, J., & Marecki, M., 2015) Wang Qiuyan’s “multimedia technology in table tennis teaching application research” points out that table tennis teaching is the main course of college physical education, the students’ favorite, so the teaching quality of table tennis teaching quality is increasingly concerned by the students, using survey method, experimental method and other methods to improve the quality of table tennis teaching, the reality of the development of table tennis teaching. In order to make the students master the table tennis technology, we must break through the table tennis teaching, seek the new teaching mode to support table tennis teaching, and make full use of the teaching method of multimedia teaching is the best combination of table tennis teaching reform. (Wilson, M. G., Ellison, G. M., & Cable, N. T., 2016) Wang Hai’s “the production of table tennis CAI courseware of Shanghai Business School,” for their own school developed a unique table tennis teaching courseware, table tennis CAI courseware throughout the process made a number of discussions, with a view to the production of sports CAI courseware. Guangdong University of Foreign Studies Department of physical education] do the development of Table Tennis Forehand Attack Technique Teaching CAI Courseware of investigation and analysis, Zhengzhou University, Institute of physical education bozez, Schlosser t the multimedia CAI courseware < Table Tennis > and development “, from different angles will multimedia technology introduced in table tennis teaching, and have achieved good results. (Alchinova, I. B., Khlebnikova, N. N., & Karganov, M. Y., 2015) The research and application of the multimedia courseware development and application of Zhang Jianfei in 2008, which is based on the teaching characteristics of table tennis game, is designed in this paper. Based on the teaching characteristics of table tennis game, the paper designs the whole structure, interactive design and the content of the courseware (Markov, A. L., Zenchenko, T. A., Solonin, Y. G., & Boiko, E. R., 2015).

1.2. The Significance of the Study

This thesis tries to understand the advantages of the teaching of the multimedia courseware and the teaching mode by means of questionnaire survey, mathematical statistics and logical analysis (Chung, W. H., & Kang, N., 2015).

As the representative of the modern information technology, CAI (Computer Assisted Instruction), the novelty and diversity are the important conditions to stimulate students' interest in learning. CAI courseware is set text, image, animation, audio, video and other multimedia information in one, through the processing and processing of the formation of the teaching system, in physical education, through the visual auditory and use, the students' attention to teaching content, enhance the cohesion and appeal of the classroom, and stimulate students' learning interest, learning desire and motivation, to complete the task of learning has important significance (Li, Q. T. M., Gil-Guillen, V. F., Clua-Espuny, J. L., Forcadell-Arenas, T., González-Henares, M. A., Panisello-Tafalla, A., ... & Lucas-Noll, J., 2015).

This research aims at the introduction of Computer Assisted Instruction technology into the teaching of table tennis technology, through the design and production of "table tennis technology multimedia CAI courseware", and the application in teaching, to explore the method and rules of table tennis teaching methods, in order to promote table tennis teaching reform to make some useful attempt (Hao, C. X., Dong, Z. F., Ge, C. Z., & Wen, Y. L., 2015).

2. Research Objects and Methods

2.1. Research Object

200 Undergraduate Students In A University.

2.2. Research Methods

2.2.1. Contrast Experiment

Randomly selected 2010 undergraduate students from a university in Sichuan, before the test (200), the students were excluded from the table tennis training, and the students were randomly divided into the experimental group (100) and the control group (100). The experimental group and the control group of teaching content, teaching progress, the same time, the same (18 weeks). Double blind method was used in the experiment, namely with a teacher to teach, and teachers do not know the purpose, students were asked did not know the purpose and requirements, avoid to produce the Rosenthal Effect, also known as Pygmalion Effect Observation of expectations will influence on the observer's behavior, this behavior also affect observed object properties or behavior). (Gasca-Hurtado, G. P., Peña, A., Gómez-Álvarez, M. C., Plascencia-Osuna, Ó. A., & Calvo-Manzano, J. A., 2015) The control group used the traditional teaching method to carry on the teaching, the experimental group of students in each class to provide 1H on the computer time, using the "table tennis technology class multimedia CAI courseware" to assist teaching, mainly to students to demonstrate and explain the action method of table tennis technique and watch table tennis teaching video. After 18 weeks of teaching experiment, using the same method to test the two groups of students' technical test results, using statistical analysis software SPSS (10) to analyze the experimental data (students' performance), draw conclusions (Kan, K., Choi, H., & Davis, M., 2016).

2.2.2. Questionnaire, and the Validity and Reliability of the Questionnaire Were Tested.

1. the validity of the questionnaire: design and the related questionnaire and the questionnaire by to the colleges and universities sports experts postal validity, will not meet the requirements of deleted or modified, and finally determine the questionnaire. (Fig.2).

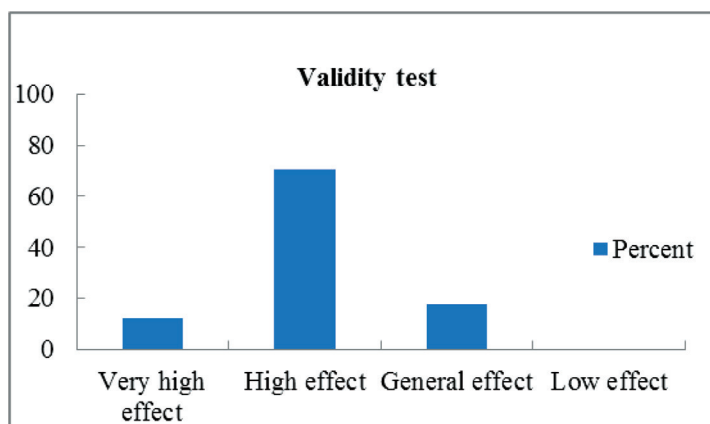


Figure 2 –Study on the Validity of the Questionnaire

2. the questionnaire reliability: test the test-retest method, time interval of 15 days, correlation coefficient $r = 0.923$. This investigation is credible. Use SPSS17.0 statistical software of conventional methods of mathematical statistics, statistical classification of the taken back the questionnaire data, the general description of count data.
3. the students of the experimental group were distributed to the questionnaire, and were filled in by the students to understand the attitude and attitude of the students to Computer Assisted Instruction. Issued 100 copies, 100 copies, the recovery rate of 100%, 99 valid questionnaires, the efficiency of 99%.

2.2.3. Statistical Method

The results of the experiment and the results of the questionnaire survey are used with SPSS (17) statistical software for data processing.

2.2.4. Logical Analysis

The results of the experiment and investigation, and the literature review and analysis, pointed out that the advantages of the application of multimedia teaching in table tennis technical courses, and put forward the corresponding conclusions and some suggestions.

2.3. Courseware Design and Production

2.3.1. Theory Guiding Ideology

What is the core problem of the design of the multimedia teaching, and how to teach the students what to teach and how to teach it. The basic guiding ideology of the design is to combine the contents of the teaching material in the course of the students' cognitive process, and to improve the students' ability of understanding and learning.

2.3.2. Basic structure of Teaching Materials

Bruner's discipline structure points out that we must make the students understand the basic structure of the subject matter. If the students have a basic understanding of the knowledge structure of the subject, we can infer other things from one fact. In the design of media content structure, the first, to establish the logical structure of knowledge, according to the knowledge points of the various sections of the difficulty, determine the choice of different media. Secondly, after the media of knowledge content, the text uses different font, size and color, the picture is clear and consistent with the content of the video, the video uses vivid, lively, action standard picture to create a learning environment, deepen students' understanding of the contents of the materials, so as to improve students' initiative and enthusiasm.

2.3.3. Courseware Development Ideas

1. the basic principles of courseware design. Scientific, practical, versatile, controllable.
2. teaching objectives of the courseware. By using computer, image, animation and other processing functions, the technical action is more standardized and knowledge points are more clear. It provides a vivid, lively and intuitive learning environment for students to expand their knowledge and improve their learning interest and learning efficiency.
3. the development of the CAI courseware (Fig.2).

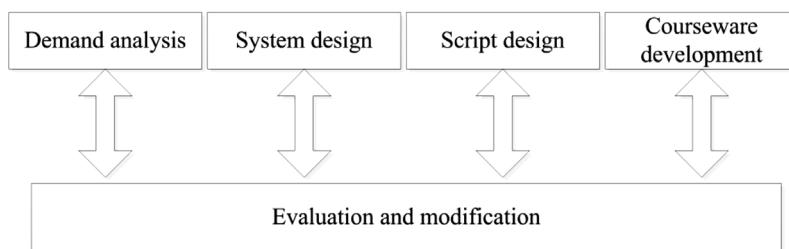


Figure 3 – Development Steps of CAI Courseware

2.3.4. Courseware Teaching Content Determination

1. teaching content structure. In Chengdu City, the table tennis teaching materials as the main reference materials, combined with the Chengdu City, the ordinary university table tennis teaching syllabus, to develop the teaching content of college teachers and students.(Fig.4)

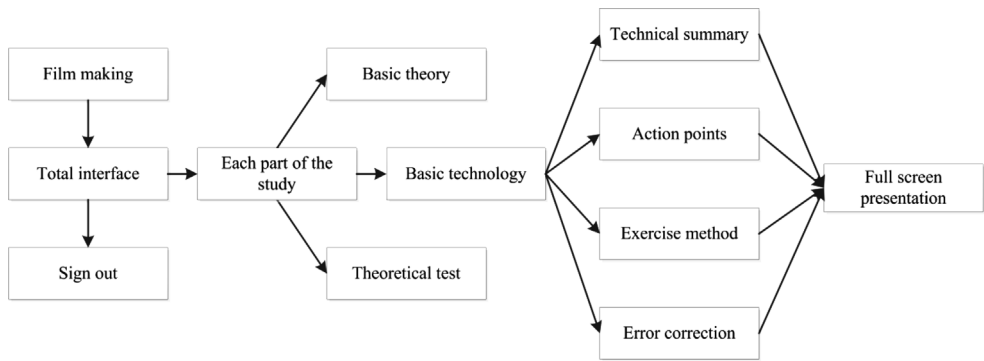


Figure 4 – Table Tennis Multimedia CAI Courseware Content Structure Diagram

2. form of information. Information is presented in the form of text, image, video and sound (Table.1).

Content	Text	Image	Video	Sound
Overview of table tennis	✓	✓	✓	✓
Basic knowledge of table tennis	✓	✓	✓	✓
Basic techniques of table tennis	✓	✓	✓	✓
Basic tactics of table tennis	✓	✓	✓	✓
Physical quality training	✓	✓		
Injury prevention and treatment	✓	✓		
Theoretical knowledge test	✓			

Table 1 – Information Presentation form of Courseware

2.3.5. Production Ofmaterial

1. the production of the text: the use of word production;
2. the production of an image: a web download or scan of an image in a material;
3. video production: video material has three sources, one is downloaded from the Internet; the two is from the VCD video segmentation for interception; three is the use of cameras to shoot.

The running environment of the courseware: P42.4G, memory 2G, hard disk can be more than 1G, the operating system is XP2 windows, the production of software is powerpoint2003.

3. Results and Analysis

3.1. T Test

Assumed that there are $x_1, x_2, x_3, \dots, x_n$ (n samples).

T test statistic is:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}} \quad (1)$$

Wherein, t is the average number of samples and the total average number of the sample; \bar{X} is the sample average, S_1 and S_2 are two sample variance; n_1 and n_2 are two sample size.

$$S^2 = \frac{1}{n-1} \sum_{i=1}^n (X_i - \bar{X})^2 \quad (2)$$

$$\bar{X} = \frac{1}{n} (x_1 + x_2 + x_3 + \dots + x_n) \quad (3)$$

Finally according to the size of N, t, P can be queried.

3.2. Comparison of the Average Scores of the Two Groups Before the Experiment

Before the experiment, the researchers studied the table tennis foundation of the experimental group and the control group. The results were shown in Table.2.

Experimental group and control group	p		
<i>Flat shot</i>	4.03+4.01	4.12+4.10	>0.05
<i>Two block</i>	5.06+1.53	6.01+2.01	>0.05
<i>Double attack</i>	4.23+1.28	4.29+1.18	>0.05
<i>Left push right attack</i>	4.02+1.10	3.23+1.03	>0.05

Table 2 – Comparison of the Experimental Group and the Control Group and t Test

This shows that there is no significant difference between the two groups ($P > 0.05$), which is a prerequisite for the experiment.

3.2. Comparison of Two Groups of Students in the Groups

After 18 weeks of teaching practice, the basic techniques of the two groups of students were tested by the same method, and the results were statistically analyzed by statistical analysis software SPSS (10). The results were shown in table.3.

Experimental group and control group	p		
<i>Flat shot</i>	40.21+8.21	23.92+7.83	<0.01
<i>Two block</i>	43.45+13.64	32.42+8.01	<0.01
<i>Double attack</i>	23.23+6.38	14.29+6.18	<0.05
<i>Left push right attack</i>	35.22+7.11	23.23+6.03	<0.01

Table 3 – Comparison of the Experimental Group and the Control Group and T Test

From table 3 can be seen that the experimental group of students of flat batting, two people backhand, double attack, left push right attack indicators such as average were higher than students in the control group, significant difference ($P < 0.05$). The use of Computer Assisted Instruction can help students improve their cognitive ability, improve the teaching effect and students' test scores.

3.3. Questionnaire Survey Result Analysis

In order to understand the students' attitude toward the teaching process of multimedia CAI courseware, the author uses a two-way evaluation attitude scale to investigate the measurement level of the proposed problem, which is divided into positive and negative two directions. The two ends of the grade are expressed in the opposite opinion. The score rate of F-measure has the nature of $[-1,1]$.

Survey items	Answer				F
<i>Ability to improve understanding of technical movements</i>	Very sure+2	Sure+1	Normalo	Negative -1	
<i>Improve the interest of learning</i>	84	16	3	0	0.88
<i>Conducive to correct their own errors</i>	82	12	5	0	0.85
<i>Willing to receive multimedia education</i>	80	15	4	0	0.83
<i>Help to master the technology</i>	79	12	8	0	0.81

Table 4 – Students on the Use of Courseware for Computer Assisted Instruction's Attitude (N=99)

Calculate the comprehensive coefficient F, the specific formula is as follows:

$$F = \frac{2 \times n_1 + 1 \times n_2 + 0 \times n_3 - 1 \times n_4}{K \times n} \quad (4)$$

K indicated the highest score, the total number of samples, n_1, n_2, n_3, n_4 for the attitude level. In the course of the teaching experiment, the students' learning interest, the students' attention, the enthusiasm of the classroom, the data of the statistical results show that the students are very interested: In the experiment, the students' interest and enthusiasm of the students in the experimental class were improved obviously, and the students' ability to master knowledge can also be improved. F-measure of the attitude of improving the ability to understand the technical action is 0.88; F-measure of the attitude of improving learning interest is 0.85; F-measure of the attitude of being willing to accept the multimedia teaching is 0.83; F-measure of the attitude of being conducive to help their grasp the technology is 0.80.

4. Discussion

In the course of the teaching of table tennis technology, the use of multimedia CAI courseware for Computer Assisted Instruction, through teaching practice has achieved satisfactory teaching results. This fully shows that the use of multimedia CAI courseware

Computer Assisted Instruction is an effective way to achieve the optimization of teaching process, improve students' understanding of the technical movements, is conducive to correct their own mistakes and help to master the technology, is a good way to achieve the modernization of teaching (Gili, J. M., Zapata-Guardiola, R., Isla, E., Vaqué, D., Barbosa, A., García-Sancho, L., & Quesada, A., 2016).

4.1. Multimedia Cai Can Provide Full Play to the Leading Role of Teachers and Students' Main Role

In the traditional teaching of table tennis, the teaching mode of "lecture style" or "training mode" is presented. With the aid of multimedia CAI courseware, the optimization combination of various teaching methods has been realized. Multimedia courseware image, text, music, animation and other information vivid, vivid, concrete, intuitive display in front of the students, so that students refreshing. Therefore, students have the motivation to learn, the mood is happy. Between teachers and students, between students, mutual influence, mutual encouragement, teaching benefits teachers as well as students, the effect is remarkable, forming a benign operation of the internal mechanism, guarantee the teaching activity is orderly, and lively, bilateral activities of teaching in the variable for multilateral activities, greatly improve the students' participation, and fully reflects the dominant position of students.

4.2. Multimedia Cai is Conducive to the Establishment of the Correct Action Image

Physiologists believe that beginning the establishment of motor imagery is dominated by visual expression and cerebral cortex in the central received from hearing, visual, tactile stimulation of a peripheral part of the analyzer excited, after consolidation, and gradually form a clear and complete representation. The United Nations Educational, scientific and cultural organization of the survey: "with the information, people can only remember 15%; through the visual and auditory simultaneous transmission of information, people can remember 65%". Using multimedia courseware to assist teaching, students are listening to the teacher's teaching, but also can use the visual images and commentary, make students' visual and auditory organs simultaneously to transfer knowledge information in the cerebral cortex, therefore, the teaching information transmission is a multi-channel, so that the technical action method is more easy to remember, so as to help establish a correct technical action image.

4.3. The Teaching Content is Comprehensive and the Teaching Quality is Improved Obviously

Because of the large storage function of the multimedia courseware, it makes up the deficiency of the teaching of table tennis. In the developing process of the multimedia courseware, we will table tennis history, skills and tactics system, competitive winning rules, innovation of techniques and tactics analysis, a detailed introduction of the fitness value, the basic technical movements essentials, is apt to make mistakes and correct approach, competition rules, organization arrangement, convenient for students to keep abreast of the latest trend of the development of table tennis. In the teaching of

technology, students have to view the advanced and standard technical demonstration action image data, which make the students form in the brain more profound. At the same time, it avoids some negative effects caused by the differences in age and professional skills, so as to improve the teaching quality.

4.4. Multimedia Can Expand the Teaching Time and Space, the Communication Between Teachers and Students in A Timely Manner

Application of multimedia teaching, students can learn through the network, to understand the content of the study, the students have targeted to repeatedly watch multimedia courseware technology demonstration and explanation, so that students will have to learn the technology can have a more comprehensive understanding, so that they will take the problem, with the purpose, to focus on learning new technology, so as to reduce the time of teachers, the time to increase the students' practice time, improve teaching efficiency. After class, the students can learn the basic technical movements and basic theory knowledge, and the teaching content of table tennis, also can be carried out online. This not only promotes the development of table tennis teaching activities, but also teachers can master the students' learning dynamics, and then adjust the teaching schedule and update the teaching content according to the feedback. Application of multimedia courseware teaching, not only extended the teaching time, but also expand the teaching space, the table tennis lessons inside and outside the connection into an organic whole, forming a new concept of table tennis.

5. Conclusions and Recommendations

5.1. Conclusions

1. the results of the experimental group were compared with the experimental group. The results of the experimental group were significantly better than that of the control group using the traditional teaching method, which improved the students' learning efficiency and learning achievement.
2. the results of the questionnaire show that most of the students in the experimental group considered the effect of multimedia teaching is good, and they are willing to accept this way to help improve their academic performance and sports skills.
3. in the teaching of sports technology, the use of Computer Assisted Instruction is beneficial to students' mastery of technology, greatly improving the learning efficiency, is the symbol of teaching modernization, the majority of physical education teachers should fully understand this, continue to learn and master the technology, improve the teaching quality of physical education.
4. the influence of the courseware to the teacher. In the traditional teaching process, the students obtain the table tennis knowledge mainly depends on the teacher's language explanation and the action demonstration. As a teacher, the level of its business directly affects the effect of teaching. Teachers should strengthen their own professional level and in teaching to ease the play itself, at the same time, in the process of teaching teachers should avoid its disadvantages, play their own advantages, gradually become the guides of students, give full play

to the leading role of teachers in teaching, to help and guide the students to learn. In the teaching of language teaching and action demonstration, teachers will be difficult to express the content of the use of multimedia CAI courseware for teaching, the teaching effect is better than the simple language expression and a single action model. Using multimedia CAI courseware can also reduce the repeated work of teachers, teachers can put more time and energy into the teaching of scientific research to better play the leading role of teachers in teaching. In order to better play the supporting role of multimedia courseware in teaching, teachers should continuously strengthen the learning of computer professional knowledge, in order to make a better and more excellent multimedia courseware to create a prerequisite.

5.2. Recommendations

1. physical education teachers should continue to learn, to a high level of teachers to learn, improve the production level, meet the needs of teaching.
2. Computer Assisted Instruction can only play a role in supporting teaching, do not completely rely on it, and deal with the relationship between the traditional teaching methods to achieve the best teaching results.

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Research on the Application of Computer Technology in the Center Community Construction of the Experimentation Area of the Two-oriented Society in Hunan Province

Yi Chun^{1,*}, Yi Qingqing²

52086483@qq.com

¹ College of architecture and urban planning, Hunan City University, 413000, Yiyang, Hunan, China

² Beijing Century International Engineering Design Co., Ltd, 100089, Beijing, China

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Abstract: With the rapid development of information technology, network technology, digital technology, intelligent building has experienced the development of electronic, automation, intelligent, and gradually evolved into the concept of the digital community. In order to solve the existing problems in the digital community, such as the poor system function, the serious information island phenomenon and so on, the construction of the digital community management information system based on SOA architecture in Changsha city is put forward. In this paper, the Service Web technology is used to construct a service-oriented architecture (SOA) digital community management platform, the information resources in the community are integrated, and the information communication channels among the functional departments of the government, the community grassroots management agencies with the community residents are built up to make the management more efficient and the service more quality. The experimental results show the effectiveness of the system. It not only can maintain the integrity and independence of the isomorphic system, but also achieve the sharing and integration of community information, and promote the continuous improvement of the application and management of digital community information management system.

Keywords: Digital community; service oriented architecture (SOA); web service technology; performance testing.

1. Introduction

During the “Twelfth Five Year Plan” period, the state clearly gives the Hunan province the “pilot” rights in the aspects of institutional and mechanisms, which provides favorable conditions for the formation of policy depression. Accelerating the construction of two-oriented society, going out of a road of the two-oriented society construction and accumulating experience and providing demonstration for the construction of two-oriented society in china, which not only are the fervent hopes that the Party Central Committee and the State Council place to Hunan, but also the scientific decisions that made by provincial Party committee and the provincial government by judging the hour

and size up the situation, and the main task and goal of scientific development in the next five years or even longer in Hunan. (Hadwan, M., & Alkholidi, A., 2016) The two-oriented society refers to “resource conserving and environment friendly society”. And the establishment of the harmonious community of the digital information network based on computer technology is an important part of “two-oriented society”. (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015) Digital information network harmonious community is the harmonious unification of community residents’ government affairs service information and life service information, with the functions of administrative management, information collection and release, convenient service and so on, which can provide the services of law, weather, medical, training, education, tourism, home economics, entertainment and so on. Integrating civil affairs, family planning, labor, statistics and other social information system with the technical means and a unified platform is good for solving the problems that the systems are too much, systems are very disorderly, and mass work is very difficult. (Ji, Y., Zhang, Y. H., & Zheng, W. M., 2016) In the exploration of the reform of the two-oriented society practice, the construction of the digital information network harmonious community not only is the comprehensive reflection of the overall level of urban civilization, but also the most valuable intangible assets and important urban brand for a city (Davies, A., 2015).

2. Research Status of Digital Community

The value of network economy not only lies in the fact that it can bring much more tangible wealth and profit to the society, but also it can create a new social form, and provide a platform for all members of society to improve social survival and economic power. Internationally, with the introduction of the speech about “Digital Earth” that put forward by U. S. (STAnISZEWSKA, E., 2015) Vice President Al Gore in the California Science Center, as well as Open GIS and other websites to publish the article, (Van Den Bossche, N., Buffel, L., & Janssens, A., 2015) the scientists who engaged in the research of space information in the world have been encouraged, and began to build the “Digital Earth” revolution of the space information after the information superhighway. On the domestic, the national science and technology achievements of Beijing University of Technology the basic framework of the digital society”, the research is as follows: The digital community is based on the network, intelligence and information, which is based on the service and divided into government service, community service, home service and personal service. It is a digital community service system which can provide a full range of services for urban community. The National Quality Supervision Bureau regulates the design and implementation of digital technology application platform for building and residential area in the construction and residential area of digital technology applications”, the platform is composed of communication system, information system and monitoring system and supporting infrastructure, including information network platform, integrated wiring system, power supply and grounding, environment, computer room system, basic system integration and so on (Lavi, E., & Breuer, O., 2016).

But at present, these systems are generally in poor system function, and the resource don’t realize the real share, the system is independent, and the construction of the phenomenon is serious, (Cheng, D., Liu, Y. M., Li, J. Z., & Mo, C. H., 2015) these problems greatly waste social resources and are not good for the development of service work.

Therefore, using computer network technology and information technology to integrate and functional develop the existing single subsystem, establish a unified community management platform to achieve information sharing, and show the platform to the users in the form of portal (Hugo, V., & ADAMI, S., 2015).

3. Related Technologies

3.1. Main Technology of Digital Community Construction

Community digital is a complex system engineering which involves different subjects, the use of a variety of professional technology, geographical range is relatively large. At present, the main technologies used in the construction of community digital are:

Integrated wiring technology: It sets up a platform for the establishment of the communication network and office automation system of intelligent building (Tolich, M., Scarth, B., & Shephard, K., 2016).

Access network technology: The technology is the key to linking the digital community and the external network. There are several ways of using the access network: The XDSL technology based on the traditional telephone system, the HFC mode based on the cable TV network, the LAN access mode and satellite broadcast network access mode based on optical fiber (Jacobson, B., 2015).

Communication network technology: The computer network, two-way cable television network and a telephone network and so on, the former two are the main broadband network (Čolović, B., 2015).

Control network technology: Computer distributed control mode has become the mainstream. Distributed control is the trend of development (Kong, X., Cui, B. J., Jin, D. C., Wu, S. H., Yang, B., Deng, Y., ... & Zhuang, X. L., 2015).



Figure 1 – Digital Community

3.2. Determination of the Expected Value of the Evaluation Index of the Social Community Construction of the Two-Oriented Society

The main component analysis method and the AHP analytic hierarchy process are the common evaluation index weight method. The subjectivity of the main component

analysis method is strong, which may lead to biased. This paper chooses the AHP analytic hierarchy process to analyze the weight of the method.

First, the original data of each index in the assignment are different units and values, therefore it is necessary to carry out the unified standards, that is, non-dimensional treatment. This paper uses the method of standard deviation method to carry out the non-dimensional parameters (Meflinda, A., Bustam, N., & Tanjung, H., 2015).

Dimensionless treatment model of positive index:

$$y_{i,j} = \frac{X_{i,j} - \min(x_j)}{\max(x_j) - \min(x_j)} \quad (1)$$

Non dimensional treatment model of negative index:

$$y_{i,j} = \frac{\max(x_j) - X_{i,j}}{\max(x_j) - \min(x_j)} \quad (2)$$

Among them, the $y_{i,j}$ refers to the comparable numerical value between the (0, 1), $\min(X_j)$ refers to the minimum of the actual value of the 13 cities in the same level, $\max(x_j)$ refers to the maximum of the actual value of the 13 cities in the same level.

4. Management System of Digital Community

4.1. SOA Technology

SOA is a component model for service oriented architecture, which applies the different functional units of the application by defining good interfaces and contracts. Interface is defined in a neutral way, which is independent of the hardware platform, (Fauzi, A., 2015) operating system and programming language. The services are mapped to the business function, (IORGA, A., 2015) and the components of the service are typically mapped to the business entity and the business rule to manipulate them. The software of implementation services are typically coarse-grained, loosely coupled, and based on message communication model. SOA contains the service provider, service requester and service registry (UDDI), which forms the three basic operations: Registration, search, and binding. As shown in Figure 2.

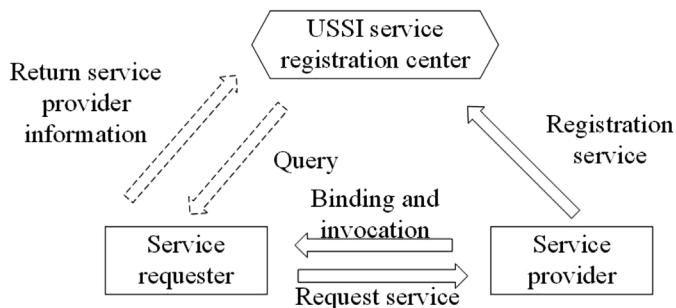


Figure 2 – SOA Basic Framework

4.2. Web Service and Related Technology

Web Service is a kind of open software platform based on service component, Internet application oriented service can be described, published, searched and called in Web. Web Service is a kind of technology structure to achieve the SOA based on XML, which has the characteristics of good encapsulation, loose coupling, the use of standard protocol specification, highly integrated ability and so on, it has the advantages of the interoperability of heterogeneous platform, wider range of software reuse, reliable communication capability and convenient business integration and so on. XML, SOAP, WSDL and UDDI are the technical basis of SOA. XML not only is the core basic technology of Web Service, and the key to the realization of Web, but also the basic format of the Web service platform and the data encoding way of Web service communication protocol, which is a cross platform in the Internet environment and is not dependent on the content of the technology; SOAP is a simple protocol of exchanging information in the decentralized or distributed environment on the basis of XML, which is composed of SOAP package, SOAP coding rule, SOAP RPC express and SOAP; WSDL is a protocol that uses XML language to describe the web service function, which makes it possible to describe the service, but also allows customers to call these services in a standard way without the need to know more about the underlying protocol. UDDI is a set of standards and specifications for the Web Service oriented information registry. At present, Web Service is the main means to achieve SOA. Web Service enables the application to provide a standard interface to the WSDL, uses the XML standard language to describe, and based on the HTTP and JMS standard transfer mode and the use of SOAP standard protocol and XMLSCHEMA to describe the data. Web Service can overcome the shortcomings of the traditional application system integration, which can provide the integrated function of loose coupling and high scalability for heterogeneous systems.

4.3. Performance Test of Web Service

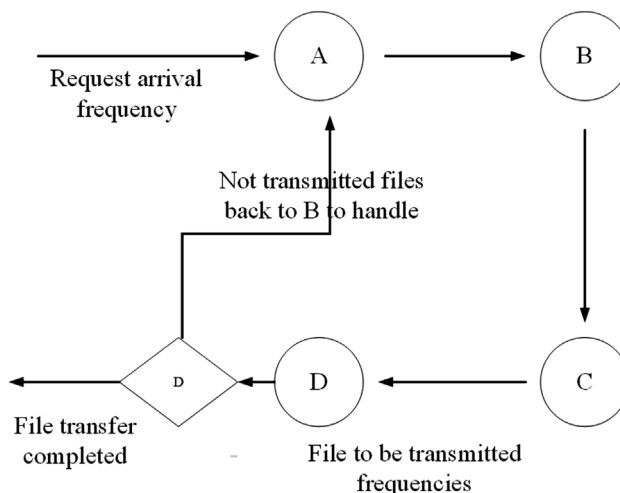


Figure 3 – Performance Analysis Model Based on Web Server

Using SPECweb99 to test a fixed Web Service, gradually increasing the simultaneous connection number, observing the actual maximum number of simultaneous connections that meet the rate requirement. As shown in Figure 4:

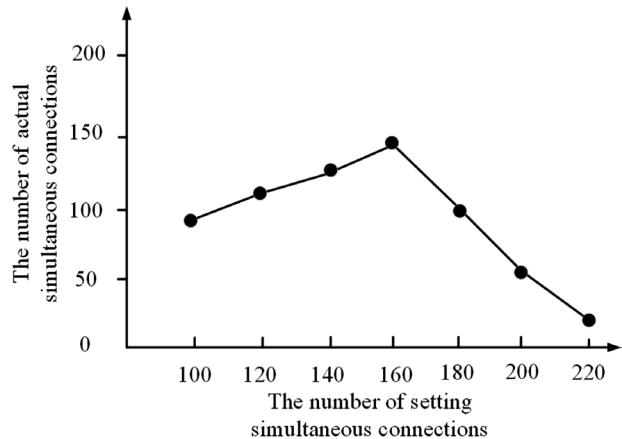


Figure 4 – Changes of Actual Performance with Load

Obviously, the response of the Web Service to the request changes with the system load. In the range of the service capacity, increasing the request to the frequency and increasing the load, the request of the Client can be processed in time. However, when the load increases to a certain extent, the system performance has a more obvious decline, called the critical point of Web Service.

In addition, the way of the server software processing dynamic request has a great influence on the performance. First of all, the dynamic part of the test set is blocked, and the pure static test of the Web server is carried out. Then the dynamic test is introduced, and the dynamic content is gradually increased, and the maximum number of simultaneous connections is observed. Test results are shown in Figure 5:

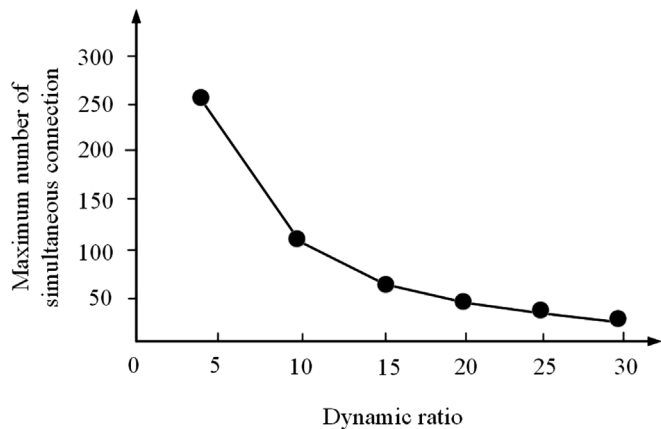


Figure 5 – Relationship Between Actual Performance and Dynamic Content Ratio

Thus it can be seen, the larger the proportion of the dynamic testing, the less the maximum number of connections that Server can support.

4.4. Function Module

The functional design of the digital community system should be based on “platform integration, technology integration, information inheritance, application inheritance” as the finger guide, the communication network and spatial database as the basis, and community service and application as the core to organize, inherit and provide services and applications. Mainly including the community health, culture education, municipal transportation, population management, property services, e-commerce and other functions.

The digital community platform carries out the centralized management to the dispersed and mutual independent subsystem through the unified system environment and the software interface, uses the cross system control process, improves the control level of the system and provides open data structure to share information resources. The system establishes the corresponding service application through the establishment of an open working platform, the collection and conversion of the sub system of data, and accepting the user's service request, so as to achieve data sharing. Through the integration of services and applications in the community, the system is divided into four parts, including the community service subsystem, the community communication subsystem, the community electronic commerce subsystem, the integrated management and maintenance subsystem.

Community service management subsystem is geared to the needs of the community residents, it arranges the information query, payment and complaints and other daily life items, and the community users can enjoy the quality service at home. Community communication management subsystem through the announcement form to convey the government's announcement, through the creation of blog and forum plate to strengthen the exchange of community residents, enrich the lives of the residents. E-commerce subsystem establishes a unified online sales and advertising platform for the community, which fully plays the advantages of short, flat, quick of the community business sales, and greatly excavates the consumption potential of community residents. Community residents can achieve the purchase of clothes accessories, intermediary services and other goods through the platform, and achieve the purchase and booking distribution of vegetables, fruits, cakes and other fresh food at the same time, which greatly facilitate the lives of residents. Management and maintenance subsystem not only contains the user management, log management, network management and security management functions of the digital community management platform, but also includes community population information management, community business information management, complaint handling and public announcement, and other functions, which mainly for the office management module.

4.5. Software System Based on SOA

System architecture design is the starting point and basis for the design of all complex systems. In order to overcome the problems that the service level of community information system is low, the application of the business system is confused, and lack of

unified technical standards. Based on SOA reference model, the architecture design of the system consists of a number of services or service composition, the system architecture is designed for the performance layer, business layer, service layer, transmission and resource layer.

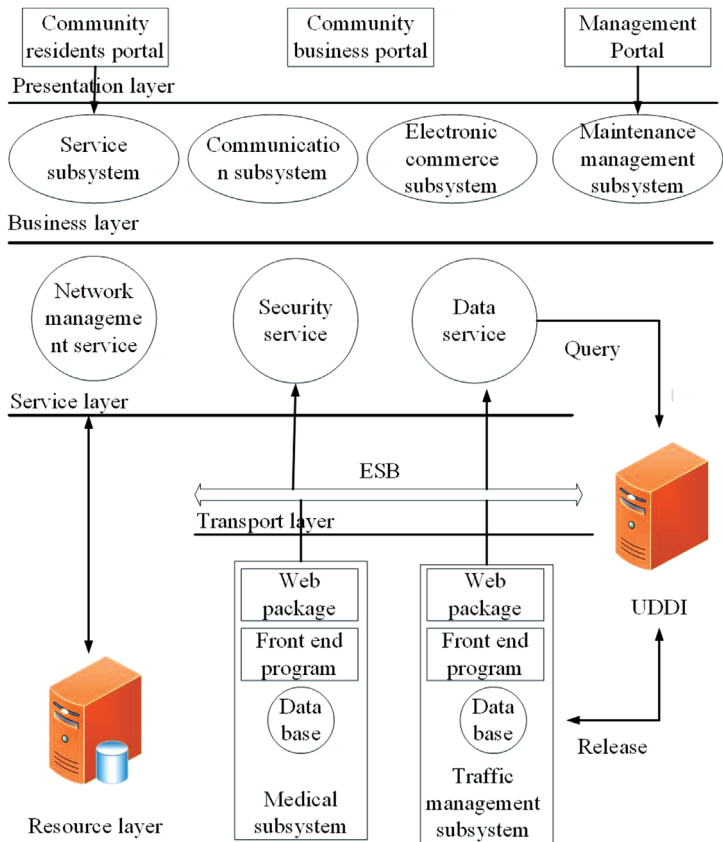


Figure 6 – Digital Community System Structure Diagram

The resource layer mainly includes the integration service of the existing information system and the new business data storage of the digital community platform. According to the service contract, the basic service that has some business functions is separated from the existing information system EIS1. In the information system layer, the existing EIS is packaged into one or more Web basic services, and the WSDL is used to provide a unified interface. The original interface with various API forms is described by using WSDL, and then the message transfer mode of the HTTP+SOAP is used to interact with the outside world. The digital community management platform not only realizes the integration of the existing sub systems, but also provides the basic services for other systems, which carries out the interaction of data services in the form of B2B, such as the quality complaints management system of the quality supervision department.

The transport layer uses the ESB enterprise service bus as the “bridge” of the transmission link service. ESB that provided by a standard connection service can be used to transform the function or data resource into the service which can be accessed by the service requester with a standard way. The service provider releases the web service to the registry center of UDDI services, and provides some basic Meta data on ESB at the same time, such as web service container type, call mode (dynamic / static) and so on. When there is a web service request, ESB provides the web service for the system as a function, each function is identified by a unique identification number, the system only needs to send the standard SOAP message of the web service data interface to ESB, then the ESB will automatically execute the web service, and the processing results will be sent to the service request system. The third layer is the service layer: The original sub system of the community usually provides the fine-grained API interface, the Web package is to use WSDL which based on XML to describe API again, after the package, the basic service is still fine, while the thinking of SOA requires service unit is coarse-grained, then carries out the service composition in the service layer, so that the service has a certain coarse granularity model. Service layer uses a variety of services to build the specific business process of the digital community management system. The presentation layer is a graphical interface to the staff and the relevant users, which completes the daily business processes and business processes through the provision of work processes and interfaces.

5. Experimental Analysis

In order to ensure that the system can run and operate stably and reliably in the actual work, this paper carries on a series of test work on the control flow of the software code quality in the process of software development. This article first carries on the function test, then the code unit testing, finally the integration testing. In addition, through the professional Web test software Load Runner to write test scripts, simulate the large amount of user access to the system’s each page, see the code’s running efficiency on the server side, improve bad code. Test results as shown below:

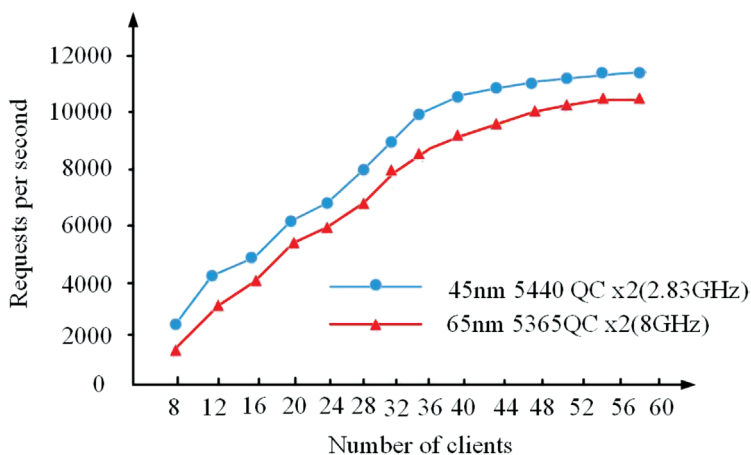


Figure 7 – Results of Web Performance Test

In the testing process, using two different servers, blue is on behalf of the 2.83GHz frequency of the server, red is on behalf of the 3GHz frequency of the server, simulating different client access number through Load Runner to carries on the concurrent access to the server, and testing the number of requests per second that the server can handle.

6. Conclusion

With the development of computer technology, the digital concept has penetrated into all aspects of social life, such as: digital city, digital community, digital home, etc.. Especially with the rapid development of the network economy, the higher and newer requirements of the social services are put forward. In order to solve the existing problems in the digital community, such as the poor system function, the serious information island phenomenon and so on. In this paper, the Service Web technology is used to construct a service-oriented architecture digital community management platform, the information resources in the community are integrated, and the information communication channels among the functional departments of the government, the community grassroots management agencies with the community residents are built up, thus the construction of the digital community management information system based on service-oriented architecture architecture in Changsha city is designed. The design of digital community management system uses the traditional close coupled system architecture in the internal system, and uses the loose coupling structure method among the systems, which not only can maintain the integrity and independence of the isomorphic system, but also realize the integration of the heterogeneous subsystems, achieve the sharing and integration of community information, and promote the continuous improvement of the application and management of digital community information management system. In the exploration of the reform of the two-oriented society practice, the construction of the digital information network harmonious community not only is the comprehensive reflection of the overall level of urban civilization, but also the most valuable intangible assets and important urban brand for a city.

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Research on EOT Filter of Abnormal Transmission of Terahertz Sub Wavelength Hole

Liu Xiang¹, Yang Dongxiao^{1,*}, Yu Chunyan¹

* yangdxiao@yeah.net

¹ College of Information Science & Electronic Engineering, Zhejiang University, 310027, Hangzhou, China

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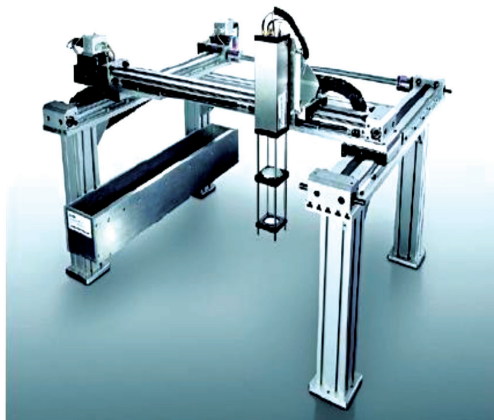
Abstract: Objective: In order to improve the development of filter design toward the direction of higher frequency. Methods: Studying the research and design of EOT filter of abnormal transmission of terahertz sub wavelength hole. Process: This paper introduces the development and related concepts of microwave technology in terahertz region, elaborates the principle of micro-nano structure of enhanced metal of large-area electric field and the propagation of electromagnetic wave on the surface of metal's sub-wavelength periodic structure. Result & Analysis: This paper studies the numerical-simulation method of the high-frequency metal structure, analyzes the transmission-spectrum data of the filter with different cavity length, and finds that the longer the length of the cavity is, the longer the generated resonance wavelength is. Result: The EOT filter of terahertz sub wavelength can be realized in theory, but it needs the design and debugging to achieve good parameters.

Keywords: EOT filter; terahertz sub wavelength; cavity length; abnormal transmission.

1. Introduction

Due to the lack of efficient emission sources and sensitive detectors in THz range, before mid 1980s, this band has not been deeply studied, its technology and applications are also very few. Relative and has been widely used in communication, imaging, detection and other fields of microwave and infrared band, the terahertz band becomes the “gap”, which is not familiar to people. In the last 20 years, development of key technologies, such as terahertz emission source and detector, terahertz Science and technology have been developing rapidly. Terahertz has aroused people's strong research interest, because it has a lot of special properties, it can be widely used in many fields. The photon energy of the THz wave is only a number of electrons, will not produce harmful response. At the same time, it is easy to be absorbed by water, which can not penetrate into the human body. Such characteristics make it a great development in the detection of human security and biological samples. Terahertz radiation can be used for spectral analysis. The terahertz frequency band contains a wealth of spectral information, a large number of molecules (especially organic molecules) show strong absorption and

dispersion in this band. This feature makes the terahertz spectral imaging technology not only to identify the object morphology, at the same time, the composition of the object can be detected. Compared with microwave, the higher frequency of THz wave is used as the carrier of communication, more information can be carried within the unit time, and because of its shorter wavelength, the direction of its emission is better than that of microwave. Therefore, terahertz wave has great development potential in the field of short distance wireless communication. Now, the terahertz technology has received much attention in basic research and application research. Has been widely studied and applied in defense, imaging, biomedical, chemical, oil and other fields (TAMURA, K., HASHIMOTO, K., & AOKI, Y., 2016). Figure 1 (a) - (d) shows the wide application of terahertz technology.



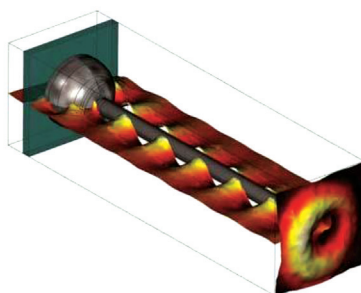
(a) Terahertz Imaging Instrument



(b) Terahertz Energy Shield



(c) Astellas Product With Terahertz Technology



(d) Linear Waveguide with Terahertz Wave Technology.

Figure 1 – Several Applications of Terahertz Technology

In recent years, the abnormal optical transmission of the sub wavelength Kong Zhen has caused wide public concern. The wavelength of transmission enhancement is controlled by the parameters of the metal material, the geometry and the arrangement of the small hole. This phenomenon was initially attributed to the interaction between the incident light and the metal surface of the free electron collective shock and the charge density wave generated on the metal surface, terahertz (THz) wave of special electromagnetic properties is also the focus of academic research. In recent years, the development of ultrafast laser technology, it provides a stable and reliable excitation light source for the generation and detection of pulse THz wave, and can conveniently detect spectrum and phase of material delay characteristics using THz time-domain spectroscopy (TDS) technology. This in many ways to make up for the deficiencies in the bandwidth of Fourier transform infrared spectroscopy and X-ray technology. In recent years, sub wavelength structure properties in the terahertz (THz) has caused widespread concern in all aspects. The THz TDS measurement system, in 5 - 300 K temperature region, with periodic hole arrays of metal NB films of THz transmission of measurement and analysis. The results show that the abnormal transmission of sub wavelength hole array is in accordance with the theoretical calculation, Nb film at low temperature due to the increase of conductivity,

the surface current increases with THz wave excitation, the transmission spectrum of THz wave is increased at the peak position (Lee, J., Chae, H., & Hong, K., 2015).

2. Materials and Methods

2.1. Large Area Electric Field Enhanced Metal Micro Nano Structure Substrate Design

In this chapter, the electric field enhancement effect of metal micro-nano arrays is studied, the electric field enhancement region of the total surface area is obtained. Simulation by rigorous numerical method, a large range of electric field enhancement region is obtained on the metal surface of the periodic sub wavelength hole array. Calculations show that not only for the hole structure, a large area of electromagnetic field enhancement is also found in other forms of the array structure (Malik, V., Subramaniam, A., & Kapoor, P. M., 2016). This phenomenon is different from the “hot spot” enhancement effect which has been widely reported before. (Laureano, R., Caetano, N., & Cortez, P., 2014) The latter enhancement region is tiny, and the corresponding Raman enhancement effect is affected by the accuracy of the nano scale range of the sample molecules. This chapter is based on the effect of surface electric field enhancement to reduce the accuracy of the sample molecules, it is helpful for people to design a more practical base in the application of enhanced spectrum. In order to understand the physical mechanism of this phenomenon in order to guide the design, we have established the surface electromagnetic field enhanced micro surface wave model, the surface wave is formed by the combination of quasi cylindrical wave, which is called the composite wave. Based on the above theory, from the wave (and in metal surface of long range propagation and the phase matching conditions of constructive interference superposition, this physical mechanism based on long range propagation mode constructive interference resulted in a large area of the field enhancement effect was found. By introducing gain medium, the scattering loss of surface wave in the scattering body is compensated, enhance the surface wave resonance, and thus optimize the enhancement factor, the electric field enhancement factor was obtained, this and no gain medium is compared to the case of an order of magnitude higher (Sarojini, R. K., 2015). The terahertz wave is located between the microwave and infrared waves in the electromagnetic spectrum, its frequency range is. In the field of electronics and optics, this band of electromagnetic waves is also known as far infrared and sub millimeter wave. But it needs further research to make the whole plasma circuit. Also due to the grating geometry parameters and the material parameters of their choice, when changing the metal surface grating structure, SPP nature, coupling effect, stimulate model, the dispersion relation will produce major change, so the use of the grating coupler legitimate excited surface plasma waves for the research content is very rich. This thesis is based on the calculation and numerical simulation, systematic research and possible applications for sub-wavelength one-dimensional metallic gratings is the directional coupling effect, as well as the physical phenomena of the optical properties of sub-wavelength metallic materials. In addition, we also study the properties of the materials by changing the metal structure of the metal, the direction of light. We believe that the design of this structure and proposed in optical devices and nano optoelectronics will be of great use (Fazil, P., & Pramodkumar, P. S., 2015).

2.2. Propagation of Electromagnetic Waves in the Surface of the Metal Sub Wavelength Periodic Structure

In 1947, the diffraction characteristics of the sub wavelength aperture of an infinite thin ideal conductance were theoretically analyzed. His results show that when the plane wave is perpendicular to the incident, Anami Changdokong can be regarded as a magnetic dipole in the hole. Its transmission efficiency is:

$$\eta = \frac{64(kr)^4}{27\pi^2} \propto \left(\frac{r}{\lambda}\right)^4 \quad (1)$$

Where there is:

$$k = \frac{2\pi}{\lambda} \quad (2)$$

Which represents the incident wave vector, R and the radius of the aperture and the wavelength of the incident light (Gandikota, M., & Chandramani, P., 2015). This type represents a transmission the ratio is proportional to the four Party of the hole radius and wavelength, this means that when the aperture size is much smaller than the wavelength, only a very small part of the light wave can be through, its transmission efficiency will be very low. Over the next decade, it is generally accepted that this conclusion is: Light can hardly penetrate the sub wavelength aperture. From the equation, the generation mechanism of surface plasma is studied. Starting from the differential equation of the passive region Maxwell equation:

$$\nabla \cdot D = 0 \quad (3)$$

$$\nabla \cdot B = 0 \quad (4)$$

$$\nabla \times E = -\frac{\partial B}{\partial t} \quad (5)$$

$$\nabla \times H = \frac{\partial D}{\partial t} \quad (6)$$

In the equation D flux density, magnetic flux density is B , E is the electric field strength, H for the magnetic field strength. Constitutive relation of matter:

$$D = \varepsilon_0 \varepsilon_r E \quad (7)$$

$$B = \mu_0 \mu_r H \quad (8)$$

Where ε_0 is the vacuum permittivity and the relative permittivity of ε_r medium, μ_0 is for the vacuum permeability, μ_r for the relative permeability of the medium. The formula (4) and the formula (5) is combined into the constitutive relation (Souidi, Y., Taleb, F., Zheng, J., Lee, M. W., Du Burck, F., & Roncin, V., 2016), get down:

$$\nabla \times \nabla \times E = -\mu_0 \mu_r \frac{\partial^2 D}{\partial t^2} \quad (9)$$

According to vector relational $\nabla \times \nabla \times E = \nabla(\nabla \cdot E) - \nabla^2 E$ and $\nabla \cdot E = 0$ can be derived:

$$\nabla^2 E - \mu_0 \mu_r \varepsilon_0 \varepsilon_r \frac{\partial^2 E}{\partial t^2} = 0 \quad (10)$$

The formula of the complex vector of time harmonic field can be obtained by the equation of plane wave electric field:

$$\nabla^2 E + \omega^2 \mu \varepsilon E = 0 \quad (11)$$

Where $\mu = \mu_0 \mu_r$, $\varepsilon = \varepsilon_0 \varepsilon_r$. Design: $k^2 = \omega^2 \mu \varepsilon$, using the separation variable method to solve the electric field of plane wave in a vacuum can be obtained:

$$E = E_0 e^{j(\omega t - k \cdot r)} \quad (12)$$

E_0 is the amplitude of the electric field, ω is the frequency of the k is the angular frequency and the wave vector is the wave vector, r is a spatial orientation vector (Wen, Y., Gao, R., & Zhao, H., 2016).

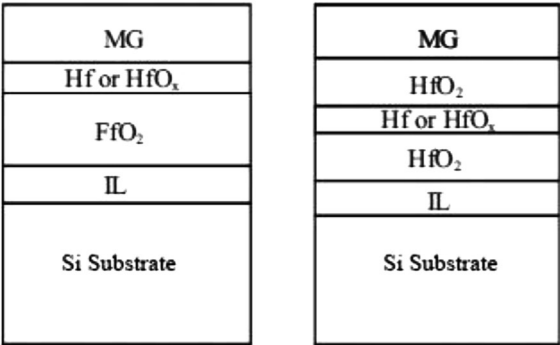
2.3. Numerical Simulation Method

The interaction between the light and the metal surface is a novel optical phenomenon and wide application prospect, attracting a wide range of interest. In theory, this mutual coupling effect can be understood as the problem of electromagnetic scattering in the metal nanostructures. For each problem, we usually have a related method to make a request. Solution. Theoretical study on electromagnetic wave, Maxwell equation is usually used to describe. Due to the complexity of electromagnetic wave propagation in real environment, the boundary value problem of Maxwell's equation is solved by the electromagnetic parameters of the environment, and there are some classical problems, that is to say, only these problems can be solved by analytical method (Jeong, T. K., & Ueda, M., 2015). In optical field, the commonly used analytical method is: Method MMp (Multile-multipole), Method Modal, (MM), and Green, and other methods; For the complexity of the actual environment, through the structure of some special rules or classical electromagnetic scattering problems, it is very difficult to use the analytical method to solve the problem, therefore, it is important to take into account other meaningful numerical solutions, the numerical calculation and simulation are carried out by computer. In the research field of sub wavelength metal structure, the commonly used numerical solution method is: Boundary element method (BEM), Green, and dyadic method, finite element method (FEM), Method MMP (Multiple-Multipole),

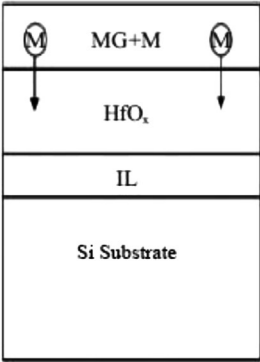
Moment method (MoM) and Difference Time Domain (Method), etc.. In addition, there is also a method of living in the numerical simulation and analysis of the derivation of the method, which is a combination of the two methods, often used is the transmission of the rectangular method, also known as transfer matrix method, characteristic matrix method. In this paper, the finite difference time domain (FDTD) method is simple and intuitive, and the accuracy is high, can directly carry out the time domain calculation and other outstanding features, is currently the most widely used method of electromagnetic numerical method for the study of SPPs related phenomena in sub wavelength metal structure (Yu, J., Liu, X., & Ni, X., 2015). The method was first proposed by Chinese scientists in 1966 by Kane.S.Yee, He makes use of a reasonable calculation of the grid system of Maxwell equations, and then, by means of the discrete method, the Maxwell's rotation degree equation is transformed into a set of differential forms, and the space electromagnetic field is gradually solved by the time axis. That is to say, the FDTD method is a kind of difference separation method, which can be used to deal with the propagation and reflection of electromagnetic pulse. During the calculation, the author begins with the stability, the selection criteria for the discrete time steps and cellular dimensions are discussed, for the electromagnetic field H, the E component is taken alternately in the time and space, and each magnetic field (electric field) is surrounded by four electric field (magnetic field), and the parameters of the medium are assigned to each cell in the pre calculation, so the algorithm can deal with the problem of electromagnetic radiation and scattering from complex shape objects and non-uniform dielectric objects, when the selected stability conditions and the size of the grid are appropriate, the results of this method can not only be well and experimental results, and the results obtained by the exact solution can be well compared with the results obtained by the analytical method (SRINIVAS, B., & SRIKANTH, M., 2015).

2.4. EOT Technology

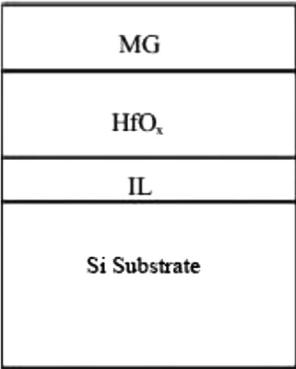
The most effective EOT (optical transmission Extraordinary) control technology is a process called oxygen uptake (scavenging). In addition to control the thickness of the interface layer, and reduce the EOT, because it does not make the high k dielectric layer and the Si substrate direct contact, so it has a high quality k/Si interface. The process of oxygen absorption process is divided into direct oxygen absorption process and the technology of remote oxygen absorption process. Direct oxygen absorption process is a metal element that is directly incorporated into the high k dielectric layer with an oxygen absorption, using the metal elements in the process of high temperature absorption of oxygen in the SiO₂ interface layer, to inhibit the growth of SiO₂ interface layer during high temperature process, even reduce the thickness of the SiO₂ interface layer. The specific implementation methods include three kinds: directly in the high k dielectric layer mixed the elements, in high k dielectric layer deposited on or insert a layer of thin metal film and metal oxide film in the middle of the high k dielectric layer; in the gate metal incorporation the elements, High k dielectric layer is reached by thermal diffusion, which is similar to HfOx (X, 2) or HfSiOx (Fu, Y., Chen, Y., & Shao, X., 2015), which is a high k layer with the ratio of unsaturated oxygen, as shown in Figure 2 (a)-(C).



(a) Direct Oxygen Absorption Technology



(b) Direct Oxygen Uptake By Two



(c) Direct Oxygen Uptake By Three

Figure 2 – Direct Oxygen Absorption Technology

Direct oxygen uptake can effectively inhibit the growth of IL layer and even achieve the effect of ZIL. But there are still some problems in the process of direct oxygen absorption, because the process requires the addition of other metal elements in the high k dielectric layer or in the high k layer, which means that the entire high k dielectric layer will be changed, the characteristics of the high k dielectric layer will be changed, and more unknown effects, these effects will bring many difficulties and uncertainties in the performance of the device, which is not what we want to see. The advantages of remote oxygen absorption process is obvious, this technique can effectively inhibit the growth of SiO_2 interface layer in high temperature process, even reduce the thickness of the original SiO_2 interface layer (SHIMAMOTO, D., TOMINAGA, Y., IMAI, Y., & HOTTA, Y., 2016). Secondly, oxygen uptake by remote oxygen uptake is not the element and has not spread to the high k dielectric quality layer, so there will be no change to a series of problems of high k dielectric layer components of chemical elements bring. A possible mechanism for the process is to be realized: In the process of high temperature annealing, the M3 elements in TiN are taken first. Oxygen atoms in a part of HfO_2 and the formation of M3 metal oxides, at this time, in the HfO_2 will be generated and the oxygen atom of oxygen. After that, the oxygen vacancies are filled with oxygen atoms released from the SiO_2 layer of the IL, while the SiO_2 layer of the IL is decomposed into Si and oxygen. And the other possible mechanism is: in the process of high temperature annealing, as the external oxygen can not enter into the high K and SiO_2 interface, the interface SiO_2 is decomposed at high temperature, SiO_2 decomposition of oxygen generated by the diffusion of K is close to the M3 element to absorb the formation of M3 elements of the oxide (Nagy, B., Nehme, S. G., & Szagri, D., 2015).

2.5. Metal Sub Wavelength Periodic Structure of Terahertz Band Stop Filter

The low frequency band, which is between the waveguide mode and the surface mode, is very obvious, and can be a band stop filter with good performance, and the parameters of the stop band can be adjusted by the structural parameters, such as changing the size of the two plate spacing can change the size of the stop band. And the structure is a band stop filter: with the decrease of w , the curve of waveguide mode tends to be flat, and the stop band at the higher frequency band is gradually increasing, and the initial frequency is decreasing, which makes the pass band of the two stop band become smaller. In $w=d$, the pass band becomes small, can not achieve the purpose of band stop filtering. So we consider the two stop band in the middle of the pass band to optimize the filter effect. By the method of dislocation, the purpose of this can be achieved. The improved structure of the two-dimensional front view is shown in Figure 3, the upper and lower two parallel plates have a displacement of L .

The structure of the dislocation displacement $l=0.5d$ after optimization, by changing the other parameters of the structure to observe the change of its characteristics.

After the dislocation structure can still adjust the size of the w to adjust the size of the stop band. As w decreases from $2.3d$ to $0.5d$, the stop band width increases from $0.01c/d$ to $0.2c/d$, when $w=2d$ and $w=2.5d$ are fine tuned, the theory can achieve narrow band filtering function ". But from the simulation results can be seen as a narrow band stop filter its characteristics is poor, in the future work should be further optimized.

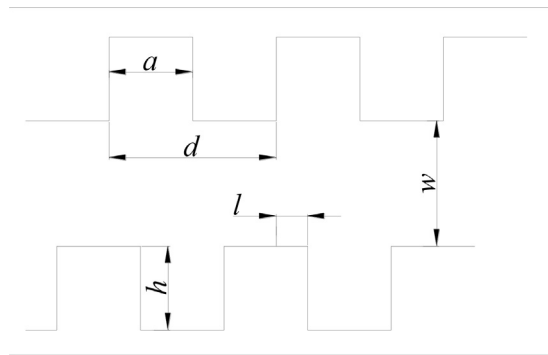


Figure 3 – After the Improved Filter Structure of Two-Dimensional View

3. Results and Analysis

The value of the L of the rectangular cavity length is 150 nm, 200 nm and 250 nm, respectively, when the cavity length of the cavity filter is longer, L , the resonance wavelength is longer and the number of standing waves is more, the result is in agreement with the experimental results, as shown in Figure 4.

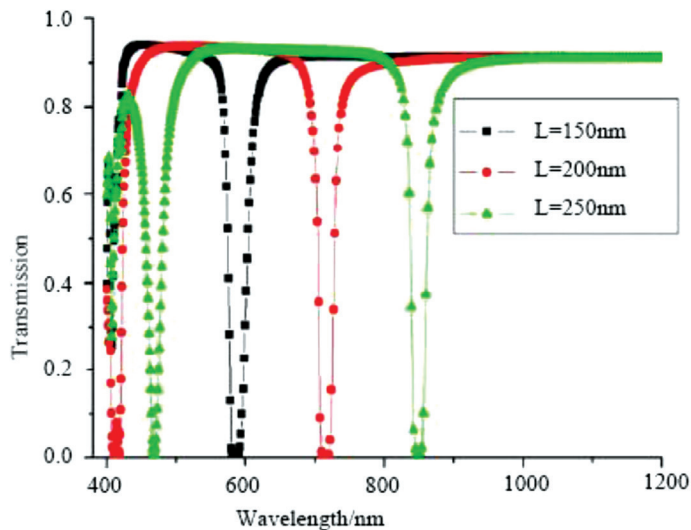


Figure 4 – The Transmission Spectrum of the Rectangular Cavity Length

The need to be raised is discussed in this paper, the medium filled in the rectangular cavity is the air, and the shape of the optical waveguide is determined by the shape of the hole filled medium and the single hole, so by changing the dielectric constant of the rectangular cavity medium, will get more different results. In addition, in the far

infrared, or near infrared band, Tsai, Ming-Wei pointed out when perpendicular to the polarization direction of the rectangular resonant cavity length is close to half of the periodic array of lattice constants, corresponding to the surface modes would appear splitting phenomenon. Its corresponding transmission peaks of the degenerate and the formation of two separate transmission peaks. This phenomenon can be realized on the EOT phenomenon again, May provide new ideas and methods for the manufacture of new related nano photonic devices.

4. Results

With the continuous development of nanotechnology, Nano photonic devices have become the basic components of the realization of the special functions of light wave control, which are also the basic devices achieving the ultimate optical path integration. And the filter is one of the commonly used devices. This article introduces the Terahertz technology's basic research and the extraordinary optical transmission of terahertz technology on a metal thin film of subwavelength hole array, designs the terahertz band stop filter with metal sub wavelength periodic structure combining with the communication theory of electromagnetic wave in metal sub wavelength periodic surface structure, and through the simulation analysis, it is concluded that the filter can be realized in theory, but it's specific parameters need to be adjusted in practice.

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Research on Data Processing Technology in Table Tennis Match

Li Peng¹

653776447@qq.com

¹ Department of physical education, Henan Polytechnic Institute, 473009, Nanyang, Henan, China

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Abstract: (reason) with the continuous development of information technology and the scale of the industry data, data processing technology continues to mature and gradually applied to the field of development. Data processing is a technology that is not trivial, implicit, unknown, and potentially valuable information from large scale data. With the development of the sports information industry, it has accumulated a large amount of data. The data processing and application in the field of sports field, especially the analysis of the data of the competitive sports competition will become a trend. (Method) this paper discusses the application of data processing in table tennis match, which is based on the study of the field knowledge and the technology of data processing. (Results) the statistical analysis system of the technical and tactical statistics of table tennis of match, and the analysis of the technique and tactics of table tennis match with computer. The problems caused by the main use of the manual are solved.

Keywords: Table tennis; data processing; tactical behavior; clustering analysis.

1. Introduction

With the rapid development of computer technology and network technology, people have ushered in a new era of information and knowledge as the main characteristics of the new era. People's contact information, especially the digital information is exponential growth. (Kikot, T., Fernandes, S., & Costa, G., 2015) The amount of information continuously is strong not only give people convenient, it is the more severe challenges. Because of the explosion of information, the dynamic balance between the supply of information and information consumption is broken, and the gap between the two is growing. In the mountains of information library contains plenty of useful knowledge to be extracted, these knowledge as the ripening crops, such as not timely harvesting will be wasted. So, how to harvest the ripe crops in time from the ocean of information, people urgently need a new generation of technical methods and tools to help mining information in the mountains of hidden treasures, and to refine, make it useful knowledge. So, a new research field -- Data processing (Huang, L. K., 2015).

Along with people's understanding and understanding of data processing technology and the significant economic benefits generated by the data processing, the application of data processing in various fields is booming. Such as telecommunications companies,

credit card companies, insurance companies and securities companies to use data processing techniques to detect fraud; medical applications through data processing to determine the effect of some of the methods may be used to treat a disease, the supermarket use of data processing and analysis of transaction data, to improve sales of goods on the shelf, the financial sector to use data processing technology to find a customer, consumer groups or organizations of financial and commercial interest, and can observe the changes in financial markets (Baporikar, N., 2015).



Figure 1 – Table Tennis Sport

After recognizing the function of data processing, the data processing technology has been applied to competitive sports in foreign countries. For example, the American NBA coach to use the data processing tools provided by ADVNAEEDSOCUT BIM to help determine the replacement players, it has achieved good results. At present, about 20 NBA teams use the software system to optimize their tactical portfolio (Liu, Y., Sun, C., Yang, Y., Zhou, M., Zhan, W., & Cheng, W., 2016). However, in our country, the application of data processing in the field of sports is very little, but it is still in the initial stage, but it has been paid more and more attention. With the gradual realization of China's sports information, in the field of sports has accumulated a lot of data, how to make full use of these data and found valuable, but has been neglected important information, has become an important task of scientific research. Table tennis is a competitive sport event, which not only requires the athletes to have higher level of technology, but also has a higher demand for the use of tactics. In many times, it is necessary to apply the data processing and knowledge discovery in table tennis match. The purpose is to find out the valuable information and knowledge from the database.

In recent years, the use of information technology to produce and collect data has greatly improved the ability to use a database for business management, government office, scientific research and engineering development, and so on, and this momentum will continue to develop. Thus, a new challenge has been raised: in this era of information explosion, the information is almost become a problem for everyone to face (Anamaria, B., 2015). How can we not be overwhelmed by the vast ocean of information, find timely and useful knowledge, to improve the utilization of information it? To make data truly become

a company's resources, make full use of it only as the company's own business decision and strategic development services to, otherwise a large amount of data may become garbage, and even become a burden. Therefore, in the face of people's desire to acquire knowledge but may be the challenge of data mining, data mining and knowledge discovery (DMKD) technology came into being, and to flourish, more and more show its strong vitality. Data mining technology is the result of research and development of database technology. At first, all kinds of business data is stored in the database of the computer, and then to the database query and access, and then to the database of real-time traversal (Meynard, T., 2016). Data mining makes the database technology into a more advanced stages, it can not only query and traverse past data, but also can find out the potential connection between the data, so as to promote the production of useful information. Now data mining technology in commercial application has been able to put into use, because the technology to support the three basic technologies (massive data collection, powerful multi-processor computer, data mining algorithm) has been developed.

FRIEDMNA lists stimulate the development, application and research of data mining in four main technical reasons: first, the emergence of large scale database, such as commercial data warehouses and computer automatic collection of data records; second, advanced computer technology, such as faster and more powerful computing ability and parallel system structure; third, rapid access to the huge amount of data; the fourth, on these data using sophisticated statistical methods to calculate the ability (Prior, M., Sood, G., & Khanna, K., 2015). Commercial databases now to an unprecedented growth rate and data warehouse is widely application in various industries; on the computer's hardware performance is more and more high requirements, can also be used now has been the development of mature parallel multiprocessor technology to meet; additional data dig mining algorithm after the 10 years of development has already become a mature, stable and easy to understand and operate. The core module of data mining technology has been developed for several decades, including mathematical statistics, artificial intelligence and machine learning. Today, these mature technologies, coupled with the high performance of relational database engine and a wide range of data integration, so that data mining technology in the current data warehouse environment has entered a practical stage.

2. Technical Method

2.1. The Research Content of Data Processing Technology

The task of data processing is to find the pattern in the data. The patterns can be found in two categories: descriptive and predictive models. The description model is a description of the facts that exist in the current data, and describes the general characteristics of the current data. The forecasting model is based on the time series data, the time series data, according to its history and current value to predict its future value (Miller, A. M., Gruskin, S., Cottingham, J., & Kismödi, E., 2015). According to the pattern feature, this pattern can be roughly subdivided as follows: first, the classification pattern classification is to construct a classification function (classification model), to map the data items with some features to a given class. The process consists of 2 steps: model creation and model use. The model establishment is to build a classification model by learning the training

data set. The model uses the classification model to classify the test data and the new data. Where the training data set is labeled with a class, that is, the category to be divided before classification is already determined. The classification model is usually given in the form of classification rules, decision trees, or mathematical expressions. Second, clustering pattern clustering is to divide data into several classes or clusters, the data should be as large as possible, and the difference between the two classes should be as small as possible. Different from the classification model, the classification of the classification is unknown, and it is a kind of non-supervised learning, which does not depend on the pre-defined class and the training data set with class labels. Third, the association pattern is the association rule between data items, which is the correlation between the different items in the same event, such as the correlation between the different commodities purchased by customers in the same time (Casanoves, M., González, Á., Salvadó, Z., Haro, J., & Novo, M., 2015). The basic idea of the algorithm is that the frequency of the multiple products in the purchase of a variety of goods, and then the frequency of the collocation to convert into association rules. The core of the algorithm is: the result of the previous scan database to generate a scan of the candidate project set, so as to improve the efficiency of the search. Subsequently, a lot of association rule processing algorithms are proposed. The main work focuses on how to improve the production efficiency and reduce the computational cost. Fourth, it sequence patterns: sequence patterns are regular or trends that are often occurring in time or other sequences, and their modeling. A typical example is: in the purchase of PC customers, 70% of the people will be in the first half of the purchase of memory. The pattern of sequence pattern is combined with the time series model, and the relation between the data is the key consideration. There are three parameters influence the sequence pattern processing results: sequence of duration t is the effective time of a time series or a user selected time periods; folding time window W is less than or equal to t , the events occurring within a certain period of time can be viewed as occurring at the same time; have found patterns in a time interval. Fifth, regression model: the function definition and classification model of regression model are similar, the main difference is that the classification model is used to predict the discrete values (such as the class label), and the regression model is used for continuous prediction. In this view, the classification and regression are all forecasting problems. But in the data processing industry, it is generally considered that the forecast of the class label is classified, the predictive value of continuous (for example, using the regression method) for the prediction of 91. Many problems can be solved by linear regression, which can be used to solve the problem of linear problems. Sixth, the deviation model: the deviation model is the description of the difference and the extreme cases, such as the outliers outside the cluster. Most of the data processing methods are considered as noise and discarded, however, in some applications, the rare data may be more useful than normal data. For example, credit card fraud detection, by detecting a given account with the normal pay in the history compared to the amount of payment in particular, the abnormal data is based on the abnormal data to find the credit card is fraudulent use (Khodwe, A., & Wadhankar, V. R., 2015).

2.2. Data Processing Method

As an example, it is one of the main methods of data processing, and it is getting more and more attention. In this section, the definition, the main data structure and the

K-MENAS dynamic clustering algorithm are briefly introduced. Then the application method and the process of clustering analysis in the technique and tactics of table tennis match are introduced.

Clustering is to divide data objects into multiple classes, which makes the objects in the same class have a high degree of similarity, and the objects of different classes have low similarity. Its definition is as follows:

Given the data set D of N object, defining the distance function (similarity) DF: $D \times D \rightarrow R$, given a positive integer.

K, the clustering problem is: the data collection D is divided into k parts ($Cl_1, Cl_2 \dots Cl_k$) the formula (1) is the smallest, and the Disp () is defined as the formula 1, and REPI is the representative of the Cl_i .

$$DISP = \sum_{k=1}^k disp(Cl_i, rep_i) \quad (1)$$

$$disp(Cl_i, rep_i) = \sum df(p, rep_i) \quad (2)$$

Typical data structures: a number of memory based clustering algorithms are chosen as the following two representative data structures:

$$\begin{bmatrix} x_{11} & x_{12} & \dots & x_{1p} \\ x_{21} & x_{22} & \dots & x_{2p} \\ \dots & \dots & \dots & \dots \\ x_{n1} & x_{n2} & \dots & x_{np} \end{bmatrix}$$

$$\begin{bmatrix} 0 & & & \\ d(2,1) & 0 & & \\ \dots & \dots & \dots & \\ d(n,1) & d(n,2) & \dots & 0 \end{bmatrix} \quad (3)$$

Dissimilarity measure: Dissimilarity is a generalization of the concept of distance. It can not only express the interval scale variables, but also express the two variables, nominal, ordinal and proportional scale variables, or the combination of these variables to describe the dissimilarity of the object. Interval scaling variable is the continuous quantity of linear scale. Selection of measurement units will directly affect the results of clustering analysis, such as the height of the measurement unit by the “m” to “cm”, may have different results. In order to avoid the dependence on the selection of measurement units, the data should be standardized, so that all the variables have the same weight. Given a variable F, the measurement value can be carried out as follows:

$$S_i = \frac{1}{n} (|x_{1f} - m_f| + |x_{2f}^2 - m_f| + \dots + |x_{nf} - m_f|) \quad (4)$$

A is the n measure of mf, and it is the average of f:

$$m_f = \frac{1}{n}(x_{1f} + x_{2f} + \dots + x_{nf}) \quad (5)$$

Calculate the standard value:

$$Z_{if} = \frac{x_{if} - m_f}{s_f} \quad (6)$$

2.3. Classification of Data Processing Method

First, the script description language: according to the actual characteristics of the table tennis match, the system proposed a set of skills and tactics of the table tennis match. The script description language defines a set of symbols for describing various techniques and tactics of table tennis match. Script description language is an innovative design, and it is proposed to solve the problem of large numbers of technical and tactical data in table tennis match. Second, the association rule analysis application in analyzing technique and tactics of table tennis match: algorithm of association rules analysis, dig out the techniques and tactics of the correlation between the players and the players, namely a player in the game and player B, using what tactics will make their points, use what tactics will make their marks. Third, it's clustering analysis of the application of the technique and tactics of table tennis match: application of clustering algorithm in the dynamic clustering algorithm, mining out the table tennis match with the high cohesion of the technical action, which is the combination of technical action with the use of the highest frequency. Fourth, based on Markov process of the data mining algorithm and its application in the analysis of technique and tactics of table tennis match this paper put forward a kind of new data mining methods, namely Markov process based data mining method. Through this kind of mining method, we can find out the influence of the technology which is from the service to the success of the whole process (Jyothi, S. M., & Kumar, M. J., 2015).

3. Data Analysis

According to the results of the system analysis, the system structure frame, function structure frame and database design model of the system are introduced.

3.1. Data Acquisition

In charge of the technical and tactical data collection, it includes two methods of mouse clicks and script input. Mouse click through the mouse button to capture the data of the game technology and tactics, script input: through the keyboard input (Kiruthika, S., Kanimozhi, G. V., & Sakthivel, P., 2015).

3.2. Data Processor

IT has in charge of comprehensive statistical analysis of various technical and tactical data, and including data statistics and tactical analysis. Data statistics: the general

statistics of the technical and tactical data, such as the success rate of the service, the success rate of the attack, and the comprehensive analysis of the techniques and tactics.

3.3. Coach

They are to realize the collection of the data of the competition and tactics, and to inquire the results of the statistical analysis.

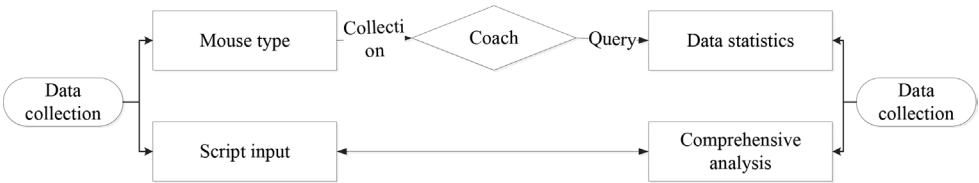


Figure 2 – System Architecture Diagram

3.4. System Structure Frame

This system is divided into four modules, which are composed of several sub modules and two sub modules, and finally form a compact structure, compact, clear, complete table tennis game technical and tactical statistical analysis system. As shown in figure (Anusha, J., & Priya, K. L., 2015).

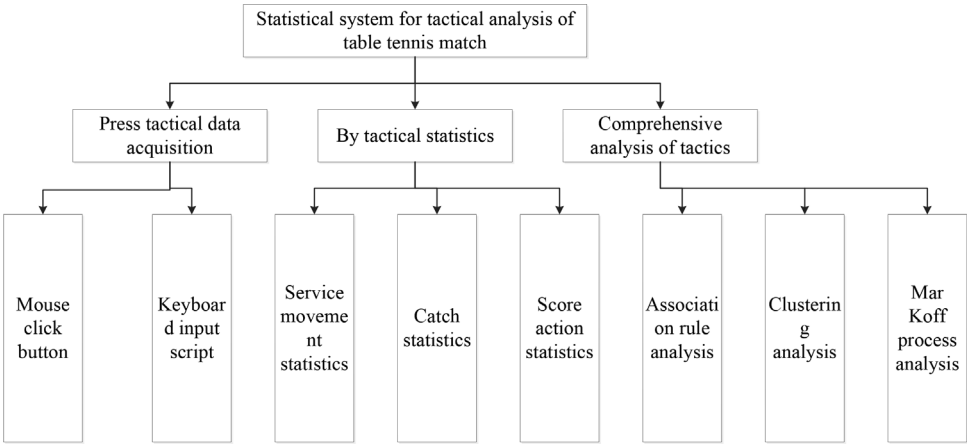


Figure 3 – System Function Structure

3.5. Database Design

This system has designed a database, in this database, and the following 5 tables are established:

Match table, store information about the game.

Coach table, store the relevant information of the coaches.

Technical type table, it is stored in the script description language, which represents the technical type of character.

Action type table, it is stored in the script description language to represent the action type of character (Anitha, J., & Rangarajan, R., 2015).

Table tennis table tennis table, and stored in the script to describe the language of the table tennis table tennis figures and characters.

Match time	Statistics	1
Competition content	Statistics	2
Place of competition	Statistics	1
Nature of competition	Statistics	0

Table 1 – Match-Table

Coach number	text	20
Coach name	text	20
Coach gender	text	10
Coach photos	text	30

Table 2 – Coach-Table

Technical type number	Data	Number
Technology type name	text	50
Technology type alias	text	50
Remarks	text	

Table 3 – Technical Type Table

Skill number	Data	Number
Skill name	text	20
Skill alias	text	20
Remarks	text	

Table 4 – Action Type Table

Track number	Data	20
Track name	text	50
Track alias	text	50
Remarks	text	

Table 5 – Action Type Table

3.6. Tactical Data Processing

In this system, the data acquisition of the technical and tactical data of table tennis match is carried out by using the mouse clicks and keyboard input script. Here are two ways to introduce (Zhang, W., Jiang, S., Zhu, X., & Wang, Y., 2016). The input data is the traditional input technology through the mouse, although the speed is not the advantage, but if the clever design of the input interface, its speed can also meet the requirements of table tennis game technology and tactical data. Therefore, the key to the mouse click on the input mode is how clever, reasonable design of the input interface to improve the input speed. Through the system of a lot of the previous table tennis match data statistics obtained ten use the highest frequency of technical and tactical actions. To this kind of technical and tactical action script combination code into mnemonics, each mnemonics made a button (a button control settings in the data mining on both sides of the window set, has been proved through practice, such a design is conducive to improve the efficiency of input is a more reasonable interface design.

3.7. The Research Results of Domestic Tactical Analysis

In 2000, Yang Li, Zhang Xiao Peng in the Sino South Korean women table tennis technical and tactical characteristics of comparative study by of China and South Korea women table tennis technical and tactical characteristics analysis, that China and South Korea women's team in the world table tennis circles will be leading the trend of the team. In the future of the world competition, South Korea will become the main rivals of the Chinese women's team, if our country does not work hard in training, it is possible to be catching up South Korean women's team.

In 2004, Jin Liang Li et al, using three segment method at the time of the Chinese table tennis men's team's main rival Boer, Zhuang Zhi Yuan, Samsonov, sever, oh sang Eun and Ryu Seung Min were microscopic analysis and put forward the corresponding countermeasures. And put forward in the table tennis instead of ball and the execution of the n points after three index method is necessary step, large sample to study, on each segment, the evaluation criteria modified. They are in order to continue to maintain the objectivity and accuracy of the traditional research methods (Rodrigues, W., & Weijermars, R., 2016).

In 2005, chapter our road in 2005 in the "analysis of the phenomenon of downturn on Wang competitions" by Wang Hao in the 2002 Egyptian open to Samsonov, 2003 world cup of Ryu Seung Min, 2004 Athens Olympic Games will to Ryu Seung Min, in 2005 the 48th World Table Tennis Championships of Metz four games technical indicators and scoring method scoring and losing situation comparative analysis, find out the competition results decline reason`.

In the future; and Wang Li Qin in the 48th World Table Tennis Championships in table tennis technical and tactical weaknesses analysis, using three index analysis and evaluation method of Wang Li Qin three scoring rate and utilization rate of offensive and defensive effect of statistical analysis, find out Wang Li Qin in game tactics weaknesses, 'that serves assaults, then aggress enough positive initiative, backhand ball in strength, speed, spin and forehand compared to a certain gap; to Taiwan in the ball the lack of effective attacking means forehand swing short capability is relatively weak, receiving

a short swing effect is not ideal; the game “slow” phenomenon more obvious for table tennis training and preparing for the 2008 Beijing Olympic Games will provide reference.

4. Conclusion

Table tennis ball into the era, each game also reduced to 11 points, making the competition process greatly shortened. Put forward higher requirements for athletes, only to quickly enter the state of the game, the constantly changing tactical data processing, play to their talent, every minute, reduce errors, in order to seize the game dominance. The idea of data processing in table tennis is that players should work hard, increase the strength, speed up the speed and strengthen the rotation. In order to make the tactical behavior toward faster, newer, more ruthless direction development must make tactical structure more reasonable [16]. So, data processing is especially important. In this paper, the K-MENAS dynamic clustering algorithm is applied to mine the technical action combination, which is the most frequently used in table tennis competition. The experimental results show that the data processing method in the table tennis game technology and tactics analysis, but in the table tennis match technology and tactics data also hide a lot of not found deeper information, how to find these information through data mining method to be further studied.

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Application of GPS Based Intelligent Dispatching System in Public Transportation

Luo Tian^{1,*}, Zhang Yunjiao¹, Zhao Jianyou¹

* ltyangliuan@163.com

¹ School of Automobile, Chang'an University, 710064, Xi'an, Shaanxi, China

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Abstract: Object: To overcome stochastic and uncertain factors in the actual operation of urban public transport vehicles, such as unexpected accidents, failures and so on, thus promote the widespread use of public transportation .Method: Dynamic public transportation dispatching based on GPS is employed. Process: The GPS based intelligent dispatching system consists of five subsystems: computer network system, communication system, GPS vehicle positioning system, large screen display system and dispatching platform system, and we build a vehicle operation model and further bring up the dynamic dispatching policy, through a series of mathematical deduction we finally have linear quadratic form of dispatching method. Result&Analysis: the system is effective in accurate and scientific dispatching decisions making, consequently realizing real-time monitoring and dispatching of public transportation, adjusting quickly to changes in the operational status of the bus and improving the efficiency of vehicle operation.

Keywords: Transportation system; GPS; intelligent dispatching system.

1. Introduction

With accelerating pace of urbanization and the increasing traveling demand, urban traffic pollution has become a common problem for all countries in the world (Wan, J., Liu, J., Shao, Z., Vasilakos, A. V., Imran, M., & Zhou, K., 2016). The key to solve the problem of urban traffic is calling people to use public transportation, such as buses, subways, etc. as much as possible. To achieve this goal, we must improve the quality of public transport services, so that people can really feel the public transport vehicles convenient, economical, reliable, fast, and so on. Intelligent transportation system has been paid more and more attention, and has become an important development direction of modern traffic engineering. The intelligent transportation system uses the communication and the information technology in the transportation, thus enhances the transportation ability, improves the transportation security, reduces the transportation to the ecological environment pollution. It is a new value-added network based on the original traffic network, which is the core of which is the use of advanced communication network and a variety of application information systems (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015).

Scientific bus dispatching is to improve the quality of public transport services. The optimal operation of the system cannot be guaranteed by the static scheduling, and the dynamic

scheduling is very important at this time. (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015) Dynamic scheduling for a work means the according to the road traffic situation, running state of the vehicle, emergency and other real-time information, modify the provisions of the vehicle running time table, to ensure vehicle punctuality rate, car interval to maintain set service level to it. Dynamic scheduling includes two aspects: scheduling scheme for real-time adjustment, namely line scheduling and cross line scheduling; operational monitoring, electronic bus stop board real time information display. Dynamic scheduling is discussed in this chapter, on the basis of static scheduling of public transit vehicles, the introduction of more mature GPS positioning technology, the scheduling of real-time adjustment. Due to the cross line scheduling involves more complex regional scheduling system, considering the length is limited, so this chapter focuses on is the real-time adjustment of a single line scheduling scheme (Batra, P., 2015).

2. GPS Based Intelligent Dispatching System

Dynamic scheduling, in addition to the location of the GPS positioning system to determine the location of the bus, but also need to continue to carry out information transmission between the mobile vehicle and the dispatch center, dispatching center to send the dispatching command and control information to the mobile vehicle, and mobile vehicles must continue to return to the control center of the mobile vehicle operation information (such as vehicle location, speed, etc.), to achieve the control center for the intelligent management of mobile vehicles. So another key of the dynamic scheduling system based on GPS is the determination of the means of communication between the mobile vehicle and the management center and the determination of the information processor of the vehicle mobile terminal (Shanthi, S., & Padmashree, A., 2015). Wireless communication must be used to manage the communication between the vehicle and the dispatch center. There are two types of wireless communication: one is based on GSM or CDMA, the public mobile network communication; the other is based on the cluster communication system or conventional radio station using a special network. Conventional radio stations need to apply for frequency points. Due to a lot of vehicles, each vehicle is constantly sending out information, to make it do not interfere with each other, the need to apply a lot of frequency points, and its communication range of tens of kilometers, so it is only used in the local area of the vehicle intelligent management and scheduling. The mobile network communication mode has a wide coverage, high reliability and large capacity, and it is suitable for the wireless communication between multiple targets in the wide area. So the dynamic scheduling system introduced here uses the public mobile network based on GSM as a means of communication between the mobile vehicle and the management dispatching center.

GPS-GSM intelligent public transportation dispatching management system based on, combined with the GPS technology, geographic information technology, sensor technology and wireless communication technology, electronic map (GIS) based by on buses, traffic and road information collection, transmission and processing, effective decision-making information, and can respond to the dispatch center of instruction, make the scheduling decision more accurate and scientific, to realize the real-time monitoring and dispatching of public transit vehicle, adjust quickly to changes in the operational status of the bus, improve the efficiency of vehicle operation. System through the interface with the external system to improve safety monitoring and coordinating

emergency search and rescue services, and in bus stations along the electronic bus stop board to provide passengers with real-time vehicle operating conditions and up to vehicle information, help passengers to choose the best travel, starting time and change the way the car, bus dispatching intelligent operation and management modernization, greatly improve the bus service level and public enterprise modernization management level (Tabassum, M., Razzaque, M. A., Hassan, M. M., Almogren, A., & Alamri, A., 2016; Guerrero Ibanez, J., Zeadally, S., & Contreras-Castillo, J., 2015).

2.1. The Composition of GPS Based Intelligent Dispatching System

The GPS based intelligent dispatching system consists of five subsystems: computer network system, communication system, GPS vehicle positioning system, large screen display system and dispatch platform system.

2.2. Dynamic Scheduling Policy

In the daily operation of public transport lines, the service of public transportation is irregular, and it will be affected by many unexpected factors. Therefore, the scheduling problem is very complicated. There are many factors that can not be predicted accurately (Sari, A., Onursal, O., & Akkaya, M., 2015). Dynamic scheduling is the main purpose of these accidents, the implementation of temporary scheduling measures to eliminate adverse effects, reduce the actual driving situation of public transport vehicles and travel plans to schedule the gap between.

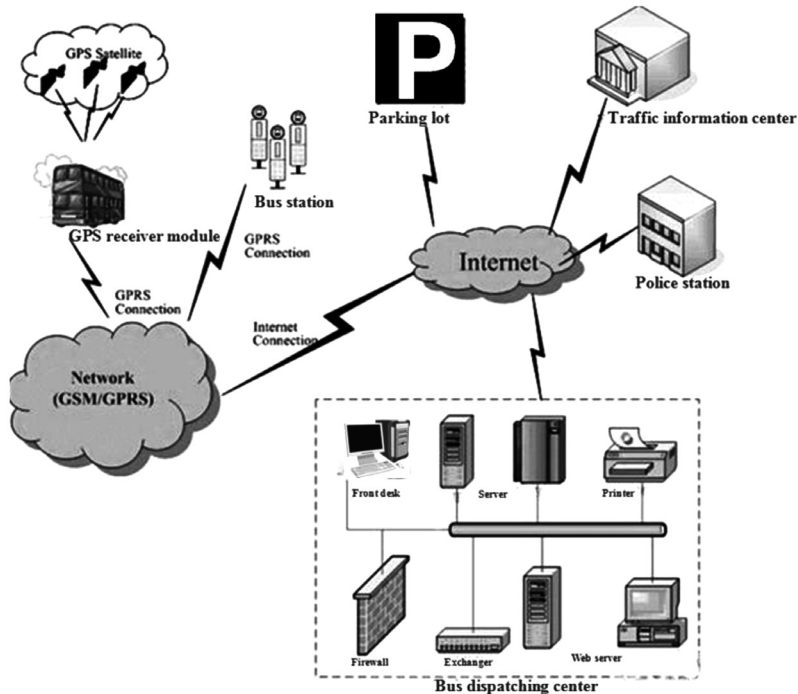
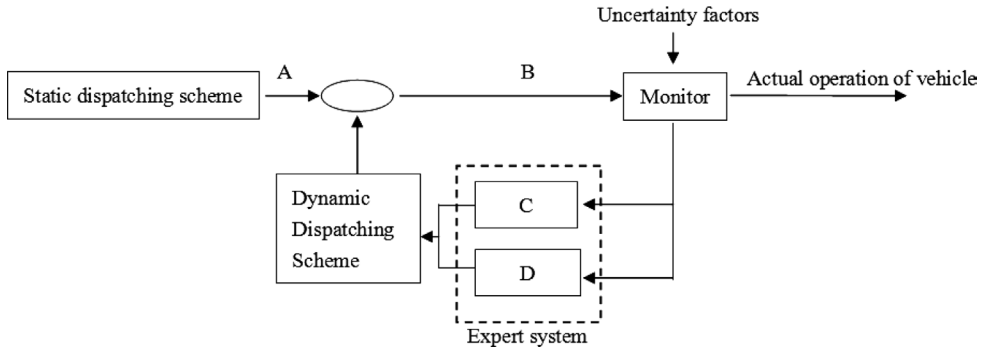


Figure 1 – Schematic Diagram of GPS Based Intelligent Dispatching System

With the help of the public traffic intelligent dispatching system based on GPS, the dispatcher can make full use of the actual operating condition of the vehicle and the experience of the human.

Scheduling strategy is: when the static scheduling scheme is used, the original scheduling scheme can not run normally due to the change of the passenger flow or all kinds of unexpected events. At this time, the dynamic scheduling strategy is applied to the actual operation of the vehicle.



A: The practice of Static dispatching scheme; B: The practice of dynamic dispatching scheme; C: Real time control on time; D: Emergency dynamic dispatching.

Figure 2 – Schematic Diagram of Dynamic Dispatching Principle of Public Transportation Vehicles

2.3. Expert System

Expert system is a kind of system with reasoning ability, which can be adapted to a variety of problems by the expert knowledge and experience of the experts in a particular field (Estape, E. A., Mays, M. H., & Sternke, E. A., 2016; Aruleba, K. D., Akomolafe, D. T., & Afeni, B., 2016). The expert system consists of expert knowledge base, inference engine and user interface and its components are as follows:

Knowledge base: Knowledge base is a place where knowledge is stored, which is composed of knowledge representation, knowledge representation, restriction and description. It contains two basic elements are facts and rules, the facts of the situation, the rules can guide the use of knowledge to solve the problem of scheduling personnel, knowledge base, the main storage of professional scheduling personnel experience, the actual investigation and collection of statistical information and public transportation enterprise scheduling rules, and can be updated regularly with the knowledge of the project.

Inference engine: Expert system process control is completed by the inference engine, as long as the input data conditions and the knowledge base of the internal conditions to adapt, and then start the internal rules of the implementation of the relevant. In this study, we use the forward inference method and data driven reasoning.

The flow of the system is as follows (Zuo, C., Sun, J., Feng, S., Zhang, M., & Chen, Q., 2016): (1) by the system automatically or manually input by the dispatcher related information, performs the inference link library; (2) when reasoning decision rules to be executed, the first placed on the agenda of the system according to the weight or the sequence out execution, and from the knowledge base in selected to adapt to the fact of the rules, to reference for decision makers.

3. Method of Dynamic Dispatching of Public Transportation Vehicles

When the operation condition or other conditions of public transport vehicles are changed, it is required to respond quickly, but only when the dynamic change range is big enough, the scheduling strategy is adopted, and the change range is not very large (Mascali, D., Castro, G., Biri, S., Rácz, R., Pálinkás, J., Caliri, C., ... & Gammino, S., 2016).

Scheduling and adjusting of public transportation vehicles can be regarded as a feedback control of time axis, which includes the monitoring and tracking of the vehicle. Encountered traffic delays encountered operating vehicles (such as the emergence of vehicle traffic jams, accidents), the need to adjust the original schedule for the line scheduling program, there are usually two ways to solve the problem (Bayliss, T. J., 2016):

1. The start time will be affected by the interference of the operating vehicle in the time axis to move;
2. Replacing the corresponding traffic failure of public transport vehicles. Specifically, it is through the online adjustment of the traffic interval, adjust the number of stops in the middle of the road (the method is likely to lead to the temporary stop station waiting passengers, but the measure is in the vehicle delay, while the station more effective way), adjust the traffic section or the replacement of other operators, get a good feasible solution near the initial scheduling. Line scheduling can be based on the scheduling object is different, is divided into the start interval adjustment scheduling and scheduling of real-time adjustment.

3.1. On Line Adjustment of Departure Interval

The online adjustment method of public transit vehicle operation scheduling is a given scheduling system parameters and road traffic information, given the initial scheduling information and dynamic changes, appropriate to modify the initial scheduling, so that the impact of changes on the subsequent operations to achieve the minimum and simple moving method is often used (Gupta, B. K., Sarkar, U. K., & Bharadwaj, S. K., 2015).

Simple moving method is to eliminate the interference by changing traffic interval to spread the interference to the follow-up operation, so that the operation to a feasible solution has not been implemented. According to the direction of the time variation of the scheduling process, 4 different kinds of mobile strategies are: forward, backward, bidirectional and not moving.

3.2. Real Time Adjustment and Dispatching of Intermediate Terminal

Adjust the real-time midway station (also called real-time control on time) refers to measures to supervise and control the line stops, statistics, records of vehicle operation, to provide information for vehicle dispatch room, adjust the command according to the dispatch room issued, take corresponding measures to control the scheduling: stop the timetable and the actual vehicle stop at the time of recording, had arrived ahead of plan to control the car, out of the station on time, to ensure the capacity of traffic between the lines and the vehicle uniform normal control; the later passenger crew in this station, many vehicles arrive at the same time, the command crew in the late skip stop. The boarding station, reduce delays car transport pressure, temporary change to send the shuttle bus or express. From the current implementation of the operation, estimated that all is in the implementation of the operation time, the start time of the operation has not been properly carried out, according to the possible occurrence of unexpected events and traffic conditions at any time online to adjust the operating vehicle traffic order, the interval and adjust the vehicle segment, in order to timely and effective performance of vehicle operation task (Parashar, S. K., & Sharma, P., 2016).

1. Related definition

The bus stop under control $k=0,1,2,\dots,N$.

The bus under control $i=0,1,2,\dots,m$.

$a_{i,k}$ stands for the time when the bus i arrives at the bus stop k .

$d_{i,k}$ stands for the time when the bus i departure the bus stop k .

$s_{i,k}$ stands for the time the bus i stops at the bus stop k .

$R_{i,k}$ stands for the time the bus i takes from the bus stop k to $k+1$.

$r_{i,k}$ stands for the rate of passengers get to the bus stop between the bus $k-1$ leaves the stop k and the bus i get to it.

$q_{i,k}$ stands for the aboard rate of passengers at the bus stop k .

$x_{i,k}$ stands for the error between actual arriving time and planned time of bus i get to stop k .

$u_{i,k}$ stands for the control time of bus i at the bus stop k .

$K_{i,k} = \frac{r_{i,k}}{a_{i,k}}$ stands for *value of arriving rate and aboard rate*, we make $\delta_{i,k} = 1 - K_{i,k}$.

2. Built of the model

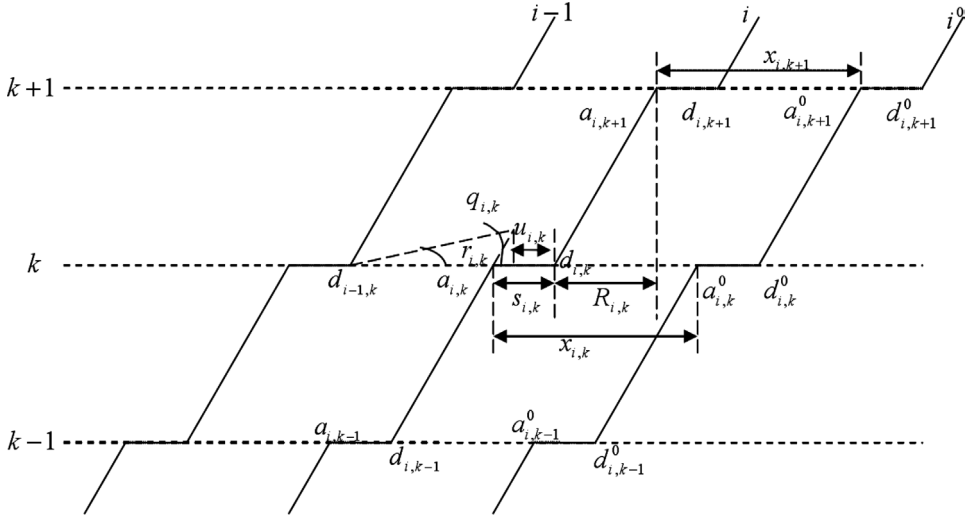


Figure 3 – Schematic Diagram of Vehicle Operation

The time passengers get on bus i at stop k : $m_{i,k}$

$$m_{i,k} = \frac{r_{i,k}}{q_{i,k}} (d_{i,k} - u_{i,k} - d_{i-1,k}) = K_{i,k} (d_{i,k} - u_{i,k} - d_{i-1,k}) \quad (1)$$

Thus the time bus i stops at stop k : $s_{i,k}$

$$s_{i,k} = K_{i,k} (d_{i,k} - u_{i,k} - d_{i-1,k}) + u_{i,k} = a_{i,k+1} - a_{i,k} - R_{i,k} \quad (2)$$

$$s_{i,k}^0 = K_{i,k}^0 (d_{i,k}^0 - u_{i,k}^0 - d_{i-1,k}^0) + u_{i,k}^0 = a_{i,k+1}^0 - a_{i,k}^0 - R_{i,k}^0 \quad (3)$$

We define that the variables with superscript is related with timetable (the planned timetable of bus) and the variables without superscript is the actual operation of the bus.

Here $u_{i,k}^0 = 0$, $K_{i,k} = K_{i,k}^0$, $x_{i,k} = a_{i,k} - a_{i,k}^0$

Additionally we assume $W_{i,k} = R_{i,k} - R_{i,k}^0$ to stand for the error of travel time of bus i takes from the bus stop k to $k+1$.

From (2) – (3), we can have,

$$s_{i,k} - s_{i,k}^0 = x_{i,k+1} - x_{i,k} - W_{i,k} \quad (4)$$

$$s_{i,k} - s_{i,k}^0 = K_{i,k} \cdot x_{i,k+1} - K_{i,k} \cdot x_{i-1,k+1} - (1 - K_{i,k}) \cdot u_{i,k} \quad (5)$$

(4) – (5), we can have (6) after processing:

$$\delta_{i,k} \cdot x_{i,k+1} = x_{i,k} - K_{i,k} \cdot x_{i-1,k+1} + \delta_{i,k} \cdot u_{i,k} + W_{i,k} \quad (6)$$

By which we can finally deduce the model of real time adjustment and dispatching of intermediate terminal as follows:

$$X_{k+1} = x_{i,k} - K_{i,k} \cdot x_{i-1,k+1} + \delta_{i,k} \cdot u_{i,k} + W_{i,k} \quad (7)$$

Among which $k=0,1,2,\dots,N$.

$$X_k = (X_{1,k}, X_{2,k}, \dots, X_{m,k}) \in R^m$$

$$u_k = (u_{1,k}, u_{2,k}, \dots, u_{m,k}) \in R^m$$

$$W_k = (W_{1,k}, W_{2,k}, \dots, W_{m,k}) \in R^m$$

When we take dynamic on-time control over the bus, we hope that the bus arrives every bus stop on time, which means $W_{i,k}=0$, so by (6) we can have:

$$\delta_{i,k} \cdot x_{i,k+1} + K_{i,k} \cdot x_{i-1,k+1} = x_{i,k} + \delta_{i,k} \cdot u_{i,k} \quad (8)$$

Further can be expressed in the following way:

$$R_{m \times m}^{(k)} X_{k+1} = X_k + M_{m \times m}^{(k)} U_k \quad (9)$$

In the equation
$$\begin{pmatrix} 1, \\ \vdots \\ m, k \end{pmatrix}$$

$$R_{m \times m}^{(k)} = \begin{pmatrix} k_{1,k} & \delta_{1,k} & 0 & \cdots & \cdots & 0 \\ 0 & k_{2,k} & \delta_{2,k} & 0 & \cdots & 0 \\ 0 & 0 & k_{3,k} & \delta_{3,k} & \cdots & 0 \\ 0 & \cdots & \cdots & \cdots & \cdots & 0 \\ 0 & \cdots & \cdots & \cdots & k_{m-1,k} & \delta_{m-1,k} \\ 0 & \cdots & \cdots & \cdots & 0 & \delta_{m,k} \end{pmatrix}$$

By the theory of matrices, we can know the matrices $R_{m \times m}$ is reversible, so the reversible matrices $R_{m \times m}^{-1}$ exists, we can transfer (9) to $X_{k+1} = R_{m \times m}^{-1(k)} X_k + R_{m \times m}^{-1(k)} M_{m \times m}^{(k)} U_k$ (10), which can be further simplified to $X_{k+1} = A_k X_k + B_k U_k$ when we assume $A_k = R_{m \times m}^{-1(k)}$, $B_k = R_{m \times m}^{-1(k)} M_{m \times m}^{(k)}$ (11), through mathematical deduction we can have linear quadratic form:

$$J_N = X_N^T S X_N + \sum_{t=0}^{N-1} (X_N^T Q X_i + U_N^T R U_i) \quad (12)$$

When the operating conditions or other conditions of public transport vehicles have a great change, only the method of line scheduling adjustment can not eliminate the impact on line operation, which can be used in dynamic scheduling method based on time and event driven. The parameters of the system can be used as the initial condition of the time and event driven method, and the scheduling method based on time and event driven is used. Time scheduling method based on is under the influence of objective condition, vehicle number and reach a time and timetable requirements gap is too large to according to the actual number of cars, one-way travel time, stop time, traffic, traffic interval are calculated and maintain line operation; based on event driven scheduling method is a major activity in the city's arrival on line, bypass, circuit breaker, suspended, etc. traffic organization scheme. According to the superior to determine the line, the calculation of the number of lines of vehicles, one-way travel time and stop time, traffic frequency, to develop a temporary traffic plan and major events after the end of the rapid recovery of the normal operation of the line measures (CHEN, H. K., 2015).

4. The Analysis of Application of Dynamic Dispatching of Public Transportation Vehicles

If the phenomenon of the actual operation of the line, the use of intelligent dispatching monitoring system to effectively monitor the operation of vehicles, in the middle of the station to take the forecast based on genetic algorithm scheduling measures to effectively eliminate the impact of unexpected problems on line operators.

Assuming something happened to the 13th bus stop of a bus, considering the condition of 6 buses is under control, we use the model we have above, hoping the left 12 bus arrive on the time planned, assuming K of every stop is $K_0=0.2$, $K_1=0.2$, $K_3=0.25$, $K_4=0.3$, $K_6=0.1$, $K_7=0.1$, $K_8=0.15$, $K_9=0.1$, $K_{10}=0.1$.

$X_0=(2,3,6,5,6,2)^T$, $X_{11}=(0,0,0,0,0,0)^T$, which means the error of the time that the bus arrive and the planned is zero.

$J_N = X_N^T S X_N + \sum_{t=0}^{N-1} (X_N^T Q X_i + U_N^T R U_i)$ among which $S = \text{diag} (6,2,1,3,2,1)$, $Q = \text{diag} (3, 1, 9, 3, 1, 2)$, $R = \text{diag} (9,1,2,3,2,2)$.

	2.000	1.418	0.817	0.423	0.253	-0.075	-0.149	-0.023	0.021	0.030	0.035	0.017
	3.000	1.595	2.865	2.148	0.685	0.459	0.681	0.453	-0.157	-0.115	-0.059	-0.032
$X =$	6.000	4.862	3.358	1.648	0.891	0.623	0.105	-0.089	-0.081	0.026	0.018	0.023
	5.000	0.231	-1.863	-0.648	-0.687	0.228	0.298	-0.089	-0.081	0.026	0.103	0.026
	4.000	2.675	1.224	0.485	-0.069	-0.152	-0.025	0.392	0.401	0.342	0.036	0.029
	2.000	2.263	1.865	1.213	1.018	0.825	0.732	0.015	-0.056	-0.035	-0.027	0.016

By the principle of minimum, we can have:

On the basis of the above analysis, it is known that the dynamic scheduling method can be used to solve the bus operation vehicles in the presence of delays or failure occurs when the departure interval or large or small phenomenon, thus ensuring a balanced full load of public transport vehicles. This will greatly improve the operational efficiency of the operation of vehicle, improve the quality of service and management of public transport vehicles, so as to achieve the goal of safe, rapid and economic comfort.

5. Conclusion

Based on GPS, we can establish the intelligent transportation system, it can realize the function of remote control and monitoring, and we can ensure the reliability of the transmission channel relying on the GSM network of digital mobile cellular communication system as the wireless transmission network, The processing of the data of the vehicle can help the traffic system to improve the efficiency and save the resources. By supervising and statistic and record, providing the vehicle operation information for the management and dispatching center, the accident rate can be lowered much. At the same time, the initial investment and operating costs are not high, the implementation of the system will be helpful in following aspects:

1. Reducing traffic congestion and traffic delays. With the increase of urban population and active social economic activity, the traffic congestion is increasing, the application of GPS based intelligent transportation system will greatly ease the traffic congestion, save the traffic time and produce economic benefits. By providing effective information services, GPS based intelligent transportation system can help the traveler make the path selection to the network equilibrium system that to be close to the optimal direction, to achieve the uniform of the road network load, can greatly reduce the traffic delay, and achieve efficient use of road resources.
2. Reducing energy consumption, reducing the pollution. Facts show that it is can not completely meet the traffic demand simply relying on transportation infrastructure to solve traffic problems, which will occupy and also consume a large amount of land and fuel resources and caused exhaust emissions, that has brought bad influence to the environment, in the future, large-scale application of GPS based intelligent transportation system, will greatly reduce the transportation energy consumption and pollution of the environment.
3. Many areas of industrial development and employment opportunities increased its design of road construction, communication, computer, electronics, automotive, automatic control, information service and network technology,

with enormous economic benefits of emerging industrial clusters. At the same time, its technology development and market demand, will promote the development of related industries, increasing employment opportunities and promoting the healthy development of the social economy.

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Application of Biological Chip Technology in Sports Field

Shi Ming¹

2608201199@qq.com

¹ Department of leisure and social sports, Harbin Institute of Physical Education, 150090, Harbin, Heilongjiang, China

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Abstract: Biological chip technology has penetrated into all aspects of life, and its application in the field of sports is relatively small. Through the theory analysis of the characteristics of biological chip, the basic principle of technology, and combined with the field of sports, which can predict the biological chip for gene selection of athletes and athletes with different racial comparison of gene sequences, and explore the rules and mechanism of exercise-induced fatigue, and accelerate eliminate fatigue, and improve exercise capacity to provide scientific research and application means. At the same time, the physiological mechanism of human's movement ability could be explored at the molecular level, and enriches the contents of sports physiology and sports genetics. Bio chip in the field of sports will have a broad prospect and greatly promote the development of sports biology and the pace of development.

Keywords: Biological chip; field of sports.

1. Introduction

Since Schena in Stanford University in the United States in 1995 in science magazine, reported the South mustard plant cDNA by PCR amplification after curing on a piece of glass, made the gene chip and intends to different tissues of Arabidopsis gene expression were studied after, just a few years, gene chip has been applied to the life science basic research, diagnosis and treatment of disease, drug screening and development of new medicines and other fields, caused the great attention of experts from around the world. (Ye, S., Wu, Y., Zhai, X., & Tang, B., 2015) There are many different functions and uses of biological chip, which is a high throughput, parallel, large scale and fast speed, and so on. It has many advantages such as high throughput, parallel, large scale and fast speed. At present in the field of Sports Biological Sciences has not been seen in the relevant literature, this paper aims to use a retrospective study and prospective analysis of the combination of methods, tracking and prediction of the development of bio chip and its application in the field of sports science (Yang, G., Zhuang, H., Chen, H., Ping, X., & Bu, D., 2015).



Figure 1 – Biological Chip

2. Classification and Characteristics of Biological Chips

Biological chip technology is a combination of modern molecular biology, bioinformatics and materials science, computer science and micro processing technology, which is the important feature of information highly integrated and peaceful. According to the different biological material, the chip can be divided into gene chip, protein chip, cell chip and tissue chip. Gene chip is one of the most mature chip of the research. (Prata, P., Fazendeiro, P., Augusto, C., Azevedo, S., & Machado, V. C., 2013) International University of Pennsylvania, Stanford, Affymetrix, Syntel, Incyte, and many universities and companies are committed to the research and development of bio chip. From the structure, information and function of the gene, the biological chip is divided into two categories: information and function. Information bio chip including gene chip, cell chip and tissue chip, which is currently the development of chip chip (or microarray DNA, DNA chip, cDNA chip, CDA) and Olige chip, also known as in situ synthesis chip, ONA). (Li, N., Su, X., & Lu, Y., 2015) Biological function of chip at present, the research of a microfluidic chip, including protein chip and lab on a chip, auxiliary ligand chip for cell manipulation. After all kinds of bio chips have been developed in our country, we have studied the electromagnetic type biological chip with independent intellectual property rights, and the single point choice of the electromagnetic array technology and the electric rotation detection technology are first created in the world. (Quertermous, T., & Ingelsson, E., 2016) With the development of science and technology, laser technology, nano technology, micro electronic technology and modern molecular biology and bioinformatics are highly integrated, the new multi-function chip technology will change with each passing day. (Boutros, M., Heigwer, F., & Laufer, C., 2015) the current development of the gene chip can be cloned into the tens of thousands of gene specific probes or its cDNA fragment fixed on a piece of DNA chip. Was detected by mRNA or cDNA in different individuals (normal or patients), tissue and cell cycle, development and differentiation, and cell cycle, and different stimulation (including different induction and treatment means). Thus, it can obtain a large number of target genes and unknown genes related to a specific research field. It has a very small amount of, compared with the traditional Northern; Because it can simultaneously study the expression of thousands of genes, the study efficiency is improved, and the high flux and large scale of gene differential screening is studied; (Shu, L., Chan, K. H. K., Liu, S., & Yang, X., 2015) It can reveal the relationship between the gene expression and the relationship between the gene and the gene, so that it can be more comprehensive and systematic study of the related gene

cluster, and can be processed in parallel; The sensitivity of detection of gene expression changes, and the expression of several orders of magnitude can be detected. At present, there are some cDNA chips, such as human cancer genes and tumor suppressor genes, cell signaling and delivery proteins, cell cycle proteins, cell apoptosis related proteins, DNA synthesis and repair, cell receptor, cell surface antigen and adhesion proteins, ion channels and transport proteins, metabolism and housekeeping genes and negative (positive) (Burgner-Kahrs, J., Rucker, D. C., & Choset, H., 2015).

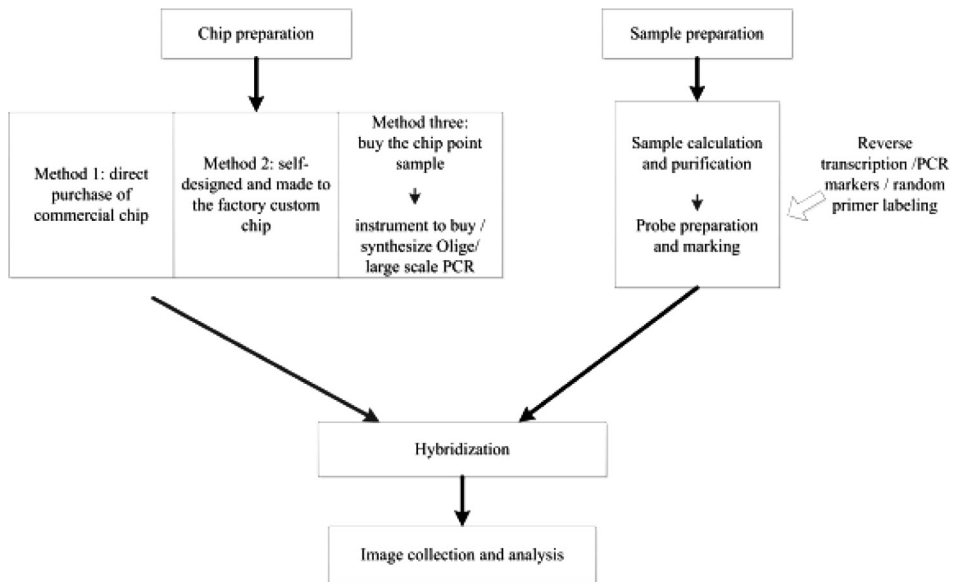


Figure 2 – The Use of Conventional Biological Chip

DNA chip is used for gene expression analysis, which has the advantage of analyzing the function of whole set of genes (expression). This is important for complex systems, such as the human genome, because the ratio of the entire set of genes in the encoding DNA has not been very low, and the expression sequence is only 3% of the whole set of genes, so the analysis of the DNA based pair will effectively reduce the complexity of human genome research. DNA chip is to be measured feature gene fragment (target genes) fixed on a slide into chip (usually by ionic bond with, will be from the tissue extract DNA or RNA after amplification by fluorescence labeling and chip of hybridization, the hybridization signal by scanner, by computer analysis, the data obtained can be directly used for gene function research (Backes, C., Meder, B., Lai, A., Stoll, M., Rühle, F., Katus, H. A., & Keller, A., 2016).

Study of gene mutation and polymorphism is usually used PCR-SS-CP, manual or automatic sequencing and heteroduplex analysis, the protein truncation test methods. All of these are required to link after electrophoresis, can not meet the requirements of large scale, low consumption and automation. Application of DNA microarray detection method can overcome these shortcomings, and with DNA polymerase and ligase combined detection can be obtained when higher resolution.

3. Basic Principles of Biological Chip

Biological chip is based on the principle of Waston and DNA proposed Crick double helix structure of a nucleic acid chain of molecular hybridization. It is a key link in chip technology, both for ONa and CDA. In this process, the selective reaction between the nucleic acid and the probe is detected, and the difference of gene expression and the data information of the unknown gene is obtained by washing, scanning and biological information analysis (Hinton, T. J., Jallerat, Q., Palchesko, R. N., Park, J. H., Grodzicki, M. S., Shue, H. J., ... & Feinberg, A. W., 2015).

At present, the application of microfluidic chips is becoming more and more widely. The initial micro flow circuit chip is mainly used for the analysis of amino acids, nucleic acid fragments and sequencing of nucleic acids. It has been used in protein analysis, immune analysis of antigen antibody, single cell analysis, enzyme analysis and micro fluidic chip used in the separation and analysis of small molecular compounds. The basic technical principles and methods are as follows (Ritchie, S. C., Würtz, P., Nath, A. P., Abraham, G., Havulinna, A. S., Fearnley, L. G., ... & Seppälä, I., 2015).

3.1. Micro Channel Chip Design

The effective channel length of the microfluidic chip is a few centimeters, so it does not need to be as high as the capillary electrophoresis (CE) (10 ~ 30keV). According to capillary electrophoresis theory, the column efficiency of CE was $N = \mu V l / 2DL$, which was N for the column efficiency, μ for the electrophoretic mobility, V for the applied voltage, l for the capillary effective length, D for the diffusion coefficient, and L for the capillary length. The higher the V/L value, the higher the column efficiency, but the V/L value can not be too large due to the Joule heating.

Almost all of the micro channel chip in the way are electric injection, that is, the role of the electric field will be the way to the micro channel flow path of the separation channel. The inlet channel is designed to be perpendicular to the separation channel, and the volume of the sample volume is the intersection of the separation channel and the inlet channel, as shown in Fig.3(a). In order to increase the sample size, the separation channel and the access channel are partially overlapped, as shown in Fig.3(b), at this time, the overlap is in the sample volume, and the sampling voltage is usually similar to the separation voltage or slightly lower.



Figure 3 – Schematic Diagram of the Vertical Cross Structure of the Sample Passage and the Separation Channel

The channel width of micro channel chip is generally 50~100 μ m, 5 ~ 50 μ m. For different applications, the design of micro channel is different, as shown in Figure 2, the design of the channel is more complex, which is used for mixing the mixed channel, and then the reaction channel. In order to improve the efficiency, multi channels are often integrated

in the micro channel chip, due to the space constraints, chip channel design into a square wave line or curved structure, has been fully utilized in the effective area of the chip. Because of the way of the square wave line or curved structure, the runway effect is caused, which leads to the separation efficiency is lower than that of the same length.

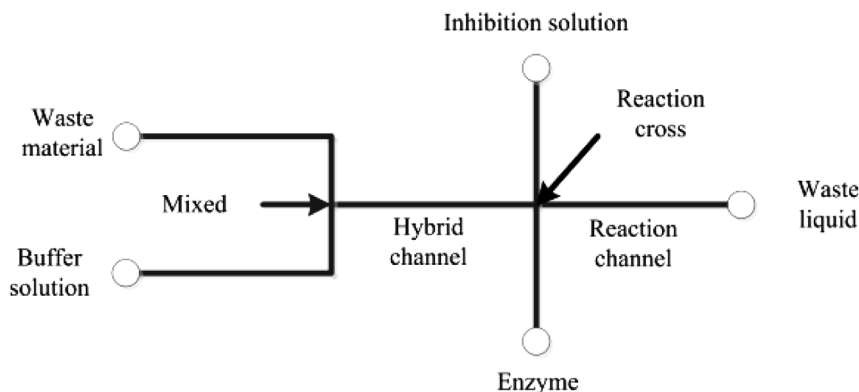


Figure 4 – Complex Microfluidic Chip for Enzymatic Reaction or Immune Response

In order to carry out the research work of micro fluidic chip as soon as possible, a micro flow structure is proposed, which can reduce the process difficulty and meet the needs of the basic microfluidic chip. Figure 5 is a schematic diagram of the microfluidic chip structure. The inlet channel is perpendicular to the separation channel. The channel is linear. The channel length is 7cm, the injection channel is 1.5cm, the channel width is 70 μ m, the depth is 30 μ m.

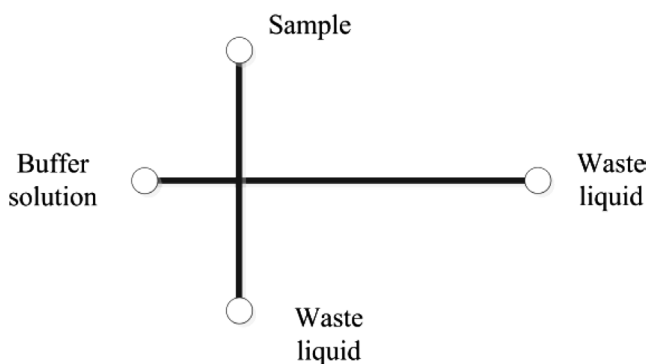


Figure 5 – Schematic Diagram of the Structure of A Simple Microfluidic Chip

3.2. Process Technology

The use of borosilicate float glass as the substrate material, shape size than conventional carrier slices, 9cm, width and conventional carrier slice of the same, 2.5cm, this can making a longer channel used for the electrophoretic separation of, and the same width to with the conventional detection equipment compatible. Process technology:

Cleaning matrix—Vacuum plating—Coated photoresist—Before baking—Exposure—Development—Corrosion chromium pattern—Back protective film—Hard film—Corrosive glass channel—Go glue and back protective film—Chromium layer—High temperature bonding of a glass substrate with a good hole—Protection channel—Polishing the upper and lower surfaces—Chip cleaning.

Channel length is very long, to avoid the entire channel range can not have any broken line (break can cause channel blockage and can not be used), for this has taken a greater exposure dose (increased 20% compared with normal exposure) and extended development time (compared with normal development 20%). Fully guarantee that the graphics of the photoresist is not broken, and the corrosion of chromium is also increased by 20%. In the corrosion process of the glass, the corrosion of HF acid is the same as that of the glass, which leads to the great extent of the channel, which is very difficult to control. For this purpose, this factor is taken into account in the design of the mask structure, and the end of the glass substrate is obtained with 70 μm width and 30 μm depth. Although the corrosion of HF acid on glass is isotropic, but the side is protected by chromium, the corrosion rate of the side is less than the depth of corrosion, and the corrosion rate of the side is about 60% of the depth. To obtain the structure of 30 μm depth, the side of each side of the drill is about 18 μm , and the total amount of the two sides can reach 36 μm . So the structure line width of the mask is 34 μm , which is guaranteed to be 70 μm in the glass.

Micro channel chip structure is a long separation channel, the other parts of the structure, because of the existence of the photoresist pinhole, resulting in the end of the glass structure surface is also affected by the corresponding pinhole, appear many pits, seriously affect the appearance of the chip image. In order to solve this problem, many methods are conducted, such as increasing the thickness of the photoresist, the structure of the localized corrosion, and the corrosion of the chromium film structure, but are not ideal. In the end, by using the transmission light to inspect the real hole, the HF is applied to the real hole, and the hole is not affected by HF acid.

4. Gene Chip Technology in Life Science Research

CDA can be used to detect the difference of gene expression, and the expression of *Arabidopsis* gene was detected by Schena et al. While the control group, including the glucocorticoid receptor and yeast TRP4 gene cDNA, was not detected in response, which showed that the array is highly specific. The detection sensitivity was mRNA total 1:50000w/w, that is, the target gene expression of mRNA was detected by 1:50000 only for the total mRNA specific gravity. The target sequence was determined and the NCBI database was searched, which indicated that there are 45 kinds of cDNA and target gene. Subsequently schena et al detected 1046 species unknown sequence of cDNA expression the expression of heat shock protein or phorbol cool regulation gene were analyzed by dual color fluorescence labeling. More than the traditional detection sensitivity is higher than 10 times, and can detect the low abundance expression levels of mRNA and detection sensitivity up to 1:5000000w/w mRNA. Lockhart et al., a probe chip with 65000 different sequences of length 20nt, was used to analyze the whole RNA population of T cells in mice by quantitative analysis of 21 different mRNA. These specially designed probes can be hybridized with 114 known mouse genes. The analysis revealed that the

expression of 20 mRNA was changed after the induced cell division. The test results show that the detection rate of 1:300000 is RNA, and the mR-NA is 1:300.

ONA can be used to search for the new gene and the detection of gene mutation, Wodicka, and so on with 4 ONA array of 260000 oligonucleotide probes, each chip has 65000 probe sites. In the vicinity of the sequence and specific oligonucleotide synthesis and a closely related and only one central mismatch. The signal of the mismatch probe is removed from the fully matched probe signal to counteract the nonspecific binding and background fluorescence. The results showed that 90% of the genes were expressed in two kinds of conditions, including most of the structural protein gene and ribosomal protein gene, 36 kinds of mRNA in the rich medium, the abundance of the 14. The species of mRNA in the most basic culture medium were higher. In addition to the known function of the gene, but also found a new gene. Chee and other analysis of the 10 auspicious, detected 5.5 polymorphic loci. Each sample can be read in the 12min, the correct rate of 9%. Gene chip can be used to study the mtDNA gene mutation and the polymorphism of mtDNA between the nation and the nation, but also can be used to reveal the relationship between mtDNA gene expression and nerve disease and longevity.

CDA can be used to analyze the mechanism of disease and the diagnosis, Ailazdeh and were constructed from 12069 cDNA clones selected from the B Library of, which were selected from 2338 of the B cells, follicular lymphoma, Mantle cell lymphoma and chronic lymphocytic leukemia library. DNA cloning and 17856 points from 3186 cDNA clones, including 128 Lymphochip clones, were prepared from lymphocytes and / or tumor cells, and the expression of 1.8x10⁶ gene was detected in 96 Marton, CDA and, were used to construct the gene expression profile of FK506 in yeast cells, which was different from that of wild type.

5. Gene Chip Technology Application in the Field of Sports Science Research

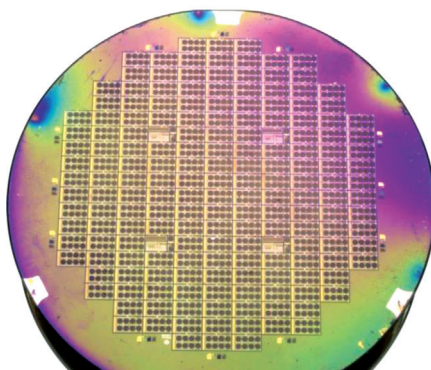


Figure 6 – Sports Field Chip

In scientific research in the field of sports biology, sports fatigue and turnover mechanism, eliminate exercise fatigue, improve the ability of the body movement of the new method of screening, the genetics of athletic ability, human existence athletic

ability of the susceptibility gene group, whether there is fatigue susceptibility gene group and exercise, nutrition and health of human molecular biology research is currently the subject of the most exciting (Farhadinia, M. S., Ahmadi, M., Sharbafi, E., Khosravi, S., Alinezhad, H., & Macdonald, D. W., 2015).

Modern competitive sports development to today, scientific selection, scientific training and scientific management have become the three major factors restricting the improvement of sports technology. Practice has proved that only those who have the talent to climb the top of the world sports. (Zhang, B., Bundur, Z. B., Mondal, P., & Ferron, R. D., 2015) The so-called athlete scientific selection, according to the characteristics and requirements of different sports, with scientific and advanced means and methods, through the test of objective indicators, comprehensive evaluation and prediction, the innate condition is superior, is suitable for a sport to engage in a small selection, system training, and continuously monitor the development of a process. The core of the process is forecast. Without prediction, there is no selection. (Liu, T., Sun, M., Feng, N., Wu, Z., & Shen, Y., 2015) Along with the development of competitive sports, the selection of athletes from the natural selection stage (mainly to sports performance as the standard), experience selection stage (mainly based on the experience of the coaches) to develop to the present multi discipline comprehensive selection stage (the main development of modern science and technology to rely on the development of modern science and Technology) stage. In the late 1990s, many scientific studies have been deeply studied (Fabrizio, D. A., Timberlake, S., Belmont, B., Goldfless, S. J., Briggs, A. W., Broering, T. J., & Vigneault, F., 2015).

The genotype is the synthesis of all the genes in vivo, which represents the genetic potential of an individual, which determines the individual's anatomy, biochemistry, physiology and behavior. A good athlete has the ability to win in competitive sport and is more adaptable than others after a period of training. Of course, even if you find such a genetic model, it is impossible to predict accurately the exact response to training and other stimuli, or whether it can become a champion. But for a coach, it is possible to use the material to predict which people are more likely to be a good athlete, for athletes to know their genetic type can help or limit their projects to reach the summit. If we can use the advanced molecular biology technology to find out the genetic basis of outstanding athletic ability, not only can provide a direct and effective way for the scientific selection of excellent endurance athletes, but also can explore the physiological mechanism of human movement, and enrich the contents of sports physiology and sports genetics.

Traditionally, molecular biologists have used genetic differences in the role of genetic differences in the role of single genes and most of the results to determine whether the individual differences in the performance of a certain type of individual differences are caused by the differences between populations, so as to find the differences in the DNA sequence of different phenotypes. Or directly in the protein or DNA level to study the relationship between the differences in the gene expression and the expression of the relationship between the main use of nucleic acid hybridization (Northern blot and Southern blot), as well as a PCR/RT PCR amplification technology. Some progress has been made in this field, and the changes of myocardial and skeletal muscle contractile protein, mtRNA content and gene expression in the myocardium and skeletal muscle were studied. Dionn studies show that the mtDNA sequence polymorphism of skeletal

muscle cells is closely related to the Vmax. Adjoa studied the variation of the expression of PFK and in endurance athletes, and found that the variation of PFK and DNA was found in CoxVa and CoxVaDNA. It is suggested that the polymorphism of cytochrome oxidase Va, PFK and mtDNA may be related to the adaptability of VO₂max and the status of endurance athletes.

Gene expression difference between skeletal muscle fiber types has been a hot topic among many experts. In one experiment, the traditional method can only report the 1-2 gene. Recent Campbell and other applications of microarray chips were used to determine the expression of 3000 mRNAs in female mice of the four head of the mouse and the flounder. The differential expression of 49 mRNA sequences in the white muscle and mixed red muscle was analyzed and determined, including the 9 transcription factors and mRNA differential expression of the 3 signal transduction proteins. However, there are thousands of genes in any cell, and the difference of gene expression between cells can reflect the growth, development and physiological functions of these cells. The traditional nucleic acid blot hybridization technique has been used to achieve the results, but there are many problems, such as complicated operation, low automation, low operation sequence, low efficiency and so on.

5. Conclusions

Gene chip technology can be used in large-scale, high throughput and parallel analysis of thousands of genes, through the design of different probe array, using a specific analysis method can make the technology has a wide variety of different applications. Along with the development of human genome project, the 40000 human genome sequences will be detected and entered into the post genomic era. The application of DNA microarray technology has the potential to provide the most direct and effective solution for the prevention of adverse and / or benign reaction of drug target genes in the molecular level. Finally, it is possible to screen the susceptibility genes, fatigue susceptibility genes and their influence factors and drug targets, and to explore the regularity and mechanism of sports fatigue, and to provide scientific research and application.

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Research on the Dynamic Simulation Model of the New-Energy Power System Based on Grey-Correlation Analysis

Tao Yubo^{1,*}, Chen Hongkun¹, Wan Jie², Liu Xin¹

* taoyubo@whu.edu.cn

¹ School of Electrical Engineering, Wuhan University, 430072, Wuhan, Hubei, China

² School of Energy Science and engineering, Harbin Institute of Technology, 150001, Harbin, Heilongjiang, China

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Abstract: Objective: In order to improve the power generation capacity of new-energy power system in China. Methods: Using grey-correlation analysis method to analyze the new energy power system. Process: This paper describes the construction of new energy power system in China, expounds the theory of grey system theory and grey-correlation analysis method, and establishes the grid structure model of photovoltaic power generation system. Result & Analysis: This paper studies the dynamic characteristics of the new-energy connected grid power system, analyzes various power generation conditions of the new-energy connected grid conditions in our country, and finds that China's new-energy power system will have a sustained growth of power generation trend. Result: The gray-correlation analysis method can be used to analyze the dynamic characteristics of the new-energy power system in China, and can promote the development of the power system.

Keywords: Power generation; new-energy power; grey-correlation analysis; photovoltaic power.

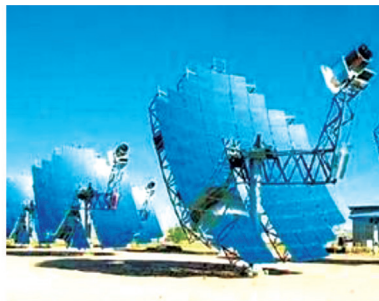
1. Introduction

In recent years, China has developed rapidly in the field of nuclear energy and wind energy, but still far behind the European countries in terms of solar energy. Taking into account the future development of energy demand and the pressure of sustainable development, our country has adjusted the energy structure in time, coordinated development of new energy such as hydropower, wind power, solar power and other new energy, it has a positive effect on the rapid economic growth and sustainable development of our country. Can be seen through the analysis of energy structure, hydroelectric power plays an important role in China's energy development and carbon emissions reduction. As of 2010, China's nuclear power installed capacity reached 10000000 kilowatts, its installed capacity will increase year by year (Ceccarelli, L., 2015). Taking into account the intermittent and volatility of wind power, by 2020, the

installed capacity of wind power will also be lower than hydropower and nuclear power. For technical and economic reasons, solar PV installed capacity in the next 10 years will slow growth. The State Grid Energy Research Institute has developed a plan for the development of clean energy and the coordinated development of UHV transmission. (Prieto, Á. E., & Lozano-Tello, A., 2014) Research shows that in 2020 the total installed capacity of China's power will reach 1600000000 kilowatts, of which, the power installed capacity of 1030000000 kilowatts. With the increase of the total capacity of power generation in china, new energy power generating capacity will reach 610000000 kilowatts in 2020, accounting for 34% of the total installed capacity of electric power. Among them, the gas turbine installed capacity reached 58900000 kilowatts, nuclear power installed capacity reached 80830000 kilowatts, hydropower installed capacity reached 340000000 kilowatts, pumped storage power station installed capacity of 50000000 kilowatts, wind power to reach 150000000 kilowatts, solar energy and biomass energy were reached 24000000 kilowatts and 15000000 kilowatts (Kou, R., Lam, H., Duan, H., Ye, L., Jongkam, N., Chen, W., ... & Li, S., 2016). Figure 1 (a) - (c) shows the new energy power generation in china.



(a) Wind Power



(b) New-Energy Grid Connected Power Generation



(c) Photovoltaic Power Generation

Figure 1 – China's New Energy Power Generation

The utilization capacity of hydropower resources in China is about 540000000 KW, at present, China has formed 13 large hydropower bases, hydropower capacity will reach 608290000 KW.h. But so far, China's hydropower resources development and utilization of only 20% (Fang, M., Xu, K. J., Zhu, W. J., & Shen, Z. W., 2016). The early development stage of China's hydropower generation is "five eleven" period, this stage of hydropower development is mainly concentrated in the northeast, the Yellow River and the Yangtze River basin. At present, a hydraulic generator installed mainly concentrated in the Yangtze River, Yellow River, the Dadu River and Lancang these large hydropower bases, by 2010, the hydropower development of these four hydropower bases are 78.7%, 34.4%, 25.6% and 23.3% respectively, and the average amount of hydropower development in the country is 25.3%. During the "Twelfth Five" and "45", China will focus on the development of hydropower resources in the southwest region. In the "Twelfth Five Year Plan" period, the hydropower planning in our country mainly concentrated in the Jinsha River, Dadu River, the Yalu River and the full Cang River Basin. The development level of hydropower resources in these four hydropower bases will reach 29%, 57.4%, 68.7% and 57.3% respectively, and the average utilization level will reach 49.3% (Cho, Y., Al-Ammar, E. A., & Hur, K., 2016).

2. Materials and Methods

2.1. Grey System Theory and Grey Relational Analysis Method

Gray system theory is the beginning of 1980s, a new subject, which is a new subject, which is proposed and established by Professor Deng Julong at Central China University of science and technology, is a systematic engineering discipline based on the theory of mathematics. In 1981, Professor Deng Julong's academic report on the control of the unknown system in the Shanghai Sino US control system was first used in the academic report of the first use of the gray system. 1982, professor Deng Julong published a series of papers, such as "the minimal information about the parameters of the system and the control of the grey system", laid the foundation of the grey system theory (Tamura,

J., Kumaki, M., Kondo, K., Kanesue, T., & Okamura, M., 2016). Grey system theory, is a new method to study the problem of less data, poor information and uncertainty, taking part of the information is known, some of the information is unknown small sample, poor information, uncertain system as the research object, the generation and development of the known information is mainly generated by the, extract valuable information, the correct description and effective monitoring of the operating behavior and evolution of the system are realized, together with the probability theory and fuzzy mathematics, it is called the three common methods to study the uncertainty system, has the ability to use the "little data" to seek the good characteristics of the reality of the law, to overcome the problem of insufficient data or the system cycle is short. In fact, the concept of grey system is proposed by British scientist Ashby (Ashby W R) "black box" concept of development and evolution of. Is the combination of automatic control and operations research. Ashby using black box to describe those internal structures, properties, parameters are unknown and only from external objects and object motion of the causal relationship between the input and output relationship to study a class of things. Deng Julong grey system theory advocates from internal affairs, from the system's internal structure and parameters to study the systematic, in order to eliminate the drawbacks of the black box theory of things from outside the known information can not give full play to the role of the. Therefore, is considered to be more accurate than the system of research methods of black box theory. Gray system theory, the objective world is the world of information, there are a lot of known information, but also a lot of unknown, non - accurate information. the unknown information is called black; the known information is called white (Scaffardi, M., Vercesi, V., Sgambelluri, A., & Bogoni, A., 2016); Part of the information is known, some of the information is unknown system, then known as the gray system. System as an objective existence, although the gray system is a complicated phenomenon, but its development has its own objective laws, it is the coordination and unification of the whole function of the system, can be through the collection of raw data to seek the law of its development. Grey system theory, all grey data sequences can be weakened by some form of their randomness, make it appear the law, the system response model can be established by using grey data sequence, and through the model to predict the possible changes in the system state. The grey system theory considers that the differential equation can reflect the objective law of the object more accurately, that is the state variable of the t , the change law of things can be reflected by the equation. Grey system correlation analysis method is essentially the analysis of correlation coefficient. Firstly, the correlation coefficient of the ideal scheme and the optimal index is obtained by the correlation coefficient, then by the degree of relevance of the size of the sort, analysis.

it is concluded that this method is superior to the classical exact mathematical method, after the intention, the viewpoint and the request of the concept, the model, therefore the grey system from the structure, model and relationship gradually from black to white, the uncertain factors gradually clear (Chelluri, S., & Sarangapani, R., 2016). This method breaks the restriction of the traditional precision mathematics, with the principle of simple, easy to master, easy to calculate, sort of clear, the type of data distribution and the type of variable without special requirements, etc., it has great practical application value, especially in computer science and technology, which can be used to describe and deal with the subject (such as biology, psychology, linguistics, social science, etc.), it uses

the geometry of the similarity degree to analyze the factors that affect the size of the. The specific calculation steps are as follows: according to the evaluation index system, the evaluation index system is determined, collect evaluation data; determine the reference data column; Non dimensional index data; Calculate the absolute difference of the corresponding elements of each of the target sequence (the comparison sequence) and the reference sequence, and calculate the correlation coefficient, calculate the correlation coefficient of the corresponding elements of each sequence and the reference sequence; Weighted correlation degree (Handa, Y. K., & Sharma, S. K., 2016).

2.2. Gray Correlation Analysis Method Based on Analytic Hierarchy Process

Grey correlation analysis is a statistical analysis method of multiple factors, it uses the geometry of the similarity degree to analyze the factors that affect the size of the. Through the above analysis, we know that the core of the grey relational analysis is the correlation degree, and the original gray correlation method is used to calculate the correlation degree, the equal treatment method, take the view of all the samples lump together, the results are not accurate and objective. In view of this problem, we introduce the method of gray correlation analysis based on analytic hierarchy process. Specific calculation steps are as follows: Preliminary analysis of data processing: Observe the change of the data in a dynamic line chart or scatter plot, and the abnormal value is processed, so that the historical data sequence tends to be stable (Patil, A. V., Bahuguna, N., & Umashankar, J., 2016). Processing methods are as follows: set the historical data as:

$x_1, x_2, x_3 \dots x_i$, make $\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$; if $x_i > \bar{x}(1 + 20\%)$, take $x_i = \bar{x}(1 + 20\%)$. If $x_i < \bar{x}(1 - 20\%)$,

take $x_i = \bar{x}(1 - 20\%)$; Sequence matrix: Yo representation for system characteristic sequence, relative factor sequence (comparison sequence) with $x_1, x_2, x_3 \dots x_i$ representation, these $i+1$ sequences constitute a matrix:

$$(X_0, X_1, \dots, X_n) = \begin{pmatrix} y_0(1) & x_0(1) & \dots & x_i(1) \\ \vdots & \vdots & \vdots & \vdots \\ y_0(k) & x_0(k) & \dots & x_i(k) \end{pmatrix} \quad (1)$$

Dimensionless: to clear the dimension and to unite in quantity, data processing with the method of "initial value". The formula of "initial value":

$$x'_i(k) = \frac{x_i(k)}{x_i(1)}, i = 1, 2, \dots, n, k = 1, 2, \dots, m \quad (2)$$

Dimensionless matrix:

$$(Y'_0, x'_1, x'_2, \dots, x'_i) = \begin{pmatrix} y'_0(1) & x'_0(1) & \dots & x'_i(1) \\ \vdots & \vdots & \vdots & \vdots \\ y'_0(k) & x'_0(k) & \dots & x'_i(k) \end{pmatrix} \quad (3)$$

Poor sequence, maximum difference and minimum difference:

According to the formula:

$$\Delta_{oi}(k) = |y_o' - x_i'(k)|, (i=1, 2, \dots, m) \quad (4)$$

We can get the difference matrix:

$$\begin{pmatrix} \Delta_{oi}(1) & \cdots & \zeta'_{on}(1) \\ \vdots & & \vdots \\ \Delta_{oi}(m) & \cdots & \zeta'_{on}(m) \end{pmatrix} \quad (5)$$

At the same time, find the maximum number of the difference matrix (maximum difference). With the decimal (minimum difference), expressed as Δ_{\max} and Δ_{\min} ; Calculating correlation coefficient:

$$\zeta_{oi} = \frac{\Delta_{\min} + \rho \Delta_{\max}}{\Delta_{oi}(k) + \Delta_{\max}} \quad (6)$$

Among them, ρ is the resolution coefficient, $\rho \in [0, 1]$, is usually taken to $\rho = 0.5$, correlation matrix:

$$\begin{pmatrix} \zeta_{o1} & \cdots & \zeta_{on} \\ \vdots & & \vdots \\ \zeta_{oi} & \cdots & \zeta_{on} \end{pmatrix} \quad (7)$$

Weighted correlation:

$$r_{oi} = \sum_{k=1}^m \zeta_{oi}(k) a(k) \quad (8)$$

The formula of affirmative treatment on the impact indicators to calculate the degree of association of the original, this does not accord with people's preference for certain indicators, or that some of the indicators are more important to the actual situation, so the formula is improved and the "analytic hierarchy process" is used to determine the weight of $a(k)$ (Maheshwar, C., 2016).

2.3. Overview of New Energy

Solar energy and wind energy are non polluting, and large reserves of environmental friendly energy, but because of its own intermittent, volatility and so on. Its use range and efficiency have been greatly restricted. In order to improve the utilization efficiency of solar energy, wind energy and other new energy, scenery complementary power generation system, wind energy storage system, optical storage system, the solar energy storage and complementary power generation system has gradually been paid attention to by people (Thakur, K., & Kruger, M., 2016). The principle diagram of solar energy storage and complementary power generation system is shown in Figure 2.

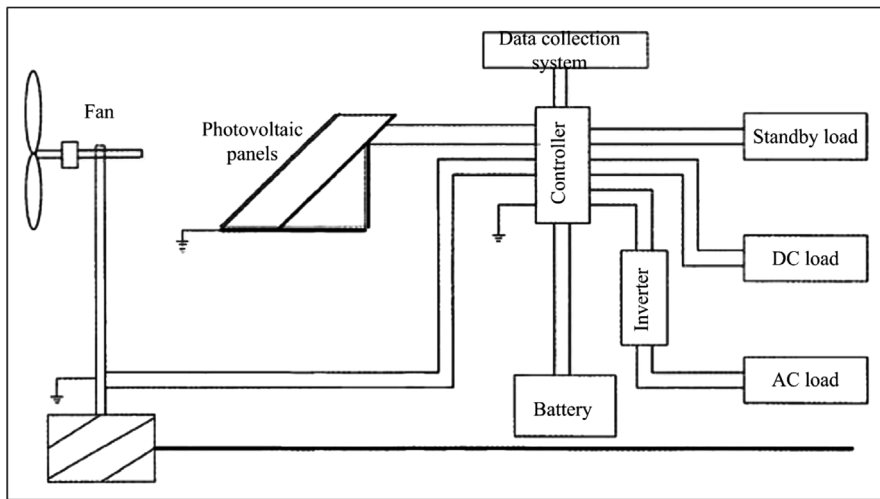


Figure 2 – Schematic Diagram of the Solar Energy Storage and Complementary Power Generation System

Based on the research and analysis of the technology and performance of the existing wind energy storage system, Zhou Wei pointed out that the power output forecast and the combination of new energy and traditional energy are the key points of the technology development in the future. From the perspective of technical economics, the economics of the solar energy storage system is analyzed, and the analysis shows that the wind power and photovoltaic power generation system of the wind power generation system is relatively simple. Using Monte Carlo method to simulate the output of wind power and photovoltaic, from the technical and economic point of view, the use of wind energy and solar energy, the feasibility of gas supply and power supply for the users. From the perspective of power generation cost, greenhouse gas emissions, renewable energy resources, energy conversion efficiency, land demand, water consumption and social impact of the wind power, hydropower, photovoltaic, geothermal and other renewable energy technologies are compared (Patel, V. C., Grewal, G. S., & Krishnamoorthy, P. A., 2016). On the basis of studying the development trend of new energy sources in the world, Jiang Kai discusses the objectives of China's new energy development planning and the relevant laws and regulations. From the demand side of the energy, the policy of the sustainable development of the energy is discussed, it is pointed out that the development of renewable energy needs to be based on the existing institutions and policies to ensure energy efficiency and improve the efficiency of the introduction of relevant policies. The relationship between renewable energy, environment and sustainable development is discussed from now and the future, which provides some theoretical reference for the formulation of energy policy (Joshi, D. B., 2016).

2.4. Solar Power Generation and Grid Technology

Solar power can be divided into two major categories of solar thermal power generation and solar power generation. Solar thermal power generation system is mainly composed

of the collector, the transmission part and the heat storage. According to the different concentrating system, it can be divided into the tower solar thermal power generation system, the trough solar thermal power generation system and the dish solar thermal power generation system. Solar photovoltaic power generation is a form of power generation that directly converts light energy into electrical energy without heat, photovoltaic power generation, photochemical generation, light induced generation and optical generation, at present the most commonly used for photovoltaic power generation. Photovoltaic power generation using solar energy semiconductor electronic devices absorb the sun photovoltaic radiation, and transforming it into electric energy of a direct generation of power. At present, the world's most widely used solar cells for single crystal baby solar cells, solar cells, solar cells, thin film solar cells, etc.. Solar photovoltaic power generation system and the grid connection diagram shown in Figure 3. The system consists of a photovoltaic cell simulator, a charging controller, a super capacitor, a battery pack, a sine wave inverter and a system monitoring component.

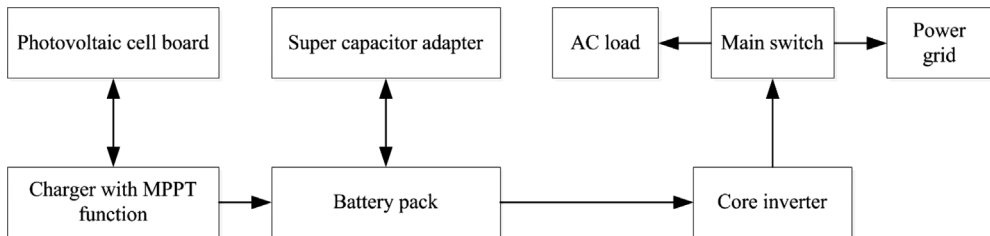


Figure 3 – Grid Connected Photovoltaic Power Generation System

2.5. New Energy Grid Connected to Power System Dynamic Characteristics

In system dynamics (Dynamics System, referred to as SD), system function depends on its structure. System in the role of internal and external constraints, according to a certain law of dynamic changes. So the behavior mode of the system depends on the internal dynamic structure and the feedback mechanism of the system. New energy grid connected power will not only affect the physical performance of the grid, will also have an important impact on the supply and demand, price and cost of electricity market. The impact involves many factors, such as the amount of electricity, electricity demand, electricity price, demand price elasticity, cost, investment income, and so on. These factors interact with each other, and they interact with each other. Therefore, the impact of the new energy grid on the power market is a nonlinear, multi variable, high order dynamic feedback complex system, which has obvious dynamic characteristics. There are 3 types of power generation technologies in the electricity market: the traditional fossil energy generation technology, the hydro power generation technology and the wind power, solar power and other new energy generation technology. Therefore, the total installed capacity of more than 3 kinds of power generation capacity. The impact of new energy grid connected to the electricity market involves the construction of power generation capacity, electricity demand, electricity price, electricity generation cost, capacity building, demand growth, price elasticity of demand, resources and other factors. These factors interact with each other, which constitute a causal link between

the impact of the new energy grid on the electricity market, which also has 6 mutual influence, mutual feedback of sub causal link ring, that power demand balance causal link; new energy grid connected power generation cause and effect ring; New installed capacity of causal link; network technology learning curve causal link; Resource development causal link.

3. Results and Analysis

Based on the SD model and setting parameters, dynamic simulation using Vensim software. Under the new energy grid conditions, the power market's power generation, electric power demand, electricity price, the cost of 30 years of change, such as Table 1.

Year	2000	2005	2010	2015	2020	2025	2030
<i>Power generation of grid-connected new energy (TW.h/year)</i>	21.6	27.5	69.8	108.3	134.6	159.8	183.3
<i>Hydropower generating capacity (TW.h/year)</i>	95.9	96.7	102.1	115.1	127.8	142.6	161.5
<i>Thermal power generation capacity (TW.h/year)</i>	192.7	208.2	228.1	251.9	265.5	268.9	273.5

Table 1 – Various Power Generation Conditions Under the New Energy Grid Conditions

From table 1, we can see that in the setting of the initial state, China's electric power demand will show a steady upward trend. In the next few decades, China's thermal power will continue to play the role of the main force, but its power generation will gradually stabilize. Hydropower development in 2005 to 2009 has been stagnant, but in the long run, hydropower development will show a steady growth trend.

In the future, water and electricity is still one of the leading energy in our country. New energy power generation in the proportion of energy consumption in China will become increasingly, especially from 2005 onwards, the amount of electricity increased significantly. The grey correlation analysis method is used to analyze the new energy power system to forecast the trend of the electricity consumption and promote the development of new energy generation technology.

4. Conclusions

With the introduction of the concept of electric power market, the investment planning and analysis of our country's transmission and distribution network has changed a lot, and a variety of analysis models have emerged. The solar energy and wind energy are large reserves of environmentally friendly energy, but because of its own characteristics of intermittent and fluctuation, its using range and efficiency have been greatly restricted. This paper introduces the power generation applications in the field of nuclear power and wind energy in our country, and establishes the storage scenery complementary power generation system model, on the basis of analyzing the grey system theory and grey relational analysis principle. At last, through experimental analysis, it's found that the analysis on the new energy power system by using grey correlation method can accurately predict the starting power trend.

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Research on the Design of Computer measurement and Evaluation System of Sports Competitive Psychology

Hou Yingfeng¹

hyf@tust.edu.cn

¹ Department of Physical Education, Tianjin University of Science & Technology, 300222, Tianjin, China

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Abstract: Objective: In order to improve the accuracy and save the resources of human resources as the starting point, this paper has developed a computer evaluation system of competitive psychological adaptability. Method: system analysis method, experimental method. Process: through the analysis of the traditional psychological test method, and then the psychological adaptability of the table computer evaluation of the feasibility of automation. In the design process of the computer measuring system of the adaptive capacity, the four modules of the design principle, structure design, database design and algorithm design are carried out. Finally, the performance of the system is verified and analyzed. Result& Analysis: Through the experimental verification, the evaluation system of competitive psychology has the characteristics of safety, operability, stability and accuracy, but also has a reasonable level of management. Result: the research and development of the system has a test platform, and provides help for the research of sports psychological researchers and coaches.

Keywords: Competitive psychology; computer measurement and evaluation system; design.

1. Introduction

1.1. The Meaning of Computer Psychological Assessment

Computer psychological assessment is an important way of modern psychological test information. With the rapid development of computer information technology, the way of psychological testing has also been developed. In the evaluation of the media, from the manual evaluation of paper to the computer without paper evaluation and development; in function, from the professional, local, single measurement to a simple, wide area, multiple psychological assessment system development; in the data processing, from the manual statistical analysis to the development of computer intelligence processing. The modern psychological test is based on Internet network, and has a strong information processing function, which provides a scientific theoretical guidance and technical support for the evaluation of the competitive psychological adaptability of athletes. At the same time, it makes the evaluation of the psychological adaptability of the athletes from the traditional paper experience evaluation to the standardization, rapid scientific

evaluation. (Hunter, J. E., Leslie, J., & Perkins, N. D., 2016; Velmeshev, D., Lally, P., Magistri, M., & Faghihi, M. A., 2016).



Figure 1 – Computer Psychological Test Room

1.2. The Status Quo and Characteristics of Computer Psychological Assessment

From the current development of view, the psychological evaluation includes: network psychological testing and evaluation, psychological software testing, the traditional scale evaluation, etc. (Pavlova, N. N., & Thompson, C. B., 2016) However, there are some problems, such as network psychological test and assessment: only limited to some small social psychological evaluation, no physical and other professional evaluation of the site; there is no single psychological test platform. (Shao, Y., Li, M., Wu, M., Shi, K., Fang, B., & Wang, J., 2015) And as a psychological evaluation software evaluation: can not carry out network remote measurement. And the traditional measurement: human and material resources is very big, and the speed is slow. (showed in Fig.2) (Yuan, L., Zhi, W., Liu, Y., Smiley, E., Gallagher, D., Chen, X., ... & Zhang, H., 2016).



Figure 2 – Traditional Test Methods

Compared to the traditional manual evaluation method, the use of computer evaluation has the following characteristics: first, centralized management, multi environment operation; two is efficient and intelligent; three is a breakthrough time and geographical constraints; four is the feedback information is intuitive and objective. So people pay more and more attention to the evaluation of the use of computer (XinXin, C., YongSheng, N., & Zheng, L., 2015).

1.3. The Value of Competitive Psychological Adaptability

The definition of competitive psychological adaptation is: when the external environment changes, the main body of the main body through self adjustment system to make a dynamic response, so that their mental activity and behavior more in line with the requirements of environmental change and its own development, so that the main body and the training, the competition environment to achieve a new balance process." (Rusli, R. K., Wiryawan, K. G., Toharmat, T., & Mutia, R., 2015; Lee, J., & Price, N., 2016).

In the technical and tactical level to reach the top of today, the competition between high level athletes is often no longer limited to the impact of training level and their own strength, to a greater extent, by their psychological quality, psychological skills. (Runa, A. I. D. N. F., & Miranda, G. L., 2015) Foreign athletes have a strong physical fitness and skills at the same time, we also have a lack of training and competition in some of the psychological qualities and skills, such as how to control the tension in the training and competition, focus and other aspects of psychological control. (Wade, A., & Stabb, S., 2015) At present, a lot of high level coaches will be psychological training as an indispensable part of daily training, and this is also the new characteristics of modern sports training, is the inevitable trend of its development. The psychological training of modern athletes throughout the body and technical and tactical training process, mainly is to cultivate athletes' motivation, perception ability, reaction ability, frustration tolerance, emotional adjustment ability, will power, tactical coordination ability and collective sense of responsibility, etc., in addition to athletes personality psychological tendencies of the correction and training. (Din, A., Abd Rashid, S., & Awang, M. I., 2015) Individual psychological training is also taking short-term psychological training, the main task is to make the athletes have the special psychological qualities necessary for the sport, or to make the athletes to form the best psychological preparation for the specific game. At the same time, in the field of sports research, the application of psychology is more and more attention (Gabielli, E., Fulle, S., & Pietrangelo, T., 2015).

2. The Feasibility of Computer Test Automation of Competitive Psychological Adaptability

Through the test of the psychological adaptability of athletes, according to the feedback information, it is an important part of the research on the psychological adaptability of the athletes. At present, in the process of testing and evaluation of the adaptability of sports, the process of collecting data is to take the test under the guidance of the psychological counseling expert. (Cranmer, G. A., & Sollitto, M., 2015) It makes us more difficult to collect the data. In the collection of information preservation, because it is a paper collection, easy to wear and loss. All the above, the reliability of the psychological counseling experts or coaches in the research evaluation. Because of the difference of the

psychological consultation, the experts themselves with the same test, the same test of the same time, the psychological counseling experts themselves with a more subjective, resulting in the evaluation is not objective and accurate. At the same time, because of the different time interval, the test data can not be guaranteed (Dos Santos, A. L., 2015).

The test of the adaptability of athletes' psychological adaptability is not only applied in the daily training of athletes, but also is more advantageous to the athletes' competitive state, which makes them play the best level. But before the competition, if the use of artificial paper testing, will not be able to timely feedback the psychological state of the athletes, which requires us to solve the test process control, score statistics speed and accuracy, feedback information and other issues (Avalos¹, T., Maximiliano, S., Dávila, B., Jesús, C., & López-Walle, J. M., 2015).

With the rapid development of computer science and network technology and the wide application of psychological testing, computer technology, with its own accuracy, fast, intelligent, and other characteristics, which has been integrated into other areas of research, and become an important tool for researchers. The rise of computer and network psychological assessment provides the basis for the computer measurement and evaluation of athletes' psychological adaptability (Cooper, J. N., & Dougherty, S., 2015).

3. The Construction of the Computer Measurement System of the Adaptability of Competitive Psychology

3.1. Analysis of the Demand of the Computer Test System of Competitive Psychological Adaptability

Role analysis is to distinguish between the test and the test, to ensure the safety and accuracy of the test results of the computer test system of competitive psychological adaptability, the paper test and evaluation process of the competitive psychological adaptability of the participants. According to the different division of participants in the competition, the competitive psychological adaptive scale computer evaluation system will be operated by the following three roles: firstly, the system administrator is the manager of the computer testing system of the adaptive capacity of the competitive psychological adaptability. The system administrator is responsible for the basic content of the computer measurement system of competitive psychological adaptability and the daily maintenance of the database, which has the authority to manage all the psychological consulting experts; secondly, psychological counseling expert refers to the need to use competitive psychological adaptive measurement system of the computer measurement system to conduct research, analysis and study of the athletes' psychological guidance; Thirdly, the test subjects were the main participants in the computer measurement system using the competitive psychological adaptability scale. According to the test object and range of the scale of competitive psychological adaptability, the computer test system of competitive psychological adaptability is only suitable for athletes of 15 years old.

The work flow of the computer measurement system of competitive psychological adaptability is mainly reflected in the work flow of the system (shown in Fig.3). The system is composed of JS, JSP, Servlet Java, Javabeen and so on. Which JS and JSP

is mainly response to action. Servlet Java is mainly to receive and return to the upper response event data, and to return the results back to the upper level, it is the middle layer, the main connection between the functional class and the upper level. Javabeen is mainly to achieve the specific functions of the class, which also includes the operation of the database, the formation of statements, MD5, display debugging information and other special features.

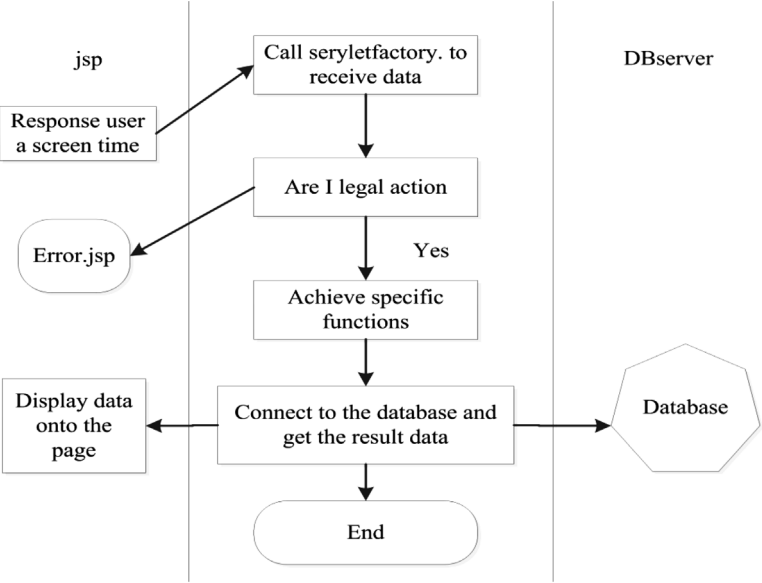


Figure 3 – System Job Technological Process

The overall goal of the computer test system of competitive psychological adaptability is the computer background operation of the test and evaluation process of the athletes' psychological adaptability. Specifically, there are five functional requirements: system administrator management functions; the management function of psychological consultation expert; test user test function; print report function; historical information query.

3.2. The Design of Computer Test System for Competitive Psychological Adaptability

The design principle of the computer test system of competitive psychological adaptability includes simple operation, administration of unity, system specification, information security, functional modularity, the system can be expanded.

The hierarchical structure is a reasonable structure, and the reasonable structure is the premise of the system is smooth operation and is widely used. Through the systematic analysis of the participants and the evaluation process, the evaluation system of competitive psychological adaptive computer evaluation system is composed of a registered login subsystem, system management subsystem, test management system, psychological counseling expert subsystem. (as shown in Fig.4).

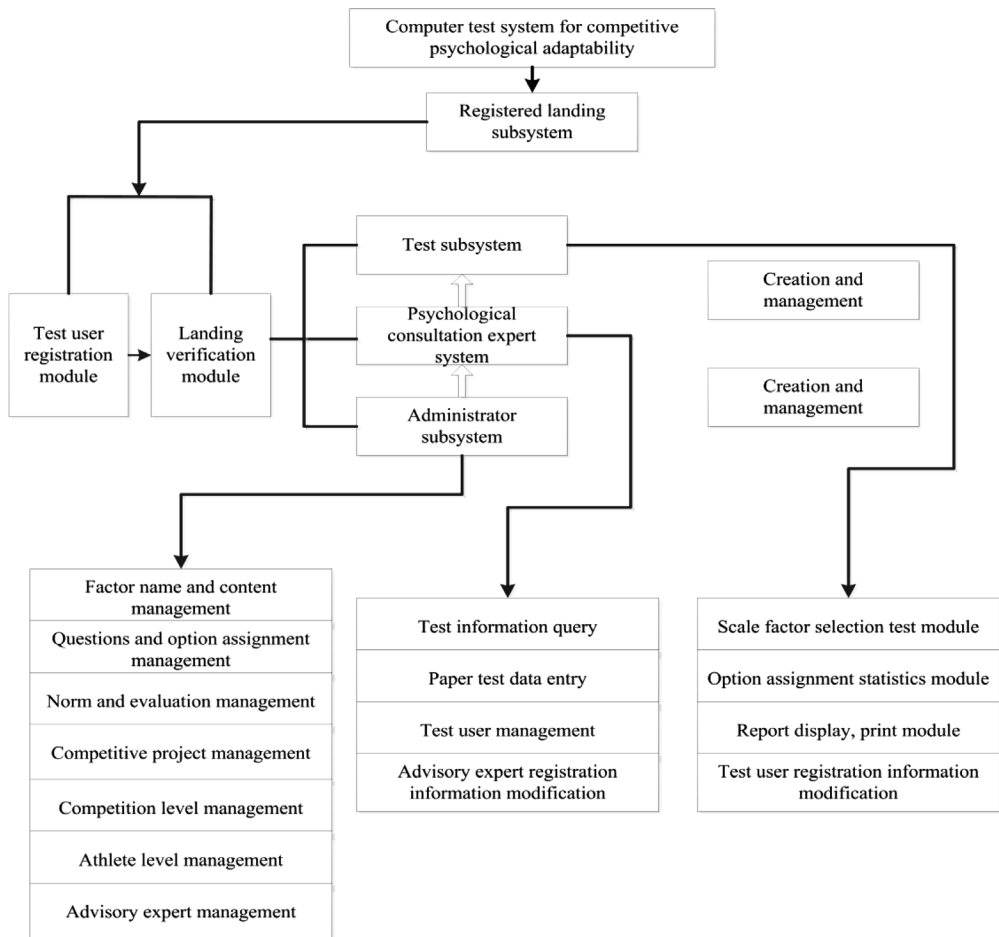


Figure 4 – System Level Theory Pattern

The evaluation system and the main module function of the competitive psychological adaptability scale: the system configuration management module of the system information management subsystem is composed of the system administrator, which is mainly for the whole system, and the authority management of the psychological consultation expert users; the psychological consultation expert system, which is composed of the psychological consultation expert, provides the data for the psychological consultation. The manual input can be used to check the information of the test; test management subsystem table questions database module is provided for user testing operation interface, mainly in order to meet the different needs of psychological counseling expert research, providing complete competitive psychological adaptability test, 12 epistatic factor of each factor test, test users choose different questions to answer and submit the answer sheets; the statistical evaluation analysis module is the module which is used to test the user's answer. The main factors are given by the test of the user's answers; after the test record

query and the condition filter query module psychological consulting experts, the query is able to query all the test data in the test user management. The operator can filter all kinds of information through different conditions; the data entry module psychological counseling expert can test the user's paper test option, and carry out the manual input. (1234 instead of the option ABCD); the report displays and print module test users answer all questions, the system can display contains the test user basic information, test time, each item option score, factor classification statistics, comparison of normal mode, psychological analysis evaluation, comparison of linear maps and other common mode, can be printed, preview and print. Psychological counseling experts can test the results of each user's management in the test of different time.

Database is the storage of data, the Access database is not just the storage of data, all data processing operations related information is also stored in the database. Therefore, the database is a data management system is an indispensable part. the design of the database table structure of the computer test system of the adaptability of competitive psychology.

According to the analysis of the basic information of the standard, the system needs to have the data table of the object of the system, which is the name of the sports events, the name of the sports, the sports level of the test. In order to facilitate the user to enter the basic information is to be able to choose to fill in, so that information standardization.

According to the analysis of the content of the standard competitive adaptability, the system database needs to have the data table of the score of each item and the option. In order to facilitate the system to test the user to submit the answer, the corresponding assignment. According to the analysis of the statistical and evaluation process of the standard competitive adaptive scale, the data table of the system database needs to be divided and the psychological evaluation and feedback information. Through this table, the system can test the results of the test users.

In the database, the management data table of the test users should be recorded to record the basic information of the test users and the test information of different time. At the same time, it should also have a management table of special psychological consultation expert, which is easy to be created and managed by the system administrator.

Query on the database of the computer test system of the adaptability of competitive psychology includes three parts: firstly, psychological counseling expert query psychological consultation with experts in test user information according to test user basic information, such as user login name, gender, sports level, to attend the Games in the class, sports events, sports projects from the database table in the transfer of data, query classification screening. Psychological counseling experts in the test of user management in the view of the history score, can be logged in user name, test questions, such as the conditions of the existing data stored in the database query query, and can query the results of test users to test the results. Sccondlythe system administrator can inquire into the basic information of each user and each test information, through different conditions for the implementation of system management settings.Thirdly, testing the user's query test users can according to different testing purposes, through the choice of test questions library of the corresponding factors of the test content.

3.3. Implementation of the Computer Test System of the Competitive Psychological Adaptability

Based on the analysis of the test and evaluation process, the database table structure of the computer test system of the adaptive scale of competitive psychological adaptability is determined. The database is composed of the system administrator information table, the scale factor classification management table, the psychological consultation expert information management table, the question answer management table and so on. All test data and system basic information will save in the corresponding data in the table, between tables is the main index value and value in the foreign key to establish correspondence. All test data and system basic information will save in the corresponding data in the table, between tables is the main index value and value in the foreign key to establish correspondence. In this paper, we show only two tables.

The table is the basic information for system administrators to manage, and save the system administrator login authority and time information. Mainly includes three fields: adminid, adminpwd, lastlogintime (shown in Table.1).

Table name	Function	Include field	Data type	Illustration
<i>admin</i>	System administrator login management	adminid	text	Administrator login ID
		adminpwd	text	Administrator login password
		Last login time	Date / time	Administrator login time

Table 1 – System Manager Information

Table name	Function	Include field	Data type	illustration
<i>coach</i>	Psychological consultation expert information management	coachid	text	Psychological counseling expert ID
		coachname	text	Full name
		coachpwd	text	Password
		coachsex	figure	Gender
		coachage	figure	Age
		coachmetier	text	Occupation
		coachsportname	figure	Engaged in sports life
		sportitem	figure	The project
		tiptoplevel	figure	Maximum movement level
		tiptopplay	figure	The highest level led to participate in the Games
		ledteamname	text	With the team
		tel	figure	Contact phone
		loginlockflag	figure	Lock flag (5 lock)
		lastlogintime	Date / time	Last login time

Table 2 – Psychology Consultancy Expert Information Management

The table of the psychological consultation expert information management table mainly includes fourteen fields: coach-name, coachpwd, coachsex, coachage, coachmetier, coachsportname, sportitem, tiptoplevel, coachid, tiptoplay, ledteamname, Tel, loginlockflag, lastlogintime. Through the table, to the psychological consultation expert personal basic information management.

3.4. Analysis Method

In this paper, we use the method of analytic hierarchy process to calculate the weight of data. The main methods are as follows:

Formule Cholesky:

$$W_i = \frac{\left(\prod_{j=1}^n a_{ij} \right)^{\frac{1}{n}}}{\sum_{i=1}^n \left(\prod_{j=1}^n a_{ij} \right)^{\frac{1}{n}}} \quad i = 1, 2, \dots, n \quad (1)$$

Calculation steps:

Step 1: the elements of the a are multiplied by a new vector;

Step 2: to open a new vector to each component of the n;

Step 3: the resultant vector is normalized to the weight vector.

Arithmetic average method: Because the judgment matrix A in each column are approximately reflects the allocation of weights, so it can be used all column vector arithmetic to estimate the average weight vector, then

$$W_i = \frac{1}{n} \sum_{j=1}^n \frac{a_{ij}}{\sum_{k=1}^n a_{kj}} \quad i = 1, 2, \dots, n \quad (2)$$

Calculation steps:

Step 1: the elements of A are normalized by column, that is $a_{ij} / \sum_{k=1}^n a_{kj}$;

Step 2: the normalized sum of the columns;

Step 3: the sum of the vector divided by the N weight vector.

Feature vector method: Weighted W right weight ratio matrix A, there is

$$AW = \lambda_{\max} W \quad (3)$$

As above, the λ_{\max} is the largest eigenvalue of the matrix, and the only one is the existence and uniqueness of the matrix.

Least square method: The weight vector is determined by fitting method, and the average of the residuals is minimum:

$$\min Z = \sum_{i=1}^n \sum_{j=1}^n (a_{ij} w_j - w_i)^2 \quad (4)$$

$$s.t. \sum_{i=1}^n w_i = 1 \quad w_i > 0, i = 1, 2, \dots, nm \quad (5)$$

4. Competitive Psychological Adaptability Table Computer Test System Performance Verification Results and Analysis



Figure 5 – Computer Psychological Test Site

4.1. Test Results and Analysis of the Stability of the Test System

Select 2014 graduate students in a university, and at the same time on different computers for the evaluation system for the installation, registration, login, management, modification, testing and other operations, in order to verify the system's function and fluency of each module, statistical verification results are shown as follows (showed in Table 3).

Through the above table 3, the competitive psychological adaptability of the computer measurement system in the installation, operation, registration, evaluation and verification, showing a stable state; Test users can operate smoothly; the function of the evaluation system is fully in line with the design requirements of the system function; At the same time, the paper makes the evaluation process of the psychological adaptability of the paper in the computer test system.

4.2. Evaluation System Accuracy Verification Results and Analysis

In 2014 (including 2014) has been tested on the test of the Chinese ice and snow project athletes test answer tab (original) 5, select a university education department students

Test items	Normal rate(%)	Abnormal rate(%)
<i>Install and run</i>	100	0
<i>Login</i>	100	0
<i>Administrator management settings</i>	100	0
<i>Psychological consultation expert management</i>	100	0
<i>The transfer of the test scale selection</i>	100	0
<i>Assignment of the answer</i>	100	0
<i>Meter report display print</i>	100	0
<i>Historical data entry</i>	100	0
<i>Classification query</i>	100	0
<i>Data transfer</i>	100	0
<i>Factor constant modulus contrast</i>	100	0

Table 3 – System Stability Confirmation

80 people, each of the answers to each of the Options tab of the options, factor statistics. Repeated comparison, the 80 selected for the 5 answers to the statistical results for the same answer card and statistical results, which is defined as the standard answer card and statistical results. Then the standard answer tab of the options are entered into the computer evaluation system, the evaluation system of statistical reports, and then compare the results of computer statistics and the consistency of the results, verify the accuracy of the evaluation system. The verification results are as follows (showed in Table.4):

Contrast verification project	Computer test system statistics		
	Number of tests	Correct number	Percent(%)
<i>Scale Test submission</i>	80	80	100
<i>Option assignment</i>	80	80	100
<i>Factor statistics</i>	80	80	100
<i>Constant modulus phase and evaluation</i>	80	80	100
<i>Contrast curve diagram</i>	80	80	100
<i>Report display</i>	80	80	100
<i>Report printing</i>	80	80	100

Table 4 – Evaluation System Accuracy Confirmation

Through the above table.4 shows that the competitive psychological adaptability of the computer test system in comparison to the standard answer option statistical results of the process, the comparison of each test item 80 passengers no error, the accuracy of the evaluation system is very high.

4.3. Comparison Results and Analysis of Computer Measurement System and Paper Test

80 students from the Department of physical education, the evaluation system and the paper evaluation are carried out, and then according to the process of operation, the accuracy, data collection, data collection, data storage, test can be operated separately, the test can be used alone, the evaluation of the number, the ability to test the factor, the results are as follows (showed in Table.5):

Contrast project	Manual test manual	System test computer statistics
<i>Evaluation of convenience</i>	Poor	Strong
<i>Accuracy of measurement</i>	Error	Error free
<i>Data collection</i>	Small	Big
<i>Data preservation</i>	Easily lost	Can be long-term preservation
<i>Can test be operated alone</i>	No	Sure
<i>At the same time, the number of people</i>	Less	Many
<i>Evaluation of the time to check</i>	Difficult	Easy
<i>Can be tested by factor requirements</i>	Not	Sure
<i>Can be tested through the network</i>	Not	Sure

Table 5 – Computer Evaluation System and Paper Evaluation Contrast

Through the above table 5 shows that the competitive psychological adaptability of the computer measurement system and the paper competitive psychological adaptability of the measurement of the comparison, the computer measurement system in the data acquisition and statistical aspects of the paper is better than the paper evaluation; the same time, the speed of the evaluation should be faster than the paper evaluation; The paper test can not be separated from the guidance of psychological professional, and the evaluation system of competitive psychological adaptive scale computer can guide the test to carry out the test; The computer measurement system of competitive psychological adaptability can be measured by the network, which not only improves the information collection, but also breaks the geographical restrictions of information acquisition.

5. Conclusions

In order to improve the accuracy and save the human resources as the starting point, this paper uses the method of system analysis and experimental method to study the test and evaluation process of the psychological adaptability of athletes. The research and development of the system has a test platform for sports psychological assessment, and provides help for sports psychological researchers and coaches to carry out competitive psychological research.

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Multiphase-Interacting Equations and Their Solutions in Simulation of Coalbed Gas Migration

Junguo Chen^{1,2,*}, Weiqun Liu^{1,3}, Qiang Li³, Zhengfeng Yi¹, xiaoji Shang¹

* chenjunguo2002@163.com

¹ School of Mechanics and Civil Engineering, China University of Mining & Technology, 221116, Xuzhou, China

² College of Mining and Safety Engineering, Shandong University of Science & Technology, 266510, Qingdao, Shandong Province, China

³ State Key Lab for Geomechanics and Deep Underground Engineering, 221116, Xuzhou, China

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Abstract: CBM has become a remarkable resource nowadays, for it's of high-quality, efficient and clean. Research on coal bed methane percolation mechanism of formation is very important for safety and efficiency in real engineering applications of CBM exploitation. By introducing gas solubility variable, coalbed methane (CBM) – water biphasic transport equations of mass conservation is established. Meanwhile, coal and/or rock solid-coupled equations are also generated. The fluid (gas and water) - solid interacting equations and their definite conditions can serve here as a mathematical treatment in simulation of coalbed gas migration. In calculation, the method of variables separation to solve gas/fluid pressure and solid displacement from equations are employed, especially time-based pressure distribution. The results show that, solubility involved in simulation can play an important role in gas migration. Our mathematical method may provide effective analysis for the CBM engineering prediction.

Keywords: Seepage; multi-phase coupling; gas solubility; separated variable method.

1. Introduction

CBM has become a remarkable resource nowadays, for it's of high-quality, efficient and clean. On the other hand, Methane (the main component of CBM) is the greenhouse gas which leads to the global warming. Study shows that: the greenhouse effect caused by methane is 20 times larger than that caused by CO₂, and do 7 time the harm to the ozone layer. Therefore, mining of CBM in safe and efficient way not only takes good use of resources, reducing methane emissions, but also relieve the greenhouse effect by CO₂ sequestration after exploitation (Ozdemir Ekrem., 2009).

Dehydration of CBM reservoirs is the very important part of methane production (Agarwal A, Mandal A, Karmakar B, et al., 2013). Scholars at home and abroad have already studied the fluid-solid coupling from many perspectives, such as M Zou establish the triple

porosity/dual permeability (TPDP) model and consider the effect of pressure difference between pore penetration and coal cleats (M Zou, C Wei, H Yu, L Song., 2015), Di Jun-zhen (Di Jun-zhen., 2007) establish coal-bed methane - solid - water coupling mathematical model , and analysis to simplify the model of a single-phase flow - Solid Coupling Simulation. Xu Jian-liang (Xu Jian-liang., 2005)from the reservoir characteristics of coalbed methane reservoirs start to establish a mathematical model of coalbed methane seepage flow solid coupling mathematical model and numerical solution using the finite . Deng Gung-hong (Deng Gung-hong., 2011) establish a CBM reservoir fluid-solid coupling mathematical physics model, and gives the auxiliary equation and boundary conditions to solution the model. Yang Xin-le (Yang Xin-le., 2013) consider the temperature field and establish a low-permeability coalbed methane CBM multi-physics coupling mathematical model with mining process heat injection. However, they all didn't take the solubility in water into consideration. This paper considers the gas variable in water while establishing methane - liquid - solid coupling seepage model, and solves the problem by separation variable method. The results provide guidance for mining technology and development program of CBM exploration (Gasca-Hurtado, G. P., Peña, A., Gómez-Álvarez, M. C., Plascencia-Osuna, Ó. A., & Calvo-Manzano, J. A., 2015).

2. Gas-liquid-solid Coupling Seepage Model

To study gas - liquid two-phase coupling seepage, the saturation of gas and liquid, and gas solubility are only consider, with no regard of source-sink, and changes of temperature, the two-phase fluid flow is in line with Darcy's law. Here g and w are used to represent the gas phase and liquid phase.

Continuity Equation of Gas can be written as Eq.(1)

$$\frac{\partial}{\partial t}[\phi(R_{sw}s_w\rho_w + s_g\rho_g)] - \nabla \cdot [\rho_g \vec{V}_g + R_{sw}\rho_w \vec{V}_w] = \rho_g q_g \quad (1)$$

Continuity Equation of liquid is defined as as Eq.(2)

$$\frac{\partial}{\partial t}(\phi\rho_w s_w) - \nabla \cdot (\rho_w \vec{V}_w s_w) = \rho_w q_w \quad (2)$$

Where $s_g + s_w = 1$; R_{sw} is gas solubility in water; ρ_w, ρ_g are the density of gas and water under formation conditions respectively; s_g, s_w is saturation of gas and water; ϕ is porosity of skeleton of coal rock; K is absolute permeability; $K_{r\alpha}$ is relative permeability of α Phase fluid; μ_α is viscosity of α Phase fluid; p_α is pressure of α Phase fluid; α represents $\alpha = (g, w)$.

$$\phi S_\alpha (\vec{V}_\alpha - \vec{V}_s) = -\frac{Kk_{r\alpha}}{\mu_\alpha} (\nabla p_\alpha - \rho_\alpha g \nabla H) \quad (3)$$

Where \vec{V}_α is the absolutely velocity of α Phase fluid, \vec{V}_s is the velocity of coal at a point, $\vec{V}_{r\alpha}$ is the relatively velocity of α Phase fluid flow to coal reservoir solid, motion equation

of gas-liquid coupling seepage in coal-bed can be given by (Robert W.Zimmerman, Wilbur H.Somerton, Michael S.King., 1986) :

Combined Eq.(3)with Eq. (1), Eq.(2) and ignore the second-order phase, results can be derived that:

$$\frac{1}{K} \left\{ \text{div} V_s + \frac{\partial}{\partial t} [\phi(R_{sw} s_w \rho_w + s_g \rho_g)] \right\} - \nabla \cdot \left[\left(\frac{K_{rg} \rho_g}{\mu_g} + \frac{K_{rw} R_{sw} \rho_w}{\mu_w} \right) \nabla p_g \right] = q_g \rho_g \quad (4)$$

$$\frac{1}{K} [\text{div} V_s + \frac{\partial}{\partial t} (\phi s_w \rho_w)] - \nabla \cdot \left[\left(\frac{K_{rw} \rho_w}{\mu_w} \right) \nabla p_w \right] = q_w \rho_w \quad (5)$$

Where, $\text{div} V_s = \frac{\partial e}{\partial t}$, e is the volume strain of skeleton of coal rock.

Coal rock is regarded as an elastic medium, under fluid phase pressure; skeleton of coal rock deformation field equation consists of balance equation, geometric equation and physics equation.

$$\sigma_{ij,j}' + (p\delta_{ij})_{,j} + f_i = 0 \quad (6)$$

$$\varepsilon_{ij} = \frac{1}{2} (u_{i,j} + u_{j,i}) \quad (7)$$

$$\varepsilon_{ij} = \frac{1}{E} [\sigma_{ij} - \nu(\sigma_{jj} + \sigma_{kk})] + \frac{\alpha}{3K_b} p \quad (8)$$

$$\varepsilon_{ij} = \frac{\sigma_{ij}}{2G}, (i \neq j) \quad (9)$$

Where $\lambda = \frac{E\nu}{(1+\nu)(1-2\nu)}$; $K_b = \lambda + \frac{2}{3}G$ (K_b is bulk modulus of porous media).

By Eq.(6), Eq.(7), Eq.(8), Eq.(9) coal mass deformation equation can be obtained:

$$G\nabla^2 u_i + (G + \lambda) \frac{\partial e}{\partial x_i} + f_i = \alpha \frac{\partial p}{\partial x_i} \quad (10)$$

$$e = \nabla \cdot u \quad (11)$$

For Eq. (10), take the divergence of both sides:

$$(\lambda + 2G)\nabla^2 e = \alpha \nabla^2 p \quad (12)$$

Combined Eq. (4), Eq. (5), Eq. (12), coal bed methane - liquid - solid coupling seepage mathematical model can be described as:

$$\begin{cases} \left(\frac{KK_{rg}\rho_g}{\mu_g} + \frac{KK_{rw}R_{sw}\rho_w}{\mu_w} \right) \nabla^2 p_g = \frac{\partial}{\partial t} [\phi(R_{sw}s_w\rho_w + s_g\rho_g)] + \text{div}\vec{V}_s + q_g\rho_g \\ \left(\frac{KK_{rw}\rho_w}{\mu_w} \right) \nabla^2 p_w = \frac{\partial}{\partial t} (\phi s_w\rho_w) + \text{div}\vec{V}_s + q_w\rho_w \\ (\lambda + 2G)\nabla^2 e = \alpha\nabla^2 p \end{cases} \quad (13)$$

Where K_{rw} is relative permeability of water fluid; K_{rg} represents relative permeability of gas fluid; ρ_w, ρ_g are the density of gas and water under formation conditions respectively; μ_w, μ_g represent viscosity of water and gas respectively; P_w, P_g are water and gas fluid pressure.

3. Solution for Gas-liquid-solid Coupling Seepage Equations

To study the two-phase fluid compressibility, oil and water generally is known as micro-compressible fluid, and gas is known as a compressible fluid. Under isothermal conditions, Fluid compression factor c_f can be given by,

$$c_f = -\frac{1}{V} \frac{dV}{dp} = \frac{1}{\rho} \frac{d\rho}{dp}, T \text{ is a constant value.} \quad (14)$$

Integrate Eq. (14) comes:

$$\rho = \rho_{sc} e^{[c_f(p-p_o)]} \quad (15)$$

The relation between viscosity and pressure can be given as:

$$\mu_p = \mu_{psc} e^{b(p-p_o)} \quad (16)$$

Divide ρ by μ_p :

$$\frac{\rho_\alpha}{\mu_\alpha} = \frac{\rho_{\alpha sc}}{\mu_{\alpha sc}} \cdot \frac{e^{[c_f(p-p_{sc})]}}{e^{b(p-p_{sc})}} \quad (17)$$

Using Taylor series expansion at $x = 0$, neglect small quantity, the equation above has the form:

$$\rho_\alpha \rightarrow \rho_{\alpha sc} \cdot [1 + c_f(p - p_{\alpha 0})] \quad (18)$$

$$\frac{\rho_\alpha}{\mu_\alpha} \rightarrow \frac{\rho_{\alpha sc}}{\mu_{\alpha sc}} \cdot 1 \quad (19)$$

Combine Eq.(18), Eq.(19) Eq.(13) and simplify the equation. Use $\rho_{\alpha 0}$ to represent the conventional formation volume factor, that is $\rho_{\alpha 0} = \frac{\rho_{\alpha sc}}{B_\alpha}$ (where $\rho_{\alpha sc}$ is density of α Phase under standard ground conditions, B_α is the formation volume factor, $\alpha = (g, w)$)

A length of 1 in Z direction is applied to simplify Eq. (13) regarded as a two-dimensional problem that is:

$$\left(\frac{KK_{rg} \rho_{gsc}}{\mu_{gsc}} + \frac{KK_{rw} R_{sw} \rho_{wsc}}{\mu_{wsc}} \right) \left(\frac{\partial^2 P_g}{\partial x^2} + \frac{\partial^2 P_g}{\partial y^2} \right) = [\phi(R_{sw} S_w \frac{\rho_{wsc}}{B_w} + S_g \frac{\rho_{wsc}}{B_g}) + \beta_0] \frac{\partial P_g}{\partial t} + \frac{\partial f(x, y, t)}{\partial t} \quad (20)$$

$$\left(\frac{KK_{rw} \rho_{wsc}}{\mu_{wsc}} \right) \left(\frac{\partial^2 P_w}{\partial x^2} + \frac{\partial^2 P_w}{\partial y^2} \right) = \left(\frac{\phi S_w \rho_{wsc}}{B_w} + \beta_0 \right) \frac{\partial P_w}{\partial t} + \frac{\partial f(x, y, t)}{\partial t} \quad (21)$$

Where $\beta_0 = \frac{\alpha}{\lambda + 2G}$

Coal bed methane and liquid phases are stored together in the coal seam. Process of migration can be divided into three stages (Zeng Yi-shan, 2003): Single-phase that is liquid phase, unsaturated liquid flow phase and saturated gas - liquid flow phase. This paper gives solution of saturated gas - liquid flow phase.

Assume that seam is infinite cylinder, then the boundary conditions turn out:

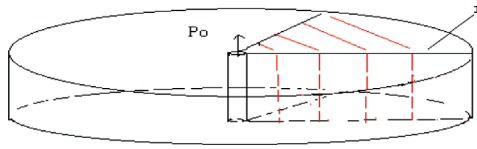


Figure 1 – Sketch Map of Coal-bed Methane Exploitation

Initial conditions of two - phase fluid flow field:

$$p_\alpha(r, 0) = \varphi(r) = \frac{p_0}{2\pi r} \quad (0 < r < R, t > 0) \quad (22)$$

The first boundary condition of seam between two-phase fluid field:

$$p_\alpha(R, t) = p_0 \quad (R \rightarrow \infty) \quad (23)$$

Where p_0 - Steady pressure before seam mining

The seam is set to be a infinite circular, as shown in Figure 2.

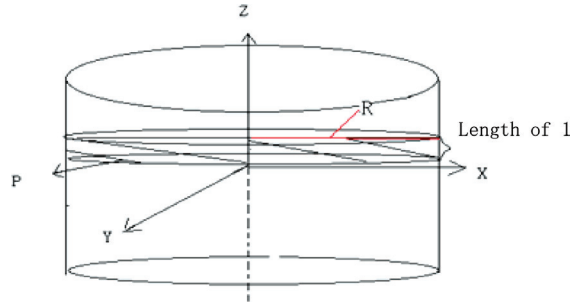


Figure 2 – Simple Diagram of Coal Bed

$$\frac{\partial^2 p_\alpha}{\partial x^2} + \frac{\partial^2 p_\alpha}{\partial y^2} = \frac{\partial^2 p_\alpha}{\partial r^2} + \frac{1}{r} \frac{\partial p_\alpha}{\partial r} \quad (24)$$

When the boundary value of fluid pressure is constant, namely $f(x, y, t)$ is constant:

$$\frac{\partial f(x, y, t)}{\partial t} = 0$$

After a combination of Eq. (20), Eq.(22), Eq. (23) Eq.(24), definite conditions problem is obtained as follows:

$$\left\{ \begin{array}{l} p_{gt} = \frac{\theta_1 + R_{sw}\theta_2}{\beta_g} (p_{grr} + \frac{1}{r} p_{gr}) \quad (0 < r < R, t > 0) \\ p_g(r, 0) = \varphi_1(r) \quad (0 \leq r \leq R) \\ p_g(r, t) = p_0 \quad (R \rightarrow \infty) \end{array} \right. \quad (25)$$

$$\text{W h e r e } \theta_1 = \frac{KK_{rw}\rho_{wsc}}{\mu_w} \quad \theta_2 = \frac{KK_{rg}\rho_{gsc}}{\mu_g} \quad , \quad \beta_g = \phi \left(\frac{R_{sw}s_w\rho_{wsc}}{B_w} + \frac{s_g\rho_{gsc}}{B_g} \right) + \frac{\alpha}{\lambda + 2G}$$

$$\beta_w = \phi s_w \frac{\rho_{wsc}}{B_w} + \frac{\alpha}{\lambda + 2G}, \text{ Use separation of variables method for solving two phase}$$

model non-zero solution.

Now suppose that $p_g(r, t) = V_1(r)T_1(t)$, and substitute it into Eq. (25) by separation of variables:

$$\frac{rV'' + V'}{rV} = \frac{T'}{\frac{\theta_1 + R_{sw}\theta_2}{\beta} T} = -\gamma \quad (26)$$

Where $\eta_1^2 = \frac{\theta_1 + R_{sw}\theta_2}{\beta}$ ($\eta_1 > 0$), so :

$$T' + \gamma\eta_1^2 T = 0 \quad (27)$$

$$V'' + \frac{1}{r}V' + \gamma V = 0 \quad (28)$$

Define it as an Eigen value problem:

$$\begin{cases} V'' + \frac{1}{r}V' + \gamma V = 0 \\ V(R) = 0 (R \rightarrow \infty) \\ |V(0)| < +\infty \end{cases}$$

$\gamma \leq 0$ is not the intrinsic value, and let's discuss $\gamma > 0$, suppose $\rho = \sqrt{\gamma}$ (Here ρ does not mean density, $V(\frac{\rho}{\sqrt{\gamma}})$ still refers as $V(\rho)$, then:

$$V'' + \frac{1}{\rho}V' + V = 0 \quad (29)$$

Eq.(29) is a classic form of the zero-order Bessel equation whose solution is:

$$\begin{aligned} V(r) &= c_1 J_0(\rho) + c_2 N_0(\rho) \\ &= c_1 J_0(\sqrt{\gamma}r) + c_2 N_0(\sqrt{\gamma}r) \end{aligned} \quad (30)$$

Where J_0 is Bessel function, $J_0(x) = 1 - \frac{1}{4}x^2$; N_0 is Zero-order Neumann function; c is Euler's constant;

According to the boundary conditions, $c_2 = 0$, $c_1 J_0(\sqrt{\gamma}R) = 0$, if $c_1 \neq 0$, $J_0(\sqrt{\gamma}R)$ should be 0, zero-order of bessel function of zero there can be countable, define $\mu_m^{(0)} (m = 1, 2, \dots)$, and then:

$$\gamma_m = \left(\frac{\mu_m^{(0)}}{R}\right)^2 (m = 1, 2, \dots) \quad (31)$$

$$V_m = c_m J_0\left(\frac{\mu_m^{(0)}}{R}r\right) \quad (m = 1, 2, \dots) \quad (32)$$

Substitute γ_m into (27):

$$T_m = D_m e^{-\left(\frac{\mu_m^{(0)}\eta_1}{R}\right)^2 t} \quad (33)$$

$$p_{gm}(r, t) = A_m e^{-\left(\frac{\mu_m^{(0)}\eta_1}{R}\right)^2 t} J_0\left(\frac{\mu_m^{(0)}}{R}r\right) \quad (34)$$

For $J_0\left(\frac{\mu_m^{(0)}}{R}r\right)$ ($m = 1, 2, \dots$) constitutes an orthogonal system with weight r , A_m is the Generalized Fourier coefficient of $\varphi(r)$, that is:

$$A_m = \frac{1}{M_m^2} \int_0^R r \varphi_1(r) J_0\left(\frac{\mu_m^{(0)}}{R}r\right) dr \quad (m = 1, 2, \dots) \quad (35)$$

Integrate A_m into (34), we can achieve the solution of model(I):

$$p_g(r, t) = \sum_{m=1}^{\infty} \frac{1}{M_m^2} e^{-\left(\frac{\mu_m^{(0)}\eta_1}{R}\right)^2 t} J_0\left(\frac{\mu_m^{(0)}}{R}r\right) \int_0^R r \varphi_1(r) J_0\left(\frac{\mu_m^{(0)}}{R}r\right) dr \quad (36)$$

By simplification, the final analytical solution is obtained:

$$p_g(r, t) = \frac{3p_0}{2\pi} e^{-\left(\frac{2\eta_1}{R}\right)^2 t} \left(1 - \frac{r^2}{R^2}\right) \quad (37)$$

Similarly the pressure of liquid phase is very like to the saturated two-phase pressure of gas, the answers is:

$$p_w(r, t) = \frac{3p_0}{\pi} e^{-\left(\frac{2\eta_3}{R}\right)^2 t} \left(1 - \frac{r^2}{R^2}\right) \quad (38)$$

4. Influence factor and changing rules of gas pressure

Choose the statistics from citation (Fu Xue-hai, Qin Yong, 2003) to calculate, which are shown in Table 1:

Parameters	Value
Coal rock elastic modulus, $E(\text{GPa})$	2.735
Poisson's ratio of coal, ν	0.3756
Coal density, $\rho(\text{kg/ m}^3)$	1500
Seam depth, h (m)	850.4
Seam thickness, $H(\text{m})$	9.2
Coal and rock porosity, ϕ	2.0%
Coal permeability, K ($10^{-3} \mu\text{m}^2$)	6.2
Seam initial pressure, $P(\text{MPa})$	12.56
Strata water viscosity, μ_w (Pa. s)	5.8×10^{-4}
	1.47×10^{-5}
Strata gas viscosity, μ_g (Pa. s)	
Density of the gas under standard conditions, ρ_g (kg/ m^3)	0.425
Density of the water under standard conditions, ρ_w (kg/ m^3)	0.998
	0.00896
Gas formation volume factor, B_g	
	1.0
Water formation volume factor, B_w	
	0.1
Initial gas saturation, S_g	
	17.63
Langmiur adsorption constant, n^∞ (m^3/t)	
	2.2809
Langmiur pressure constant, P_L (Mpa)	
	1.3
Gas solubility in water, R_{sw}	
	7.2%
Gas relative permeability, K_{rg}	
	7.2%
Water relative permeability, K_{rw}	

Table 1 – Parameters of Gas Reservoir and Fluid

Set $r=100\text{m}$, after substituting the relevant parameters into Eq.(38), gas pressure and can be given by,

$$p_g(r,t) = 5.33063e^{-3.51688 \times 10^{-9} t} \quad (39)$$

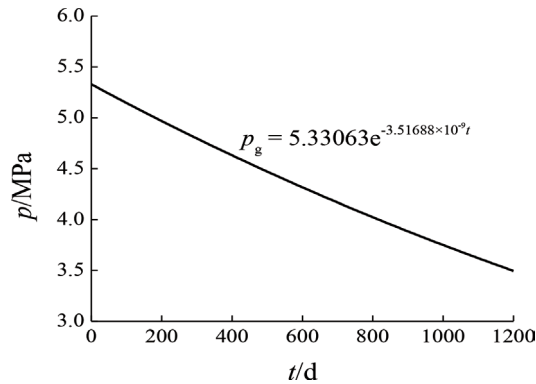


Figure 3 – Effect of Time on Gaseous Pressure

Eq.(39), as shown in Figure 3. With the growth of mining time, gas pressure decreases from initial 5.33063MPa at $r = 100\text{m}$. The speed of gas pressure keeps slowing down until it reaches 0, during extraction. For, with time increasing, CBM desorbs, the gas migration velocity keeps increasing, which leads to the decrease of gas pressure. While with the desorption going on, the gas available for desorbing shrinks, slowing the speed of the gas phase pressure decreases.

4.1 Effect of Gas Solubility in Water on Gaseous Pressure

If we choose $R=300\text{m}$, $r=50\text{m}$ in the Eq.(38), apart from gas solubility parameter, the other parameter values are taken from Table 1, According to the reference (Fu Xue-hai, Qin Yong, 2003), R_{sw} is assigned 0.75, 1.25, 1.5, 1.75 respectively.

Determined by the function formula, the gas pressure are as shown in Figure 4:

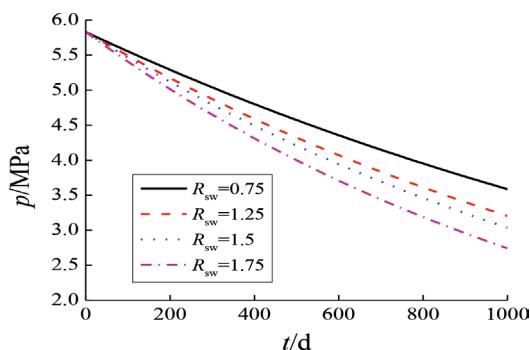


Figure 4 - Effect of Gas Solubility on Gaseous Pressure

From the figure we can see that the higher the gas solubility is, the more the gas pressure decrease. On 1000 days, when R_{sw} is 0.75, pressure of gaseous stream reduces to

3.998MPa; while pressure of gaseous stream is reduced to 2.676MPa when R_{sw} is 1.75. Therefore, the higher the gas solubility in water is, it is easier for gas to desorb, the higher the gas permeability is, and the greater the pressure drops of gas phase.

4.2 Effect of Gas Saturation in Water on Gaseous Pressure

Refer to the results from citation (Deng Gung-hong., 2011), different gas Saturation correspond to different relative permeability, so when gas Saturation s_g changes, another three physical parameters change as well, shown as follows:

- (1) When $s_g=10\%$, $s_w=90\%$, $K_{rg} = K_{rw} = 7.2\%$, $P = 5.83038e^{-0.000599285t}$
- (2) When $s_g=28.6\%$, $s_w=71.4\%$, $K_{rg} = K_{rw} = 18.5\%$, $P = 5.83038e^{-0.00177821t}$
- (3) When $s_g=43.1\%$, $s_w=56.9\%$, $K_{rg} = K_{rw} = 24.7\%$, $P = 5.83038e^{-0.0027t}$
- (4) When $s_g=78.9\%$, $s_w=21.1\%$, $K_{rg} = K_{rw} = 21.4\%$, $P = 5.83038e^{-0.00353825t}$

Substitute the parameters into Eq.(28) and plot:

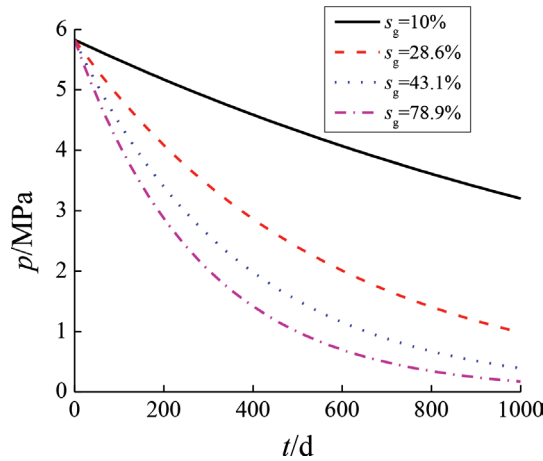


Figure 5 - Effect of Gas Saturation on Gaseous Pressure

From the figure we can see that, when $t=200d$, s_g is 10%, the gas pressure decreases to 5.3758MPa, and s_g is 28.6%, the gas pressure decreases to 4.4351MPa, and when s_g is 78.9%, the gas pressure decreases to 2.7376MPa. To conclude that: when gas saturation increases, there is a large gas pressure decrease in this period, and higher the gas saturation is, the more obvious such phenomenon exhibits. In the same conditions, the water saturation drops quickly if the gas saturation is high, similarly, if the gas relative permeability increases the water relative permeability decreases, the production of CBM improves, the gas pressure fall sharply to a stationary value which means extraction turns into the state of fast gas-generating.

5. Conclusions

Compared with previous models, the paper provides introduction of the gas solubility in water. So the gas - water phase pressure can be taken into consideration. Separation of variables method is applied to solve the problem in the model. Obtained fluid pressure and pressure distribution curve with time of any time, any displacement conditions can be obtained. It can provide a theoretical basis for the exploitation of coalbed methane. The distance of gas well is closer, the velocity is faster. Consider gas solubility in water, day in 1000, when gas increased 57% solubility in water, the vapor pressure of the fluid is reduced by 33%. The higher the gas solubility in water is, it is easier for gas to desorb, the higher the gas permeability is, and the greater the pressure drops of gas phase. It is make mining broad scope of change which can be more efficient exploitation of coalbed methane. And when gas saturation increases, there is a large gas pressure decrease in this period, and higher the gas saturation is, the more obvious such phenomenon exhibits. This shows that when the water phase relative permeability values decreasing, gas relative permeability values will increase accordingly, CBM production rose, while the vapor pressure drops rapidly to a steady value, mining also entered the peak gas production state.

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Wireless Sensor Network Node Scheduling Algorithm Based on Energy Saving Strategy

Zhihu Wang^{1,2,*}

* tigger_wang@163.com

¹ Wuhan University of Technology, 430070, Wuhan, China

² Guangxi Cadres University of Economics and Management, 530007, Nanning, China

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Abstract: Wireless sensor network depends on its batteries for energy supply, but the energy of batteries is limited. And once the sensor nodes are deployed, it is difficult to change or recharge the batteries because of the restrictions of its working environment. The purpose of node scheduling is to schedule as many as possible redundant nodes into sleep mode, thus to reduce unnecessary energy cost, and to extend the lifetime of the networks. Based on classic LEACH protocol, under the circumstances of coverage and the principle of minimizing energy cost in a cluster, node scheduling could be turned into optimization problem. A kind of improved particle swarm optimization is chosen to solve this problem, because of its excellence in complicated optimization. The experiment results show that the proposed algorithm can save much energy than traditional particle swarm optimization. Besides, it has faster convergence speed. It is an efficient energy saving strategy for wireless sensor network.

Keywords: Wireless sensor network; node scheduling; energy saving.

1. Introduction

Wireless sensor network is a new information acquirement and processing technology, which is an integration of sensor technologies, embedded computation technologies, distributed information preprocessing technologies and wireless communication technologies (F. V. C. Martins, E. G. Carrano, E. F. Wanner, R. H. C. Takahashi and G. R. Mateus., 2011). Because of its important practical value in many fields, wireless sensor network has become a new research hotspot, and is recognized as one of the most influential technologies in the 21st century (H. Lee, A. Keshavarzian., 2008). Wireless sensor network depends on its batteries for energy supply, but the energy of batteries is limited. And once the sensor nodes are deployed, it is difficult to change or recharge the batteries because of the restrictions of its working environment. Thus the core issue of software and hardware designing in wireless sensor network is to reduce its energy cost (H. Lee, A. Keshavarzian, H.K. Aghajan., 2008). Because of the high density of sensor nodes in wireless sensor network, there are quantities of redundant sensor nodes. All sensor nodes working simultaneously will lead to great waste of energy. One of the efficient methods for energy management is to schedule some nodes into sleep mode while others keep

active and make the node work in turns. The purpose of node scheduling is to schedule as many as possible redundant nodes into sleep mode, thus to reduce unnecessary energy cost and to extend the lifetime of the networks. Coverage control is a basic problem in wireless sensor network. The main content of coverage control is to ensure the network do have certain quality of service. Then, you can optimize it by some technology or protocol. So that it can meet its maximize coverage area. People may get reliable monitoring data and target tracking service. Effective strategies of the coverage control and algorithms can be used to optimize the allocation of resources of wireless sensor network, increase the efficiency of the energy usage of network nodes, and improve the perceived quality of service and the overall survival time. How to combine different environmental demands and design a practical strategy for coverage is a significant research field. Researchers have put forward the strategies for reducing energy consumption and prolong the network life cycle from all aspects of the wireless sensor network. These strategies can be divided into four basic categories: sleep scheduling scheme, adjusting the sensing radius of the nodes, choosing the best route and highly effective data fusion system. A distributed detection algorithm was put forward by Ye F (Ye F., Zhong J., Cheng J., et al., 2003), which let always node in the work state always work until the energy was consumed. Nodes in the idle state woke up every a random time to detect whether there is working node within a radius of the perception. If there is working node, it continues to enter into idle state. Otherwise, it enters into the working state. Distributed detection algorithm was simple, easy to implement, but it did not guarantee the complete coverage of the network. A node scheduling protocol covering perception was proposed by Jun Lu (Jun Lu, Tatsuya S., 2003). Each node entered into idle state according to their contribution to the network coverage. This method could guarantee certain network coverage, but it did not guarantee the connectivity of the network. In order to make energy consumption minimal, a kind of wake-up scheduling algorithm was put forward by R. Cohen (R. Cohen and B. Kapchits & Idquo., 2009). For clustered wireless sensor networks, a kind of TDMA scheduling algorithm was proposed by Shi. L (Shi. L., Fapojuwo, A. O., 2010), which can optimize energy efficiency and minimum delay. J. Jia used multi-objective genetic algorithm to save energy of wireless sensor networks (J. Jia, J. Chen, G. Chang and Z. Tan., 2009). Besides, ant colony algorithm and multi-objective evolutionary were used to control energy consumption of wireless sensor networks (J.W. Lee , B.-S. Choi and J.J. Lee., 2011). From the research status of node scheduling, it can be seen that researches on sensor network node scheduling focus on finding a mechanism which can efficiently close redundant nodes to reduce the network energy consumption and can guarantee the network coverage (Y. Lin, X. Hu and J. Zhang., 2010). At home and abroad, there are few researches combining the network energy consumption with node scheduling (Lee, J.W., Ju-Jang Lee., 2012). In the existing various kinds of clustering algorithms, in order to reduce the energy consumption of the whole sensor network, specific algorithms are used to optimize the number of cluster or adjust the structure of cluster in the process of clustering (Sengupta, S., Das, S., Nasir, M., Vasilakos, A.V., 2012). It does not consider a large number of redundant nodes in the cluster due to larger distribution density of sensor nodes. In the next section, energy consumption model of wireless sensor network is investigated. In section 3, scheduling algorithm based on improved particle swarm optimization is put forward. In section 4, the simulation experiments are done to verify the performance of proposed scheduling algorithm. In the end, some remarks are given (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015).

2. Energy Consumption Model

Node scheduling algorithm is on the basis of guaranteeing network coverage to schedule nodes according to the principle of minimal energy consumption inside the cluster, (V. C. Gungor, B. Lu and G. P. Hancke., 2010) so it is needed to consider the relevant coverage and energy consumption model. The monitoring area of sensors is divided into virtual grid of the same interval and the grid vertex is called grid point, also called sampling points. When the grid density is big enough, the whole area coverage can be taken as point covering approximately. Of course, the transformation from regional covering to point set covering can brings to deviation between covering model and actual situation. So it is needed to find a suitable grid density, while it satisfies a certain accuracy requirement, it keeps low computational complexity. The energy consumption model in the LEACH cluster is as follows. For a given threshold value d_o , under the condition of close range transmission $d < d_o$, the energy consumption is proportional to d^2 . When the distance is larger, the sender and the receiver are close to the ground. There is much interference. Energy loss increases sharply with the increase of distance. At this time, communication energy is proportional to d^4 . Transmission distance of k bit of data packet is d and energy consumption is.

$$E_{Tx}(k,d) = \begin{cases} E_{elec}k + \varepsilon_{fs}kd^2, & d < d_o \\ E_{elec}k + \varepsilon_{mp}kd^4, & d \geq d_o \end{cases} \quad (1)$$

The energy consumption of receiving k bit of data packet is $E_{Rx}(k) = E_{elec}k$.

In this algorithm, the goal of node scheduling is to reduce energy consumption in the cluster as far as possible and schedule redundant nodes as many as possible to enter into idle state. At the same time, it should guarantee the working nodes after scheduling to cover all sampling points in the monitoring area. In actual cases, the nodes are randomly scattered in the monitoring area. Because of numerous nodes, each node can not be installed with positioning system. Usually only 5%- 10% of the nodes have positioning system, which can determine its own position, known as the reference node. The common node estimates its place by means of exchanging data with reference node. So we do the following assumptions. (1) Every sensor knows the location in the network and the position is represented by coordinates (x,y) . (2) All sensors in the network have the same perception, the perception scope is a circle, the center of which is (x,y) . The radius is r . (3) In order to make sure network connectivity after node scheduling, communication radius of sensor nodes is greater than or equal to two times of the radius. (4) Sensor network is the data collection network and the node has data to be sent. (5) All sensor nodes do not move when the algorithm is running.

3. Scheduling Algorithm Based on Improved Particle Swarm Optimization

Particle swarm optimization is a typical swarm intelligence optimization algorithm. Its basic idea stems from the simulation of biological acts in community-based social. The external information is not used in search process. The fitness function value is the basis criterion of evolution. Due to particle swarm optimization algorithm has great

advantage in solving complex optimization problems, so particle swarm optimization algorithm is used to solve the problem. Sampling point set is P_i , which is covered by node i . The total coverage area of N number of nodes in the network is $P = \bigcup_{i=1}^n P_i$, which

is set of M number of sample points. S represents N number of sensor node sets. D represents M number of sampling point sets. x_i represents the state of sensor node i . When $x_i = 1$, the node starts to work. When $x_i = 0$, the node sleeps. y_{ij} represents whether sensor node i covers sampling point j . $y_{ij} = 1$ represents sensor node i covers sampling point j .

h_j represents sampling node j is not covered by working node and h_j represents sampling node j is covered by working node. AE_i represents sum of consumed energy of sensor node i . The minimal energy consumption is taken as the goal of node scheduling. The constraint condition is that network coverage is the same before and after the scheduling. The following node scheduling model is set up.

$$\min \sum_{i \in S} AE_i \cdot x_i \cdot \sum_i \sum_j y_{ij} \cdot x_i > \sum_j h_j, \forall i \in S \text{ and } \forall j \in D \quad (2)$$

$$y_{ij} \leq x_i, \forall i \in S \text{ and } \forall j \in D. 0 \leq y_{ij} \leq 1, \forall i \in S \text{ and } \forall j \in D \quad (3)$$

$$h_j \geq 0, \forall j \in D. x \in \{0,1\} \quad (4)$$

The problem is transformed into extremum problem under constraint conditions. Penalty function is used to remove constraints and establish the fitness function. The constructed optimization function is $F(x) = f(x) + P(x)$. $P(x)$ represents penalty

function. $P(x) = s \cdot \left[\sum_{i=1}^{m_1} g_i^+(x) + \sum_{i=m_1+1}^m |h_i(x)| \right]$.

$g_i^+(x) = \max\{0, -g_i(x)\}$, s represents penalty factor. $f(x) = \sum_{i \in S} AE_i \cdot x_i$,

$g_i(x) = \sum_i \sum_j y_{ij} \cdot x_i - \sum_j h_j$. The optimization model is,

$$\min \left[\sum_{i \in S} AE_i \cdot x_i + s \cdot \max \left\{ 0, \left(\sum_{j=1}^m h_j - \sum_{i=1}^m \sum_{j=1}^m y_{ij} \cdot x_i \right) \right\} \right] \quad (5)$$

In a cluster, there is one cluster head node and n number of common nodes. The energy consumption is described as follows. Energy consumption of cluster head is

$E_{CH} = E_m + n \cdot (E_{Rx} + E_{Da}) + E_{Tx}(c)$. E_{mem} represents energy consumption of common nodes. $E_{mem} = E_m + E_{Tx}(d)$. E_m represents working energy of the node. E_{Da} represents energy consumption used for data fusion. $E_{Tx}(c)$ represents energy consumption of cluster head sending data to base station. $E_{Tx}(d)$ represents energy consumption of common node sending data to cluster head. The total energy consumption is $E_{sum} = E_{CH} + nE_{mem}$. The fitness function is,

$$\min F(x) = E_{CH} + \sum_{i=1}^n (E_{mem} \cdot x_i) + s \cdot \max \left\{ 0, \left(\sum_{j=1}^m h_j - \sum_{i=1}^m \sum_{j=1}^m y_{ij} \cdot x_i \right) \right\} \quad (6)$$

In the improved particle swarm optimization, $V_{id} \in [V_{\min}, V_{\max}]$, $X_{id} \in [X_{\min}, X_{\max}]$. P_i represents the history optimal location of particle i and P_g represents history optimal location of all particles. The improved speed and position update formula is $V_{id}^{t+1} = w \cdot V_{id}^t + c_1 \cdot (P_{id}^t - X_{id}^t)$, $X_{id}^{t+1} = X_{id}^t + V_{id}^{t+1}$.

$w = w_{\max} - (w_{\max} - w_{\min}) \cdot \frac{t}{t_{\max}}$. t_{\max} represents the maximum iteration times, w_{\max} represents the maximum value of inertia weight and w_{\min} represents the minimal value of inertia weight. The speed of particle i is $V_i = (V_{i1}, V_{i2}, \dots, V_{id})$ and position of particle i is $X_i = (X_{i1}, X_{i2}, \dots, X_{id})$. c_1 represents learning factors. The process of improved particle swarm optimization is as follows. Step 1. A group of particles is randomly initialized. The swarm scale is M . The initialized parameters include the maximum iteration times t_{\max} , inertia weight w , learning factor c_1 , the maximum speed V_{\max} , X_{\min} and X_{\max} . Step 2. Calculate fitness value of each particle. Step 3. If the iteration times $t > t_{\max}$, the iteration stops and output the optimal value. Otherwise, turn to step 4. Step 4. Particle speed and position is updated. Step 5. Compare fitness value of each particle with P_i and P_g . If fitness value is better than P_i and P_g , the fitness value is taken as the best P_i and P_g . Otherwise, keep the original value. Step 6. If it meets termination condition, the algorithm stops. Otherwise, turn to step 3. Firstly, the monitoring area is determined. Each node determines its own covering sample point information. Covering sample point information and position information is sent to the cluster head node. Cluster head node runs scheduling algorithm based on improved particle swarm optimization to find the nodes needing to work within the cluster. Cluster head sends dormancy instruction to make other redundant nodes in idle state.

4. Result Analysis and Discussion

Supposing the experiment are done in the square area of $50m \cdot 50m$. The cluster head node is in the center of the area. The number of nodes is 50. Common nodes are randomly deployed. The perception radius of node is 10m. The network density is 0.5m. Above of the network area is the base station, the coordinate is (25, 75). $E_{elec} = 50nJ/bit$, $\varepsilon_{fs} = 10pJ/bit/m^2$, $\varepsilon_{mp} = 0.0013pJ/bit/m^4$, $E_{Da} = 5nJ/bit/signal$. The size of particle swarm is 60, $c_1 = 60$ and w decreases linearly from 0.9 to 0.4. The iteration times is 100. It can be seen that working nodes and network energy consumption of the improved particle swarm algorithm is less than basic particle swarm optimization algorithm. At the same time, computing speed of improved particle swarm optimization algorithm is faster. Evolution curve of standard particle swarm optimization and improved particle swarm optimization is shown in figure 1. When the basic particle swarm optimization algorithm is trapped into premature convergence, most of the particles can't jump out attraction of local optimum and the entire population is in the state of stagnation. It is unable to continue to evolve. Our improved particle swarm algorithm can jump out of local optimum, which can continue to search for the optimal solution in the solution space.

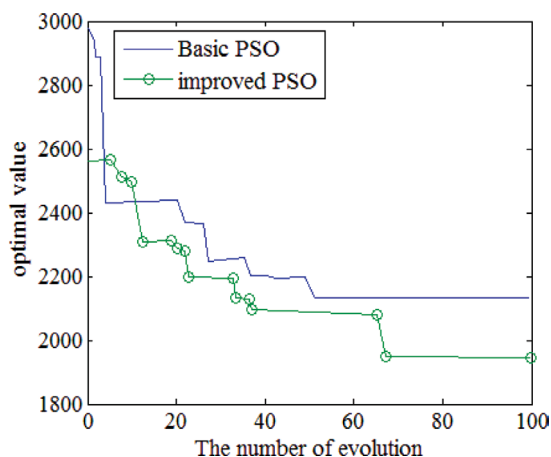


Figure 1 – Evolution curve of Standard Particle Swarm Optimization and Improved Particle Swarm Optimization

The size of perception radius of the sensor nodes will affect the number of node selection. As the sensing radius increases, the coverage scope of each sensor node also increases and the number of needed nodes covering corresponding area decreases. Through the above experiments, it shows that the proposed scheduling algorithm based on improved particle swarm can effectively shut down redundant working node within the cluster, and reduce the energy consumption of the network.

5. Conclusion

Based on the classic LEACH clustering protocol, on the basis of the guaranteeing network coverage range, at the same time, according to the principle of minimal energy consumption within the cluster, node scheduling is converted to a combinatorial optimization problem. Particle swarm optimization algorithm has powerful advantages in solving complex optimization problems. Because standard particle swarm optimization is easy to fall into local optimum. A kind of improved particle swarm optimization is put forward. Simulation results show that the proposed node scheduling algorithm is correct and effective and has good energy saving effect. Compared with the standard particle swarm algorithm, the global search ability and convergence speed of proposed scheme have been significantly improved, at the same time, it can effectively avoid premature convergence. Through simulation experiments and compared with other algorithms, it is proved that this algorithm can effectively balance the network energy consumption and prolong network lifetime.

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An Empirical Study on Spatial Heterogeneity of Manufacturing OFDI Reverse Technology Spillover and Dynamic Threshold of Absorption Capacity

Shen Fei ¹

wycf2005@126.com

¹ Zhejiang Yuexiu University of Foreign Languages, 312000, Shaoxing, Zhejiang, China

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Abstract: Based on the refining of R & D capital including OFDI, FDI & IM(import), this assay conducts a multi-variant non-linear panel threshold regression validation, then it also leads a correlation analysis of the dynamic threshold together with the technology absorbing capacity ranging the variable such as host countries' market maturity, R & D intensity, human capital, economic scale as well as their cross terms of R&D capital. The result proves that there exists anisotropic threshold of manufacturing industry reverse spillover, potential difference syntropy, as well as spatial heterogeneity, the latter two contain dual attributes of dynamic threshold. Furthermore the selected parameters contain significant and relatively stable dynamic threshold characteristics. Overall, the dynamic threshold correlation of manufacturing industries' reverse spillover has the partial character of "quantity" in structure.

Keywords: Manufacturing; OFDI; Reverse spillover; Threshold characteristic; Spatial heterogeneity; Absorbing capacity

1. Introduction

With the acceleration of economic integration, countries of emerging economies has been enhancing the strength of outward foreign direct investment (OFDI) and investment entity also take advantage of cast resources and mechanism in countries holding technical advantages beyond those of home countries to form the embedding and digging mode of foreign technology and obtain reverse spillover from OFDI. However, the OFDI advantages to manufacturing as well as the whole China's economy growth is not only restricted by embedding degree and various factors in objects countries who accept oversea investment, and will also form different degrees of reverse spillover effect due to the difference of various factors in industries of home countries (Prata, P., Fazendeiro, P., Augusto, C., Azevedo, S., & Machado, V. C., 2013).

2. Literature Review

As for the dynamic composition and existence effect of OFDI technology spillover, authors verified the reverse OFDI composition sourcing from import made up the source

of OFDI reverse-fostering technical advance in home country, through the regression of international R&D capital (Coe, D. T., Helpman, E., & Hoffmaister, A. W., 1997). OFDI has absorption difference effect in reverse-fostering the home countries' technology ,based on promoting factor theory of Dunning(Saad, R. M., Noor, A. H. M., & Nor, A. H. S. M., 2014). As for the implementation form of OFDI reverse spillover, multinational corporations and foreign direct investment (FDI) has become the main communication channel of international knowledge and technology (Battisti, M., Belloc, F., & Del Gatto, M.,2015). As for OFDI reverse technology spillover effect,OFDI was a potential knowledge distribution channel and home country was subjected to knowledge spillover effect related with OFDI(Bitzer, J., & Kerekes, M., 2008), based on the combination of industrial data from17 countries in OECD. The function of OFDI to per capita economic growth in USA was superior to those of her domestic investment.,based on the panel data of American OFDI employment rate,(Ford, T. C., Rork, J. C., & Elmslie, B. T., 2008). As for spatial heterogeneity of OFDI technology spillover, according to the analysis of OFDI in Spain, social economy distance is an important influencing dimensionality of OFDI reverse technology spillover effect and proved by structural equation (SEM-PLS) based on partial least squares that OFDI from Spain is similar to that of China,and has significant spatial heterogeneity(Drogendijk, R., & Martín, O. M.,2015). OFDI reverse spillover has the threshold characteristics of human capital and trade increment, and home country has the threshold effect of absorbing more competitive human capital and technical capital spillover (Jyun-Yi, W., & Chih-Chiang, H., 2008). In conclusion, current studies are lack of the comparative analysis on formation mechanism of OFDI reverse spillover based on the technical difference between host and home countries,which leads the absence of structural exploration to reverse spillover composition mechanism and influence factors.Therefore, this works takes manufacturing, as an example, discusses the structural formation mechanism of this effect under the frame of multiple-variant non-linear panel threshold regression,and validates the connected factor influencing mechanism of the above effect based on the potential spatial difference.

3. TFP Correction of OFDI Reverse Spillover Basic Dynamic Threshold

To further define the threshold connected factors of OFDI reverse spillover, the study introduces the technology potential difference of OFDI in home country and target country, based on the division of capital defined by Coe, D. T., Helpman, E., & Hoffmaister, A. W. (1997)with the combination of the study from Duverger, C., & Van Pottelsberghe de la Potterie, B.(2011),that is potential difference PD. Threshold feature analysis of R&D capital reverse spillover containing OFDI sources is embodied by linear cross way, Based on the above modifications, the study perform regression in the form of multiple non-linear panel threshold to estimate panel threshold value ,and validate the significance of corresponding thresholds through the following modified model based on the above mentioned formula:

$$\begin{aligned}
 Ln(TPF_{it}) = & \alpha_0 + \alpha_1 LnRDS_{it}^{fn_{ofdi}} \prod I(LnRDS_{it}^{fn_{ofdi}} \leq \varphi_1) + \\
 & \alpha_2 LnRDS_{it}^{fn_{ofdi}} \prod I(LnRDS_{it}^{fn_{ofdi}} > \varphi_1) + \dots + \\
 & \alpha_{n+1} LnRDS_{it}^{fn_{ofdi}} \prod I(LnRDS_{it}^{fn_{ofdi}} < \varphi_n) \alpha_1 + \\
 & \beta_1 Ln(RDS_{it}^{dm}) + \beta_2 Ln(RDS_{it}^{fm}) + \beta_3 Ln(RDS_{it}^{fdi}) + \mu_{it}
 \end{aligned} \tag{1}$$

$$\begin{aligned}
Ln(TPF_{it}) = & \alpha_0 + \alpha_1 LnRDS_{it}^{fn_{ofdi}} \prod I(LnPD_{it}^{fn_{ofdi}} \leq \varphi_1) + \\
& \alpha_2 LnRDS_{it}^{fn_{ofdi}} \prod I(LnPD_{it}^{fn_{ofdi}} > \varphi_1) \dots + \\
& \alpha_{n+1} LnRDS_{it}^{fn_{ofdi}} \prod I(LnPD_{it}^{fn_{ofdi}} < \varphi_n) \alpha_1 + \\
& \beta_1 Ln(RDS_{it}^{dm}) + \beta_2 Ln(RDS_{it}^{fn_m}) + \beta_3 Ln(RDS_{it}^{fn_{fdi}}) + \mu_{it}
\end{aligned} \tag{2}$$

Thereinto, $\varphi_1 \sim \varphi_n$ is the threshold value to be estimated and I is indicator function expressing when the in-equation in formula (1~2) is valid or invalid, it takes the value 1 or 0.

4. Variables and Data Sources

4.1. Conversion of Basic Variables

4.1.1. Domestic R&D Capital Stock Conversion

In view of data availability, and the statistical background of OFDI data from 2003, the study measures domestic R&D capital RDS_{it}^{dm} by the division with the sum of average growth rate g (in logarithmic form, annually) and capital depreciation rate, according to following formula:

$$RDS_{2003}^{dm} = RD_{2003} / (g + \delta) \tag{3}$$

4.1.2. R&D Capital Stock Conversion

R&D capital stock conversion from OFDI, is conducted according to following formula:

$$RDS_{it}^{fn_{ofdi}} = O_{it} \times RDS_t^{fn_{ofdi}} = \sum_{j=1}^9 (OFDI_{jt} / GDP_{jt}) RDS_{jt}^{dm} \tag{4}$$

Thereinto, O_{it} ; $OFDI_{it}$; GDP_{it} respectively represents the OFDI proportion in the time sequence t and province in spatial domain i , the OFDI proportion in China from time sequence t and country j , GDP of country j in time sequence t ; RDS_{jt}^{dm} ; RDS_{jt}^{dm} / GDP_{jt} respectively represents the R&D capital stock of country j in time sequence t and R&D intensity of unit GDP in country j in time sequence t .

4.1.3. R&D Capital Stock Conversion Sourcing From FDI

The R&D capital stock conversion sourcing from FDI can be conducted by the following formula:

$$RDS_{it}^{fn_{fdi}} = \sum_{j=1}^9 (FDI_{jt} / GDP_{jt}) RDS_{jt}^{dm} \tag{5}$$

Thereinto, FDI_{jt} depicts the FDI stock of country j in time sequence t ; description for GDP_{jt} and other parameters are the same as above.

4.1.4. Conversion of R&D Capital Stock Sourcing From Export

Conversion of R&D capital stock sourcing from export can be performed by the following formula:

$$RDS_{it}^{fm} = M_{it} \times \sum_{j=1}^9 (M_{jt} / GDP_{jt}) RDS_{jt}^{dm} \quad (6)$$

M_{it} ; M_{jt} respectively depicts the import amount proportion in time sequence t and spatial domain i ; the import proportion from country j in time sequence t ; description of other parameters is the same with above.

4.2. Data Sources

The spatial domain verified by the study is with province as unit. Data of 29 provinces and cities (Tibet, HK, Macao and Taiwan is excluded due to shortage of data within statistical period) is collected by “China Statistical Yearbook of Industrial Economy”; in view of technology potential difference formulated by TFP, combining the situations of direct investment overseas in manufacturing in recent years, the study regards ROK, Singapore and G7 member countries, totally nine countries as the main objects of OFDI. Based on data availability, this study approximately replace the TFP of OFDI objects countries required by the study with the average labor productivity of the above 9 countries; GDP of each country is converted to US price by flat subtraction, and with which is divided by the value of employed population in time sequence is converted to labor productivity in each province. Thereinto, the labor productivity data of each country originates from “International Statistical Yearbook” in the corresponding time sequence.

5. Empirical Analysis on China Manufacturing OFDI Reverse Spillover

5.1. TFP Measurement of OFDI in Manufacturing

According to above analysis, the study measures the TFP according to technology spillover potential difference of home country and home country, and threshold characteristics. The study chooses the total output value of manufacturing in each province of China, the number of labor forces related with the years in each time sequence, and fixed asset investment amount as the TFP variable factors. The year 2000 is regarded as the conversion year of base price of total industrial output value, labor forces and capital factors. Malmquist index is introduced to make conversion with Onfront2.0(as shown in Fig. 1).

It can be seen from above diagram that the reverse technology spillover of China manufacturing has some improvement in threshold context, but the TFP growth under threshold effect is mainly formed by the flat EC(Efficiency Change). Comparatively, TC(Technical change) generally presents significant development comparison with rapidly declines an amplification level of 0.875 (2009/2010) after reaching to the highest amplification of 1.125 (2008/2009), which indicates that the foreign technology spillover obtained by China in the form of OFDI tends to improve the direct efficiency of industry, rather than the technical advance for home country after absorbing overseas investment innovation.

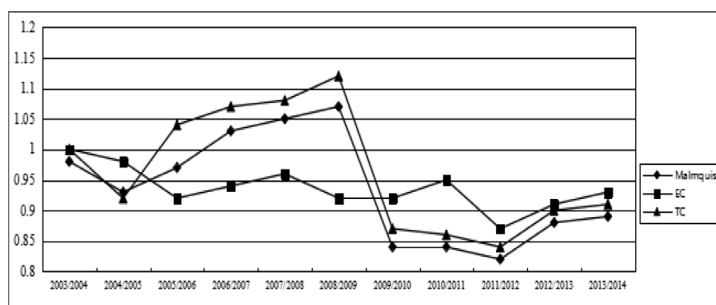


Figure 1 – TFP Decomposition of OFDI Reverse Technology Spillover in Manufacturing

5.2. Threshold Feature Estimation of OFDI Reverse Spillover in China Manufacturing

The study conducts robustness and threshold eigenvalue analysis with Stata software. Based on the above formula (2-3), the study performs the null hypothesis of zero threshold and alternative hypothesis of one threshold; null hypothesis of one threshold and alternative hypothesis of two thresholds; null hypothesis of two thresholds and the alternative hypothesis of three thresholds to determine the number of thresholds of China OFDI reverse spillover; the study verifies and determine corresponding threshold hypothesis p value based on the bootstrap by Hansen. According to Lagrange's multiplier verification, the spillover of R&D capital from OFDI obtains a threshold value, with the corresponding amount of 72.7 million USD, and the critical value of 1%, 5% and 10% significance test is 7.989, 5.212 and 4.627; the potential difference of OFDI R&D capital contains two threshold values, 11.278 and 18.567; the critical value of significance test reports 8.666, 3.871 and 1.617.

Variable	Estimated Value	T- value	Confidence Interval
$S_i^{fn_{ofdi}} < 7270$	-0.005*	-1.78	(-0.001, 0.011)
$S_i^{fn_{ofdi}} \geq 7270$	0.017**	2.57	(-0.009, 0.017)
$PD < 11.278$	0.0122*	1.71	(0.006, 0.032)
$11.278 \leq PD \leq 18.567$	0.0197**	2.81	(0.001, 0.047)
$PD \geq 18.567$	0.0067*	1.68	(-0.005, 0.025)

*, **, ***separately represents significance on the 10%, 5% and 1% significance test level

Table 1 – Threshold Parameter Analysis

Combined with the estimated value from formula (2~3), when R&D capital stock from OFDI in time sequence i doesn't exceed single threshold value of corresponding amount of 72.7 million USD, it obtains the negative result (-0.005) whose significant level is at 10%; otherwise, it obtains the positive correlation (+0.017) of 5% significant level. It proves that China, as the home country, has significant threshold feature of reverse

spillover of R&D capital from manufacturing OFDI; the potential difference of OFDI R&D capital presents homodromous threshold characteristic difference. The above threshold value of respectively reports the significance correlation of 10%, 5% and 10% with results of 0.0122, 0.0197 and 0.0067.

5.3. Spatial Heterogeneity Verification of Reverse Spillover Threshold Characteristics

Meanwhile, combined with the basic data of spatial domain, the study divides the threshold value spatial heterogeneity interval of reverse spillover of OFDI from 2003 to 2013 with the utilization of the OFDI reverse spillover threshold and potential difference value, that is high area of reverse spillover ($PD \geq 18.567$), mean area of reverse spillover ($11.278 \leq PD \leq 18.567$), and low area of reverse spillover ($PD < 11.278$). Shanghai, Jiangsu and Zhejiang in Yangtze River delta region, Beijing and Shanghai are brought into the high threshold interval of OFDI reverse spillover of manufacturing. The OFDI reverse spillover of cities in this interval is significant and potential difference effect should tend to rise significantly; while the Inner Mongolia, Gansu, Shanxi and Shanxi in central and western regions reports low level interval of OFDI reverse spillover and significance estimated value -0.004; accordingly, Sichuan and Chongqing reports the result in middle section in the estimation of homonymous potential difference threshold value, with which the reverse spillover influence factor is 0.0197, presenting rising trend (as shown in Fig. 2). Therefore, the study further conducts manufacturing OFDI reverse spillover dynamic threshold validation with the combinations of spillover potential difference under the potential difference basic on two stage least square (2SLS).

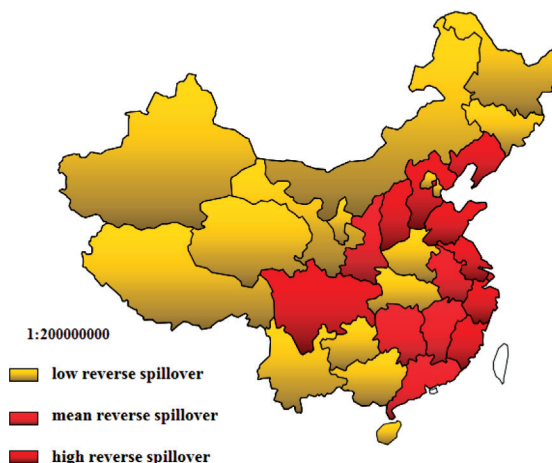


Figure 2 – OFDI Reverse Spillover Spatial Heterogeneity Division in Potential Difference in Manufacturing

5.4. Validation of Reverse Spillover Dynamic Threshold Basic on 2SLS

It can be seen from above table 2 that in terms of the domestic R&D capital of home country, OFDI reverse spillover (0.2286) of eastern coastal cities in high level zone

reports over twice on national integral level (0.1141) on the TPF growth level and significantly higher than other validated spatial domains in the country.

It proves the high efficiency of conversion of outward investments in manufacturing of eastern coastal cities, especially as Yangtze River delta region from the above mentioned spatial heterogeneity interval. Secondly, as a whole, the FDI reverse spillover reports the result of 10% significant level, -0.0588. This is mainly because the R&D composition of China during the introduction FDI in the above time sequence is at low level and technical composition in trading products is small, but trading amount is large, the reverse spillover from FDI is counteracted. However, eastern coastal zone reports the highest reverse spillover validation result (0.087, 5%) of China in spatial domain; western zone reports 0.0301, and then FDI reverse spillover effect is insignificant, with which totally demonstrates that there also exists certain spatial heterogeneity threshold during different regions' opening and introduction of FDI in the whole nation's manufacturing. Thirdly, as for reverse spillover sourcing from export, the nation and each spatial domain reports the 5% significance testing result of positive validation; eastern coastal (0.0477) and central section (0.0148) are the highest and lowest zone in the country.

Finally, from the result of OFDI reverse spillover, the nation, eastern, central and western zone respectively reports 5% significance testing result of 0.0108, 0.0127, 0.197 and 0.0068, together with the dual attributes of potential difference and reverse spillover, that is to say, when the OFDI potential difference of manufacturing is lower than 11.278, it is in positive correlation with reverse spillover and the technical returns of manufacturing to home country are enhanced; when OFDI potential difference lies between 11.278 and 18.567, the technical returns of manufacturing OFDI to home country are slowed down; when potential difference exceeds the threshold value of 18.567, the technology reverse spillover of manufacturing for home country is reduced, which indicates that China manufacturing is restricted in absorbing of OFDI technology reverse spillover and needs to push the R&D of OFDI to higher level.

	All States	Eastern	Central	Western
$S_i^{fn_{ofdi}}$	-	$PD < 11.278$	$11.278 \leq PD < 18.567$	$PD \geq 18.567$
	0.0108**	0.0127**	0.0197**	0.0068**
	(0.0039)	(0.0043)	(0.077)	(0.0023)
S_t^{dm}	0.1141***	0.2286***	0.1546***	0.0566*
	(0.0308)	(0.0688)	(0.0018)	(0.0021)
$S_t^{fn_{fdi}}$	-0.0588*	0.087**	0.0337	0.0301
	(0.0105)	(0.0197)	(0.0068)	(0.0048)
$S_{it}^{fn_{im}}$	0.0388**	0.0477**	0.0148***	0.0306
	(0.0078)	(0.0089)	(0.0056)	(0.0035)
$Adj R^2$	0.7894	0.79715	0.7548	0.7218

Note: *, **, *** separately represents significance on the 10%, 5% and 1% significance test level; dev. Std in brackets is the standard deviation

Table 2 – Analysis on Spatial Heterogeneity of OFDI Reverse Spillover Dynamic Threshold
Basic on 2SLS

6. Dynamic Threshold Validation of OFDI Reverse Spillover

6.1. Model Modification for OFDI Reverse Spillover Basic on Dynamic Threshold And Absorption Capacity

It can be seen from above analysis that during the process of OFDI in manufacturing, there is spatial heterogeneity as well as the dual attributes of potential difference and reverse spillover. Simultaneously, large potential difference, low technical level and absorption capacity, as well as small potential difference, high technical level but narrow absorption space also encounters the restriction of OFDI reverse spillover.

Therefore, how to adjust and improve the OFDI reverse spillover factor combination to form reasonable potential difference in spatial domain and optimize the transition of OFDI reverse spillover of manufacturing becomes the key of this study.

Furthermore, the study conducts correlation validation of technical absorption capacity and threshold by R&D capital with cross term of parameters such as market maturity, R&D intensity, human capital and economic scale. Targeting interval transition and potential difference through combination of OFDI factors of manufacturing, this study further adjusts parameters as R&D capital of home country, OFDI, FDI, IM and their cross terms, with which to conduct the validation of reverse spillover effect correlation based on the TFP total factor productivity in lagging stage I. The specific modified model is shown as follow.

$$\begin{aligned} TFP_{it} = & c_{it} + \alpha_{it}RDS_{it} + \beta_{it}FDI_{it} + \gamma_{it}OFDI_{it} + \theta_{it}M_{it} + \\ & \delta_{it}RDS_{it} \times FDI_{it} + \tau_{it}RDS_{it} \times OFDI_{it} + \rho_{it}RDS_{it} \times M_{it} + \\ & \kappa_{it}TFP_{it-1} + \lambda_{it}RDS_{it-1} + \mu_{it} \end{aligned} \quad (7)$$

Correcting the above potential difference PD and spatial heterogeneity by terms crossed with OFDI. This study measures the dynamic threshold of reverse spillover from manufacturing OFDI with R&D capital lagging stage I through the following formula:

$$\begin{aligned} TFP_{it} = & c_{it} + \alpha_{it}RDS_{it-1} + \beta_{it}RDS_{it} + \gamma_{it}OFDI_{it} \times I(Q \leq R) + \\ & \theta_{it}OFDI_{it} \times I(Q > R) + \delta_{it}RDS_{it} \times OFDI_{it} + \mu_{it} \end{aligned} \quad (8)$$

Combining the R&D capital of manufacturing in home country, OFDI and its cross terms of indication function I , this study measures the OFDI reverse spillover absorption capacity of manufacturing in home country with total factor productivity lagging stage I through the following formula:

$$\begin{aligned} TFP_{it} = & c_{it} + \alpha_{it}TFP_{it-1} + \beta_{it}RDS_{it} + \gamma_{it}OFDI_{it} + \\ & \theta_{it}OFDI_{it} \times RDS_{it} \times I(Q \leq R) + \delta_{it}OFDI_{it} \times RDS_{it} \times I(Q > R) + \mu_{it} \end{aligned} \quad (9)$$

In formula(10), the RDS is capital stock. The $RDS \times FDI$ cross term in formula (10) is used to measure the technology absorption capacity of home country. I is indication function and are with the same meaning above; Q , R respectively represents threshold

characteristic variable and threshold value. Thereinto, the threshold characteristic variable is composed by human capital of home country, R&D capital stock, R&D intensity and scale and the degree of marketization.

6.2. Validation of Dynamic Threshold Effect of OFDI Reverse Spillover in Manufacturing

To prevent the possibility of error of generalized matrix method in large sample estimation, the study will proceed the following validation with systematic generalized matrix *SYS – GMM*. As for data, except the data of OFDI in each spatial domain and national manufacturing is collected from “China Statistical Bulletin of Outward Foreign Direct Investment”, other data all comes from the manufacturing part of “China Statistical Yearbook”. Stocks and first-order lag stocks are obtained by perpetual inventory method (PIM); human capital in threshold characteristic parameters is obtained by referring to the measurement method of Barro, R. J., & Lee, J. W. (1993); marketization degree is chosen from the data in “China Marketization Indexes” according to province domain. Economic scale is obtained by flat subtraction used to determine GDP stated above; R&D intensity is still the reduced value of R&D investment per unit GDP.

The study conducted ADF stationary test and co-integration test of dynamic threshold regression validation at advance. The validation process will not be repeated here due to the length. The inspection result of ADF is all variables can access to the stability of 5% significance level. According to co-integration test of Engle-Granger, the *P* value of ADF inspection result is 7.06112 and 0.0297. It verifies the long-term stationarity of variables in modified model. By referring to formula (5), it can be found from the analysis of dynamic effect of OFDI reverse spillover in manufacturing that the result of *Sarg an* test and *AR(2)* test have verified the validity of *SYS – GMM* method for the above mentioned estimation. R&D capital of domestic manufacturing of home country and parameter in lagging stage I reports -0.167 and -0.451, but the cross terms of two types respectively and contrastively reports +0.117 and +0.379, which proves that OFDI of China manufacturing contains certain time-lag feature of reverse spillover. According to the above time-lag feature of reverse spillover and orthometric interest margin, this study conduct conversion and elimination of individual effect to obtain the correlated factor validation result of reverse spillover effect of OFDI in manufacturing and dynamic threshold effect with the following formula:

$$RDS_{it}^* = \sqrt{\frac{T-t}{T-t+1} \left[RDS_{it} - \frac{1}{T-t} (RDS_{i(t+1)} + \dots + RDS_{iT}) \right]} \quad (10)$$

6.3. Validation Result

6.3.1. Human Capital (HRC)

Firstly, according to validation result, dynamic threshold value of human capital factor for China's manufacturing OFDI is 0.334 and the minimum residual sum of squares (RSS) is 0.1031. *F* value of Wald represents the significance of this parameter's dynamic threshold feature. According to validation, the minimum value of LR is significantly lower

than the critical value of 5% significance level, which demonstrates the above correlated factor validation according to threshold characteristic of spatial heterogeneity is valid. Secondly, it can be seen from table 3 that in correlating validation, OFDI and cross term of indicator function I (before exceeding threshold) reports the fluctuation from -0.1411 (5%) to -0.1037, which verifies the negative correlation of human capital on OFDI reverse spillover tends to be weak. Meanwhile, absorption capacity index forms the variation from 0.1048 (1%) to 0.1221 (5%), In other words, once human capital parameter exceeds the corrected threshold of potential difference, the positive correlation with OFDI reverse spillover significantly tends to be strong. Thereupon then, it forms significant drive force to manufacturing's absorption through OFDI reverse spillover technology .

6.3.2. R&D Capital Stock (RDS)

The R&D capital stock (RDS) forms the variation from -0.0051 to 0.0421 (1%), which indicates that after this parameter exceeds corrected threshold, the will of seeking and affecting reverse spillover in the manufacturing of home country turns from negative to positive, and the latter has gain significance promotion; accordingly, capital stock variable reports 5% and 1% negative significance for various selected parameters. It proves that after parameter exceeds dynamic corrected threshold, they have the space to form significant reverse spillover with the OFDI of manufacturing.

6.3.3. R&D Intensity

It can be seen from the table 3 that this parameter forms the variation from -0.1522 (5%) to -0.1451 (5%), which proves that after R&D intensity exceeds corrected dynamic threshold, the negative correlation with OFDI reverse spillover tends to be weak, while its absorption capacity index reports the variation from 0.0117 (5%) to 0.1133 (5%). It has significant contribution to dynamic threshold parameter and proves that the key of OFDI reverse spillover lies in the initiative of investment in R&D of home country.

6.3.4. Economic Scale(GDP)

The economic scale(GDP) scale forms the variation from -0.1327 (5%) to -0.1249 (10%) and confirms that the economic increment of home country has fundamental significance to China's manufacturing absorption of technology spillover. It not only improves the technology learning will of home country for OFDI reverse spillover in manufacturing, but also forms higher technical absorption capacity; meanwhile, corresponding absorption capacity index forms the variation from 0.0087 (10%) to 0.0107 (5%), which proves that in terms of OFDI reverse spillover dynamic threshold, economic scale and technology spillover has the contradiction that positive correlation is improved but correlation degree is weakened, especially for the reverse spillover. That means economic increment is helpful to promote the absorption of OFDI reverse spillover in early stage, but not good for long-term reverse absorption.

6.3.5. Marketization Degree(MKD)

Marketization degree(MKD) forms the variation from -0.1617 (5%) to -0.1331 (10%), which proves that marketization degree of manufacturing in home country contains the

fundamental significance, which is similar to of economic increment for OFDI reverse spillover, as well as the significant correlation degree between technology reverse absorption will and capacity to a certain extent.; the corresponding absorption capacity index reports the variation from 0.0079 (5%) to 0.0215 (1%), which indicates that as for the economic scale of manufacturing in home country, marketization degree also has the correlation tendency similar to dynamic threshold, but the critical significant relevance of dynamic threshold is weaker than that of the parameter of economic scale.

	HRC		MKD		RDS		GDP		RS	
	d.t.	a.c.	d.t.	a.c.	d.t.	a.c.	d.t.	a.c.	d.t.	a.c.
threshold value	0.334	0.334	-1.056	-0.081	-0.376	-	-0.371	-0.371	0.000	0.000
RSS	0.1031	0.1163	0.1428	0.1861	0.1233	-	0.2887	0.1508	0.2087	0.2112
RDS	-0.1467**	-0.1533***	-0.1253**	-0.1088*	-	-	-0.1256**	-0.1377***	-1.5337***	-0.1561***
	(-2.71)	(-2.71)	(-2.27)	(-1.93)	-	-	(-2.07)	(-3.61)	(-2.77)	(-2.71)
OFDI×I (Q≤R)	-0.1411**	0.1048***	-0.1617**	0.0079**	-0.0051	-	-0.1327**	0.0087*	-0.1522**	0.0117**
	(-2.66)	(2.61)	(-2.41)	(2.13)	(-0.83)	-	(-2.04)	(1.78)	(-2.39)	(2.34)
OFDI×I (Q>R)	-0.1037	0.1221**	-0.1331*	0.0215***	0.0421***	-	-0.1249*	0.0107**	-0.1451**	0.1133**
	(-1.55)	(2.67)	(-2.06)	(3.61)	(3.51)	-	(-1.85)	(2.23)	(-2.11)	(2.59)
TFP-1	0.2571**	0.2681***	0.2674***	0.2716***	0.2337***	-	0.2537***	0.2627***	0.1966***	0.1949***
	(3.59)	(3.71)	(3.71)	(3.91)	(3.18)	-	(3.14)	(3.61)	(2.69)	(2.66)
RDS×OFDI*	0.0097**	-0.1465**	0.1011**	-0.1241*	-	-	0.0086*	-0.1288*	0.0107**	-0.1544**
	(2.17)	(-2.27)	(2.46)	(-1.99)	-	-	(1.83)	(-1.98)	(2.44)	(-2.31)
C	0.0013	0.0004	0.0824	0.0144	0.0028	-	0.0011	0.0001	0.0016	0.0015
	(-0.16)	(-0.04)	(0.75)	(1.07)	(0.49)	-	(0.14)	(0.03)	(0.17)	(0.15)
Adj R ²	0.2993	0.2919	0.2724	0.2721	0.2971	-	0.1511	0.2907	0.2566	0.2527
Wald test	10.033***	7.527	10.126**	11.801*	10.105***	-	7.876*	7.449*	24.317***	24.191***

Note: RDS×OFDI* is the validation result of OFDI single parameter for absorption capacity; *, **, ***separately represents significance on the 10%, 5% and 1% significance test level;d.t.=dynamic threshold,a.c.=absorption capacity

Table 3 – Dynamic Threshold and Absorption Capacity Measurement of Manufacturing OFDI Reverse Spillover

7. Main Conclusion and Policy Enlightenment

After validation, it proves that current OFDI reverse spillover of manufacturing has incongruous threshold, homonymous potential difference and spatial heterogeneity. The latter two has the dual attributes of dynamic threshold, and the parameters selected all have significant and stable dynamic threshold characteristics of reverse spillover. Economic scale and marketization degree of home country has fundamental significance to manufacturing reverse spillover from OFDI. The dynamic threshold characteristics associated with the reverse spillover in human capital and R&D intensity are comparatively modest; on the contrary, the dynamic threshold characteristics

associated with the reverse spillover in R&D capital stock are comparatively tight. As a whole, the dynamic threshold correlation structure of OFDI reverse spillover of China's manufacturing leans on the accumulation of quantity in objective side, rather than the improvement of "quality" in passive side. The details are as follow:

First, The launch of different conversion policies from different level of intervals for manufacturing OFDI reverse spillover is suggested: for high level area, utilize the hierarchy technology conversion platform to form the connection of manufacturing products with outward investment management and general technology of domestic enterprises, and with commerce chamber, cluster, massive manufacturing economy as the incubation core of innovation technology, activate the development and innovation of series products, product technology improvement, product package and service with different tax strengths.

Second, as for the basic functions of the economic increment scale and R&D capital for OFDI reverse spillover, the study suggests that they are the dilemma between technical level improvement and trade increment during the pursuit for interest. Firstly, it is suggested the "shortsighted" action of low-efficiency competition should be avoid during China's manufacturing industries' pursuit of economic increment. Low-level potential difference areas should "introduce" and "launch" multiple combinations to urge the clustering and optimization of R&D capital, and shift from the current "leader driving" mode to "multiple levels" accompanied with differentiated hierarchy network for the OFDI technology reverse spillover mode. Organize and figure out the reasonable structure to embody regional economic increment of manufacturing through service specialization, eliminating the products or enterprises which are lack of product technology efficiency of inner service increment; areas of each potential difference interval should enhance the strength of introducing technology capital to embody the parallel development of OFDI economic increment in manufacturing and accumulation of R&D capital.

Third, more effective reeducation oriented by technical returns of talents should be implemented. Deep internal training should be provided based on the implement of market target, product technology strategy and marketing innovation strategy; with the technical fall between domestic and foreign market as observation point, organize the external introduction and internal selection of human resources in China's OFDI manufacturing, and exchange for the OFDI reverse spillover with the human capital improvement with low-cost increment, and improve the maturity of manufacturing enterprises' market competition as well as the HR factors' improvement for OFDI reverse spillover to embody co-integrated advancement in China's manufacturing OFDI.

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Logistics Forecasting Method Based on A Hybrid Quantum Particle Swarm Optimization and RBF Neural Network Model

Syed Abdul Rehman Khan CSCP ^{1,*}, Zhang Yu ²

* sarehman_cscp@yahoo.com

¹ Institute of Logistics & Supply Chain Management, School of Economics and Management, Chang'an University, 710064, Xi'an, China.

² School of Economics and Management, Xi'an University of Technology, 710054, Xi'an, China.

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Abstract: Logistics requirements forecasting is a crucial problem in modern logistics management, therefore, this paper aims to forecast logistics requirements with high accuracy. In the proposed method, RBF neural networks are used to forecast logistics requirements. RBF neural networks (RBFNN) are designed utilizing radial basis functions, and RBFNN are built up by three layers: a) input layer, b) hidden layer, and c) output layer. As the performance of the RBF neural networks highly depends on the quality of parameter selection, we optimize parameters of RBF neural network using quantum particle swarm optimization. Afterwards, outputs of the RBF neural network are performed as the logistics forecasting results. Experiment dataset is collected from a province of the east China to test the performance of our proposed algorithm from 2000 to 2014, and three types of transportation (highways, railways, and waterways) are analyzed respectively. Experimental results demonstrate that the proposed method is able to significantly improve the accuracy of transport volume prediction in logistics process for three different types of logistics modes, such as highway, railway, and waterway. Particularly, the proposed method can be exploited in modern logistics industry to reduce operating costs of logistics enterprises. The main innovations of this paper are that we propose a hybrid quantum particle swarm optimization and RBF neural network model to predict logistics requirements.

Keywords: Logistics forecasting; quantum particle swarm optimization; rbf neural network; parameter selection.

1. Introduction

With the rapid development of national economy and the improvement of the national trade, the national logistic market develops rapidly as well. China's national economy is significantly enhanced by logistic industry (Zhang Qinhong, Segerstedt Anders, Tsao Yu-Chung, Liu Biyu, 2015). However, many persons ignore the requirements of logistics. Hence, it is a basic premise for the sustained and healthy development of our national logistic requirement to construct a scientific and applicable prediction model for logistic requirement analysis (Fanti M P., Iacobellis G., Ukoyich W., Boschian V., Georgoulas G., Stylios C., 2015).

It can be observed that civil economy and international economic integration increase continuously, and the business between Cities, regions and countries expand rapidly as well (Oliveira Rodrigo R., Cardoso Ismael M G., Barbosa Jorge L V., da Costa Cristiano A., Prado Mario P., 2015). Hence, logistics forecasting has been paid more and more attentions. In recent years, researchers have studied on the logistics forecasting problem with quantitative method, and several mathematics models have been constructed (Creazza Alessandro, Colicchia Claudia, Dallari Fabrizio, 2015). Logistics requirement prediction system needs to be studied on complicated influential factors in the development of modern logistics (Song Dong-Wook, Parola Francesco, 2015).

Logistics requirement forecasting is a basic problem in logistics management. The logistics requirement increases rapidly, however, traditional methods are hard to predict the requirement with high accuracy (Zhou Cheng, Tao Juncheng, 2015). How to build up a forecasting model for logistics requirement is a crucial problem in logistics management. Researchers and employees have realized that it is of great importance to predict logistics requirement accurately. In particular, the projection of logistics requirements means an important basis of the different departments of companies to plan and control (Tian Xin, Liu Liming, Lai K K., Wang Shouyang, 2013). From the view of macro perspective, the accurate logistics requirement forecasting is crucial for making the policy of logistics industry development.

To forecast the Logistics requirements accurately, a hybrid quantum particle swarm optimization and RBF neural network model is proposed in our work (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015).

RBF neural network refers to an artificial neural network, which exploits radial basis functions as activation functions. The output of RBF neural network can be represented as a linear integration of radial basis functions of the inputs and neuron parameters. Radial basis function networks have been successfully used in many fields, such as Model Reference Adaptive Sliding Mode Control (Fang Yunmei, Fei Juntao, Ma Kaiqi, 2015), aircraft and vehicle control (Cseko Lehel Huba, Kvasnica Michal, Lantos Bela, 2015), Forecasting Volatility in Oil Prices, Second-Order Sliding Mode Guidance for Mars Entry Under Uncertainties and Forecasting Interval Time Series (Martins, J., Gonçalves, R., Santos, V., Cota, M. P., Oliveira, T., & Branco, F., 2015).

However, parameter selection greatly affects the performance of RBF neural network. Hence, Quantum particle swarm optimization is used to estimate the optimal parameters for RBF neural network. Jin et al. presented the application of hybrid artificial neural network (ANN) and Quantum Particle Swarm Optimization in software fault-proneness prediction (Bildirici Melike, Ersin Ozgur, 2015). Li et al. utilized Quantum-Behaved Particle Swarm Optimization to optimize the important parameters of LSSVM (Li Bo, Li Duanyou, Zhang Zhijun, Yang Shengmei, Wang Fan, 2015). Cheng et al. studied on how to integrate the advantages of both QPSO and ANN to promote the generalization performance of the forecasting model (Xiong Tao, Bao Yukun, Hu Zhongyi, Chiong Raymond, 2015). Li et al. proposed an improved multi-objective quantum-behaved particle swarm optimization based on spectral-clustering to find the overlapping community structure in complex networks (Li Shuang, Jiang Xiuqiang, 2015). Moghaddam et al. proposed a stable deviation quantum-behaved particle swarm optimization algorithm in the constrained optimal piezoelectric actuator (Jin Cong, Jin Shu-Wei, 2015).

In this paper, we integrate quantum particle swarm optimization and RBF neural network model together to construct a hybrid model, and the output vector of RBF neural networks acts as logistics requirements forecasting results. This paper is organized as follows. In the next section, we introduce the overview of the RBF neural network. Section 3 discusses how to optimize parameters of RBF neural network using quantum particle swarm optimization. Section 4 proposes an experiment to testify the effectiveness of our proposed algorithm, and the whole paper is concluded in section 5.

2. Overview of the RBF Neural Network

The neural network model of logistics requirement forecasting has the characteristics of data driven, which utilize nonlinear characteristics of the neural network to estimate a time series or a time series variant by the logical relationship in neural network.

Radial basis function (RBF) neural network is able to be used in logistics requirement prediction, and RBF neural networks is developed based on the radial basis functions. As is given in Fig.1, RBF neural networks are made up of three layers, such as input layer, hidden layer, and output layer.

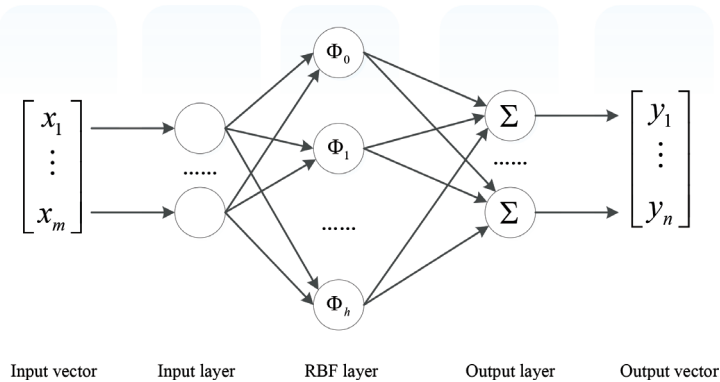


Figure 1 – Internal Structure of the RBF Neural Network

In RBF neural network, $X = [x_1 \ \dots \ x_m]^T$ refers to an input vector, and $Y = [y_1 \ \dots \ y_n]^T$ means an output vector, and $\Phi = [\Phi_1 \ \dots \ \Phi_d]^T$ is a radial basis vector. Particularly, the hidden layer Φ_j is defined as follows.

$$\Phi_j = \exp\left(-\frac{\|X - C_j\|^2}{2\sigma_j^2}\right), j \in \{1, 2, \dots, k\} \quad (1)$$

where C_j can be represented as the vector $(c_{j1}, c_{j2}, \dots, c_{jk})^T$, which represents the centroid vector of neuron C_j . $\|X - C_j\|$ denotes the norm of $X - C_j$, which is calculated as follows.

$$\|X - C_j\| = \sqrt{\sum_{k=1}^n (x_k - c_{jk})^2} \quad (2)$$

Next, output information y_i of the RBF neural networks are computed by the following equation.

$$y_i = \sum_{m=1}^q W_{im} \cdot \Phi_m \quad (3)$$

where W_{im} means the m^{th} hidden neuron of node i in the output layer.

We suppose that multiple variables are represented as $(X_{1n}, X_{2n}, \dots, X_{in})$, $(X_{1n+1}, X_{2n+1}, \dots, X_{in+1})$, ..., $(X_{1n+m}, X_{2n+m}, \dots, X_{in+m})$, and then use the RBF neural network to forecast the state in time $n+m+k, k > 0$. Afterwards, RBF neural network is applied to fit a nonlinear function:

$$X_{n+m+k} = f \left\{ \begin{array}{l} (X_{1n}, X_{2n}, \dots, X_{in}), (X_{1n+1}, X_{2n+1}, \dots, X_{in+1}), \\ \dots, (X_{1n+m}, X_{2n+m}, \dots, X_{in+m}) \end{array} \right\} \quad (4)$$

Then, k states can be predicted by the following steps:

Step 1: $X_n, X_{n+1}, \dots, X_{n+m}$ (input), X_{n+m+1} (output)

Step 2: $X_{n+1}, X_{n+2}, \dots, X_{n+m+1}$ (input), X_{n+m+2} (output)

.....

Step k : $X_{n+k-1}, X_{n+k}, \dots, X_{n+m+k-1}$ (input), X_{n+m+k} (output)

However, the performance of the RBF neural networks is greatly influenced by parameter selection.

3. Optimizing Parameters of RBF Neural Network Using Quantum Particle Swarm Optimization

Quantum particle swarm optimization (denoted as QPSO) is developed by analyzing the convergence of particle swarm optimization and quantum system. In the QPSO algorithm, a state of quantum is defined as the function $\varphi(x, t)$, and the position of each particle is estimated as follows.

$$x_{ij}^{t+1} = p_{ij}^t + \chi \cdot L_{ij}^t \cdot \ln \left((u_{ij}^t)^{-1} \right) \quad (5)$$

$$L_{ij}^t = 2 \cdot \lambda \cdot \left| mbest_j^t - x_{ij}^t \right| \quad (6)$$

where the value of χ is in the range $[-0.5, 0.5]$, and the symbol p_{ij}^t means local attractor:

$$P_{ij}^t = \mathcal{G}_{ij}^t \cdot P_{ij}^t + (1 - \mathcal{G}_{ij}^t) \cdot P_{gj}^t \quad (7)$$

where \mathcal{G}_{ij}^t refers to a random number and $\mathcal{G}_{ij}^t \in (0, 1)$, and P_{gj}^t denotes the global best position.

$$L_{ij}^t = 2\eta \cdot |p_{ij}^t - X_{ij}^t| \quad (8)$$

where η is exploited to modify the convergence speed. Based on the above definitions, new position is updated as follows.

$$X_{ij}^{t+1} = p_{ij}^t + \eta \cdot |p_{ij}^t - X_{ij}^t| \cdot \ln\left((u_{ij}^t)^{-1}\right) \quad (9)$$

The centroid of *pbest* position of a given swarm is calculated as follows.

$$\begin{aligned} mbest^t &= (mbest_1^t, mbest_2^t, \dots, mbest_N^t) \\ &= \left(\frac{1}{M} \sum_{i=1}^M P_{i1}^t, \frac{1}{M} \sum_{i=1}^M P_{i2}^t, \dots, \frac{1}{M} \sum_{i=1}^M P_{iN}^t \right) \end{aligned} \quad (10)$$

Hence, the position of particle is updated by Eq. 10.

$$X_{ij}^{t+1} = p_{ij}^t + \eta \cdot |mbest_j^t - X_{ij}^t| \cdot \ln\left((u_{ij}^t)^{-1}\right) \quad (11)$$

Implementation of quantum particle swarm optimization is described as follows.

- (1) Uniformly and randomly produce an initial population with position.
- (2) Initialize *pbest*, *gbest*, *mbest* and the fitness values.
- (3) Update the contraction-expansion coefficient η .
- (4) Compute the *mbest* by Eq. 10.
- (5) For $i=1$ to N .
- (6) Update *pbest_i* and *gbest*.
- (7) Create random number φ and u .
- (8) Compute local attractor *p_{ij}* by the following equation.

$$p_{ij}(t) = \varphi_{ij} pbest_{ij}(t) + (1 - \varphi_{ij}) gbest_j(t), \varphi_{ij} \in [0, 1] \quad (12)$$

- (9) For $j=1$ to D .
- (10) Update the position of the i^{th} particle by Eq.9.
- (11) End for.
- (12) Update the fitness of the i^{th} particle.
- (13) End for.
- (14) Quantum particle swarm optimization when the ending condition is satisfied.

After the parameter optimization process, output of the RBF neural network are performed as the logistics forecasting results.

4. Experiment

In this section, we choose a province of the east China to test the performance of our proposed algorithm, and three types of transportation are utilized, that is, (1) highway, (2) railway, and (3) waterway. Afterwards, we suppose that the transport volume vary for these three transportation types (shown in Fig. 2 to Fig. 4).

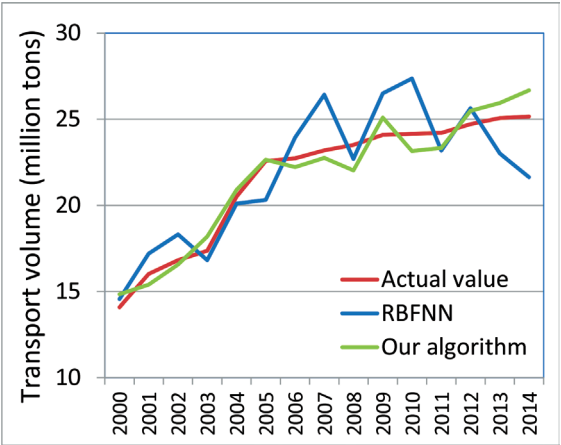


Figure 2 – Transport Volume of Highways From 2000-2014.

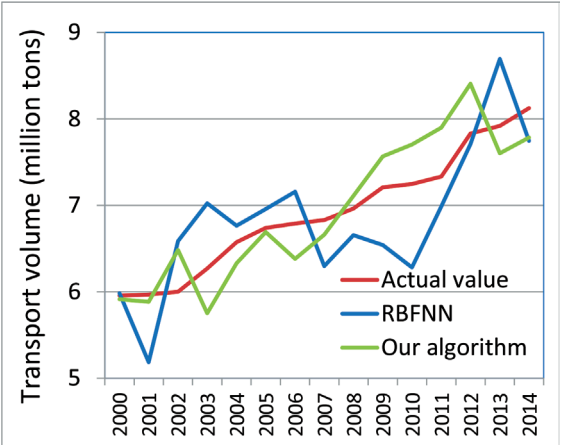


Figure 3 – Transport Volume of Railways From 2000-2014.

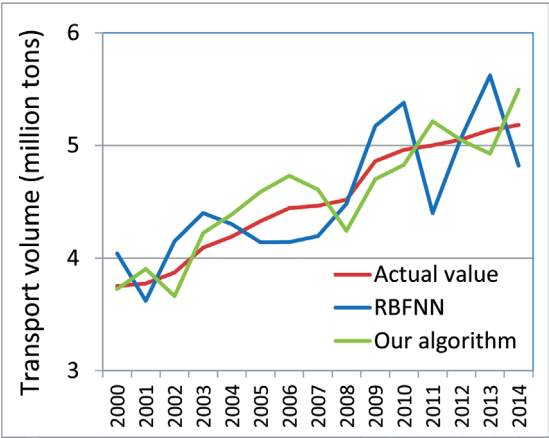


Figure 4 – Transport Volume of Waterways From 2000-2014.

Integrating all the above data, the forecasting error rates for these three types of transport are listed in Table. 1.

Year	Highway		Railway		Waterway	
	RBFNN	Our algorithm	RBFNN	Our algorithm	RBFNN	Our algorithm
2000	0.033	0.053	0.004	0.007	0.077	0.007
2001	0.074	0.039	0.131	0.014	0.041	0.034
2002	0.089	0.016	0.097	0.080	0.072	0.054
2003	0.032	0.047	0.120	0.083	0.075	0.031
2004	0.020	0.019	0.029	0.037	0.026	0.047
2005	0.100	0.003	0.032	0.007	0.043	0.060
2006	0.053	0.023	0.054	0.060	0.067	0.065
2007	0.140	0.018	0.078	0.025	0.060	0.032
2008	0.034	0.062	0.044	0.021	0.008	0.061
2009	0.100	0.042	0.093	0.049	0.064	0.033
2010	0.133	0.041	0.133	0.063	0.084	0.027
2011	0.042	0.036	0.047	0.077	0.120	0.043
2012	0.037	0.031	0.016	0.074	0.003	0.001
2013	0.082	0.035	0.098	0.040	0.094	0.041
2014	0.139	0.061	0.047	0.042	0.070	0.061
Average	0.074	0.035	0.068	0.045	0.060	0.040

Table 1 – Error Rates for Three Types of Transport

From Table. 1, it can be observed that when utilizing quantum particle swarm optimization, our proposed algorithm can significantly promote the accuracy of transport volume prediction in logistics process. Furthermore, from the above experimental results, the following conclusions can be obtained.

1. Highway

According to the service request of “door to door”, which is put forward by logistics theory, the highway transportation system is the only irreplaceable means of transportation in the logistics system. Therefore, transport volume of highway are obviously higher than others.

2. Railway

The imbalance of resource distribution and industrial distribution in China bring the advantages for railway freight transportation. Due to the uneven distribution of resources and industrial layout, long distance, large capacity, our country highly relies on the railway transportation. In a long term, other type of logistics model cannot replace railway.

3. Waterway

Water transport plays an important role in long distance transportation, and it can effective save cost in long distance transportation. Furthermore, water transport is very important in the international and domestic trade. With increasing trade dependence in domestic product, in the future, water transport will become an important part in modern logistics transportation.

5. Conclusion

This paper studies on the problem of logistics requirements forecasting, which is an important problem in modern logistics management. We forecast logistics requirements using a hybrid quantum particle swarm optimization and RBF neural network model. As the performance of the RBF neural networks highly relies on parameter selection, we optimize parameters of RBF neural network with quantum particle swarm optimization. Finally, output of the RBF neural network are regarded as the logistics forecasting results.

In the future, we will extend our proposed method to forecast logistics requirements in other types of logistic transportation, and we also will try other parameter optimization algorithm to enhance the performance of RBF neural network.

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Qualitative Analysis of a Rumor Transmission Model with Multiple Transmission Pathways

Chen Hua¹

chenghua@163.com

Xi'an University of Science and Technology, 710054, Shaanxi, Xi'an, China

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Abstract: The diversity of rumor transmission pathways has a certain influence on the spread of rumor. To explore the influence, an SIWR S (The unknown), I(Tale), W(The traditional media in the tale), R(Immune),(SIR and W denote the Unknown, the Propagator, the Immune and the Propagator through Traditional Media respectively) rumor transmission model is constructed, which includes various transmission pathways. Using the qualitative theory of ordinary differential equation, detailed qualitative analysis is conducted about the boundedness of the solutions and the existence of equilibria. By constructing the Lyapunov function, it is proved that the equilibria for the SIWR model are globally stable, and that using an SIR model rather than the SIWR model can lead to under-estimates of the basic reproductive number and the infectious scale. Furthermore, the numerical simulations reveal the impact of media coverage on the spread and control of rumor spreading.

Keywords: Rumor spreading; stability; lyapunov function; basic reproductive number.

1. Introduction

Being a common social phenomenon, rumor spreading has been systematically studied since World War II. Spreading from mouths to mouths was considered as the main way to spread rumors by traditional theories. However, with the development of science and technology, the ways to spread rumors have changed from "mouths to mouths" to new media including the blog, mobile phones, forums and BBS, thus the word "rumors" has been given a lot of meanings. Since the spread by new media is fast, influential and harmful, people come to believe that new media is the "cradle" of the generation and spread of rumors, or the chief cause of rumor spreading. After studying the starting channel of protestant rumors from the year 2003 to 2013, Lei Xia points out that in the era of new media, even though there are a considerable number of protestant rumors which use the Internet forum, Tieba, the government website, micro blog and other new media platforms as the starting channel, there are also many rumors that are spread via mouths and other traditional media. (Lei Xia, 2014) Although a variety of new media platforms play a major role in the spread of rumors, they are not the only ways. As a major way of spreading rumors in ancient times, spreading via mouths continues to play

an important role in the era of new media. Moreover, (Kikot, T., Fernandes, S., & Costa, G., 2015) traditional media are by no means the insulation in the spread of rumors. Thus ignoring other ways especially the traditional ways and the spread by media professionals and simply thinking that new media is the only way to spread rumors are not desirable. Therefore, exploring the characteristics of rumors spreading in a variety of ways, grasping its propagation, and thus effectively immunizing and controlling, are worth paying much attention to (Liao Shu, Yang Weiming, Chen Xiangzhen, 2014).

Based on the principle of system dynamics, the research of rumors by establishing rumors spreading models can date back to the 1960s. Since the spread of rumors in interpersonal networks can be very similar to the diffusion of virus, most of the existing models of rumor spreading borrow ideas from the epidemic models. (Zhang Fang, Si Guangya, Luo Pi, 2009) In 1965, Daley and Kendall (Daley D J, Kendall D G, 1965) drew lessons from the idea of epidemic "compartment" model and created a mathematical model for rumor spreading (DK model), pointing out that although it seemed that the spread of epidemic and rumors can be very similar, the tiny differences in propagation mechanism can lead to obvious differences in the result of the spread. In the DK model, based on the effect of rumor spreading, the state of the audience is divided into three categories: S (Susceptible) - tingible status or health status, the individual has never heard of the rumors; I (Infected) - infection status, the individual knows rumors and spreads them; R (Recovered) - removed or immune status / recovery status, the individual does not know the rumors nor spread them. In 1967, Dietz (Dietz K., 1967) stressed on the rationality of using epidemic models to explain the spread of rumors by focusing on the differences and similarities between the spread of epidemic and the diffusion mechanism of rumors. In recent years, along with the in-depth study of the dynamics, the spread of rumors based on dynamics has drawn even more attention. In 2003, Dickinson et al. (Dickinson R. E., Pearce. C. E. M., 2003) made comparison between the spread of epidemic and the diffusion mechanism of rumors, and then summarized the time-related evolutionary process in the spread of the two things. In 2008, Kawachi et al. (Kawachi K, Seki M, Yoshida H, et al., 2008) established the SIR model of rumors spread which considers various ways of contacting, and thus determined the threshold value of whether the rumors are spread. In 2014, based on System Dynamics, Huo Anliang and Huang Peiqing (Huo Liang'an, Huang Peoqing, 2014) proposed a dynamic spread model of false information. In 2015, Zhao Yong et al. (Zhao Hongyong, Zhu Linhe, 2015) built a social-network-rumor-spread model described by partial differential equations. Such study shows that the in-depth reports about the rumors in the social networks can largely reduce the propagator density online, and thus expanding the stable areas of the system. The above study of models can only be classified as a way of transmission, or a way of abstract transmission. As a matter of fact, during the process of rumors spreading, differences between spread in traditional ways and spread in new media environment exist. Therefore it's of great importance to study the propagation of rumors in different ways. However, since the present literature haven't considered this kind of difference, the purpose of this article is to establish in theory more rumors spreading ways and propagation models, analyze it in dynamic ways and reveal the inner mechanism of rumor spreading. Based on the analysis above, put into the SIR model the W bin which represents the density of the rumor propagator in traditional media. That is to say that the transmission ways include the spread between people in the new media environment

as well as the spread between traditional media and new media environment. Thus establishing the following rumor propagation model:

$$\begin{cases} \frac{dS(t)}{dt} = \mu N(t) - \beta_I S(t)I(t) - \beta_W S(t)W(t) - \mu S(t), \\ \frac{dI(t)}{dt} = \beta_I S(t)I(t) + \beta_W S(t)W(t) - \alpha I(t)(I(t) + R(t)) - \mu I(t), \\ \frac{dW(t)}{dt} = \gamma I(t) - \xi W(t), \\ \frac{dR(t)}{dt} = \alpha I(t)(I(t) + R(t)) - \mu R(t), \end{cases} \quad (1)$$

$S(t)$, $I(t)$, $R(t)$, represent the people who don't know, the propagator and the immune people respectively in the new media environment. $W(t)$ represents the number of people who spread rumors through traditional media; $N(t)$ represents the total population in the new media environment; β_I represents the infection rate coefficient of the propagators in $S(t)$ and $I(t)$; β_W represents the infection rate coefficient between $S(t)$ and the propagators through traditional media; α represents when propagators meet or propagators and immune people meet, the probability of propagator turning into immune people; γ represents the probability of propagators in new media environment turning into propagators in traditional media environment. ξ represents the probability of the propagators in traditional media environment being removed. μ represents the probability of every individual moving in or out of certain groups. The rumors spreading chart is as follows:

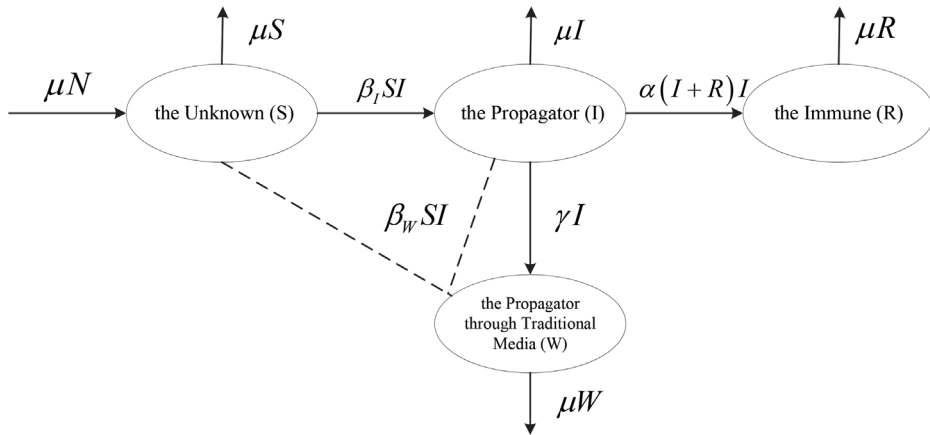


Figure 1 – SIWR Rumors Spreading Schematic Diagram

Suppose the parameters are positive, the initial condition is:

$$S(0) \geq 0, I(0) \geq 0, R(0) \geq 0, W(0) \geq 0. \quad (2)$$

For convenience, making dimensionless transform $s = S / N$, $i = I / N$, $r = R / N$, $w = W / N$, $\beta_1 = \gamma \beta_w N / \xi$, $\beta_2 = \beta_I N$, $\tilde{\alpha} = \alpha N$, Still taking S, I, R, W, α as $s, i, r, w, \tilde{\alpha}$, so system(1) becomes:

$$\begin{cases} \frac{ds}{dt} = \mu - \beta_1 s w - \beta_2 s i - \mu s, \\ \frac{di}{dt} = \beta_1 s w + \beta_2 s i - \alpha i (1 + r) - \mu i, \\ \frac{dw}{dt} = \xi (1 - w), \\ \frac{dr}{dt} = \alpha i (1 + r) - \mu r. \end{cases} \quad (3)$$

Initial condition is,

$$S(0) \geq 0, I(0) \geq 0, R(0) \geq 0, W(0) \geq 0. \quad (4)$$

The lemmas about the existence, non-negativity and bound of the solution is as following:

Lemma 1 suppose $\varepsilon > 0$, define,

$$\Omega = \{S, I, R, W \geq 0 : S + I + R = 1\}, \Omega_{W \leq 1 + \varepsilon} = \{(S, I, R, W) \in \Omega : W \leq 1 + \varepsilon\}.$$

Solutions that satisfies the initial condition(4)in system(3) are (S, I, R, W) which exist and remain non-negative in $[0, +\infty)$, $(S, I, R, W) \in \Omega$, and when there be $T_\varepsilon > 0$ that makes $t > T_\varepsilon$, we have $(S, I, R, W) \in \Omega_{W \leq 1 + \varepsilon}$.

Prove: It's easy to prove that the solutions which satisfy initial condition (4) in system(3) are $(S(t), I(t), R(t), W(t))$ which exist and remain non-negative in $[0, +\infty)$.

Let $N(t) = S(t) + I(t) + R(t)$, then from system (3) we can have $\dot{N}(t) = \mu - \mu N(t)$, which means $N = 1$ is a fixed point and $\lim_{t \rightarrow \infty} N(t) = 1$. Since $N(0) = 1$, we have $S(t) + I(t) + R(t) = 1$, which means any solution to system (3) match $(S, I, R, W) \in \Omega$. Also, Since,

$$\left. \frac{dS}{dt} \right|_{S=0} \geq 0, \left. \frac{dI}{dt} \right|_{I=0} \geq 0, \left. \frac{dR}{dt} \right|_{R=0} \geq 0$$

Thus the solution which satisfies initial condition(4)in system(3)is constant in positive ways.

Since $I(t) \leq 1$, from the third equation in system (3) we can know that when $W(t) > 1$, $\dot{W}(t) < 0$, thus to any solution satisfies $W > 1$, $W(t)$ shall be a monotone decreasing, thus $W(t)$ is limited. Finally, we have to prove that any solution which satisfies initial condition is constant in positive ways in $\Omega_{W \leq 1 + \varepsilon}$. It's obvious that we only have to prove that $W(t) \leq 1 + \varepsilon$ succeed to any solutions. Suppose that the solution that satisfies initial

condition (4) in system (3), $(t) \leq 1 + \varepsilon$, don't succeed, so any solution which satisfies $W(0) > 1 + \varepsilon$ has $W(t) > 1 + \varepsilon$. Take $T_\varepsilon = (W(0) - (1 + \varepsilon)) / (\xi \varepsilon)$, we have $W(T_\varepsilon) > 1 + \varepsilon$. But from system(3) we can know that $W(t) < -\xi \varepsilon$, thus $W(T_\varepsilon) < W(0) - \xi \varepsilon T_\varepsilon < 1 + \varepsilon$, contradict. Thus any solution which satisfies initial condition is constant in positive ways in $\Omega_{W \leq 1 + \varepsilon}$. Theorem prove finished.

2. Partial stability of the equilibrium point

In this section we study the existence and the partial stability of the equilibrium point in system (3). We have the following theorems concerned with the existence of the equilibrium point.

Theorem 1.1 (1) System(3) always has boundary equilibrium point(Rumor-free equilibrium, RFE) $E_0 = (1, 0, 0, 0)$;

(2) When basic reproduction number $R_{0SIWR} = \frac{\alpha + \beta_1 + \beta_2}{\alpha + \mu} > 1$, system (3) has the only positive equilibrium point (Rumor-endemic equilibrium, REE) $E^+ = \left(S^*, \frac{\mu - \mu S^*}{(\beta_1 + \beta_2)S^*}, \frac{\mu - \mu S^*}{(\beta_1 + \beta_2)S^*}, 1 - S^* - \frac{\mu - \mu S^*}{(\beta_1 + \beta_2)S^*} \right)$, $S^* = \frac{1}{R_{0SIWR}}$.

Prove Let the right side of the equation in system (3) be 0, then,

$$\begin{cases} \mu - \beta_1 SI - \beta_2 SW - \mu S = 0, \\ \beta_1 SI + \beta_2 SW - \alpha I(1 + R) - \mu I = 0, \\ \gamma I - \xi W = 0, \\ \alpha I(1 + R) - \mu R = 0. \end{cases} \quad (5)$$

It's obvious that the boundary equilibrium point $E_0 = (1, 0, 0, 0)$ always exist.

When $S \neq 0, I \neq 0, R \neq 0, W \neq 0$, from the third equation in equation group (5) we have $W^* = I^*$. Take it into the first equation, then we have.

$$\mu - (\beta_1 + \beta_2)S^*I^* - \mu S^* = 0 \quad (6)$$

Add the first, second and forth equation in equation group (5) and we have

$$R^* = 1 - S^* - I^* \quad (7)$$

Put (6)and(7) into the second equation in system (5) and we have

$$S^* = \frac{\alpha + \mu}{\alpha + \beta_1 + \beta_2}.$$

From literature (Chen Lansun, Chenjian, 1993), we can calculate that the basic reproduction number is

$$R_{oSIWR} = \frac{\alpha + \beta_1 + \beta_2}{\alpha + \mu}.$$

When $R_{oSIWR} > 1$, it's easy to calculate that $I^* = W^* = \frac{\mu - \mu S^*}{(\beta_1 + \beta_2)S^*}$. Theorem prove finished.

Theorem 1.2 Let R_{oSIR} , R_{oSIWR} be the basic reproduction number of the *SIR model* and the *SIW Rmodel* respectively, then $R_{oSIR} < R_{oSIWR}$.

In fact, when $R_{oSIR} = \frac{\alpha + \beta_2}{\alpha + \mu}$, it's easy to prove that $R_{oSIR} < R_{oSIWR}$.

Note: When system doesn't contain W, system (3) degenerates into a SIR rumors spread model. Based on the practical meaning of the basic reproduction number (Describes the number of people who are infected in the average infection period when an infected person is involved in all the vulnerable populations. It's generally believed that only when $RO > 1$, the disease will spread in the region, thus we can make a series of precautions and methods to cure the epidemic by the value of R_o), theorem1.2shows that it's not accurate to ignore the rumors spread between traditional media and new media in rumors spread model and get the basic reproduction number which is less than the actual situation. Thus will largely influence the various qualitative analyses and the making of prevention strategies based on the value of R_o .

As for epidemic dynamics, analyze the spread of the epidemic by studying the epidemic growth rate is a simple and effective method of analysis. Similarly, we can calculate the growth rate of the spread of rumors, first through calculating system (3)'s main characteristic value in Jacobian determinant of the boundary equilibrium point to get the initial growth of the spread of rumors.

$$r = \frac{\beta_2 - \mu - \xi + \sqrt{(\beta_2 - \mu - \xi)^2 + 4\xi(\beta_1 + \beta_2 - \mu)}}{2}$$

$$= \frac{\tilde{r} - \xi + \sqrt{(\tilde{r} + \xi)^2 + 4\xi\beta_1}}{2}$$

When $\beta_1 \rightarrow 0$, $r \rightarrow \tilde{r}$, and $r \geq \tilde{r}$, $\tilde{r} = \beta_2 - \mu$ refers to the initial growing rate of the rumors spread in SIR model.

Since

$$\frac{dr}{d\beta_1} = \frac{r}{\tilde{r} - r - (\xi + r)} < 0 \text{ and } \frac{d\tilde{r}(\beta_2(\beta_1), \beta_1)}{d\beta_1} = \frac{\partial \tilde{r}}{\partial \beta_2} \frac{\partial \beta_2}{\partial \beta_1} + \frac{\partial \tilde{r}}{\partial \beta_1} = -1.$$

Therefore,

$$\frac{dr}{d\beta_1} = -\frac{\partial r}{\partial \beta_2} + \frac{\partial r}{\partial \beta_1} < 0.$$

Thus, we can draw the following conclusion.

Theorem 1.3 When $R_{oSIWR} > 1$, $\frac{dr}{d\beta_2} > \frac{dr}{d\beta_1}$.

Note: Theorem demonstrates that when $R_{oSIWR} > 1$, the growing rate is more sensitive in the spread between people in new media compared with the spread between people in new media and traditional media.

About the stability of the equilibrium point, we have following theorem.

Theorem 1.4 When $R_{oSIWR} < 1$, E_0 is partly asymptotically stable; when $R_{oSIWR} > 1$, E_0 is unstable.

Prove The characteristic equation of system (3) in the boundary equilibrium point E_0 is

$$(\lambda + \mu)^2 (\lambda^2 + (\xi - \beta_2 + \mu)\lambda + \xi(\mu - \beta_1 - \beta_2)) = 0 \quad (8)$$

Apparently, the two characteristic roots of characteristic equation (8) are $\lambda_{1,2} = -\mu < 0$. From Routh-Hurwitz Stability Criterion, we can know that the stability of E_0 is determined by the signs of root in the following equation:

$$\lambda^2 + (\xi - \beta_2 + \mu)\lambda + \xi(\mu - \beta_1 - \beta_2) = 0$$

And we have $\lambda_3 + \lambda_4 = -(\xi - \beta_2 + \mu)$, $\lambda_3\lambda_4 = \xi(\mu - \beta_1 - \beta_2)$. Thus, when $R_{oSIWR} < 1$, all the roots of the characteristic equation (8) has negative real parts, and E_0 is partly asymptotically stable; when $R_{oSIWR} > 1$, E_0 is unstable. Theorem prove finished.

Theorem 1.5 When $R_{oSIWR} > 1$, E^+ is partly asymptotically stable; when $R_{oSIWR} < 1$, E^+ is unstable.

Prove System (3)'s characteristic equation at positive equilibrium point E^+ is

$$(\lambda + \mu)(\lambda^3 + a_1\lambda^2 + a_2\lambda + a_3) = 0 \quad (9)$$

Among which

$$a_1 = \xi + \beta_1 S^* + \mu / S^*$$

$$a_2 = (\xi + \beta_1 S^*)\mu / S^* + (\alpha + \beta_1 + \beta_2)\beta_2(\mu - \mu S^*) / (\beta_1 + \beta_2)$$

$$a_3 = (\alpha + \beta_1 + \beta_2)\xi(\mu - \mu S^*)$$

Apparently, the characteristic root of characteristic equation (9) is $\lambda_1 = -\mu < 0$, thus the stability of E^+ is determined by the signs of root in the following equation:

$$\lambda^3 + a_1\lambda^2 + a_2\lambda + a_3 = 0$$

Since

$$H_1 = a_1 = \xi + \beta_1 S^* + \mu / S^* > 0$$

$$H_2 = \begin{vmatrix} a_1 & a_3 \\ 1 & a_2 \end{vmatrix} = f(\xi) = \frac{\mu}{S^*} \xi^2 + \left(\left(2\beta_1 S^* + \frac{\mu}{S^*} \right) \frac{\mu}{S^*} - \frac{(\alpha + \beta_1 + \beta_2) \beta_1 (\mu - \mu S^*)}{\beta_1 + \beta_2} \right) \xi$$

$$+ \frac{\beta_1 \beta_2 S^* + \frac{\beta_2 \mu}{S^*}}{\beta_1 + \beta_2} (\alpha + \beta_1 + \beta_2) (\mu - \mu S^*) + \mu \beta_1 \left(\beta_1 S^* + \frac{2\mu}{S^*} \right)$$

$$H_3 = \begin{vmatrix} a_1 & a_3 & 0 \\ 1 & a_2 & 0 \\ 0 & a_1 & a_3 \end{vmatrix} = a_3 H_2$$

and $a_3 = (\alpha + \beta_1 + \beta_2) \xi (\mu - \mu S^*) > 0$, thus the sign of H_3 is the same as the sign of H_2 .

When $R_{oSIWR} > 1$,

$$f_{\min}(\xi) = (\alpha + \mu) \beta_1 \left(\frac{2\beta_1 + 2\beta_2 - \alpha - \beta_1 - \beta_2}{\alpha + \beta_1 + \beta_2} + \frac{\mu(\alpha + \beta_1 + \beta_2)(\beta_1 + \beta_2)}{(\alpha + \mu)^2 \beta_1} \right) > 0,$$

Thus, $H_2 > 0$.

From Routh-Hurwitz Stability Criterion we can know that when $R_{oSIWR} > 1$, E^+ is partly asymptotically stable; when $R_{oSIWR} < 1$, E^+ is unstable. Theorem prove finished.

3. Overall Asymptotic Stability of the Equilibrium Point

In this section, we will further study the overall asymptotic stability of the equilibrium point in system(3).

Theorem 2.1 When $R_{oSIWR} < 1$, the equilibrium point E_0 in system(3) concerned with $\Omega_{W \leq 1+\varepsilon}$ is overall asymptotically stable; when $R_{oSIWR} = 1$, E_0 concerned with $\Omega_{W \leq 1+\varepsilon}$ is overall attracted.

Prove Here we use the Lyapunov-LaSalle invariance principle to prove that E_0 is overall attracted concerned with $\Omega_{W \leq 1+\varepsilon}$. Consider the non-negative function on the compact set.

$$V = (S - 1 - \ln S) + I + R + \frac{\beta_1 + \beta_2}{\xi} W \quad (10)$$

Apparently, V is constant in $\Omega_{W \leq 1+\varepsilon}$, and along with system(3), the derivative of the solution satisfies,

$$\begin{aligned}
\dot{V}|_{(3)} &= \frac{S-1}{S} \dot{S} + \dot{I} + \dot{R} + \frac{\beta_1 + \beta_2}{\xi} \dot{W} \\
&= \frac{S-1}{S} (\mu - \beta_1 SI - \beta_2 SW - \mu S) + \beta_1 SI + \beta_2 SW - \alpha I(I+R) - \mu I \\
&\quad + \alpha I(I+R) - \mu R + (\beta_1 + \beta_2)(I-W) \\
&= -\frac{\mu}{S} (S-1)^2 - (\mu - \beta_1 - \beta_2)I - \mu R - \beta_2 W
\end{aligned}$$

When $R_{oSIWR} \leq 1$, $\dot{V}|_{(3)} \leq 0$, thus, V is a Lyapunov function of system (3) in $\Omega_{W \leq 1+\varepsilon}$. Define the subset of $\Omega_{W \leq 1+\varepsilon}$, E is

$$E = \{(S, I, W, R) | (S, I, W, R) \in \Omega_{W \leq 1+\varepsilon}, \dot{V} = 0\}$$

Meanwhile, let M be the biggest fixed subset of system (3) in E . From the invariance of M and system (3), it's easy to prove that $E = E_o$.

Thus, from the Lyapunov-LaSalle invariance principle we can know that E_o is overall attracted. And from Theorem 1.4, when $R_{oSIWR} < 1$, E_o is partly asymptotically stable. Therefore, when $R_{oSIWR} < 1$, the equilibrium point E_o in system (3) concerned with $\Omega_{W \leq 1+\varepsilon}$ is overall asymptotically stable; when $R_{oSIWR} = 1$, E_o concerned with $\Omega_{W \leq 1+\varepsilon}$ is overall attracted. Theorem prove finished.

Theorem 2.2 When $R_{oSIWR} > 1$, the positive equilibrium point E^+ of system (3) is overall asymptotically stable.

Prove Consider the non-negative function on the compact set.

$$\Omega_{W \leq 1+\varepsilon}$$

$$V = (S - S^* - \ln S) + (I - I^* - \ln I) + \frac{\beta_1 S^*}{\xi} (W - W^* \ln W) + (R - R^* - \ln R)$$

Apparently, V is constant in $\Omega_{W \leq 1+\varepsilon}$, and along with system (3), the derivative of the solution satisfies,

$$\begin{aligned}
\dot{V}|_{(3)} &= 2\mu - \mu S - \mu \frac{S^*}{S} - \beta_1 SW \frac{I^*}{I} - \beta_2 SI^* - \beta_1 S^* W^* \left(\frac{I}{W} - 1 \right) \\
&\quad + \alpha I^*(I+R) + \alpha I(I^*+R^*) - \mu R - \alpha I \frac{R}{R^*} (I+R) \\
&= -(\mu - \beta_1 S^* I^*) \left(\frac{S^*}{S} + \frac{S}{S^*} - 2 \right) - \beta_1 S^* I^* \left(\frac{I}{W} + \frac{S}{S^*} \frac{W}{I} + \frac{S^*}{S} - 3 \right) \\
&\quad + \alpha I^*(I^*+R^*) \left(\frac{I+R}{I^*+R^*} + \frac{I}{I^*} - \frac{R}{R^*} - \frac{I}{I^*} \frac{R^*}{R} \frac{I+R}{I^*+R^*} \right) \\
&= -(\mu - \beta_1 S^* I^*) \left(\frac{S^*}{S} + \frac{S}{S^*} - 2 \right) - \beta_1 S^* I^* \left(\frac{I}{W} + \frac{S}{S^*} \frac{W}{I} + \frac{S^*}{S} - 3 \right) + \frac{\alpha}{R} g(R)
\end{aligned}$$

Among which

$$\begin{aligned} g(R) &= I^* R^* (I + R) R + I (I^* + R^*) R^* - (I^* + R^*) I^* R^2 - I R^{*2} (I + R) \\ &= -(I^* R - R^* I)^2 \leq 0 \end{aligned}$$

And since

$$\mu - \beta_1 S^* I^* = \frac{\mu(\beta_1 + \beta_2) + \mu\beta_1 S^*}{\beta_1 + \beta_2} \geq 0, \quad \frac{S^*}{S} + \frac{S}{S^*} - 2 \geq 0$$

And

$$\frac{I}{W} + \frac{S}{S^*} \frac{W}{I} + \frac{S^*}{S} - 3 \geq 0$$

Thus, $\dot{V}|_{(3)} \leq 0$, therefore, V is a Lyapunov function of system(3) in $\Omega_{W \leq 1+\varepsilon}$.

Define the subset of $\Omega_{W \leq 1+\varepsilon}$ be E'

$$E' = \{(S, I, W, R) | (S, I, W, R) \in \Omega_{W \leq 1+\varepsilon}, \dot{V} = 0\}$$

Meanwhile, let M' be the biggest fixed subset of system(3) in E' .

Thus,

$$E' = \{(S, I, R, M) | (S, I, R, M) \in \Omega, S = S^*, I = I^*, R = R^*, W = W^*\}.$$

From the invariance of M' and system (3), it's easy to prove that $E' = E^+$. Thus, from the Lyapunov-LaSalle invariance principle we can know that E^+ is overall attracted. And from Theorem 1.5, when $R_{0SIWR} > 1$, E^+ is partly asymptotically stable. Therefore, when $R_{0SIWR} > 1$, E^+ is overall asymptotically stable.

4. Numerical Simulation Analyses and Discussion

In this section, according to the practical meaning of system (3), we run numerical simulation in Matlab software and discuss the influence to rumors spreading via various ways of transmission. In the following chart, the red line represents the rail line of SIR model, while the blue line represents the rail line of SIWR model.

Choose parameter $\mu = 0.1$, $\beta_1 = 0.3$, $\beta_2 = 0.3$, $\alpha = 0.25$. Choose $\xi = 0.3$ from SIWR model, the initial value is $(S(0), I(0), W(0), R(0)) = (0.9, 0.1, 0, 0)$, correspondingly, in SIR model, $\xi = 0$, initial value is $(S(0), I(0), R(0)) = (0.9, 0.1, 0)$. By calculating we can know that the basic reproduction number of SIWR model $R_{0SIWR} = \frac{\alpha + \beta_1 + \beta_2}{\alpha + \mu} = 2.2 > 1$,

and there exists positive equilibrium point $E_{SIWR}^+ = (0.454, 0.171, 0.171, 0.374)$; the basic reproduction number of SIR model $R_{oSIR} = \frac{\alpha + \beta_2}{\alpha + \mu} = 1.6 > 1$, and there exists a positive equilibrium point $E_{SIR}^+ = (0.625, 0.15, 0.225)$. Apparently, $R_{oSIR} < R_{oSIWR}$ succeed (theorem2). Line graph1 shows the trends of population density in two different models.

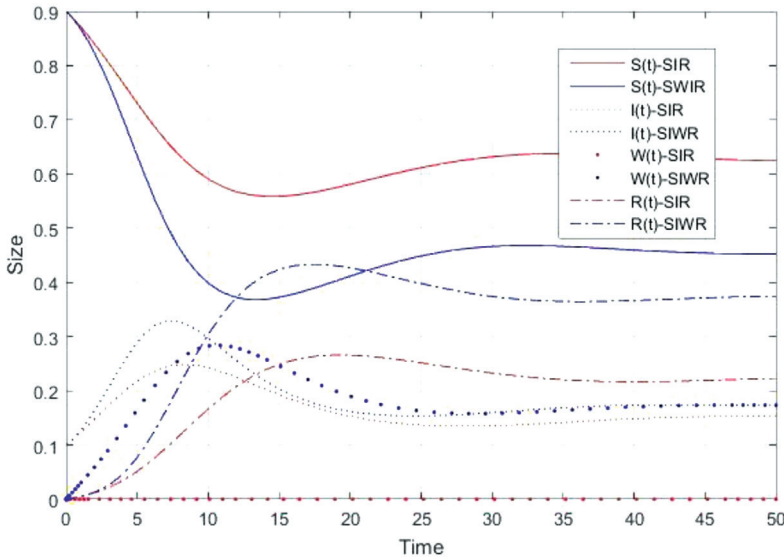


Figure 2 – Line Graph1 the Comparative Graph of the Trends of Population Density Between SIR and SIWR

From line graph1 we can see that, with the spreading of rumors, the density of the propagators in SIR and SIWR models both have instantaneous growth point, then the density of propagators begins to stabilize after reaching a peak value. The density of the unknown people keeps decreasing while the density of the immune people keeps increasing until they reach a stable status respectively. However, by comparing the two models we find that the densities of unknown people in SIR model is bigger than that of SIWR model, while the density of the propagators and the immune people in SIR model are smaller than that of SIWR model. This fully demonstrates that compared with SIWR model, SIR model would underestimate the scale of rumors spreading. From the overall trend of each rail line, when the basic reproduction number is bigger than 1, the rumors will be spread, which means the positive equilibrium point is globally asymptotically stable. (Theorem 2.2) Therefore, in the prevention and control of the spread of rumors, the rational use of the basic reproduction number can provide an important reference for the effective prevention of the proliferation in the spread of rumors.

5. Conclusion

1. This essay established the rumor propagation model (SIWR rumor propagation model) with various transmission routes and obtained the basic reproductive number R_{0SIWR} . When $R_{0SIWR} < 1$, the boundary equilibrium point (Rumor-free equilibrium, RFE) E_0 of system (3) is globally asymptotically stable. When $R_{0SIWR} > 1$, the positive equilibrium point (Rumor-endemic equilibrium, REE) E^+ of system (3) is globally asymptotically stable.
2. By the comparison of the basic reproduction number of SIWR rumor propagation model and SIR rumor propagation model, it is discovered that the basic reproductive number of SIWR rumor propagation model is greater than the basic reproductive number SIR rumor propagation model, which means that SIR model would underestimate the basic reproduction number.
3. The numerical results show that, compared with SIWR model, SIR model underestimates the scale of the spread of rumors. Thus, the diversity of communication channels has a significant impact on the scale of the spread of rumor. This also confirms that the network platform of new media isn't the only way to spread rumors in the era of the new media network, and other forms of distribution still play a very important role. To prevent and control the spread of rumors, government should take into account both the traditional media and the new media, and make reasonable and feasible control measures such as using multi-channel ways to distribute the refutation of rumors — from traditional media to new media, from the press conference to government micro-blogging, etc.

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Research on Damage Mechanics of Modified Soil Sub-grade in Cold Regions under Coupling Effect of Freeze-Thaw Cycle and Load

Zhang Li-qun ^{1,*}, Cui Hong-huan ¹

* zhanliqun5133@163.com

¹ School of Civil Engineering, Hebei Institute of Architecture and Civil Engineering, 075000, Zhangjiakou, Hebei, China

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Abstract: The modified soil has been widely applied in paving sub-grade in cold regions due to its low price, relatively stable mechanical properties and relative high intensity. At present, the research on the basic properties and freeze-thaw damage characteristics of the modified soil is mainly conducted by test under the conditions of temperature change and frost-thaw cycle. Most studies of the rock body are conducted from the angle of material microstructure and literatures about researches of freeze-thaw mechanics with the method of damage mechanics are few. There is lack of research on the freeze-thaw damage model of the modified soil now. Taking the sub-grade modified soil as the research object, using the constitutive theory of concrete damage, combining the actual mechanical properties of lime modified soil and cement modified soil, this paper makes a research on its damage evolution law under the condition of freeze thawing and load coupling. This paper considers the coupling of freeze thawing and load, explores the damage form and evolution process in the micro-level occurring inside the sub-grade modified soil, and establishes the freeze thawing-load damage model. In order to improve application of modified soil in cold regions engineering.

Keywords: Freeze-thaw cycles; damage factor; constitutive relation; sub-grade; modified-soil.

1. Introduction

Frost heave and thaw collapse of frozen soil sub-grade in cold regions have long been plaguing the stability and the normal operation of line projects. Frost heave, thaw collapse and frost soil are several phenomena arising when soil body of sub-grade is under load effect of trains during the freezing and thawing process, and they have close inner links. Soil frost heave and thaw collapse are complex processes, involving moisture migration, change of temperature field and effect of stress field. The sub-grade in Tibetan Plateau has long stayed in water-heat interaction in the system of atmosphere-active layer of soil body-permafrost (Li SQ., Gao LX., Chai SX., 2012). Due to the features of plateau, such as large temperature difference between day and night and prominent climate change, the sub-grade is easily to undergo relatively large frost heave and thaw collapse under the joint effect of water, heat and force; meanwhile, the intensity is prone to degrade,

resulting in plastic failure. This is the fundamental reason why the sub-grade defects easily happen in the cold highland regions (Galván, J. B., Recarte, L., & Pérez-Ilzarbe, M. J., 2014).

With the great development of railway construction, currently the modified soil has been widely applied in paving sub-grade in cold regions due to its low price, relatively stable mechanical properties and relative high intensity. At present, the research on the basic properties and freeze-thaw damage characteristics of the modified soil is mainly conducted by test under the conditions of temperature change and frost-thaw cycle (Lai YM., Yang YG., Chang XX., 2010). Numerous studies have indicated that the frost-thaw effect can not only change the structure, intensity, volume, void ratio, permeability, density and modulus of the modified soil, but also speed up the damage.

There is lack of research on the freeze-thaw damage model of the modified soil now. Most studies of the rock body are conducted from the angle of material microstructure and literatures about researches of freeze-thaw mechanics with the method of damage mechanics are few. For instance, through the CT test, Ge Xiurun (Yang Gengshe, Zhang Quansheng, Pu Yibin., 2004) and other people have analyzed the extension law of rock microscopic damage and the damage characteristics. Through the CT scanning technology, Sun Xingliang (Lianbo, zhang guisheng., 2006) and other people have made a dynamic observation of the change of the permafrost's microstructure damage during the triaxial shear process, and analyzed the evolution mechanism of the permafrost's microstructure damage. Based on the distribution law of CT numbers of scanning rock, Yang Gengshe and other people (Jing GQ., Feng K., Gao L., Wang J., 2012) have established a mathematical model, and deduced the quantitative relationship between the rock damage density and CT numbers (Zhou FX., Lai YM., 2010).

As an artificial remodeled soil, the modified soil has a high degree of compaction and a high intensity. In the aspect of mechanical damage, it has the elastic-brittle property similar to that of the concrete as well as the mechanical characteristic of the soil body. In the aspect of freeze-thaw damage, during the freezing process at low temperature, the moisture migration results in the increase in the moisture content on the frontal surface of the frozen soil body, thus intensifying the volume expansion and increasing the pore volume of the soil body. Meanwhile, the volume expansion from water to ice breaks the original structure, thus changing the property of the soil body. When the pore ice melts, some enlarged pores cannot return to their original states, so that the soil body becomes relatively loose and the binding strength between soil particles reduces, thus resulting in freeze-thaw damage (Xu XZ., Sun X., 2005).

Taking the sub-grade modified soil as the research object, using the constitutive theory of concrete damage, combining the actual mechanical properties of lime modified soil and cement modified soil, this paper makes a research on the its damage evolution law under the condition of freeze thawing and load coupling. We believe that: under the condition of freeze-thaw cycle, the damage of the modified soil can be equivalent to coupling of the two modes of freeze thawing and load. This paper considers the coupling of freeze thawing and load, explores the damage form and evolution process in the micro-level occurring inside the sub-grade modified soil, and establishes the freeze thawing-load damage model (Zhou FX., Lai YM., 2010).

Description of the problem.

2. Soil Damage Model Under the Freeze-Thaw Cycle and Load

2.1. Damage Model

Damage mechanics theory is a powerful tool to evaluate and predict materials and the macroscopic mechanical behaviors of its structure, and settle the issue concerning the failure of material or its structure in the practical engineering. When the material damage is analyzed through the damage mechanics theory, it is necessary to select the appropriate damage variables to define and describe the damage degree of materials. According to the strain equivalence hypothesis created by Professor Lemaitre: the strain caused by the effect of total stress σ on the damaged material is equivalent to the strain caused by the effect of the effective stress σ' on the undamaged material, namely:

$$\varepsilon = \frac{\sigma'}{E_0} = \frac{\sigma}{E'} \quad (1)$$

The strain energy density of the damaged material is:

$$\rho\phi = \frac{1}{2E'}\sigma^2 \quad \rho\phi = \frac{1}{2}E'\varepsilon^2 \quad (2)$$

According to the remained strain energy equivalent proposed by Sidoroff, namely:

$$\rho\phi = \frac{1}{2E'}\sigma^2 = \frac{1}{2E}\sigma'^2 \quad (3)$$

Wherein

$$\sigma' = \frac{\sigma}{1-D} \quad (4)$$

D is the damage factor.

Therefore,

$$\rho\phi = \frac{1}{2E(1-D)^2}\sigma^2 \quad (5)$$

According to the orthogonal relationship, there is:

$$\varepsilon = \rho \frac{\partial \phi}{\partial \sigma} = \frac{1}{E(1-D)^2}\sigma \quad (6)$$

Namely, the stress-strain relationship is:

$$\sigma = E(1-D)^2 \varepsilon \quad (7)$$

The release rate of damage strain energy is:

$$y = \rho \frac{\partial \phi}{\partial D} = \frac{1}{E(1-D)^3} \sigma^2 = E(1-D)\varepsilon^2 \quad (8)$$

Assume the damage evolution equation is:

$$y = A(\varepsilon) \frac{dD}{dz} \quad (9)$$

Wherein, Z is the value indicating the transformation increase. It is the function of ε . So

$$\frac{dD}{dz} = \frac{1}{A(\varepsilon)} E(1-D)\varepsilon^2 \quad (10)$$

Therefore,

$$D = 1 - \exp \left[- \int_{z_0}^z \frac{E}{A(\varepsilon)} \varepsilon^2 dz \right] \quad (11)$$

Wherein, z_0 is the initial damage threshold (Bi GQ., Zhang X_B Li GY., 2010), namely, when $z > z_0$, the material damage will happen. If taking $A(\varepsilon) = \frac{E}{k} \varepsilon^2$.

Then the damage evolution equation is:

$$D = 1 - \exp[-k(z - z_0)] \quad (12)$$

We define: $z = \varepsilon_{\max}$, ε_{\max} is the maximum strain that the material reached. For axial loading, $z = \varepsilon_{\max} = \varepsilon$.

2.2. Freeze-Thaw Damage Factor

Here we define a dependent variable ε_n that can indicate the freeze-thaw damage. It is a parameter reflecting the relation between the freeze-thaw frequency and the strain. To stabilize the ratio of the thaw deformation to the height of the soil body before freeze thawing, namely:

$$\varepsilon_n = \frac{h_0 - h_n}{h_0} \quad (13)$$

Wherein, h_0 is the original height of the specimen; h_n is the height of specimen after n-time freeze thawing, measured through test, n is the number of freeze-thaw cycles.

Consider the damage constitutive equation can be expressed as:

$$\sigma = (1 - D)^2 E\varepsilon \quad (14)$$

$$D = \begin{cases} \varepsilon_n & \varepsilon \leq \varepsilon_0 \\ 1 - \exp[-k(\varepsilon_n + \varepsilon - \varepsilon_0)] & \varepsilon > \varepsilon_0 \end{cases} \quad (15)$$

After discussion of the above equation, it can be seen that:

When there is no freeze-thaw damage, material only suffers the mechanical damage, then,

$$D = \begin{cases} 0 & \varepsilon \leq \varepsilon_0 \\ 1 - \exp[-k(\varepsilon - \varepsilon_0)] & \varepsilon > \varepsilon_0 \end{cases} \quad (16)$$

Equation (14) shows that the total freeze-thaw load bearing damage to the soil body changes along with 2 evolution approaches of freeze thawing and strain, reflecting the character that the freeze-thaw cycle index and strain are mutually coupled and affected with the material damage propagation, so that the damage mechanical behavior of frozen soil and damage propagation law can be relatively truly revealed.

Equations (14) and (15) show that, when $\varepsilon = \frac{1}{2k}$, $\sigma - \varepsilon$ curve has the extreme point; when $\varepsilon = \frac{1}{k}$, $\sigma - \varepsilon$ curve has the inflection point, and therefore:

$$k = \frac{1}{2\varepsilon_u} \quad (17)$$

Wherein, ε_u is the strain at the stress-strain peak value of modified soil, therefore, equation (14) can be turned into.

$$D = \begin{cases} \varepsilon_n & \varepsilon \leq \varepsilon_0 \\ 1 - \exp\left[-\frac{1}{2\varepsilon_u}(\varepsilon_n + \varepsilon - \varepsilon_0)\right] & \varepsilon > \varepsilon_0 \end{cases} \quad (18)$$

If taking $\varepsilon_0 = 0$, then equation (17) is changed as the damage factor under the condition of freeze-thaw cycle and load coupling:

$$D = \begin{cases} \varepsilon_n & \varepsilon = 0 \\ 1 - \exp\left[-\frac{1}{2\varepsilon_u}(\varepsilon_n + \varepsilon)\right] & \varepsilon > 0 \end{cases} \quad (19)$$

3. Experimental Verification

3.1. Freeze-Thaw Cycle Test

The freeze-thaw process is the process of soil body from the unstable state to the stable state and the repeated freeze-thaw cycle changes its property and shape, so that the soil body develops towards a new dynamic stable state. In order to understand the impact of freeze-thaw cycle and load on the damage factor of specimen in an accurate way, it is required to measure its heights before and after freeze thawing, for subsequent calculations.

This paper respectively analyzes the 9% lime modified soil and 6% cement modified soil and studies the damage constitutive relation under the coupling effect of freeze-thaw cycle and load. The cement is 325 labeled Portland slag cement and the initial setting time is 4h; the lime is the calcium quicklime powder. Respectively mix the cement modified soil and lime modified soil, retain them for a day, process them into the cylindrical specimens of $\phi 39.1\text{mm} \times 80\text{mm}$, and then start the freeze-thaw cycle test. Put the prepared specimen into the freeze-thaw test chamber for freeze-thaw cycle test. It shall be maintained for 12 hours in the incubator at a negative temperature for freezing; and it shall be maintained for 12 hours in the incubator at 5° when thawing. This process is a freeze-thaw cycle period (Wang L., Zhang S., Peng SB., 2010).

The following figure is the temperature-time curve in the incubator in the freeze-thaw process.

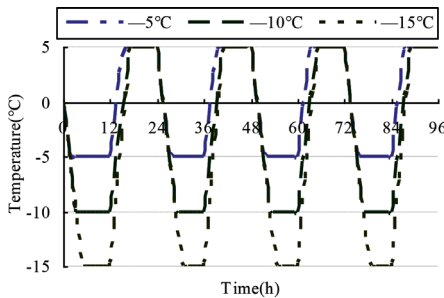


Figure 1 – Temperature-Time Curve

The freeze-thaw cycle periods are selected as 0, 1, 3, 6, 8, 10 times. After the cycling times are reached, some specimens shall be taken for triaxial compression, and freeze-thaw cycle test shall be continued for the remaining specimens. Then observe the height change of the tested specimens, draw the relation chart $A(\varepsilon_n)$ -n, which is shown in Figure 2.

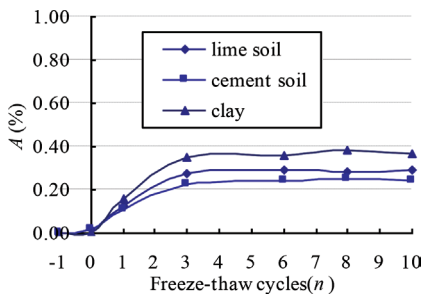


Figure 2 – Relation Between the Coefficient of Thaw Collapse and the Freeze-Thaw Cycle Index

3.2. Experimental Determination of the Thaw Coefficient

The relation between the height of specimen after the freeze-thaw stability and the cycle index is in exponential decrease, therefore, after regression, A - n can be fitted to the following equation.

$$A = 1 - \frac{ae^{-\frac{n}{l}} + h_w}{h_o} \quad (20)$$

h_w is the specimen height after stability of repeated freeze-thaw cycles; h_o is the original height of specimen; n is the freeze-thaw cycle index; a , l are the fitting test parameters. According to Figure 2, the fitting results are as follows:

	A	L	R
<i>Lime soil</i>	0.15571	4.8653	0.884
<i>Cement soil</i>	0.14333	5.4216	0.892
<i>Prime soil</i>	0.13393	3.1842	0.931

Table 1 – Fitting Results in Thaw Test

It is difficult to obtain the thaw height of specimen in the final stable state, so it can be replaced by the basic thaw height after several freeze-thaw cycles. Figure 2 shows that, through the analysis of the results after 0, 1, 3, 6, 8, 10 freeze-thaw cycles, the specimen height and its moisture content basically remain constant. This indicates that its internal structure reaches a new dynamic balance though 8-time freeze-thaw cycles. The specimen volume is no longer affected by freeze-thaw effect. According to the above conclusion, this paper may select the specimen height at the 8-time cycle as the stable thaw height. In addition, it is suggested to select the specimen height at the 8-time cycle as the stable thaw height in the practical application.

3.3. Constitutive Model Verification Under the Freeze Thawing and load

After the sub-grade soil undergoes several freeze-thaw cycles, its defects continuously produce and expand, resulting in freeze-thaw damage inside the sub-grade. The load borne by the sub-grade soil under the condition of freeze-thaw cycle can be equivalent to the damage to the soil under the two kinds of loads. Thus, the damage factor should scientifically reflect the coupling effect of the freeze thawing and load.

Substitute equation (19) into the equation (18), and obtain the change law of the damage factor of the loaded soil through many freeze-thaw cycles. Therefore, the coupling damage factor can be expressed as equation (20):

$$D = \begin{cases} 1 - \frac{ae^{-\frac{n}{l}} + h_w}{h_o} & \varepsilon = 0 \\ 1 - \exp \left[-\frac{1}{2\varepsilon_u} \left(\left(1 - \frac{ae^{-\frac{n}{l}} + h_w}{h_o} \right) + \varepsilon \right) \right] & \varepsilon > 0 \end{cases} \quad (21)$$

The elastic modulus of the modified soil modulus in each freeze-thaw cycle can be calculated by the empirical formula (21):

The ratio of the increment of deviatoric stress corresponding to the axial strain of 1.0% to the increment of axial strain is used as the elastic modulus for the research on clay:

$$E = \frac{\Delta\sigma}{\Delta\varepsilon} = \frac{\sigma_{1.0\%} - \sigma_0}{\varepsilon_{1.0\%} - \varepsilon_0} \tag{22}$$

Wherein, $\Delta\sigma$ is the increment of deviatoric stress; $\Delta\varepsilon$ is the increment of axial strain, $\sigma_{1.0\%}$ is the deviatoric stress ($\varepsilon_{1.0\%}$) corresponding to the axial strain of 1.0%; σ_0 and ε_0 are respectively the initial stress and strain. Therefore, according to the measured data in the triaxial compression test and the formula (21), the elastic modulus of each modified soil in Table 1 can be concluded.

	E_0	E_1	E_3	E_6	E_8	E_{10}
6% Ceme-nt Modi-fied Soil	$1.92*10^8$	$1.53*10^8$	$1.36*10^8$	$1.14*10^8$	$9.3*10^7$	$9*10^7$
9% Lime Modified Soil	$2.43*10^8$	$1.95*10^8$	$1.75*10^8$	$1.55*10^8$	$1.3*10^8$	$1.21*10^8$

Table 2 – Elastic Modulus of Two Kinds of Modified Soils

Combine the test data of modified soil in literature 8, and take the ε_u of the damage factor as 2.0 % (Quan XJ., Li N., Li GY., 2004).

3.4. Constitutive Model Verification

Compare the test data and the results of equation (14), shown in the following figure:

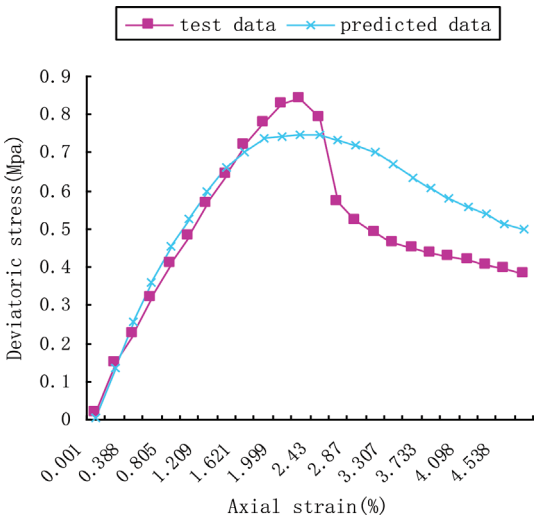


Figure 3 – $\sigma - \varepsilon$ Curve After Three Freeze-Thaw Cycles of 9% Lime Soil

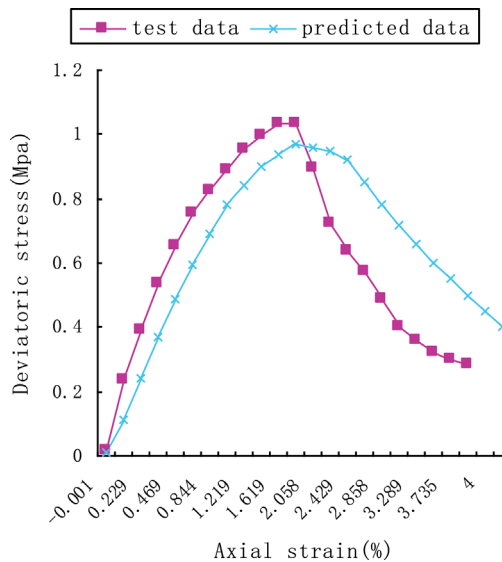


Figure 4 – $\sigma - \varepsilon$ Curve After Three Freeze-Thaw Cycles of 6% Cement Soil

Figure 3 and Figure 4 show the test data based on the triaxial compression test. Compared with the results curve obtained from the damage constitutive formula under the freeze thawing and load (14) proposed by this paper, it can be the calculation of damage can be better consistent with the observed results in terms of change trend especially at the rise of curve, and the test data is identical with the predicted data. However, in the strain softening stage, the fitting effect of the prediction curve is relatively poor. The reason, the author think, is that the constitutive model given by this paper is established based on the elastic-brittle damage of the concrete and considering freeze-thaw cycle and the plastic failure is also reflect after the invalidation of the modified soil, therefore, the constitutive model has limitations. Specimen stress curve takes the peak point as the demarcation point, namely, it is divided into ascent part and descent part. In test, we observe that the modified soil specimen has been damaged after the peak point. Therefore, the constitutive model of the damaged modified soil under the freeze-thaw cycle proposed in this paper has the features of utility in engineering utility and convenience in research.

4. Results

Figure 5 and Figure 6 show the change laws of the damage factor of the two kinds of modified soils under the effect of different freeze-thaw cycles and axial load, obtained from the Matlab programming calculation of equation (20).

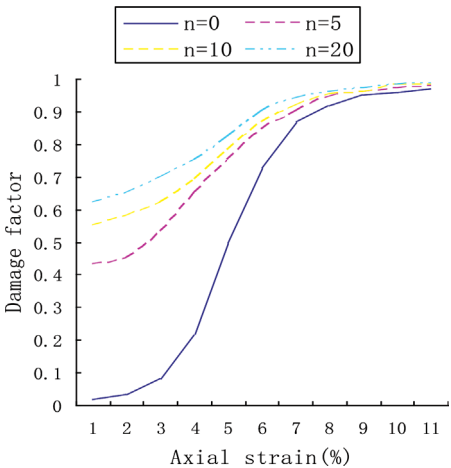


Figure 5 – Change La of Damage Factor of 9% Lime Modified Soil

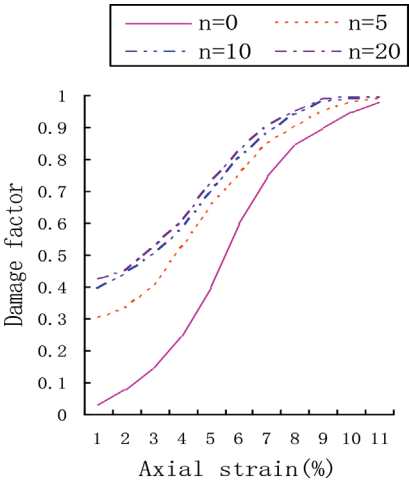


Figure 6 – Change Law of Damage Factor of 6% Cement Modified Soil

Figure 5 and Figure 6 show that, the deterioration degree of the freeze-thaw damage of lime modified soil increases sharply with the increase in freeze-thaw cycles, especially compared with no freeze-thaw cycle, and there is significant difference of the damage degree, indicating that its freeze-thaw durability is poor. For the cement modified soil of 10 or less freeze-thaw cycles, the damage increases with the increase in freeze-thaw cycles and the intensity decreases slightly; in case of 10 -20 cycles, the damage variable changes little and the freeze-thaw damage tends to be constant, indicating that the mechanical properties of the cement modified will tend to be stable after a certain freeze-thaw cycles. The first freeze-thaw cycle affects the soil most largely. With the increase in

the freeze-thaw cycle, the intensities tend to be constant values. Under the same freeze-thaw cycles, the damage respectively to the cement modified soil and lime modified soil increases with the increase in the strain. The initial stage of the load-bearing modified soil before freeze thawing is the damage attenuation stage. The micro-pores and micro-cracks in the soil gradually close and the density and intensity increase. Afterwards, the mechanical property of the modified soil is in the linear stage. When the deformation reaches a certain level, the damage to the modified soil begins to evolve and expand stably until the damage propagates at an accelerated speed. Accompanied are the micro-cracks initiation, propagation and convergence in the modified soil. The macroscopic damage occurs, then the intensity of the soil body is reached, and thus the damage occurs.

5. Conclusion

The freeze thawing and load induce the damage with the different mechanical mechanisms. They are mutually coupled and affected. The evolution law of the mechanical properties about the cement modified soil and lime modified soil obtained from the damage model under the freeze thawing and load, are consistent with test phenomena and analysis conclusion in literature 8.

1. The freeze thawing and load are bound to bring changes to the mechanical properties of the modified soil. The joint effect of the freeze thawing and load can intensify the total damage to the soil body. Based on the strain equivalence hypothesis, created by professor Lemaitre, this paper establishes the modified soil damage constitutive model under the coupling effect of the freeze-thaw cycle and load. Its calculated fitting results are relatively identical with the test data, indicating that the damaged modified soil constitutive formula is reasonable and feasible. This constitutive model is simple with clear concepts and with no need of assumptions. It has a good practical value.
2. Through damage calculation, under the same freeze-thaw cycles, the damage respectively to the cement modified soil and lime modified soil increases with the increase in the strain. On the same degree of damage, with the increase in the freeze-thaw cycles, the strains of two kinds of modified soils decrease. Under the different freeze-thaw cycles, when the damage variables of the cement modified soil tend to the maximum value, the strains are very close, indicating that the freeze-thaw cycle index has little impact on the intensity limit. Finally, the load damage results in the damage to the cement modified soil. The lime modified soil mainly suffers the freeze-thaw damage.

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